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For everyone who loves a garden

The Garden of Eden was said to contain "every tree that is pleasant to the sight, and good for food." No garden since has had the same spiritual significance, yet all through the ages gardens have been symbols of splendour and places of peace. In Babylon, the Hanging Gardens were of such magnificence that they became one of the Seven Wonders of the World; the Empress Josephine’s garden at Malmaison was a botanical extravagance with arbours and architectural follies set among the rarest plants that Napoleon’s empire could produce; for Winston Churchill the garden at Chartwell was a retreat where, in the darkest hours of the war, an afternoon’s bricklaying took his mind off momentous problems.

For most of us a garden is a private refuge where we can satisfy our need for beauty, tranquility and achievement. The garden provides a link with Nature, for in each plant, and in the smallest creatures that live in its shadow or draw life from its substance, lie the balance and harmony of the living world. In the growth of a seed, to seedling and then to full blossom, the miracle of life itself is revealed.

Each garden is an entity, creating from its share of the sun and rain and the qualities of the soil its own unique character. This, perhaps, is the fascination of gardening, and why men have always written about their gardens—about their beauty, the richness of their produce and the manner of their cultivation.
PREFACE

The Complete Library of the Garden sets out to portray the garden in all its aspects: to give all the basic information necessary for good husbandry, and to reveal the pleasures and excitement to be found in the garden.

The book begins, therefore, by tracing the history and evolution of the garden, and the origins of many well-known plants. This is a story of adventure—of explorers and botanists who brought from remote corners of the earth the plants that now flourish in our gardens. But the greater adventure is the story of how plants live and function—how they feed, grow, breathe; how they reproduce their kind; how they survive drought and hard seasons. This basic knowledge leads to an understanding of the special needs of each plant. It is helpful to know, too, something about the soil and its water supply, its minerals and organic foods; of the part played by earthworms and other soil creatures; and of the kinds of plants which flourish in varying soil conditions.

The three main sections of the book cover the known and tried varieties of fruits, flowers and vegetables, the familiar and much loved plants of our gardens. But their cultivation is not the whole of gardening today. There is growing interest in the rarer varieties of plants and in the cultivation of cacti, succulents and other house plants; there are water gardens, rock gardens, ferns and exotic orchids; there is the planning, the construction of paths and pergolas. And after the labour comes the reaping, the making of preserves and pickles, wines and pot-pourri; the many ways in which fruit, flowers, vegetables and herbs can be used in the home.

But these volumes look beyond the plant world; they look at all life in the garden. There are birds to watch, a changing and varied procession of insects, as well as the larger wild creatures that sometimes stray into the garden. Every member of the animal world has its influence, often good but sometimes destructive.

Much of the work in a garden is governed by the weather. Advice on cultivation has therefore been given for the climate which might be expected in the middle of England in an average year. As spring comes to the north of Britain later than to the south, planting programmes need to be adapted accordingly. There are
also minor but significant variations in temperature and humidity that create different growing conditions in different corners of the same garden.

For ease of reference, plants are listed by their Latin names, followed, where they exist, by their common names. Both Latin and common names are included in the index.

More than sixty authorities have contributed to these volumes: writers, consultants and artists, men and women who have come to specialize in a branch of horticulture. They offer the advice and guidance gained through many years of practical experience.

The illustrations have been specially drawn in the manner of old herbals, in which the form and structure of the plant was thought to be of the first importance. Colour has, therefore, been subordinated to form, and is used to give only an indication of the tones that are so vivid in the living plants.

The thought behind this book is best expressed by the words of Rudyard Kipling: “the glory of the garden lies in more than meets the eye.”

THE EDITORS
Since the Elizabethan era, plantmen have valued unusual forms in flowers. Plants that "spotted" double flowers instead of single, or white blooms instead of colored, were the ones most prized and most useful for hybridizing.

TODAY'S GARDEN
HOW IT EVOLVED

Hundreds of thousands of years ago, before the Ice Ages virtually obliterated the rich flora of much of northern Europe, plants such as magnolias, giant conifers and weird tree ferns thrived in what are now the British Isles. In due course, the ice crept slowly back to the north, and by degrees plants that could live in a cooler climate spread northward from those parts of Europe that had not been frozen. Then, somewhere about 7000 to 5000 B.C., the North Sea gradually found its way through what is now the English Channel and joined up with the Atlantic. The British Isles were cut off from Europe, and continental plants could no longer reach them.

The native plants of the British Isles are therefore singularly few, consisting only of those that were growing there at
the time the sea broke through. Many of these now thrive so vigorously that they are regarded as weeds.

The majority of the plants grown today in the British Isles have been brought from many parts of the world over the centuries, and have been cultivated in the temperate climate and favourable soil that resemble their natural habitats.

CLIMATE

One reason why plant life in the British Isles is so lush is that nowhere is the sea very far away. The great mass of water surrounding the land heats up and cools down slowly thus preventing extreme variations in temperature. On the southern and western coasts, as far as the north of Scotland, ocean currents tend to bring warmed water in the winter, so that there is a long if not very wide band of country where winter frost is seldom of any consequence. The Atlantic weather brings many rain clouds, which break mostly over the mountainous western areas.

On the eastern side there are few mountains. The northerly seas are colder, and the air sweeps over either from the continent or from the west, where it has already deposited much of its moisture. So the east coast is cooler, drier, and, particularly in late summer and autumn, sunnier than the west. Thus it is that European and sun-loving plants grow better in the more fertile eastern counties than in the west.

The climate of the west favours plants that come from rather similar coastal districts, such as the North American Pacific coast, islands like Japan, or mountainous districts such as are found in western China or the Himalayas.

Between the west and east coasts the climate may vary considerably and be very local, and a great deal of study has lately been made of “micro-climates”, which may exist even in a small garden.

For example, in one spot a particular plant may be regularly damaged by a May frost, while if it is replanted only a few yards away it will grow unharmed. The configuration of the land may also modify local climate. A cool, open, breezy place seldom suffers the crippling spring night frosts that fall in sheltered hollows, where temperatures may rise much higher during the day.

A knowledge of local climate is, then, the gardener’s first tool. Correctly used, it will enable him to cultivate plants brought from the vast areas of the world that have a similar climate.

SOIL

The soils of the British Isles range from heavy, rich (often clay) land to light heathland, which is dry and sandy where natural drainage exists, boggy where it does not. Most of these soils can be made fertile in some degree.

Some soils contain lime and are termed alkaline, while others do not and are called acid. (Between these two extremes are, of course, various near-neutral stages.) These differences have had an important effect on the garden. Camellias, most heathers, certain magnolias and other shrubs and plants that have been introduced, particularly from western China and Japan, and which have been highly developed by nurserymen during the present century, cannot be grown on an alkaline soil. All are splendid for the purpose of naturalizing in the garden with an acid soil. Fortunately, most plants that grow naturally on alkaline soils can also be cultivated reasonably well on acid soils.

Modern gardens are, therefore, divided into two very distinct types—the acid soil garden, where rhododendrons can be grown, and the limestone soil garden, where the rose family and a great many kinds of bulbs are at their best.
TODAY’S GARDEN

HISTORY OF BRITISH PLANTS

PLANTS FROM OVERSEAS
The similarity of the British climate and range of soils to those of such varied places as Europe (including the Mediterranean coast), the mountains of northern India and western China, the Pacific coast of North America, the isles of Japan, and even parts of South America, has made it possible, from very early times, to overcome the poverty of the native British flora by bringing plants from overseas. A few examples are the potato and runner bean from South America; rhododendrons from south-east Europe, North America, China and Tibet; apples from the continent of Europe (only the harsh, almost inedible kind of crab apple is a native); the horse chestnut from the Balkans; and all roses, except those of the hedgerows, from the continents of Europe, Asia and North America. Some of these plants now grow more vigorously in the British Isles than they do in their natural homes.

EARLY PLANT COLLECTORS
There are no reliable records of how plants were brought to this country before 1548, when William Turner, who had a garden at Kew, compiled a list of plants grown in England. He named a number of plants from overseas already well known in cultivation. Such were the black mulberry, now believed to have originated in central China; southernwood or lad’s love (*Artemisia abrotanum*) from southern Europe; the winter cherry (*Physalis alkekengi*) from Europe; the almond and apricot from western Asia; the common white jasmine, which ranges from Persia to Kashmir and China; and the old red peony from southern Europe.

In 1596, John Gerard, who was gardener to Lord Burleigh, but who also had his own physic garden in Holborn, added very considerably to the list by publishing a catalogue of the plants he grew, some 1,030 kinds. Sometimes he named the man who introduced a plant, usually a merchant or someone with overseas trading connections, who was also a gardener. It is to be noted that his list included plants from across the Atlantic, such as the so-called African marigold from Mexico, and the tomato (long grown for decoration but not eaten) from western South America.

In 1597 Gerard published his famous *Herball, or generall historie of plantes*. One of its most interesting features is the frontispiece—a portrait of the author holding in his hands a spray of potato in flower, with its berry; the plant is also described in the book.

The potato is without doubt one of the most important and valuable plants ever introduced into the English garden and, much later, to the farm. This picture and description were the first to be published, not only in England but in Europe.

The manner of the arrival of the potato has long been a puzzle. Gerard wrote that it came from Virginia. Tradition has it, in one version, that Drake introduced it to Britain, while another and more popular version maintains that Raleigh was responsible. There are extremely sound reasons for dismissing these stories as legends, for the potato is a native of South America and was quite unknown in North America until a century after Drake’s single visit there, and Raleigh never visited Virginia.

The true history seems to be this: the Spaniards originally collected tubers from their Spanish colonies, probably in the 1560’s; they certainly cultivated them
as early as 1573. By 1580 Spanish ships were being provisioned with them. When Drake raided Cartagena he apparently seized supplies of the Spanish tubers and had some on board when he brought back to England from Virginia a certain Thomas Harriot, mathematician and scientist. It was Harriot who realized their importance, and obtained some to give to his botanical friends, among them Gerard. Harriot’s patron was Ralegh, who also received some roots and was probably the first to grow the plant on his estates in Ireland.

Within the next few years there was a steady influx of plants and trees from the English estates in North America, or via Paris from French colonies in America. Others came through Dutch traders in the Cape and East Indies. The horse chestnut, which plays such a lovely part in the spring landscape, arrived from Constantinople via France, during or shortly after 1615. It was long believed to originate in India, but in 1879 was found to be a native of Greece and Albania.

In 1629 John Parkinson published his *Paradisi in Sole Paradisus Terrestris*, in which are noted many plants new since Gerard’s *Herball*. It also contains an account of John Tradescant, formerly the famous gardener at the Earl of Salisbury’s Hatfield House, and one of the earliest gardener-botanist plant collectors. From Hatfield House, Tradescant travelled to the nurseries and botanic gardens of Europe buying rare plants for his employer. When Salisbury died in 1612, Tradescant went to work for Lord Wotton, and, becoming interested in the Virginian trade, imported many new American plants. One of these was later chosen by the great botanist Linnaeus to bear his name: *Tradescantia*. Several kinds of this plant are now very popular as room plants, but the one Tradescant obtained was hardy, the spider-wort *Tradescantia virginiana*.

Tradescant then joined a band of gentleman adventurers formed to harry the Barbary pirates, and was soon making highly dangerous landings on the Barbary coast of North Africa to collect plants. A quieter spell at home then followed, and he was soon appointed gardener to the favourite of King James I, the Duke of Buckingham, who addressed letters to the Admiralty urging the officers of His Majesty’s ships to make every endeavour to obtain rare plants for the Duke’s collection—Tradescant, of course, being responsible for these requests.

During the 17th century a number of new plants came to England through the so-called “Turkey Merchants”, an English trading community centred at Aleppo. It seems fairly certain that the merchants’ chaplain, the Rev. Edward Pococke, was responsible for introducing, in about 1640, the cedar of Lebanon, a tree that during the succeeding centuries has lent great dignity to the lawns of many houses and parks.

Much that was new came from Holland, then as now a nation of gardeners. At that time the Dutch had close connections with South Africa and the Dutch East Indies and introduced many of the strange and brightly coloured Cape bulbs which can be grown in Britain if kept free from frost.

Dutch traders were also almost the only contact with the then largely unapproachable islands of Japan—for centuries the home of wonderful garden art. In 1690 the German traveller, Kaempfer, was attached to the Dutch Embassy in Japan. The result of his two-year stay was the first account of the natural history of Japan, its plants and gardens. The popular and exotic-looking Japanese *Iris kaempferi* is named after him.

From Holland also came the great vogue for the tulip. This remarkable plant arrived in about 1578 via Holland.
A flower brought from South America in the late 19th century by a sailor as a present for his wife began the popularity of fuchsias. James Lee, a nurseryman, saw it in the window of a house in Wapping and persuaded the sailor's wife to part with it. From this plant he raised 300 cuttings, which he sold for £1 each, and then other plantmen set to work. By 1842 the first white-sepalled fuchsia had been raised and the first tricolour appeared in 1872. With the reaction against Victorian tastes, the fuchsia went out of fashion; today it is again popular and many new kinds—such as Springtime (above)—have lately been raised.
from Vienna, having been introduced there from Constantinople in about 1554. By 1629 Parkinson was able to name 140 varieties. Many other plants came from France, particularly pears, many of which today still bear French names.

Quite as important as those who collected the new plants were those at home who were prepared to pay for them and cultivate them. At Fulham Palace, Henry Compton, who became Bishop of London in 1673, grew for the first time in England many trees and plants, particularly those that had come from North America. In his stowe houses, seeds from the East and West Indies were raised. A contemporary described his collection of these “Indian” plants as “very wonderful and scarcely credible”. But when Compton died in 1713, his successor either destroyed or sold this wonderful collection of “exotics”—and replaced it with vegetables and fruits.

The London Quaker, haberdasher and linen draper, Peter Collinson, began growing plants collected from all over the world in the garden of his house at Peckham (then a quiet village in Surrey) and later at Mill Hill. Through his business connections with North America and the West Indies, many plants were sent to him. In 1731 he received an orchid from the Bahamas which he successfully brought to flower—the first tropical orchid to bloom in England. In return for helping to finance the travels of the American John Bartram, founder of the first botanical garden in America, near Philadelphia, Collinson received the first azaleas and rhododendrons to be grown in England, as well as maples, magnolias, and other plants now found in many gardens.

In 1772 Kew Gardens sent overseas the first of its numerous plant collectors, the Aberdonian, Francis Masson. He travelled principally in the Cape of Good Hope, and to him are owed the plants from which the modern cineraria has been bred; the Cape heather, popular in greenhouses and as a room plant; and many bulbs.

John Frazer of Inverness, who was a Chelsea draper, became absorbed in the plants of the Chelsea Physic Garden, and resolved to go to America as a collector, making his first visit in 1780.

In 1796 he went to Russia, sold a collection of plants to the Empress Catherine, and obtained a commission to collect plants for Tsar Paul. But when he returned with them, a new Tsar was on the throne who refused to acknowledge him. On his final trip he collected a rhododendron, _R. catawbiense_, which he never saw flower. This was to become the chief ancestor of the race of hardy rhododen- drons that is now such a prominent feature of many gardens and parks in early summer.

**ROCK GARDENS**

Most gardens have a rock garden of some kind, or at least a few alpine plants. Rock gardening and the cultivation of alpines are relatively new interests, but at the end of the 18th century the now popular flowers of the European Alps were almost unknown.

But in 1775 two “curious gardeners” (a name given in the 16th century to those gardeners who were of an inquiring and experimental turn of mind), Dr. Fothergill and Dr. Pitcairn, engaged the former’s gardener, Thomas Blaikie—another Scot—“to undertake a journey to the Alps in Switzerland in search of rare and curious plants, the product of that country”.

From this trip Blaikie sent home some 440 packets of plants, seeds and specimens. The two doctors acquired considerable fame for this first collection of alpine plants, although they failed to give any credit to Blaikie.
TODAY'S GARDEN

TREES AND PLANTS FROM THE WEST

Today, the woodlands of the British Isles are largely formed from trees of the Pacific coast of North America, whence come also countless plants that are now common and almost indispensable in the garden. At the beginning of the 19th century parts of the Pacific coast area were extremely wild and inhabited only by a few hunters and lawless Indians. The coastal land had been visited and to some extent surveyed by Captain George Vancouver on his voyage round the world of 1791–95. He had with him, as surgeon, Archibald Menzies, who was also a botanist. From him came the first detailed account of the rich flora of the California coast.

The Horticultural Society of London (now the internationally famous Royal Horticultural Society) was formed in 1807, and its committee felt that a plant-collecting expedition to follow up Menzies' discoveries would be rewarding.

In 1823 they sent yet another young Scot, David Douglas from Scone, to the eastern United States, but he met with little success. Then in 1824 he sailed for the North Pacific coast—the first of his highly adventurous and often solitary journeys. He brought back the now common mahonia (Mahonia aquifolium), the snowberry, clarkia, the musk plant, nemophila, the shrubby garrya, the red flowering currant, and the annual, Limnanthes douglasii, which carries his name. The Douglas fir, discovered by Menzies but introduced by Douglas, is now an important British timber tree. Douglas died tragically in Hawaii when only 35 years old, but during his short life he contributed valuable new additions to the ever-growing flora of the British Isles.

In 1840, William Lobb, travelling for the enterprising Exeter firm of nurserymen, Veitch, went to Brazil and Chile. Many of the plants he collected were best suited for cultivation in greenhouses, which, with improved heating, were rapidly becoming popular. To Lobb is owed the monkey-puzzle tree (Araucaria araucana), for although a few had previously been received in Britain, he collected a large quantity of seed in Chile, from which Veitch raised thousands of plants that sold at a high price. In 1849 Lobb went to California, and worked over the country first covered by David Douglas. The triumph of this trip was his introduction of the California "big-tree", or wellingtonia, which proved to be a sensational success. Lobb also introduced the first gloxinia.

PLANTS FROM THE FAR EAST

Meanwhile, the enterprising Horticultural Society became interested in Chinese plants. Although China was closed to British travellers, there was some British trade with the ports, and fortunately a certain John Reeves, tea inspector in China for the East India Company, had developed a successful technique for sending plants home in the care of the Company's captains. These plants included peonies, chrysanthemums, camellias and azaleas.

In 1842 a treaty opened further ports to the British, and the Society (of which Reeves, now retired from China, was an active member) decided to send out Robert Fortune of Kelloe, County Durham, as a collector.

Fortune was helped by a new invention, an airtight plant case produced by the amateur naturalist, Dr. Nathaniel Ward. The introduction of plants by seed, even in the days of sail, was not too difficult. The seeds were sealed up in containers and so protected against changes of temperature on a long voyage. But to keep plants alive at sea for weeks on end through the changing temperatures and
climates was another matter. Ward’s invention much improved their chances of survival.

Fortune made several journeys, but although he was never allowed to go far inland, he ranged more widely than any previous collector. He had a flair for picking out from the wealth of Chinese plants those that would both thrive and be liked in the British Isles. To him are owed the winter-flowering jasmine, the so-called Japanese anemones, one of the first forsythias, Prunus triloba, Primula japonica, and many rhododendrons, azaleas, tree paonies and chrysanthemums. He also obtained the tea plant from China and introduced it into India.

William Lobb’s brother Thomas was a pioneer collector of orchids. In 1843 he visited parts of India, Burma, Malaya and Borneo, and orchids soon became immensely fashionable.

In the middle of the 19th century, the Bavarian Philipp von Siebold was appointed physician and naturalist to the Dutch East Indies Company, which had a trading station in Japan. Siebold had graduated as an eye specialist, and was therefore readily accepted by the Japanese, who suffered badly from eye trouble. With their help he collected and sent to Europe numerous Japanese plants, many of which are so popular in gardens today—notably camellias, azaleas and primulas.

But only the fringes of China and Japan were explored, and the plants collected were mostly those grown in gardens. It was realized that many Japanese plants had originated in China, and later, that the plants in the gardens of China itself had originated far from the coast, in the mountains of western China and Tibet, which were then unknown to Europeans. This discovery was made by Russian naturalists who approached these regions from Europe, and by French Jesuits who were allowed to open missions in these remote areas. Among the French priests were several naturalists, including Father David, who discovered countless new plants, of which he sent specimens to France. The purple buddleia, now common everywhere, is named Buddleia davidii after him. Father Delavy also sent to Paris 200,000 specimens of plants, neatly pressed and labelled.

Another 19th-century collector was an Irish doctor named Augustine Henry, who, disliking doctoring, joined the Chinese Customs Service. At a remote station high up the Yangtze River he combated his boredom by collecting the local plants. From this accidental start he became one of the greatest authorities on the plants of western China. He sent 158,000 dried specimens to Kew Gardens, hundreds of which were new to Great Britain.

So it was that during the latter part of the 19th century, the museums of France, Britain and Russia were enriched by the pressed and desiccated specimens of a flora of unbelievable richness. For long no one grasped the fact that much of it could be grown in new surroundings.

One of the first to realize the possibilities of this new world of plants was Harry Veitch, a descendant of the family that had commissioned the Lobb brothers. At Kew Herbarium he saw pressed specimens of a remarkable tree discovered by Father David and sent home by Augustine Henry—the “handkerchief tree”, so called because of the huge, flapping, white brackets that surround its tiny flowers. Its botanical name is Davidia, after its discoverer.

Veitch decided he must have seeds and grow the plant in England. He asked the Director of Kew Gardens to recommend a collector, and Ernest Henry Wilson from Chipping Camden was selected.
The original sweet pea, *Lathyrus odoratus* (above) came from Sicily in 1699. It was insignificant and proved very difficult to hybridize until Henry Eckford, gardener to a Gloucestershire doctor, decided to try to develop it. His slow and painstaking work resulted in the first "modern" sweet pea, shown in 1881. When the first variety with wavy edges appeared in 1901 it caused a sensation in the gardening world. New forms and fresh colours are still being introduced in modern sweet peas (right).
After an appalling journey and a great many vicissitudes, he found a davidia and was able to collect quantities of seed.

On another trip Wilson found and sent back to England quantities of that great favourite, the regal lily.

Wilson made other journeys, and his additions to the gardens of the British Isles included flowering cherries, clematis, primulas, poppies, azaleas (which he brought from Japan) and rhododendrons. Many of these, although now almost commonplace, are among the most beautiful of plants.

Other great collectors followed Wilson, among them Frank Kingdon-Ward, who discovered *Meconopsis*, the blue poppy.

**PLANTS FROM OTHER AREAS**

Although much of the astonishing flora of Asia that can be grown in temperate climates comes from areas that are now out of reach, other districts still provide British collectors with rewards. A number of plants from the cooler parts of South Africa, particularly some of the dazzling annuals, have been introduced or reintroduced.

The enthusiasm of alpine gardeners and growers of bulbs has caused several collectors to visit the lands lying in or round the Mediterranean. They have not brought back many spectacular plants, but those that they have collected are particularly suited to the small garden: charming cyclamens, narcissi, snowdrops, crocuses, irises and tulips. Peter Davis has been honoured by the Royal Horticultural Society for his work in eastern Europe and the Middle East. Oleg Polunin has worked in the Near East. Two great authorities on bulbous plants, Patrick Synge and Paul Furse, have visited Turkey and northern Iran.

New plants have come from North and South America. The rich flora of California and the Rockies continues to provide novelties. From wind-swept Patagonia, Mrs. Ruth Tweedie has brought back several plants that promise well, including a blue oxalis and a scarlet ourisia.

Nor should the ardent band of amateurs be forgotten. Helped by immense improvements in transport and armed with appropriate permits, they return from their holidays with gems collected in the mountainous regions of Europe, and in the Middle East.

**MUTANTS AND HYBRIDS**

Apart from the great diversity of plants that have been collected from many countries, and which have settled happily in the British Isles, others have evolved—first the singular variations that on rare occasions occur naturally, sometimes producing a plant that is much more desirable than the standard type; and second, variations produced by man.

**THE MUTANT**

In the first case, a change takes place within the plant—a mutation—causing an obvious exterior change. These mutations occur very infrequently, and even then usually pass unnoticed, for, as mutants are usually so abnormal as to be weakly, Nature soon eliminates them and they disappear.

A good example of one type of mutant is the florist’s double flower—perhaps a daffodil or a cherry. Something occurs to an individual plant which causes the stamens (which carry the anthers and the pollen necessary for fertilization) to turn into rather distorted petals. These are quite sterile and useless for perpetuating the plant by seed, particularly as the style (an essential part of the female or seed-bearing part of the flower) is also frequently petal-like. These abnormalities can easily be seen by examining a double flower.

Other mutants are the occasional
white-flowered form of a plant that is normally some other colour, or the shoot of a bush rose that unexpectedly begins to climb. From time immemorial observant gardeners have noticed these peculiarities, particularly in food plants when some change has resulted in more food-producing growth, and they have nurtured and propagated this growth by one of the numerous means available to man but not found in Nature, such as the rooting of cuttings, grafting, and budding.

Until recent times man had been unable to produce these “sports” as they are called. Now, however, he can do so to some extent.

One method is by the use of a substance called colchicine, found in the autumn crocus (Colchicum). Atomic radiation may also have the same effect. But such methods are very haphazard. Often the embryo plant under treatment is killed, and many of the mutants that do result are useless.

THE HYBRID

The second method of producing new plants occurs sparingly in Nature, but has been used by man on an enormous scale particularly during the last century. If pollen is taken from one kind of plant and placed on the seed-producing organs of another, the seedling, or hybrid, will have qualities that differ from both its parents.

There are, of course, very severe limitations on the production of hybrids. The parents must be closely related members of the same flower family. It is often possible to hybridize, or “cross”, two kinds of rose, but a rose could never be crossed with a holly or a lupin.

Hybrids can occur naturally when two kinds of plant grow close together, are compatible with one another, flower at the same time, and bees, flies or wind carry the pollen at an appropriate time from one to the other. The London plane tree is a particularly famous example of the almost infinite possibilities of producing new plants, for, strange as it may seem, one parent comes from the New World and the other from the Old. It seems certain that at some time an American plane was placed close to an Oriental plane. The wind carried the pollen of one to the female flowers of the other. The seedlings from this union varied from their parents and, probably in the 17th century, were brought to England and planted. The trees proved to be ideal for growing in smoky London.

No one knows how, when or by whom the first London plane tree was produced, though botanists have now proved conclusively that it does unite in its cells elements drawn from an American tree with those from one restricted to Europe and Asia.

Very many hybrids owe their origins to the accidental planting of two varieties of the same family close to one another. For many centuries gardeners unknowingly brought about the necessary conditions by placing plants side by side, and then selected the new plants that arose as seedlings. As far as is known, it was not until the early 18th century that gardeners understood how hybrids arose, and became aware of their power to emulate the process by transferring the pollen themselves.

This was a development of the utmost importance to the human race, for in the hands of scientific breeders plants can be bred to fulfil special conditions—to resist disease, to give bigger and better crops, or to produce more showy flowers. Desirable parents may be brought together from any part of the world, or pollen from an early-flowering plant may be kept alive, by means of refrigeration, for use on a plant that flowers at a different season.
That domestic animals could be purposefully bred had been known for centuries. Now many skilful men took up the work of breeding plants for a specific purpose.

One of the most important was Thomas Andrew Knight (1759–1838), a squire living on the borders of Herefordshire, who was already a skilled breeder of animals. One of the first plants he tackled was the apple, which, although not a native, can be grown to better favour in England than in any other country.

Knight tackled the job systematically, and, in addition to apples, bred pears, cherries, nectarines, plums, currants and other plants. But though his practical achievements were great and one or two kinds he raised are still grown, he failed to arrive at the fundamental laws of heredity that lie behind all breeding, possibly because he experimented with too many different plants.

These laws were discovered in 1865 by Johann Mendel, Abbot of Brno, following experiments he began in 1856, using only peas for his research. Mendel read a paper on his work to the local natural history society, which was duly published, and then forgotten. It was not until 1900, after plant and animal breeders had wasted great energy in experimenting on an ever-increasing scale, that three breeders, searching for information in out-of-the-way scientific literature, came across Mendel’s paper. It was soon published to the world at large, and the scientific study known as genetics was born.

Its immense importance is shown by the fact that there is probably not a single vegetable plant or fruit tree in the garden today that is not a hybrid. A few are probably accidental in their origins, but the majority are the result of purposeful breeding. Among flowers, almost all roses, irises, lupins and most annuals have been developed in this way.

**THE NAMING OF PLANTS**

One of the problems for the gardener, and not only for the beginner, is the extraordinary confusion caused by botanical nomenclature. The subject is highly complicated, and though popularly supposed to be scientific, is not so. It is governed by nothing more than a set of rules that have grown up over the centuries. For practical purposes it is a great help to know something of these rules and how they evolved.

Right from the beginning one major difficulty had to be faced. A wild flower seldom confines itself to an area where all the inhabitants speak the same language. For instance, the common daisy of the British lawn grows almost everywhere throughout Europe and western Asia. As the English name “daisy” means nothing to a Frenchman, a German, or a Russian, and as botany and gardening transcend national boundaries, an international name is necessary, so that all nationalities can use it without any misunderstanding, and without the need for further description.

In the early days of botanical science, Latin was the one language that was universally understood among all educated Europeans. Botanists consequently chose Latin names for their plants.

Modern plant names are not nearly as complicated as they were more than two centuries ago. For example, many gardeners grow a small variegated maple usually called the box-elder, the leaves of which are rather like those of the ash, but marked in green and silver. When, in 1688, the great English naturalist Ray wanted to describe the natural green form of this tree, he wrote: *Arbor exotica foliis fraxinii instar pinнатis & serratis Necundo perpetum credita*. All this was necessary to identify this pretty little tree to his botanical colleagues.
Hemerocallis flava (left) was known in Britain during the 18th century; it had grown wild in eastern Asia long before, as early Chinese paintings show. Present garden forms of day-lily (below), with their wide range of colour, flower shape and size, have been developed largely during this century. They are the result of crossing several species and their varieties and recrossing the progeny.
The present-day botanist has simplified matters by calling the variegated form Acer negundo variegatum.

Certain plants have a general similarity, and from early times botanists have tried to classify and group plants according to these likenesses, which usually occur in the fundamental structure of the flower. Superficial similarities, such as thorns, are ignored. For some while there was a general trend towards this classification, but it was not until the Swede Carl Linné (or, in international Latin, Linnaeus) produced his book Genera Plantarum in 1737 that a sound system of naming plants originated.

Plants are grouped into large units, which may be likened to races, tribes and families. The genius of Linnaeus was that he evolved a system by which any plant could be identified by means of two names, sometimes with the addition of a third. The large units—the Divisions, Subdivisions, Classes and Families, as they are called—are ignored so far as the name of a single plant is concerned. They remain in the background. Linnaeus reduced his system to a final unit, the genus. Each genus comprises all those plants that have certain similarities, within a much more restricted range than those characterizing a family, for example.

In the case of the small variegated maple, Acer negundo variegatum, the genus is Acer—the maple genus, so named because it was the Roman name for some kind of maple.

But as there are several kinds of maple, such as the sycamore and common hedgerow maple, Linnaeus distinguished between the members of the genus Acer by adding another name, the specific epithet—describing the individual species within the genus. For the variegated maple he chose one of the words used by Ray, negundo, the name of a tropical plant with leaves similar to those of this particular maple. Thus Linnaeus named the species Acer negundo.

Acer negundo normally has green leaves, while on this particular tree they are variegated. This variety therefore receives a third name, and becomes Acer negundo variegatum. Thus it is understood that the tree is the maple with leaves like those of the negundo but variegated. Moreover, this is understood by botanists of any nationality.

Once such a description of a plant is published, the botanical name generally remains the plant’s name for ever.

Names do change, however, because botany is a continually changing science. To take the variegated maple as an example—it will be noticed that the leaves are not like those of most other maples, such as the sycamore, but rather like those of the ash. Today some botanists believe that it is not a true maple, but a genus on its own, which they call Negundo. The tree thus becomes Negundo fraxinifolium, the ash-leaved negundo.

Although a specific epithet is sometimes the old name for a plant, such as negundo, it is more often a descriptive adjective. A few examples of well-known plant names are: the common rhododendron, Rhododendron ponticum, the rhododendron coming from the Black Sea district that was once called Ponticum; the lily-of-the valley, Convallaria majalis, the convallaria of (that flowers in) May; the common nasturtium, Tropaeolum majus, the big-flowered tropaeolum.

In a few cases the name of a person is used, usually someone connected with the flower. Many people grow Mlokosewitsch’s beautiful pale yellow paony, which is known to the botanist as Paeonia mlokosewitschii.

These rules apply today to most of the trees and shrubs, and to the plants that the alpine gardener likes—that is, true
natural species. The plants of the vegetable garden and herbaceous border, however, and a few shrubs such as roses and rhododendrons, have been interfered with by man, so that the result is far from natural. Whereas a natural species will reproduce itself in more or less the same pattern for countless generations, very few of the so-called man-made plants will “come true” from seed. They are increased by cuttings, division of the roots, grafting, or budding.

Hybridization has given them a complex parentage and inheritance, which splits up again when seedlings are raised, and which in some cases causes sterility.

A new name has quite recently been devised to describe this type of plant. This is “cultivar”, a sensible umbrella word that has brought into the nomenclature of plants such names as Peace for a particular rose, Cox’s Orange Pippin for a particular apple, and Pink Pearl for a particular rhododendron. The rules are somewhat similar to those for species—an adequate description must be attached to the generic and specific names, which appear in Latin and in italics; the cultivar name is given in whatever language it was first published.

**HISTORY OF GARDENING**

The craft and science of gardening developed out of the herbalist’s profession, while its art was closely connected with the adornment of architecture, and perhaps with the adornment or garlanding of the human body. All these were practised in the early civilized communities such as those of Greece and Rome.

But even in Britain, at the time of the Roman invasion, the natives decorated themselves with woad, the dye (later replaced by indigo) that was prepared from the leaves of *Isatis tinctoria*, almost certainly an introduced plant.

When the Romans came to Britain they brought their gardening knowledge and a number of their plants with them. Later the Anglo-Saxons, with their continental origins, must have cultivated many plants that were not native.

**HERBS AND HERBARIA**

More important, however, were the great religious orders that came with William the Conqueror. Their learned members brought with them a botanical and herbal knowledge and a tradition which dated back to Aristotle and his successor, Theophrastus, who lived three centuries before Christ.

A great deal of this knowledge was good practical sense concerning the use of herbs for ill-health. Even in Tudor times, such plants as were not cultivated for food, and even flowers like the rose, were grown primarily for the amelioration of illness and distempers of every kind.

The cultivation of plants and the craft of the gardener were undoubtedly developed and spread over the British Isles by the monks. Most monasteries had their *Herbarium* or herb garden, in the charge of a monk, who would employ lay workmen. These, if at all intelligent, would absorb some of the monk’s theoretical and practical knowledge, and in turn disseminate it. Pot-herbs and vegetables such as leeks, carrots, garlic and onions, which were not treated as field crops (as were peas and beans) were also grown. The monasteries also planted orchards and, in the few places where the situation and climate were suitable, vineyards.

Nothing is known of the techniques of
these early medieval gardeners, though the monasteries’ account books show that small payments were made for soil, for the labour of hoeing, planting, and the gathering of crops, and quite frequently for leather gloves.

Something of the gardeners’ appearance is known from the Church itself. In Canterbury Cathedral there is a fine window, made about 1127, showing Adam scantily dressed and using a spade. The spade is of wood, having a pointed blade shod with iron. In Lincoln there is a later carving of a gardener, now well dressed in a cape, though still bare-footed, using a wide-ended spade also shod with iron. Other carvings show men very roughly clothed using heavy hoe-like instruments and picks.

ROYAL AND NOBLES’ GARDENS

There were also royal gardens and those belonging to the nobles, which contained choice fruit. Kent was already producing cherries and apples for the London market. In the 14th century there were the “neat house” gardens, situated where Pimlico now stands, making good use of the neat’s (cattle) dung from the neighbouring cattle sheds.

But gardening and the gardener were really of little consequence in medieval Britain compared with the Continent, and the Customs House records of the period show that great quantities of vegetables and fruit were imported.

With the coming of the Tudors, gardening increased. A detailed account exists of the great garden begun at Thornbury Castle in 1511 by the Duke of Buckingham, referring to “many roses and other pleasures”, for plants were no longer purely utilitarian and medicinal. Other accounts tell something of the grandiose gardening activities of Cardinal Wolsey at Hampton Court, and of the smaller garden of Sir Thomas More at Chelsea, which was probably more of a plantsman’s garden.

SKILLS FROM THE CONTINENT

During the latter part of the reign of Henry VIII, a new and probably important influence on horticulture was the arrival of the first refugees from religious persecution on the Continent. They came at different periods and were of different nationalities, Flemings, Walloons and French. Although it is well known that their skill in various crafts contributed to the industrial development of Britain, their effect on horticulture must also have been considerable. They settled particularly in East Anglia and south-east England, where they specialized in vegetable culture for the London market.

By now the gardeners and the garden artificers were men of skill, though little is known of their methods. Other French and Dutch experts came in addition to the refugees, and by 1548 there were established seedsmen and nurserymen. What was probably the first book on gardening to appear in England was published in 1568, but this was largely a literary work and no more than a translation of older continental literature put together to make a “briefe and pleasaut treatysse” by a journalist, Thomas Hill, who clearly sensed the growing interest in the subject.

INCREASING INTEREST

IN GARDENING

The success of Gerard’s *Herball* in 1597 clearly indicates the increasing number of gardeners and their interest in gardening. At the same time there emerged that most important type of gardener, now called a “plantsman”, the man interested above all in the successful cultivation of plants, particularly new, rare
Phlox

Introduced from North America in 1731, Phlox paniculata (above) was the ancestor of the modern phloxes. It was a variable plant, and only recently was work begun to produce the extraordinarily wide range of colour and form that exist today. Unusual varieties were first selected, then crossed, and from them the most outstanding offspring were selected for hybridizing. A modern bloom is shown on the left.
and interesting kinds, who was then and for a long time after called “a curious gardener”. To this type of man was due the increased variety of plants grown and the great improvement in methods of cultivation.

Half-way through the reign of Elizabeth I, William Harrison, then Dean of Windsor, wrote with every authority, “If you look at our gardens... how wonderful is their beauty increased not only with flowers... but also with rare and medicinal herbs sought up in the land these forty years”. The emphasis is now on beauty rather than on medicinal plants.

Gardens on the grand scale were made famous by Elizabethans such as Sir Christopher Hatton and Lord Burleigh. At Beddington, in Surrey, Sir Francis Carew was growing oranges successfully, and in August 1599 he was able to pluck ripe cherries a month or more beyond their due season, to present to his Queen on her visit to his garden. The skill of his gardeners had delayed their ripening until the great day.

There was now a rapidly increasing class of smaller householders with a modest garden. From Thomas Tusser’s *A hundred good pointes of husbandrie*, which contained in doggerel much practical advice on gardening, and from other sources, it is clear that women, too, were taking an increasing part in gardening.

*In March and in April, from morning to night,*  
*In sowing and setting, good housewives delight,*  
*To have in a garden, and other like plot,*  
*To trim up their house, and to furnish their pot.*

The herb and flower gardens were the wife’s province; the orchard (very important in Elizabethan times) and vegetable garden, the walls and fences, and often the moat (by now a fish-pond) were the responsibility of the husband.

When James I came to the throne, a number of great houses were completed that had gardens of such grandeur as was previously unknown. A notable example was the Earl of Salisbury’s Hatfield House in Hertfordshire (the gardens are today very different from the original design). It was the skill of his celebrated gardener John Tradescant that led to the successful cultivation, often for the first time in England, of many plants acquired from continental nurseries.

Tradescant was typical of the new and growing body of professional gardeners employed by the enterprising new aristocracy. William Coys of North Okington in Essex, a “curious” amateur of the same period, was one of the first of many country gentlemen gardener-botanists to whom so much is owed. Though the yucca had been grown in England for some years, Coys was the first to bring it to flower. He was also one of the first successful cultivators of the persimmon, the sweet potato and the common potato. The little ivy-leaved toad flax, now common and almost a weed in much of the British Isles, was first cultivated in his garden as a rarity from Spain.

Fortunately a number of these country gentlemen gardener-botanists kept records of the plants they grew, and bequeathed valuable knowledge to the gardener of today.

**BOTANIC GARDENS**

The modern gardener also owes a great deal to the scientific cultivators of the past who worked in botanic gardens.

These were situated at seats of learning all over Europe, the first being started at Padua near Venice in 1543, followed shortly by others on the Continent, one at Oxford in 1621, another at Edinburgh in 1670, and one at Cambridge in 1762. The Edinburgh garden, now known as the Edinburgh Royal Botanic Garden,
Cyclamen

When Cyclamen persicum (right) was introduced from the Near East in 1731, it was too tender a plant to be much grown in Britain. But during the mid-19th century great advances were made in the construction and heating of greenhouses, and the cyclamen attracted the attention of plantsmen who could use these improvements. Larger flowered forms with unusual colours were developed, and years of breeding evolved the plants that are now so popular for winter decoration (below)
is famous for its rhododendrons, primulas, gentians, and plants from western China, while the one at Cambridge has lately been greatly extended and is of particular interest to those who garden on limy or chalky soils. A garden was also made at the beginning of this century at Liverpool University.

But the most important in Great Britain are the Royal Botanic Gardens, Kew, the hub of botany in the British Commonwealth. In 1730 Frederick, Prince of Wales, and Princess Augusta went to live at Kew House. Both were interested in gardening, and Augusta was particularly keen on growing rarities. Soon their garden had a great reputation for choice plants. After the Prince died, his widow devoted still more time to the garden. In it the arts and sciences were admirably combined, and it quickly became known far beyond the British Isles. In 1789 William Aiton, then in charge of the plants, listed some 5,500 in his care.

When the Princess died, her brother-in-law, George III, another enthusiastic gardener, bought the adjoining estate of Richmond House, adding it to Kew, and Sir Joseph Banks became the director of the gardens. He was an intrepid traveller, besides being a great administrator and a first-class scientist, and was the first to arrange for men from Kew to go far afield to collect plants. After his death, the gardens lost their glory. The Prince Regent took no interest in them, and though various attempts were made to keep the gardens going, it was not until 1842 that they became a national institution, and Kew Gardens, as we know them today, were opened to the public.

No account of botanic gardens can be complete, however, without some mention of the Royal Horticultural Society’s garden at Wisley in Surrey. It is not a true botanic garden, but a gardener’s garden on a huge scale; scientists participate in its administration, and report on it for the benefit of horticulturists. A new and important venture has been the formation of the Northern Horticultural Society’s garden at Harlow Car, Harrogate, which is to provide gardeners of the northern counties with an equivalent to Wisley.

**FIRST GARDENING BOOK**

But the knowledge gained from a botanic garden cannot be disseminated without gardening books or other publications. The first real British gardening book was published in the early years of the reign of Charles I. This was John Parkinson’s *Paradisi in Sole Paradisus Terrestris* (1629). The book described not only the natural history of many rare flowers “useful for physic or admiral for beauty”, but also kitchen gardens and orchards. It showed a remarkable first-hand knowledge of the plants and their cultivation.

**GARDENING PROGRESS**

During the period of the Civil War and Cromwell’s Commonwealth, gardening progressed, for though initially the horticultural activities of a number of prominent Royalists ceased, others retired from the Court and politics to the country and cultivated their gardens. Such a one was Sir Thomas Hamner, who also kept a garden book which is full of historical and practical interest. The great Roundhead, General Fairfax, maintained a celebrated garden at Nunappleton in Yorkshire.

In Cromwell’s latter years, two distinguished French gardeners, the Mollets, who were later to take a part in introducing the French style that came with the Restoration, were working in the London parks. And gardening enthusiasts such as John Evelyn, who retired to the Continent during those troubled times, learned a great deal from the French and
Dutch, then the most horticulturally advanced people in the world.

Following the restoration of Charles II, progress continued. "I may affirm that there is now, 1691, ten times as much gardening about London as there was in 1660. . . . In the time of Charles II gardening was much improved and became common," wrote John Aubrey.

It was at this time that the long and distinguished history of the gardens at Woburn Abbey began. The first Duke of Bedford entertained on an elaborate scale, and he and his large retinue needed a high production of food. Field, the head gardener, filled the walls with a wide range of apricots, peaches, nectarines, plums and cherries. He grew oranges, lemons, myrtles and aloes, which stood on the terrace in summer, and in the autumn were carried into the orangery, which was heated by a small stove. He maintained a bowling green, and kept the green arbours clipped; he filled the borders with polyanthus and gillyflowers, and raised marigolds, nasturtiums and clover, not all as flowering plants, but for pickling to make winter salads. And he saw to it that the wide gravel paths were kept in first-rate condition, always fresh and dry for the perambulations of the family and its multitudinous guests. He also made suitable arrangements to deal with the sightseers who, even at this early stage, flocked to see the place.

Much of the garden labour at this time was casual and only seasonally employed, women being engaged for weeding.

Contemporary pictures give a good idea of the tools used in gardening. John Evelyn, for instance, made a careful drawing of those in use in his garden. They were very similar to those used in Victorian times. Fork, hoe, rake, riddle and barrow changed but little in design in the years between these two periods, apart from alterations to suit a substitution of materials, such as steel for wrought iron, although spades long continued to be iron shod. For centuries, at least as far back as Roman times, the timber of ash has provided the best handles for gardening tools.

NURSERYMEN

In 1681 Field of Woburn became a partner in a new firm of nurserymen, which, looking to the expanding interest in gardening, began operations on a large scale with a hundred acres of good land at Brompton Park. The most active member of the firm was George London, gardener to Bishop Compton at Fulham and a specialist in the introduction of new trees and shrubs. The firm was joined by a younger man, Henry Wise, and within a year or two, the older partners having died or retired, London and Wise on their own became the most important nursery firm in the British Isles. Often working with the architect concerned, they laid out the great formal gardens that spread round the many new mansions being built, supplied the plants that they grew at Brompton, and often maintained them. London travelled round to visit his clients, but Wise usually stayed at Brompton. This was a closely organized business, with high standards of technique in rearing and moving plants, particularly the evergreens and other trees for the avenues that became so fashionable in the days of William and Mary. It was estimated in 1705 that the nursery stock was worth over £40,000. The firm of London and Wise was undoubtedly the first to bring the methods of "big business" into horticulture. It probably also cut into the export trade of the Dutch, who normally supplied large numbers of evergreens and other trees, particularly limes.
TODAY'S GARDEN

During the early Georgian days, probably the most important development was the gardeners' skill in cultivating the new plants introduced from the "Indies" (a vague term covering a wide area), North America, and even China.

Conspicuous horticulturists at this time were members of the rapidly growing professional classes, particularly the successful physicians. They were busy men, and their often unknown working gardeners were responsible for the day-to-day maintenance of their novel and untried plants.

18TH-CENTURY PUBLICATIONS

During the 18th century a great leap forward was taken in British horticultural literature and illustration, the latter having been of poor quality before this time. Philip Miller, who was a Scot, though born in England, became the greatest scientific gardener of his day, and from 1722, when he was given charge of the Apothecaries Garden at Chelsea, until his retirement, he was the outstanding figure in British gardening. In 1735 he published his Gardener's Dictionary, which ran into numerous editions and was for decades the standard encyclopedia of gardening.

In 1787 William Curtis founded and edited The Botanical Magazine; or, Flower Garden displayed, which has continued to this day to publish good coloured drawings of garden plants, accompanied by descriptions. The early success of this publication led to the appearance on the market of a number of rivals. None lasted long, though some contained beautiful drawings.

The effect of smoke pollution on plants had been noticed as far back as 1691, when the evergreens of Lord Devonshire's London garden were remarked upon as being "smutty from smoke". In 1722 Thomas Fairchild published The City Gardener, the first book to deal with urban gardening, which showed that by this time the major problem to be combated was the smoke from coal fires in London, and the fumes from the new factories in the provinces.

FLORIST'S FLOWERS

The harsh industrial conditions of the northern counties at the end of the 18th century, and particularly in the 19th, led to a new and delightful and very highly skilled form of gardening. The mill owners who, in the early days, had lived close to their works, moved away to country estates as the factories became larger and belched out more and more fumes, and developed their properties in the newly-arising suburbs. The houses for the mill hands became more and more tightly packed round the factories; fresh air and greenness slowly vanished. Life was grim, particularly in periods of bad trade. One compensation was the cultivation in tiny gardens of florist's flowers. They were grown to achieve a perfection laid down by the strictest rules of size, form, colour and proportion. The plants chosen to bring colour into the sooty air were the tulip, auricula, carnation, pink, anemone, ranunculus, hyscinth and polyanthus. Hundreds of local florist's societies were formed, and regular meetings and exhibitions held. These artisan gardeners knew intimately and tended with parental solicitude every one of their plants.

The factories were often closely concerned with the production or manufacture of iron, and cast iron in particular entered very much into the gardener's world. The early 19th century saw the beginning of the era of mechanical and labour-saving gadgets.

MECHANIZATION

One invention that had a revolutionary impact upon gardening was the mowing
machine. The “shaven lawns” that were the pride of the 18th-century landscape gardeners were mown by gangs of men and rolled with stone rollers. Then in 1831, Ferrabee’s new mowing machine appeared. It was invented by a certain Budding, and was based on a machine used to cut the pile on cloths. The principle was identical with the majority of mowers in use today. By 1858, seven thousand had been sold, and in 1860 Messrs. Green of Leeds were selling a machine that not only mowed but rolled and collected its own grass. The original Ferrabee machine was particularly recommended because “country gentlemen may find, in using the machines themselves, an amusing, useful and healthy exercise”.

Within a decade or two the gardener’s world was completely revolutionized. By the early 1850’s, wire-netting had become available at 1d. per sq. ft. plain, 2d. galvanized. Vulcanized rubber hosepipe was in use, and hand syringes were being produced to take the place of manhandled “water engines”—tanks to which jet-throwing pumps were attached.

The gardener was gaining more and more help from mechanization, but he also had to cope with new problems, not the least of which was scientific progress. To comprehend this a better education was needed. In 1836 the Horticultural Society of London decided to admit no young men into their gardens as journeymen who had not received some school education; nor would they recommend their men for situations as head gardeners unless they had received the certificates of proficiency which were dependent on the society’s regular examination in scientific knowledge.

At this period began the great development of the greenhouse, warmed by the circulation of hot water. Apart from housing tropical plants, such a greenhouse enabled the gardener to raise quantities of half-hardy plants (plants that would grow outdoors satisfactorily in summer, but which needed protection in winter). These were bedded out as soon as the fear of frost had passed, and brought dazzling new colours to the garden. The cultivation of flowers, vegetables and fruit reached new standards of perfection.

But during the 19th century, although mechanical developments were numerous, the gardener still worked without the armoury of insecticides and fungicides and the wide range of compounded fertilizers available to him today.

**GARDENING TODAY**

In the last three or four decades, the great increase in the number of houses with small gardens has brought gardening within the reach of a vast new public.

The most experienced men and the finest brains have been devoted to meeting its needs, so that gardening shall be simplified for all. The latest remarkable scientific developments in garden chemistry and mechanical aids of all kinds, including the use of petrol and electric power, and self-adjusting devices for heating greenhouses and frames, are available to everyone.

Adam’s profession has changed out of all recognition in its tools and techniques. But even though these are now labour-saving and highly efficient, there is still room for the development and enjoyment of human skill, observation and imagination, either with or without the help of modern science and technology.

The chapters that follow explore these skills and the findings of modern science and technology as applied to the garden. They also provide guidance on the cultivation of many widely differing plants, and the uses to which their fruits and flowers can be put.
WHERE THE PLANTS IN OUR

SOUTHERN AFRICA
EUROPE AND THE MEDITERRANEAN COASTS
NORTH AND SOUTH AMERICA
ASIA

The richness and colour of British gardens is owed almost entirely to plants that originated overseas. Even those plants that are now very much a part of the British scene will usually be found to have foreign ancestry: roses are natives of Continental Europe, Asia and North America, snowdrops come from the Crimea, rhododendrons from Southern Europe and the Far East, horse chestnuts from the Balkans.

They were brought here—usually as wild forms—by explorers, merchants, missionaries and adventurers. They came along the trade routes and the trails of discovery—along the "Silk Road", the caravan route from the East to Europe and Persia; aboard the tea clippers from the Orient; round Cape Horn on the long voyage from the west coast of America. Jesuit missionaries in Peking sent seeds and specimens overland to St. Petersburg by caravan, and the English trading community in Aleppo shipped home many plants during the seventeenth century, including the Cedar of Lebanon.

In the rich soil and temperate climate of the British Isles, plants from all over the world have flourished—finding, in various parts of the country, conditions like those of their native habitats.

The maps on the following pages show the sources of many plants, particularly the flowers that have been so painstakingly developed over the years by British botanists and gardeners.

Key to Maps

● Principal botanic gardens through which plants were distributed
▲ Wild parent of garden varieties
★ Cultivated form
★★ Important source of cultivated plants
GARDENS HAVE COME FROM

Where Plants Came From
SOUTHERN AFRICA
Where Plants Came From
EUROPE AND THE MEDITERRANEAN COASTS
Where Plants Came From
NORTH AND SOUTH AMERICA
Where Plants Came From

ASIA

MAP OF ASIA

U.S.S.R.

MANCHURIA

GOBI DESERT

KOREA

Yellow Sea

Japan

SINHAIAN DESERT

TIBET

CHINA

India

West Pakistan

Arabian Sea

Bay of Bengal

Indian Ocean

Ceylon

Map of Asia showing the distribution of plants from Asia.
HOW PLANTS LIVE

Plant life was the first life on earth. The first primitive plants appeared in the seas over 600 million years ago, but more than 160 million years went by before plants appeared on land. These plants were simple, without roots, and as yet leafless, but their presence on land made possible the emergence of animal life from the sea, by providing a source of food. All the brilliant and complex variety of the plant kingdom has evolved from these first land plants.

A plant is generally considered to be a green, living thing with roots in the soil and with stem, leaves and flowers above ground. Yet a plant is not necessarily green, and it may have no roots, leaves or flowers. Flowering plants comprise only one of the thirteen divisions into which botanists now classify the plant or vegetable kingdom. The twelve other divisions consist of more lowly and less evolved plants, such as bacteria, algae, diatoms, fungi, mosses, liverworts, horsetails and ferns, all known collectively as cryptogams or non-flowering plants.

All plants are alike in that they are made up of living matter called cells, are capable of living on inorganic substances, have no power of locomotion to give them freedom of movement, and no specialized sense or digestive organs.

The simplest plants consist of a single cell able to live, breathe, feed, grow and reproduce by itself. Many bacteria and algae are in this group. But in the course of evolution plants have become increasingly complex, the most highly evolved and complex being the flowering or seed-producing plants—the familiar plants of the garden and countryside. These plants have a well-defined structure of root, stem, shoot, leaf, flower and seed, though the form of their structure is variable and diverse.

FLOWERING PLANTS

There are more than 250,000 species of flowering plants in the world, and these are split into two divisions—the first, plants with naked or incompletely protected seed (gymnosperms), which include the coniferous trees such as pines, firs and cypresses, and some plants, now extinct, which are only known as fossils; and the second, plants with seeds enclosed or covered in their ovaries (angiosperms), which include the vast majority of all garden and farm plants.

Angiosperms are themselves divided into two groups. The first is the monocotyledons—plants with seeds containing one embryonic seed leaf or cotyledon; with many tufted roots of equal length and thickness; with leaf veins parallel and equal in size and thickness, and flower parts in threes or multiples of three. The second group is the dicotyledons—plants with seeds containing two embryonic seed leaves; with a root system of a main central tap-root and side roots branching from it; with leaves containing a main vein and lateral veins branching from it and a network of fine veins between, and flower parts in fours or fives, or their multiples.

SEEDS

Seeds of different plants vary greatly in size, shape, texture and colour, but all
have the same basic structure. Every fertile seed is a dormant embryonic plant, and is hard and dry and covered with a protective coat.

Within the seed coat lies a food storage organ, called the endosperm, and the embryonic plant itself with its primary leaf or leaves (the cotyledons). In many seeds these primary leaves fill much of the space and contain most of the food reserves for the embryonic plant. They are the two halves found in seeds like peas, beans and walnuts. Between and attached to them is the embryonic plant, sometimes called the germ, from which root and stem develop when the seed germinates.

**GERMINATION**

To germinate or begin to grow, a seed needs air, moisture, darkness and warmth. The degree of warmth required depends on the origin of the plant. Seeds of tropical or subtropical plants need higher temperatures than those of plants native to the temperate zones.

Moisture and air enter the seed through a minute hole (the micropyle) in the seed-coat near the tiny scar or hilum that shows where the seed was attached to its parent plant. The seed softens and swells, the seed-coat splits, and the first growth to emerge is the young root or radicle. This grows rapidly. If it is a dicotyledonous plant other roots are formed branching from this original one, but if it is a monocotyledonous plant the root is quickly joined by other roots growing from about the same point of origin.

**ROOTS**

The root system is usually the larger part of the plant. It not only anchors the
HOW PLANTS LIVE

DIAGRAMMATICAL REPRESENTATION OF A PLANT AND ITS LIFE PROCESSES

LIGHT

- Flower attracts insects for pollination
- Leaf surface—water diffused by transpiration
- Leaf absorbs carbon dioxide for photosynthesis
- Carbon dioxide freed in respiration

RAIN

- Oxygen given off by photosynthesis
- Leaf
- Fruits
- Terminal bud
- Shoot
- Stipule
- Cotyledon leaf
- Leaflet
- Main or tap root
- Lateral roots acting as buds
- Water solution from roots to leaves and food from leaves to rest of plant, transported by stem.
SEEDS AND SEED GERMINATION

Dicotyledonous seed (broad bean)

Testa

Plumule

Radicle

Hilum

Cotyledon

Cotyledon

Testa removed showing cotyledons opened

Monocotyledonous seed (wheat)

Embryo

Pericarp

Wheat grain

Longitudinal section

Germination of a dicotyledonous seed (broad bean)

Testa

Cotyledon stalk

Germ of a monocotyledonous seed (maize)

Leaf

Plumular sheath

Germination of a monocotyledonous seed (maize)

Radicle

Pericarp

Primary root

Lateral roots

Plant in the soil but seeks and absorbs the nutrients needed for growth. In some plants the root is also a storage organ, which enables the plant to survive a winter and grow again the next season. Although to fulfil their tasks roots invariably grow downward, this tendency may be somewhat modified by obstacles in the soil and by available space and food materials.

ROOT TIP

When a plant is uprooted, what is seen is the tough, brownish older parts of the root system that served to hold the plant firm in the soil. The working and growing part of a root is the fragile, whitish flexible tip, which is usually torn off when a plant is lifted from the soil. The cells at this tip form a protective thimble-like root cap, and are constantly being rubbed off at the outside as the root
works its way through the soil, thus making the tip slimy and helping it to slip easily between the soil particles. At the same time the cells are renewed from within, so that the root cap remains constant in size.

**ROOT HAIRS**

Just behind the tip is a smooth and glistening part of the root, where cells elongate, and, as they lengthen, extend the root through the soil to exploit fresh feeding grounds. Behind this part is a velvet-like zone, where fine whitish hairs grow out from all sides of the root. These hairs vary in length from \( \frac{3}{30} \) in. to \( \frac{1}{2} \) in., growing longer as they age and eventually withering. New hairs are formed constantly near the root cap as the root grows; the shorter hairs are therefore nearer to the root cap, and the hair zone remains constant in length. At no time is the active hair zone more than a fraction of an inch long.

Collectively, the root hairs form the “mouth” of the plant. It is their job to take in moisture and nutrients. To do this they penetrate the minute spaces that separate the soil particles, and tap the microscopic film of water solution adhering to them. The absorption of water solution to maintain a constant stream of sap through the plant is a herculean task. A single wheat plant may need half a gallon a day, while a fairly mature maple tree in active growth can use as much in two minutes.

To absorb this quantity of water solution, the root system branches into tremendous complexity and length. The measurement of root systems is very difficult but it has been estimated that a single rye plant can produce root

**ROOT HAIRS**

The root hairs form the “mouth” of the plant, taking in moisture (shown by arrows) from the soil.

Diagram (enlarged) showing root hairs, particles with air spaces and pockets of water.
hairs with a total length of over 6,000 miles, and that a sunflower plant had a total root length of 1,448 ft., and that a single grass plant, occupying a cubic inch of soil, had between 16,000 and 20,000 root hairs with a total length of 3,000 to 4,000 ft.

PLANT FEEDING
The water solution is a thin "soup" of soil moisture and dissolved mineral salts which the roots absorb by various complex processes, some of which are not yet fully understood. The most important is osmosis, a process whereby water and the dissolved substances needed by the plant filter through the permeable membrane walls of the root cells and root hair cells and pass into the cells of the plant itself. As a result, the cells become swollen, and a pressure is built up within their walls. Under this pressure, the watery solution or sap begins to move from cell to cell and is driven upward through the plant.

CORK TISSUE
Behind the root cap and hair zone the root develops an outer skin of cork-like tissue, almost impervious to water, and also increases in girth. This increase exerts a pressure like a wedge on surrounding soil, displacing it and tending to make it more friable.

ROOT SYSTEM
The root systems of individual plants vary considerably according to their kind and to the texture and structure of the soil and the plant nutrients it contains. For instance, a dense, heavy clay offers more resistance to root development than a light loam or sandy soil. Roots branch more freely and extensively in the latter in their search for food. Most soils are better aerated and more fertile near the surface, so that the feeding roots of
plants tend to be more numerous and active in these areas. Nevertheless, roots penetrate deep into the soil, and a plant's root system is never static.

Apart from their functions as feeding and anchoring mechanisms, the roots of many plants keep them at a constant level in the soil, moving the plants slightly up or down by means of root growth and contraction. By this faculty many bulbous and perennial plants, when left undisturbed, are kept at the same level year after year. As a plant ages, some roots die, while others may be injured, and the root system will bud and form new roots to take their place.

ADVENTITIOUS ROOTS
The ability to form new roots is inherent throughout the plant, particularly so at points where there are numerous living and identical cells, such as nodes. Roots that do not originate from the seed or root system are called adventitious roots. Such roots form naturally on strawberry and blackberry shoots and at the back of ivy stems, though in this latter case the roots serve only as an anchor. The faculty to produce adventitious roots is exploited when plants are propagated by means of cuttings or layers. Once the cut surface is brought into contact with moist soil or humid conditions, the roots begin to form.

STEMS AND THEIR STRUCTURE
The downward growth of a plant's primary root from its seed is swiftly followed by the upward growth of its primary shoot—the stem or plumbule. Both grow from a common beginning—the same single cell—but what causes their subsequent growth to differ is an unsolved riddle. Although in structure and growth they have much in common, the embryo stem grows to the light as eagerly as the embryo root grows down into the soil.
When a seedling stem makes its way above ground it is white or yellowish with a tapering budding tip. The seed leaf or leaves (cotyledons) may remain below ground, as in the case of the broad bean and sweet corn seedlings, or be carried above ground on the stem, as with runner bean and onion seedlings, but the true leaves develop quickly.

Once exposed to light, the young stem tissues quickly turn green, as the light energizes within them the formation of a green pigment, chlorophyll. From this moment, the new plant can synthesize its own food, and feed its growing tissues. Roots do not have chlorophyll.

The stem has two chief functions: to bear and support the leaves and flowers where they can best play their part in food manufacture and reproduction, and to provide the channels through which the water solution absorbed by the roots may be carried to the leaves, and the food then produced in the leaves circulated to all other parts of the plant.

Although stems vary considerably in form, shape and structure, from the tall trunks of trees to the thin basal plates of underground bulbs or the squat crowns of some herbaceous plants, they possess features in common.

A broad distinction is, however, made between the stems of dicotyledonous and monocotyledonous plants.

**DICOTYLEDONOUS STEM**

In dicotyledons, which include many flowering plants, hardwood trees and shrubs, the growing point (or meristem) of the stem consists of closely packed cells with thin walls. These cells elongate and develop into different kinds of cells with different jobs to do. The outer cells divide to add new cells to the outer covering of the stem, the inner ones to form the tissue of the stem, while at the tip cells form the embryo buds. As the plant develops, these tip buds form leaves and bend to one side, while the stem continues to elongate beyond. At each point where a leaf is formed a tiny group of cells within the axil (the angle formed by the leaf and the stem) do not elongate but remain to form another bud or buds. They behave like the original growing point of the main stem. In some plants they form lateral stems or branches, in others they remain as dormant buds for a season or more, or they may form leaves or flowers.

The point at which a leaf joins a stem is called a node, and the length of stem between one node and the next is called an internode.

Meanwhile, the stem itself builds up its substance. A cross section of the stem shows cells in concentric rings. On the outside is a single layer of cells with their outer walls covered with a tough varnish-like cuticle, impervious to moisture. This is the skin or epidermis. In perennial stems such as those of trees, this outer layer becomes one of bark or cork which consists of dead cells formed and pushed out by a layer of active cells behind it, called the cork cambium.

Within the epidermis is a broader ring of softer cells with large cavities inside them. This layer is called the cortex, and in it are the most important structures of the stem, the vascular bundles. These are long, tough strands of cells which run from the roots to the leaves. Each vascular bundle is made up of different kinds of cells which run alongside each other. Towards the inside of the vascular bundle are the long cells with firm woody walls making up the tissue known as xylem (wood). These cells have lost their protoplasm but are very permeable to water and, apart from strengthening the stem, are the tubes through which the water solution of salts absorbed by the roots moves to connecting cells in the leaf veins.
On the outer side of a vascular bundle is a ring of long cells, called phloem. Their chief function is to convey the sugars and other foods manufactured in the leaves to all other parts of the plant. These cells contain protoplasm and are soft, and the walls between them are full of holes. Hence the older name for phloem, sieve cells.

Between the xylem and phloem is a ring of narrow young cells called the cambium. As these cells divide and mature, those on the inner side of the ring change to xylem (woody) cells and those on the outer side to phloem (softer) cells. In persistent stems such as branches and trunks of trees the formation of xylem pushes the cambium and phloem farther out and the stems thus grow thicker.

The xylem cells formed in spring and early summer, when growth throughout the plant is most active, are larger than those of late summer and autumn. The result is a ring of annual growth that can be seen when the stem is cut across. The width of the growth ring reflects the growing conditions of the year in which it was formed, and by counting these rings the age of a tree can be assessed.

In the centre of a young stem is a mass of large, thin-walled, soft cells, called the pith, that help in water conduction. Later these cells die or dry out to form a light dry mass such as is found at the centre of a willow stem, or they disappear to leave a hollow centre as in the delphinium, or harden as at the heart of some tree trunks. Connecting the pith with the cortex are thin sections of similar cells running between the vascular bundles and called medullary rays. Collectively, these are known as parenchyma, and are sometimes called ground tissue. They hold water and food reserves, and help to keep the plant turgid and firm.

MONOCOTYLEDONOUS STEMS

The stems of monocotyledonous plants are less complicated. The vascular bundles are scattered throughout the stem among pith and ground tissue cells and do not form a ring as they do in the dicotyledonous stems. There is no cambium, so the stems do not enlarge or become stronger each year. Consequently, most monocotyledonous plants are herbaceous; that is, the parts above ground die down each year. They include the grasses and cereals, sedges and rushes, lilies, hyacinths and other bulbs.

MODIFICATIONS IN STEMS

The purpose of stems is to carry the leaves and flowers into the air and light, and therefore the stems of most plants grow erectly and have strong woody cells to make them self-supporting. But in others the stems are modified for climbing. These stems grow through other plants or up supports, either by twining as in the honeysuckle, by tendrils as in the pea, by adhering by suckers or aerial roots as in the ivy, or by hooking by prickles as in the blackberry. Such climbing stems are very supple, devote less energy to forming rigid woody tissue and so grow more quickly.

In certain plants the stem is modified and grows underground. The tubers of the potato are really modified stems. Other plants with underground stems, known as rhizomes, are lily of the valley and iris.

At the base of a plant the stem merges into roots, the channels of xylem and phloem are continuous, and the root structure is made up of similar cells. These cells are, however, differently arranged. Vascular bundles are concentrated at the core of the root, with the xylem strands alternating with the phloem. In older roots a cambium forms between the two tissues, thus enabling the root to grow and enlarge. The core
ROOT MODIFICATIONS

Root tubers have the internal structure of the root

Turnip

Carrot

Dahlia

STEM MODIFICATIONS

Plants that are self-supporting, climbing or underground-growing have modifications that suit these habits of growth

Stem tendrils of sweet pea

Butcher's broom: the leaflike organs are modified stems with flowers borne half-way along the midrib

Underground stem or rhizome of iris

Thorns of hawthorn: thorns develop from buds in the axils of leaves, and are stunted stems
is surrounded by ground tissue and then an outer skin through which branch roots may grow or, at the root ends, the root hairs. The roots of monocotyledonous plants differ from those of dicotyledonous plants in that they have a little pith at the centre.

In the stalks and veins of leaves the construction and arrangement of cells are similar to those of the roots.

LEAVES IN FORM AND FUNCTION
Much of the beauty in a garden is provided by the colour, form and texture of the leaves of plants. But this beauty is a consequence of and is subordinate to function, for within the leaves lie the food factories of the plants.

PHOTOSYNTHESIS
The great function of plant leaves is a unique chemical process known as photosynthesis—literally, manufacture by light. The leaves have the ability to use the energy of light to make sugars and other complex foods from the simple raw materials of the water solution absorbed by the roots from the soil and of the carbon dioxide absorbed by the leaves from the air. These sugars and foods serve to feed the plants themselves and, in turn, almost all other living organisms which depend on plants for their food.

Photosynthesis is a process which no chemist has yet been able to simulate. Without it neither plant nor animal life, as we know them, could exist.

CHLOROPHYLL
The key to the process is the substance contained in the leaves that makes them green—chlorophyll. This substance absorbs the light rays, chiefly the red, blue and violet, and converts them into a form of energy for the manufacture of the plant’s food.

LEAF FORMS
The arrangement, disposition, shape and structural characteristics of a plant’s leaves are the result of its evolution in its native habitat, and are designed to enable the plant to carry out photosynthesis and related processes with the maximum efficiency.

Leaves are of many sizes, shapes and textures. The larger the leaves, the fewer the plant has of them. Magnolia obovata may have leaves up to 18 in. long, while those of a heath, such as Erica carnea, are only ¼ in. or less.

Leaf shapes vary astonishingly. Botanists divide them broadly into simple, single leaves, like those of a cabbage, compound leaves like those of a clover, palmate like those of the horse chestnut and pinnate like those of the ash.

They further split them into four series—oblong, with more or less parallel sides; elliptic, with curved sides tapering equally to base and tip; ovate, with curved sides like an oval and widest below the centre; and obovate, with curved sides, widest above the centre.

Each series is further graded according to the ratio of length to breadth, and leaves may be smooth-edged, toothed, lobed or divided.

LEAF ARRANGEMENT
The shape of the leaves and their disposition on the plant is part of the plant’s solution to the problem of securing the maximum exposure of leaf surface to light and air. If a plant is looked at from above and from all sides, it will be seen that it makes the best possible arrangement of its leaves on their stems to ensure that the leaves receive the most light. This arrangement is known as leaf mosaic.

The leaves, branches and shoots of a plant are arranged in any one of three ways. The leaves may grow in opposite
So that photosynthesis and the related processes can be carried out with efficiency, plants have evolved varying leaf shapes to suit their habitats.
pairs, with each new pair produced at right angles to the previous one, as in the ash or lilac, or the leaves may grow in whorls of more than two leaves at the same level. Each whorl turns sufficiently to allow its leaves to grow directly above the spaces between the leaves of the whorl underneath. In some plants the whorl is a rosette of leaves just above ground level, as in the daisy. The commonest arrangement is spiral, where the leaves alternate in two or three rows in their appearance on the shoot, like a circular staircase. This is the pattern of arrangement adopted by many shrubs and trees.

**LEAF DEVELOPMENT**
Young leaves are first formed closely packed together as buds at the growing point of the stem. Although they develop from the meristem of the stem, they have no growing points themselves, and once mature, add no more parts. A common exception to this is the grass plant. Grass leaves have meristems at their base and these account for their readiness to grow again after being cut.

**LEAF STALKS**
Sometimes the leaf consists only of a blade (or lamina) growing directly from the stem. Many leaves are, however, carried from the stem by leaf stalks or petioles. Often, as in the rose, where the petiole joins the stem there are two winged lobes. The petioles are often devices to make the foliage of a plant an efficient light trap, not only by extending the leaf blades into the light but also in turning them to face the sun’s rays most effectively. The petiole also serves to attach the leaf to the stem and connects the vascular system of the stem with the veins of the leaf blade.

**LEAF VEINS**
The leaf veins form the structural skeleton of the leaf. Through them run the tube-like vascular bundles to supply water and salts to the tissues and to carry away manufactured food products to other parts of the plant.

**LEAF STRUCTURE**
Although often very thin, a leaf blade is made up of several layers of cells. Enveloping the whole leaf is a single layer of clear transparent cells, placed lengthways closely together, to form a skin or epidermis. This is covered with a waxy cuticle to make it virtually air- and water-proof, and to check moisture loss and gas diffusion from within the leaf.

In between the upper and lower surfaces of the leaf are tiers of cells, collectively called mesophyll. Light falls through the clear top surface skin of the leaf on to clusters of long narrow cells arranged vertically to it. These are known as palisade cells, the largest of which rarely exceeds a diameter of about \( \frac{1}{12} \) in.

These cells are bright green because countless minute bodies (chloroplasts) filled with chlorophyll float within them. The chloroplasts, indistinguishable to the naked eye, tend to concentrate near the cell walls and thus give leaves their characteristic green colour. The palisade cells make up about half the depth of the leaf. Below them and down to the lower skin is a jumble of cells of irregular shapes and sizes, with variable spaces between, just like a sponge, and known collectively as spongy mesophyll.

These cells also contain chloroplasts, though the latter are less numerous than in the palisade cells. The spaces between the cells are interconnected and allow the living leaf to contain air, which, with the moisture in the cells, is needed by the leaf food-factory.

The internal structure of the monocotyledonous leaf differs from the dicotyledonous leaf by having palisade cells on both its upper and its lower sides.
LEAF ARRANGEMENTS

The pattern of leaves enables differing plants to expose the maximum amount of leaf surface to light and air.

Leaves in opposite pairs
(White or Evening campion)

Leaves grow in whorls
(Goose-grass)

Leaves grow in a rosette
(Plantain)

Leaves grow in spiral form
(Wild plum)
STOMATA
The lower surface of the leaf, like the top surface, has a transparent waxed layer of cells, but differs from it in the majority of plants by being perforated with openings or valves, known as stomata. The stomata are usually very numerous and are extremely minute holes a hundred times smaller than those made by a fine sewing needle. A strawberry leaf may have 250,000 to the square inch of surface, a single plum leaf over a million. Only in the submerged leaves of water plants are they absent. They are sometimes to be found on the upper surface of the leaves too, though this is rare.

FUNCTION OF THE STOMATA
A single stoma—the Greek word for mouth—is a narrow opening between two kidney-bean or banana-shaped cells, lying with their concave sides facing and their ends just touching. These are called guard cells. In both dicotyledonous and monocotyledonous plants the guard cells are more or less crescent-shaped but, among the latter, the grasses and sedges differ by having dumb-bell-shaped guard cells, framing hexagonal openings or pores. When moisture supplies to the leaf are abundant, the cells distend outward and so increase the space between them. Thus more air can enter the leaf, more water vapour escape, and food manufacture can go forward more quickly. When water is short, as in periods of drought, the cells shrink, the opening narrows and the activity of the leaf slows down.

This functioning of the stomata as tiny air valves is also affected by light. The guard cells contain chloroplasts, although the surrounding cells of the leaf’s epidermis have none. The chloroplasts become active in light, the sugar content of the cell increases and so more water is required. The water entering the cells makes them swell and the stomata open. With a reduction of light as at night, the reverse happens. The sugar turns to starch, the cells lose water and the stomata automatically close.

LEAVES AND PLANT FOOD
In the presence of light, leaves synthesize food from the raw materials of water solution and carbon dioxide.

The water solution is taken in by the root hairs from the soil and flows up through the roots, stem and leaf veins via the xylem to fill the tissue inside the leaf blades. The carbon dioxide comes from the air which passes through the stomata and diffuses in the spaces between the leaf cells. Carbon dioxide molecules then dissolve in moisture about the cells and slowly diffuse into them through their walls.

When water and carbon dioxide molecules come together in the cells containing chlorophyll in the presence of light, a series of reactions is sparked off by the light energy captured by the chlorophyll.

In simplified chemical terms, the atoms of six molecules of water and six molecules of carbon dioxide are taken apart and re-combined by photosynthesis to form one new and more complex molecule of glucose, which is a sugar or carbohydrate, while six atoms of oxygen are freed in the reaction. This oxygen, in gaseous form, eventually finds its way back to the atmosphere via the stomata.

As glucose accumulates in the leaf some of it is converted into sucrose or starch or fructose—other forms of carbohydrate—but photosynthesis stops when light fails at night. These carbohydrates are then reconverted into simple sugars and move out of the leaves into the phloem cells, and are thus distributed to all parts of the plant. By the process of photosynthesis, therefore, the leaves manufacture an organic substance
from inorganic materials.

Research indicates that 50 to 55 per cent of plant food made in the leaves goes to the roots, 30 to 35 per cent to the stem, and the remainder to support young growth. Some of the sugar is, however, converted into cellulose to make plant structure; some is stored as starch, but much is used as energy to meet the needs of the plant's growth.

It has been estimated that it takes a square yard of leaf surface one hour to make about one gram of glucose in photosynthesis, but the actual amount will vary according to the plant and the prevailing conditions. Much depends upon the content of chlorophyll in the leaves.

Chlorophyll is unstable and has to be replaced constantly. Its manufacture is closely linked with a supply of iron, manganese and other nutrients from the soil. If one or more of these nutrients is lacking, chlorophyll is not properly formed; the leaves turn pale and yellow, the plant suffers from the sickness known as chlorosis, and may die.

**COLOURED-LEAVED PLANTS**

Some garden plants, such as coleus, Japanese maples and rhus, are grown for their reddish-tinted foliage, but these colours are caused by pigments which mask the presence of green chlorophyll without impairing its efficiency. On the other hand, plants with yellow or white variegation in their leaves, like variegated ivies, have little or no chlorophyll and their efficiency is impaired. Such plants need good culture and ample light to do well.

**EVERGREENS**

The greener the leaf, the more chlorophyll it contains. Evergreen plants whose foliage has to function the year round tend to have richly green leaves. Plants that have adapted themselves to grow in shade have usually developed big leaf areas and densely green leaves.

**LIGHT**

Green leaves, photosynthesis and light go together. Without light, leaves turn white, and growth ceases. Generally, the more intense the light, the greater the rate of photosynthesis.

All light-loving plants have mechanisms, usually in their leaf stalks, whereby they can turn their leaves to present the greatest amount of leaf surface towards the source of light. Any plant growing in an uncomfortable, ill-lit position tends to extend or lean its growth to the light, as do pot plants when grown in a window.

**TEMPERATURE**

Temperature affects plants and influences the rate at which photosynthesis takes place. It decreases in very cold and very hot weather, but varies with the kind of plant and the natural conditions under which it has evolved.

For most of the plants grown outdoors, photosynthesis begins in earnest somewhere about 40° F. (4° C.) and quickens progressively as the temperature rises to about 90° F. (32° C.). After that it diminishes.

**RESPIRATION**

Photosynthesis results in the setting free of oxygen into the air. But this process should not be confused with the breathing or true respiration of the plant. All living cells in plants and in animals breathe all the time, and in much the same way. Oxygen is used to convert food materials into new tissue and energy, and in the process carbon dioxide is liberated. In plants, the two processes of photosynthesis and respiration go on at the same time, even in the same cells, during daylight.

The carbon dioxide freed in respiration is used in photosynthesis, together with
more taken from the atmosphere. During darkness, photosynthesis stops, and traces of carbon dioxide may be released into the air, but in nothing like the quantities to justify the superstitious removal of flowers or plants from a sick room at night, lest their respiration should poison the atmosphere.

**WATER AND TRANSPERSION**

The need of a plant for water is constant. Water forms 90 per cent or more of the substance of most plants. It is the solvent that carries nutrients from the soil through the roots and stems to the leaves, and foods from the leaves to every other part of the plant. It takes part in all the living plant processes and provides hydrogen and some of the oxygen
for the building up of carbohydrates and other plant foods.

A plant invariably tends to take up more water than it can use. The excess is eliminated by the leaves. Their thin, flat structure and interior arrangement of loose cells with many air spaces between makes this possible. The surplus water oozes through the cell walls and vapourizes in the air space surrounding them. A little goes through the skin, but most of it moves out through the stomata.

This giving off, or evaporation of water by the leaves of plants, is called transpiration. A green plant in active growth may absorb and transpire anything from about one quarter to twice its own weight of water in a day. It has been estimated that an average potato plant can use 25 to 35 gallons of water in a growing season, while a large tree may transpire water at the rate of 10 to 15 gallons an hour. Almost all the water comes from the soil, although leaves can absorb a little from rain, dew or artificial watering.

The water given off escapes as an invisible vapour into the atmosphere; but in the cool upper layers of the air it condenses, forms cloud and returns to the earth as rain. In this way, the earth’s vegetation helps to maintain the humidity of its climates. It is a cycle in which trees are especially important; their roots search out water in the deep layers of the soil, and because of their enormous area of leaf surface they give off more water vapour than the smaller plants. They can almost be said to create, and attract, their own rain.

The raising of water in the tree, through the microscopically narrow tubes of the xylem to the topmost leaves, is a tremendous feat of hydraulics. The manner in which it is accomplished is not fully understood. It is believed that transpiration sets up an osmotic pressure in the leaf cells losing water vapour to the air spaces surrounding them. This causes water to flow into them from neighbouring cells, and these in turn draw water from the xylem in near-by leaf veins.

In the xylem cell tubes there are extremely narrow capillary columns of water which are continuous, extending back through leaf veins, stem and roots to the tiny root hairs. Drawn by the osmotic pressure in the leaves, the water column moves up, almost as a solid, while at the lower end a pressure is created in the root hairs to absorb more water from the soil. It is this process which explains the occasional wilting of cut flowers when they are placed in water. The end of the stem has been cut in air and has drawn some into the xylem tubes; as a consequence, an air lock forms and it loses its power to pass on moisture. The end of some stalks, especially those which are hollow, as they are in delphiniums, should always be cut under water if flowers are to remain fresh.

The transpiration stream can move at a speed of about 3 in. a minute in day-time, but the rate of transpiration is not constant. It increases as temperatures rise and in dry or windy conditions, and slackens in cool, humid or rainy weather. It is greatly reduced at night when photosynthesis stops and the stomata close.

When the root hairs are unable to find and absorb sufficient water quickly enough to maintain transpiration, growing points, leaves and stems droop, and the plant wilts. Unless the water position is restored, the plant will gradually die as its cells dry out.

**Adaptations of Leaves**

Against the ever-present danger of unsatisfied thirst and subsequent drying out, many plants have evolved some kind of safeguard.
Most plants have their stomata on the underside of their leaves, away from the drying rays of the sun. Often when the water content of the leaf falls, the leaf curls or folds inward to close the stomata and check transpiration losses.

Many plants, such as thyme, heathers and coniferous trees, living habitually in exposed conditions, have small leaves to reduce transpiration losses. Others, such as Stachys lanata (lamb’s ear), have a covering of hair or silky down on their leaves to retard the drying effect of wind; others, such as the hollies, grow shiny, leathery leaves with fewer stomata, and others, such as primulas, develop waxy or mealy coatings to retard evaporation.

Plants native to hot, dry conditions often reduce their leaves to stems, as in the cactus, or develop thickened leaves with capacity for water storage, as in succulents such as houseleeks. On the other hand, plants that grow in damp places, such as Caltha palustris (marsh marigold), tend to have large soft leaves, well equipped with stomata to allow them to transpire freely.

In warm regions where there is a continuous supply of water, leaves may carry on their work all the year round. Plants in these regions do not shed their leaves, but tend to become evergreen.

Much of the variation in the shape, size, texture and appearance of leaves, that lends so much beauty to the garden, is dictated by the plants’ water requirement.

Where there is a season of cold, drying winds, such as an English winter, or a season of drought, a plant loses more moisture than it can make good. Many plants adapt themselves to such conditions by storing up reserves of food, forming latent or dormant buds, and dropping their leaves. The trees and shrubs that do this are called deciduous.

Before falling, the green chlorophyll in their leaves decomposes, often allowing the hitherto masked bright pigments to show and make a blaze of autumn colour. Then the leaves are pushed off and the framework of the plant, with its reserves of food, can weather the adverse season.

Herbaceous perennials adapt themselves by losing all their top growth, and storing food reserves below ground in their roots or, as in the case of bulbs, corms and rhizomes, in what are swollen leaves or stems.

FLOWERS

All living things can reproduce their own kind. The smallest, single-celled plants, the algae and bacteria, reproduce by dividing themselves. Ferns and fungi form tiny specialized cells called spores, which are highly resistant to adverse growing conditions. They can rest almost indefinitely during poor growing periods, and are ready to sprout as soon as conditions improve.

The most highly evolved plants reproduce themselves by forming the intricate, colourful, delicate, richly scented and beautiful structures called flowers. Flowers are regarded as modifications in form of leaves, converted for the sake of reproduction. Their primary purpose is sexual, to form and house the male and female organs of reproduction and to facilitate their union. From such a union comes the seed of a new generation.

Flowers are formed from the meristem at the ends of stems or shoots or on very short stalks in the axils of leaves on stems.

They may arise singly, or they may arise in groups from a single point of origin when they are spoken of as an inflorescence or flower head. There are many different ways in which these tiny groups of flowers can be arranged and
each is given a different name. Some are shown in the illustration on page 68.

FLOWER CONSTRUCTION

In some cases the individual flower has four kinds of parts, all growing from a common base, called the receptacle, at the head of the stalk or peduncle. On dissecting such a flower as that of the delphinium or buttercup (which belong to the same flower family, Ranunculaceae), working from the outside in, the first parts to be removed are the sepals, collectively called the calyx. Just inside will be found the coloured petals, together forming what is known as the corolla. Sepals and petals together make up the perianth.

Taking off the petals exposes the male sex organs known as stamens. Each stamen has a stalk or filament at the head of which is attached a sac or anther, containing the pollen grains which are the male cells of the plant. The stamens are collectively known as the androecium (male part).

With the stamens removed, a central structure, the pistil or gynaecium (female part), is revealed. This structure will be found to be made up of smaller stalked bodies, apparently fused together. These are carpels. Each carpel is made up of a hollowed swelling (ovary) at its base, with a small stalk (style) arising from it and having a sticky top (stigma). In the swelling are tiny round bodies—the female cells, which are known as ovules.

Not all flowers have all four kinds of parts; one or more may be lacking, and in some flowers other parts may be present. But all flowers whose number and arrangement of parts correspond exactly with those of other flowers are said to be in the same flower family or natural order. In every such flower, no matter how complex or peculiar, the parts present are in the same constructional relation to one another and carry out the same functions.

The vital parts of the flower are the pollen and the ovules, since they contain the gametes or sex cells, and the organs—stamens and carpels—that bear them. The majority of plants have flowers containing both stamens and carpels. But on other plants, the flowers contain only one of the sex organs.

FLOWER FUNCTION

The function of flowers is to produce pollen grains and ovules, and, by bringing about their union, to produce seed.

FERTILIZATION

To effect a union, pollen grains must alight on the sticky stigma or carpel. If they are ripe and from the same species of plant, the sticky material on the stigma makes the pollen grains germinate and grow a long tube which reaches down the style to the ovary. There a male nucleus from the pollen unites with the female nucleus of the ovule. Once fertilized, the ovule swells rapidly and builds up the food stores and protective tough outer coat that make it into a seed.

POLLINATION

Pollination is the prelude to fertilization and is the process of getting pollen grains on to the sticky stigmas. In many plants equipped with both stamens and carpels, the anthers shed their ripe pollen on the stigmas and the plants are said to be self-pollinated. When the pollen of one plant is transferred to the stigma of another similar plant, what is known as cross-pollination takes place. This gives a stronger and more robust offspring, and is common in Nature and often resorted to in plant breeding.

Nature uses two main agencies to help in the work of pollination, the wind and animals, chiefly insects.

Plants which are adapted for wind-pollination usually have flowers with little or no perianth and of one sex. The
HOW PLANTS LIVE

EXAMPLES OF INFLORESCENCES

The arrangement of flowers in flower heads, or inflorescences, may take many different forms.

Raceme  Spike  Panicle  Corymb  Compound umbel

Umbell  Different types of cyme  Capitulum

Spike (Wall barley)  Umbell (Wild garlic)

Panicle (Privet)

Corymbose cyme (Elderberry)
male flower has stamens prolific of pollen (often in the form of catkins) and the female flower has comparatively large stigmas and styles but no petals. The pollen grains are released in clouds and wafted far and wide, mostly to be wasted, for chance alone determines that only a few alight on receptive stigmas. Grasses and many trees are wind-pollinated (examples are hornbeam, hazel and willow).

Most flowers that are admired for their beautiful shape, colour or fragrance are devices to lure an insect to the plant for the purpose of pollination. For instance, white flowers, sweet-smelling and opening at dusk, attract night-flying moths. Brightly coloured day flowers attract butterflies; blue, red and white day flowers attract bees. Yellow flowers often attract beetles, and putrid-smelling flowers attract flies. Colour and scent advertise that the plant has food to offer, usually nectar, a dilute sugary solution produced by small organs called nectaries, well inside the flower.

To reach the nectar the insect comes in contact with the pollen released by the anthers and carries some of it away on its body. It is also likely to touch the sticky stigmas of the flowers it visits, and some of the pollen from its body adheres to their surface.

In some flowers the pollen may stick to their own stigmas as the insect withdraws. More often, it is transferred to other flowers on the same plant or on other plants of the same kind. In many plants modifications of flowering or of flower structure prevent self-pollination and ensure crossing. A common trick is for the stigma to mature before the pollen in the same flower, or vice versa; then pollen must come from another flower of suitable maturity for pollination to be accomplished.
Often the construction of a flower is adapted to one particular kind of insect. It requires the burly weight of a bumblebee to depress the lip of an antirrhinum flower so that it can be entered and pollinated.

Successful pollination is usually followed by fertilization, but not always. Both actions bring about swift changes, but they are not synonymous.

FRUIT
Fertilization takes place in the ovule and results in the formation of a seed. At the same time the fertilized flower sheds its petals, and the ovary containing the seed or seeds develops into a fruit.

Fruits are said to be hard, dry, soft or succulent. The dry, hard hazel nut and the soft, succulent tomato are unlike in appearance but alike in origin. Both are fruits developed from a matured ovary, with their seed enclosed in a fruit wall known as the pericarp.

The fruit serves as a nursery for the maturing seed, and a protective covering and a mechanism for the seed’s dispersal when ripe. Both fruits and their seeds are wondrously modified for the act of dispersal in various ingenious ways.

DISPERSAL OF SEEDS
The simplest device adopted by several many-seeded dry fruits, such as peas, beans and turnips, is a pod which splits when ripe so that the seeds are shaken out by the wind. Poppies form a capsule with small holes near the cap and when the head sways in the wind, or is knocked, the ripe seeds are shaken out and scattered. Plants such as broom, violas and gorse eject their seeds from pods forcibly, and the pods curl back.

Many seeds, such as the plumed seeds of dandelions, clematis and willow-herb and the winged seeds of sycamore, ash and birch, are dispersed by air currents. Other plants disperse their seeds by letting them fall on flowing water. Some seeds have hooks or barbs by which they can attach themselves to passing animals and be carried afar. The seeds of cleavers and agrimony are transported in this way. Other seeds, such as those of colchicum, are sticky and travel by adhering to the feet of animals or birds. Food-storing animals, such as squirrels, move tree seeds or nuts, and ants are often responsible for removing and transporting seeds of broom and gorse.

The succulent fruits, such as berries (gooseberries, blackberries, ivy) and drupes (stone fruits), have seeds resistant to digestion which travel in and through the animals and birds that eat them.

The so-called false fruits, such as apple, pear, strawberry, rose hip and haw, are largely succulent developments of the receptacles of their flowers. They carry hard, dry, one-seeded fruits known as achenes (on the outside in the case of the strawberry), and these achenes may also pass without damage through the digestive tracts of animals or birds.

It is wise to thwart the dispersal of weed seeds in the garden by controlling the weeds before they come into flower.

SEED SAVING
Many garden plants set seed freely and it is tempting to harvest them when ripe to save for future sowing. But such seeds are only likely to give plants similar to the parent plant or to breed true to type when they are the result of self- or cross-pollination between plants of the same species or strain.

Among vegetables, for instance, it is usually safe to save seeds from peas, broad beans, French beans and runner beans where they are grown in rows with some distance between varieties. Lettuce and tomatoes are self-pollinating and the seeds from first-class plants can be saved. Biennials like carrots and parsnips, when grown for seed, need to be isolated
FLOWER CONSTRUCTION

Flowers are modifications in form of leaves to enable highly-evolved plants to reproduce themselves.

**SCROPHULARIACEAE**
(Forget-me-not)

**LABIATAE**
(White dead nettle)

**PRIMULACEAE**
(Primrose)

**RANUNCULACEAE**
(Hellebore)

**LEGUMINOSAE**
(Garden pea)

**RANUNCULACEAE**
(Delphinium)

Lower corolla

Style

Stigma

Anther

Filament

Calyx

Ovary

Stamens

Stigma

Anther

Filament

Calyx

Ovary

Petals

Stamens

Stigma

Anther

Filament

Calyx

Ovary

Spurred calyx

Stigma

Anther

Filament

Calyx

Ovary

Spurred calyx

Stigma

Anther

Filament

Calyx

Ovary

Spurred calyx

Stigma

Anther

Filament

Calyx

Ovary
HOW PLANTS LIVE

THE DEVELOPMENT OF AN APPLE

Fruits serve as a “nursery” for maturing seeds and act as a mechanism for dispersing seeds when they are ripe.

Vertical section of fruit

Transverse section of fruit

Leaf, showing shape and vening

After petal-fall receptacle swells, calyx and stamens persist

Bud

Blossom

Petals

Anther

Filament

Sepals

Ovules

Section through flower

Cortex

Core

Seed

Pericarp

Pith of receptacle

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CROSS-SECTIONS OF FRUIT PERICARPS SHOWING SEEDS

BLACKBERRY (COLLECTION OF DRUPES)
- Epicarp
- Mesocarp
- Endocarp
- Seed
- Receptacle
- Sepal
- Stamens
- Style
- Drupe

TOMATO (BERRY)
- Epicarp
- Mesocarp
- Endocarp
- Seeds

PLUM (DRUPE)
- Petals
- Stamens
- Pistil
- Sepal
- Ovary
- Flower

CHERRY (DRUPE)
- Epicarp
- Mesocarp
- Endocarp
- Seed
- Fruit

HAWTHORN (DRUPE)
- Sepal
- Remains of stigma
- Receptacle
- Teats
- Cotyledon
- Flower

STRAWBERRY (FALSE FRUIT)
- Receptacle
- Seeds
- Stigma
- Flower
EXAMPLES OF PERICARPS

CAPSULES

Scarlet pimpernel opened to show seeds

Opium Poppy partly opened to show seeds

Balsam after splitting

ACHENES

Single achene of goathead

Seed

Single achene of Clematis

PODS

Honesty

Wallflower

WINGED SEEDS

Seed

Silver birch

Elm

Sycamore
according to variety, and the garden must be kept free of weeds of the same flower family ( Cruciferae ) if seeds are to be true to the parent type. Among brassica crops cross-pollination is rife and seed from garden-grown plants is hardly ever worth saving.

Onions and leeks yield good seed in their second year, but if they are being grown for seed it is necessary to isolate them according to variety to prevent cross-pollination.

In the flower garden, seeds from cherished plants grown more or less in isolated groups of their own kind often give rewarding plants. Many annual species yield useful seed, but some strains and varieties of hybrid flowers are so highly bred as to give only mixed results from home-saved seed, while some are even sterile.

It is tempting to experiment with cross-pollination, though hybrid seed will yield progeny of variable quality. This is the beginning of the high adventure of hybridization, the path along which finer and better plants may be found.
THE SOIL

THE ROOTS of many plants are not limited to the so-called “top-soil”. To learn the conditions their roots will have to meet it is necessary to look beneath the surface by digging down to about 3 ft. or even more to disclose the soil “profile”.

Most soils dug in this way show a series of definite layers, one above the other, with different colours and different properties. These layers have been produced through the centuries by the action of climate and vegetation on mineral matter, and are known collectively as the soil profile. This is the basis of soil classification. The main things to look for when examining a profile are depth, texture, structure, colour and drainage.

A soil profile usually consists of two or more layers lying parallel to the land surface. For instance, often a foot of sandy soil overlies several feet of clay soil. The upper layer, which is generally called the top-soil, is, as a rule, darker in colour than the lower layers owing to its higher humus content. In this upper layer life in such forms as bacteria, fungi, insects and other small animals is most abundant. Being near the surface it receives the rainfall first, so that its nutrients and lime are washed down and lost more easily than in deeper layers. In addition, the humus slightly acidifies the soil water, so that its solvent power is increased, and a number of salts are washed out. It is in this way that lime is lost, so even in shallow, chalky soils it is not unusual to find the upper layer acid. On steep slopes the upper layer is commonly thin, and on building sites it is often completely destroyed by the builders, or covered over with raw earthy material from excavations.

THE SUBSOIL.
This is the name usually given to the layer below the top-soil. It is generally harder to dig when dry, and is much stickier when wet, owing to its higher clay content, much of which has been washed out of the top-soil. The subsoil often has a brighter colour, due to the washing down of red oxides of iron and other elements, which in some cases collect and cement the soil particles together into hard continuous layers known as pans. These, of course, very effectively prevent roots from penetrating any farther.

THE ORIGIN
Below the top-soil and the subsoil—the layers which constitute the true soil—lies the mineral matter of geologic origin which may or may not be the parent material of the soil above. This mineral matter may be loose and porous to great depths, and may have accumulated in place by the breakdown of hard rocks, or it may have been moved to its present position by water, wind or ice. Both this layer and the one above are poorer in humus and in organic life than the top-soil, and when dug should only be brought to the surface bit by bit for fear of spoiling the top-soil. Deep soils hold more moisture and nutrients than shallow soils. Plants will grow in shallow soils but, just as when grown in pots, do need more frequent feeding and watering than when grown in deeper soils.
WHY IS SOIL?
The soil has four main components—mineral or inorganic particles, vegetable or organic matter (humus), air and water, the latter usually being called the "soil solution" because it contains traces of various salts which have been derived from the weathering of rocks. As well as being in part mineral and in part vegetable, the soil is also animal, this part being the teeming hordes of insects, worms, minute animals such as protozoa, as well as fungi, bacteria and other primitive life. All these constitute the population which gives the soil its animal or living nature.

FRAMEWORK
The proportions of the four major components vary greatly from garden to garden and even with depth in the same soil. Inorganic soil particles occupy only about one half of the total bulk of most soils, and do not fit together like the pieces of a jigsaw puzzle, but have spaces between them. These inorganic or mineral particles are the residue of the rocks from which the soil is derived, and which have resisted the action of weathering. As they are the most unchanging part of the soil, they really represent its skeleton or framework. Many of these particles can be seen quite easily, but others are so small that they can be examined only with an extremely powerful microscope.

TEXTURE
Soil scientists find it convenient to divide the mineral particles into fractions or separates, according to their size. These fractions or separates they call coarse or fine sand, silt and clay. Soil layers rarely consist of one fraction only, but usually contain a mixture of all three. The proportion of sand, silt and clay in each soil layer is called the soil "texture", and as many recommendations for the management and improvement of garden soils are keyed to it, the texture should be judged by the gardener. The texture in most soils changes from layer to layer, the subsoil generally containing more clay than the surface soil above it or the layer below it.

Samples of soil can, of course, be sent to a laboratory for analysis, but with a little practice the relative amounts of sand, silt and clay can be estimated by rubbing a pinch of moist soil between thumb and forefinger.

SAND
Sands feel harsh and gritty, and the particles scarcely hold together at all, even when moist. Soils containing a high proportion of sand are called coarse-textured soils. They are well aerated and "light" or easy to dig, but they hold little moisture and nutrients and therefore, for good plant growth, need constant replenishment with water and very frequent feeding.

SILT
Silt feels smooth, soft and floury and is intermediate in size between sand and clay. Being smaller than sand grains, the particles pack together with smaller air spaces, which slows up the movement of air and water in the soil. Thus very silty soils drain slowly and remain moist for long periods. They are difficult soils to improve since they are not granulated by and made less sticky by liming, by frost or by cultivation. Large dressings of bulky organic manures make working easier.

CLAY
As opposed to light sandy soils, clay soils are termed "heavy" because they are hard work to cultivate. Clay minerals are quite different from the sand particles. They
are not merely fragments of the original rock, but are a secondary product of rock weathering, and are exceedingly fine, at least 1,000 times smaller than sand particles. Their peculiar structure gives unique properties to clay and is responsible for the plasticity and stickiness of the soil. Most gardeners think of clay as a nuisance, for excessive amounts of clay lead to a very bad structure, but it does play a vital role in the soil; in proper amounts it can act as a conditioner by binding soil particles into granules—a property which is normally associated with the condition known as "good tilth".

Clay particles are able to retain chemical elements dissolved in the soil solution surrounding them. Many of these elements are plant nutrients, and when so held are readily available to plant roots. Thus clay and humus (which is very similar to clay in many ways) serve as a nutrient storehouse, the clay because its particles are so small, and the humus because of its spongy nature.

Soils with a high clay content are notoriously difficult to handle. Compression occurs if they are cultivated when wet; compact lumps are formed and these dry out into steely clods. When
THE SOIL

dry clays are moistened, the colloidal matter (very fine sticky particles) swells and tends to block their pores and make them impassable for water. Heavy clays, therefore, become easily waterlogged or "puddled". When the clay dries, it shrinks again forming the great deep cracks so often seen in heavy soils in summer. These cracks admit air to the soil and help to improve the structure.

TYPES OF SOIL

Sands are not necessarily all sand, nor are clays necessarily all clay. In between these two extremes, both of which would be most unfavourable to plant growth, there are a number of different textural classes, of which 12 are commonly recognized in Great Britain. These 12 classes can be placed in three broad groups—coarse soils, medium-textured soils and fine-textured soils. Chalky soils may be coarse, medium or fine, depending on the other constituents.

COARSE SOILS

The coarse-textured soils which include sands, loamy sands and sandy loams are valuable not only for their ease of cultivation but for their "earliness", for they warm up quickly in spring.

Soon after wet weather they can be cultivated—hoeing and sowing can be carried on.

Poor drainage is rarely a problem. But it is often only a matter of a few days after rain that they dry out, and, unless there is a good water supply, young seedlings soon die of drought. They are also very hungry soils, because bulky manures rot quickly and some plant nutrients are quickly washed out of reach of plant roots. Lime, also, is readily washed out, thus making such soils very prone to acidity.

MANAGEMENT OF COARSE SOILS

Coarse soils are best managed by heavy manuring with spongy humus-forming manures, and feeding little and often with fertilizers. The addition of clay or marl (a chalky clay) can work wonders provided the two soils are mixed thoroughly. But this treatment is rarely feasible, and it is usually necessary to depend on organic matter in large amounts for the improvement of sandy soils.

MEDIUM-TEXTURED SOILS

In the medium-textured soil group are loams which contain sand, silt and clay in such well-balanced proportions that none produces a dominating influence. When moist they feel neither gritty, silty, nor sticky, and when a moist lump is rubbed with the thumb it leaves only a rough smear. They are among the most fertile soils, and with proper management almost any crop can be grown in them. They are apt to become cloddy when worked too soon after rain, but break down into a good tilth fairly easily when dry.

MANAGEMENT OF MEDIUM-TEXTURED SOILS

These soils are easy to manage, for they do not need any of the careful treatment required by either coarse- or fine-textured soils.

FINE-TEXTURED SOILS

As the amounts of silt and clay in the soil increase, so the soil becomes more difficult to work. Such soils are slow to drain, the rain lies about in puddles for a long time, and the soils, being wet, are cold and cause delay in spring sowing and planting.

Care must be taken to choose the right
SANDY SOIL
Deep, easily-worked soil that is suitable for all plants. It is derived from sandstone rock and its chief drawback is its low water-holding capacity. This defect can be overcome by liberal watering and heavy dressings of bulky organic manures to prevent drying out. Regular liming counteracts sourness and helps to maintain fertility.

CHALKY SOIL
Shallow soil that is good for brassicas, flowers, salads and many shrubs except rhododendrons. Too shallow for fruit trees. Drainage is satisfactory but many chalky soils dry out in summer. With plenty of humus and regular feeding, it can be made into a useful soil. Organic matter rots very quickly and must be replenished constantly.
WET SOIL
Plants will soon be drowned in this soil when they reach the wet layer, unless drainage tiles are placed about 3 ft. below the soil surface. Cox's Orange Pippin apples would die unless these measures were taken, but cooking apples and black currants might survive. The only ornamental plants which will tolerate this soil are bog and waterside plants.

CLAY SOIL
Although the top layer of granular soil is quite good the raw clay lumps in the subsoil make a poor home for roots, and would hold up drainage in winter when the cracks close up. This soil is unsuitable for root crops, but would grow most plants if drained artificially so that the structure channels and crevices are preserved.
THE SOIL

time to cultivate them, for if they are dug or worked while they are too wet their structure will be ruined for the whole season. When wet they are like plasticine, and when dry like concrete. They must be caught just at the right moment when they are neither too wet nor too dry, and then work on them must be done at full speed. The advantages of these soils are that they do not dry out as quickly as sandy soils do, and though plants take a long time to establish themselves in them, once they are established large yields of high-quality crops can be expected.

MANAGEMENT OF FINE-TEXTURED SOILS

Corrective treatment often includes artificial drainage or the mixing in of coarse organic matter such as peat or compost or strawy manure, in order to open up the soils and so let air into them and water through them. Where possible dig clay soils roughly in the autumn and allow them to remain in a rough state throughout the winter so as to expose the biggest surface area possible to frost action, which will pulverize the lumps into smaller pieces by the spring.

It is possible to decide whether a soil is clay or not by rolling a little when moist between thumb and finger. Moist clay will roll into long threads which bend into a ring without fracturing, and will polish if rubbed lightly with the thumb. Silt, although often simulating the heaviness of clay, feels smooth and lacks its stickiness. Clay soils are not necessarily acid. If, however, they do become acid, very large quantities of lime are necessary to counteract the acidity.

STRUCTURE

The structure of the soil is just as important as its texture. A careful examination of an undisturbed side of the soil pit will show a very distinct anatomy or structure in many soils. In some soils the particles are clumped together into what resembles the crumbs of a loaf. Other soils may appear to be made up of angular blocks or clods. These predominant shapes of the soil, or aggregates as they are called, are known as the "structure", and structure is as much an essential characteristic of the soil as colour, texture or chemical composition. Although the mechanism of structure formation is not fully understood, it is believed that some kind of natural cement must be present to bind the soil particles together and keep them in these shapes, clay, as well as humus and various oxides of iron, being the chief cements.

SOIL STRUCTURE

BAD TILTH
In poorly structured soil, block-like lumps are difficult to break up

GOOD TILTH
Soil with a good, crumbly structure—typical in a meadow soil
The soil can be likened to a city of many inhabitants, and like any city it has its own system of communications. Some of the main routes are the work of earthworms, of which there may be more than a million in an acre of soil. Their tunnels often penetrate to a depth of 3 or even 6 ft., and allow water and air to circulate through the soil. They may, ultimately, form the layout of root systems.

Plant roots, too, make their own contribution towards the breaking up of the soil, by running in between the blocks of soil formed by the earthworms' tunnels and preventing them from sticking together again. This is most noticeable with freshly broken-up grassland. Grass is one of the best agents for producing a good structure, which is one of the reasons for the practice of ley farming whereby fields are sown with grass and grazed or mown for several years before breaking up and re-cropping. The more fibrous the root system, the greater the effect. Tilth formation may also be in part the handiwork of certain soil microbes, whose gums and sticky substances help to bind the particles together. These microbes feed on organic matter, and this explains why organic matter is important.

CRUMBS

The individual particles of an ideal garden soil are grouped together into granules or crumbs, and soil scientists consider that the best size of crumb lies anywhere between about one-fifth of an inch to one-twentieth of an inch in diameter. Therefore, one aim in cultivating the soil is to try to achieve a good crumb structure when making seed beds. The crumbs, being porous, soak up the soil water and retain part of it in their tiny internal pores. But there are also large pores between them which allow the rapid penetration and drainage of heavy rains, thus reducing surface run-off and the danger of erosion.

TILTH

A granular or crumb structure is associated with good tilth—a rather vague and mysterious term used in connection with the fitness of the soil for the growth of a given plant. In other words, a tilth that is ideal for lettuce is not necessarily ideal for beans or other larger seeds and mature roots which can live in coarser soil. But it is not sufficient to have a good tilth just at the surface and a cloddy, lumpy soil below. What is really required, but is very difficult to achieve in practice, is a good system of large pores running right down to bedrock or to the water table, through which fresh air can go in and carbon dioxide can come out. An abundance of smaller pores in which water is held is also needed.

To find out whether a soil has a good or bad structure, dig out a spit of undisturbed soil, let it drop on to a hard surface or path, and then notice how it shatters. A moist soil of good structure should come apart in rounded porous crumbs, whereas a poor-structured soil will break into block-like clods with flattened surfaces and sharply angular sides. A cloddy, lumpy soil, with extremely fine and almost invisible pores, is a sure sign of soil compaction or structure deterioration.

MAINTAINING A GOOD TILTH

To produce a good tilth and keep it once it has been produced are two different arts. The principal enemy of soil structure is exposure to heavy rain, when the raindrops are harmful and batter the crumbs into their individual particles, which then clog the pores after muddy water has subsided. When this clod layer dries, a hard crust forms varying anything from a fraction of an inch to several
inches thick, and acts as a barrier to the development of seedlings. Therefore, where there is poor germination the soil conditions should be examined. Heavy feet walking on wet soil are also powerful agents of destruction, and clay soils which are low in humus soon become massive if stirred or walked upon when wet.

The traditional method for building up and maintaining tilth is to work in bulky organic manures that rot down into humus, which is a valuable soil conditioner. But to do any good a tremendous amount of organic matter is required, for most bulky organic manures consist largely of water. For instance, a ton of farmyard manure consists of 15 cwt. water and 5 cwt. dry useful matter. For this reason a good thick coat of such organic manures has to be applied all over the soil for any improvement to be made.

Grassing down is Nature's restorative, but unfortunately a number of years in grass are needed before the soil fully recovers. The porosity of heavy clay soils can, of course, be increased by mixing in coarse materials such as grit and well-weathered ashes, with a view to opening the soil and improving aeration. The mixing of marl into sandy soils helps to bind the sandy soil particles together into groups and improve their moisture-holding capacity. But as the structure of sandy soils is very easily broken down by rainfall, it is probably better to ensure that they are always covered by a crop. Annual weeds grown during the winter on sandy soils will act as a blanket and take the first impact of the raindrops, and weeds will, of course, absorb nutrients which would otherwise have been lost in drainage. If the weeds are dug in, in the early spring, an improvement in the soil structure will usually be noted.

It is therefore important that the living conditions for plant roots are really good. If they are not good the best results will not be obtained from fertilizers and manures, for if the holes in the soil are too small for roots to enter, they cannot explore every nook and cranny, however rich the soil may be in nutrients. Fertilizers applied to a poor tilth cannot be used to their best advantage.

**COLOUR**

Chalky soils that are too limy for most plants dry out white in hot weather. Yellow soils often suggest leaching, that is, the washing out of nutrients, as do the grey and white soils in upland areas.

Colour is a most useful guide to soil drainage. When soils are completely waterlogged their colours become grey or greyish-blue; if they contain much humus they may become black due to the formation of iron sulphides. Poor drainage, which is quite common in many soils of heavy texture or in those with hard layers below, cannot always be detected at the surface. If there is any doubt about drainage, dig some holes about 2 or 3 ft. deep, fill them with water and then wait for about 24 hours. If the water disappears within half an hour or an hour, then the soil is well drained and will be good for all garden plants that require well-drained soils, but if it does not disappear within 24 hours only shallow-rooted plants can be expected to survive. Well-drained soils have a pleasant uniform brown colour, extending to a depth of 3 to 4 ft., but any sign of bluish or rusty mottling is always suspicious. Where the waterlogging is continuous there is greyness in the soil. Where the drainage is bad in winter but improves in summer, rust stains and deposits appear.

Colour also provides an idea of the amount of humus in the soil. Brownish-black and dark brown colours usually
show a good humus content, but blackness in top-soil in low ground may indicate bad drainage, particularly if peat is present as well. And in low ground, if the soil surface is nearly black-grey or greyish-green then again poor drainage is indicated.

It is important to identify such conditions in advance in order to decide whether they are bad enough to justify artificial drainage or not. If the soil is really badly drained, tile drains for removing the excess water will need to be installed. In cases where water comes primarily from adjoining higher land, an intercepting ditch or drain may be all that is necessary. Where drainage is not feasible, only those plants which can tolerate wet feet can be grown. Or, alternatively, raised beds may be used.

It is the winter crops, the deep-rooted crops, and the rapidly growing young plants, that are prone to damage by poor drainage. Some soils that are well drained during the summer and wet only in the spring will grow annual plants, but roots of perennials cannot live over the winter in them.

ORGANIC MATTER
The soil in an acre may contain anything up to 100 tons of organic matter, which is made up of plant and animal debris, for although plants take a part of their sustenance from the soil they also return to it leaves, decayed stems and roots. And all the numerous organisms living in the soil also play their part in producing this organic matter.

Most soils rarely have enough organic matter unless green crops are regularly grown for digging in. This is why bulky manures are needed to make good the deficiency.

USES OF ORGANIC MATTER
The soil, with its teeming millions of workers, is very much like a factory, and the workers, that is to say the bacteria and many other types of living organisms, all require the food and energy which organic matter provides. But not only does the organic matter provide nutrients for the soil organisms and for plants, but it also improves the physical condition of the soil. In heavy soil it has an opening effect, and prevents soil particles from settling into a solid mass. Roots can run better in soils which have plenty of organic matter. But more important, in well-drained soils the organisms that decompose organic matter produce substances that lead to granulation and a better structure. Hence the clay soils are made more fluffy and porous, and thus are able to give the roots better circulation.

Organic matter adds "body" to sandy soils and acts like a sponge in holding moisture. It also holds nutrients. It is no good watering a very sandy soil if there is nothing in it to hold the moisture. Bulky organic manures, such as sawdust, farmyard manure and peat, when applied to the surface of the soil as a mulch, help to control temperature, to reduce losses by evaporation, and to keep down weeds.

Organic matter is also the chief source of nitrogen in the soil. Manure or compost derived from a wide range of plants give a balanced supply of slowly available nutrients, and in particular the trace elements which are so often absent from fertilizers.

HUMUS
The bulk of organic matter is seldom decomposed completely. Usually a resistant residue of partly decomposed matter remains, which continues to break down very slowly.

This residue is humus; a dark brown or sticky substance, quite different in appearance and properties to the fibrous
and bulky material from which it is formed. So, contrary to the belief that it can be bought by the sack, humus can only form in the soil. Not only humus is required to improve the soil but also the strawy or fibrous material remaining in it, as well as the products that are formed in the process of breaking down. Constant replenishment is necessary in order to maintain the turn-over of these valuable products.

Fresh organic materials vary widely in their breakdown rates, and in the amount of plant nutrients, especially nitrogen, that they release.

Some contain fairly large amounts of protein or other nitrogen-bearing matter, and these decompose readily. In fact, the breakdown processes may go on so rapidly and furnish so much nitrogen that the materials are regarded primarily as fertilizers. Castor meal and various other vegetable seed remains have this property. Grass remains decompose very quickly, and so does straw, but the latter is low in protein and so provides very little nitrogen. Most peats decompose slowly and give only minor supplies of nutrients.

In a fertile soil the organic matter contains about 10 times as much carbon as nitrogen. But leaves, straw, old stems and most of the plant materials commonly available are dry, coarse and contain much more carbon—they may have 40 times as much carbon as nitrogen. When added to the soil it is not only hard to mix them in evenly, but they need a large amount of moisture. Their excess carbon provides the bacteria with a great deal of energy food which acts rather like sugar and helps the soil population to
increase enormously. But the soil population also needs nitrogen and phosphates, and these it takes from the soil. To compensate for this, add some nitrogen and phosphatic manures when burying vegetable refuse or very strawy manures, otherwise the plants will be temporarily robbed of the valuable nitrates they need for early growth. Better still, break this refuse or strawy manure down in a compost heap, the purpose of which is to produce an organic matter approximately like that in a fertile soil.

It is a great mistake to bury bulky manures deeply. Always mix them with the top-soil either by placing them against the walls of the trenches when digging or, provided they are well rotted, by incorporating them with a rotary cultivator, or by forking them into the soil where the rows are to be sown or planted.

THE THEORY OF “NO DIGGING”
Some people who do not believe in digging claim to have obtained good results by simply using heavy organic mulches without incorporating them into the soil, but the usual practice is to work the material into the surface to a depth of 6 to 8 in. The nutrients in organic manures are of no direct use to plants until they have been broken down into simpler substances. For example, the protein which is a source of nitrogen in farmyard manure is of no use at all until it is converted into nitrates, when it can be taken up by the plants. And if there were no microbes in the soil, manure and organic fertilizers such as dried blood and bone meal would yield no nutrients at all.

LIVING SOIL ORGANISMS
The soil is teeming with hordes of small creatures belonging to both the animal and vegetable kingdoms. Vast numbers of earthworms, insects, protozoa and other small animals are at home in the soil, as well as tiny microscopic plants such as bacteria, fungi, algae and actinomycetes. These latter are generally called micro-organisms, and there may be billions of them in a small lump of soil, a fact which is difficult to believe without seeing them through a powerful microscope.

Not all soils contain the same kind and number of micro-organisms, but most rich garden soils contain numerous bacteria. Most of these microbes are beneficial. In fact, were it not for microorganisms the earth might still be covered with rocks only, and would be without the greatest natural resource of all, the soil.

ROOTS OF LEGUMINOUS PLANTS
Small nodules or tubercles form on the roots of peas, beans and other leguminous plants. They contain nitrogen-fixing bacteria which absorb nitrogen gas from the air in the soil and supply it to the plant for its growth. In return the plant provides some of the food required by the bacteria.
Of the many different organisms that break down organic remains, earthworms start the ball rolling by eating debris and partially decomposing it. It is thus reduced to a suitable condition for attack by the micro-organisms. During the processes of decay, the dead plant tissues are broken into simpler forms, which are then available for the growth of numerous kinds of plants.

In addition to the decomposition of inorganic and organic residues by micro-organisms, some special bacteria convert nitrogen from the air so that it is available for the growth of numerous kinds of plants. Some nitrogen-absorbing bacteria live on the roots of peas, beans, and other légumes, and thus create the characteristic nodules which are often seen when such plants are lifted from the soil. That is why it is best to bury the roots of peas and beans so as to conserve nitrogen in the soil.

Other kinds of bacteria convert ammonia into nitrates, which are then also available for plant growth. Sulphate of ammonia, used as a fertilizer, depends upon this kind of bacteria for its action.

There are also the mycorrhiza fungi which live on the roots of many plants, from which they receive at least part of their food. In return they may act as water absorbers for their hosts, and may supply them with certain useful chemicals. But many organisms attack the roots of plants, causing damping-off diseases and various root rots.

Not all organisms live on decaying vegetable matter. Some are predatory, living on other soil organisms, so that the crowded community of micro-organisms in the soil is rather like a jungle. Many species prey upon others and the waste products of one become the food of others. Soils rich in organic matter also breed certain moulds and actinomycetes which reduce the numbers of fungi that produce plant diseases, as well as breeding powerful antibiotic substances that have opened up new vistas in medicine. These all come from microbes.

**ACTIVITY OF SOIL ORGANISMS**

The activity of micro-organisms varies with the season of the year, being greatest in the spring and autumn, and least in the summer and winter. Fortunately, the spring peak of activity coincides with the maximum growth of plants, and is probably one of the reasons why certain kinds of manures are most effective when applied in spring. Nutrients released by bacterial action are set free into the soil in the greatest amounts at the time they are most needed. So, when feeding crops, do not forget the microbes. There are so many below the ground, busily eating—and very efficient foragers they are too—that in an acre of land the weight of livestock below the surface is as great as the weight of livestock feeding above the ground. The microbes have first call on any nutrients which may be applied; the green plants really get what is left over.

In boggy areas, where the ground is waterlogged and often acid, bacteria do not thrive, and consequently plant remains are not properly decomposed. The operation of breaking down tissues is then taken over by fungi, which can tolerate greater acidity than the bacteria. This results in a slow accumulation of partially decayed vegetable matter that when compressed, forms peat.

**SOIL MOISTURE**

The soil is permeated with pores or cavities which are filled with air, or water, or both. Too much water or too little water are the chief problems facing the gardener, so that the control of water is essential except in places where wild plants that can put up with wet, dry or alternately wet and dry conditions have been naturalized.
THE WATER TABLE
When water falls, either as rain or from a sprinkler, some of the water penetrates into the ground and is retained by the soil. It is held by strong physical forces, the proportion of the soil pores filled depending upon the amount of rainwater that is falling. The soil surface is saturated immediately after rain, but in a well-drained soil this state is only temporary. The surplus water runs away down the work tracks, cracks and large pores until it reaches rock or some other hard impermeable layer upon which it collects, forming a permanently waterlogged layer. The upper surface of this waterlogged layer is known as the "water table," and resembles an underground lake.

The water table may be only a few feet or even a few inches from the surface, or it may be several hundred feet down, according to the area. In soils by rivers the water table may be at the surface during the winter, and, as a result, these soils will be thoroughly marshy. Waterlogged soils hold no air and therefore roots cannot grow in them because they become suffocated. On sloping ground where the subsoil is very compact, some of the drainage water often appears at the bottom of the slope, forming a marshy place. If the water table is too near the surface, only a small space will be left for plants to grow in and, as a result, they will be short, shallow-rooted and stunted.

The water table rises and falls but is nearest the surface in the winter. Ideally it should be about 4 ft. below the surface. Some of the deeper roots can then obtain moisture which rises a foot or so from the water table.

WATER RETENTION
Sometimes rain merely runs off the surface without penetrating the soil. This "run-off", as it is called, occurs in crusted soils and can be very serious on slopes.

The soil is rather like a tank, the size of
## MOISTURE CHART

### APPEARANCE AND FEEL OF SOILS

<table>
<thead>
<tr>
<th>AMOUNT OF AVAILABLE SOIL MOISTURE</th>
<th>COARSE TEXTURE</th>
<th>MEDIUM TEXTURE Fine Sandy Loam, Loam, Silt Loam</th>
<th>FINE TEXTURE Clay Loam, Clay</th>
</tr>
</thead>
<tbody>
<tr>
<td>None</td>
<td>Loose, falls through fingers</td>
<td>Small lumps which break down into powder. Powdery</td>
<td>Cracked surface, hard, baked appearance</td>
</tr>
<tr>
<td>Less than half</td>
<td>Looks dry, will not form a ball when squeezed</td>
<td>Crumbly, but will form a ball when squeezed</td>
<td>Forms a ball quite easily</td>
</tr>
<tr>
<td>Half to three-quarters</td>
<td>Forms a ball that crumbles easily</td>
<td>Forms slightly pliable ball. Smears when rubbed between thumb and finger</td>
<td>Forms a ball and long threads when rolled between palms of hands</td>
</tr>
<tr>
<td>Three-quarters and over</td>
<td>Forms ball that crumbles easily. Ball easily broken by pressure. Dark colour</td>
<td>Forms very pliable ball. Sticks to hands, particularly when clay content is high</td>
<td>Very sticky. Forms long threads which can be bent into a ring. Dark colour</td>
</tr>
</tbody>
</table>

which is determined by the depth of rooting. A sandy soil will hold about 2 gal. per sq. yd., to a depth of 1 ft., whereas a clay soil will hold much more, possibly up to 5 gal. per sq. yd. to a depth of 1 ft.

Plants keep drawing on the water held by the soil. A mature tomato plant, which even on a dull day uses about a quarter of a pint of water, on a sunny day will take up to about 4 pints. The 2 gal. in a sandy soil will not, therefore, last long, particularly as some of the water which is held by the soil is not available at all. Much of the water held by the soil is retained very firmly against the action of roots, the force holding the water being known as the moisture tension. As roots gradually exhaust the available water, they have to struggle harder to overcome the moisture tension.

In the smallest pores water is held with the greatest tenacity, often so tightly that plants are unable to extract it. They then give up the unequal struggle and wilt, even though the soil in which they are growing may contain quite a lot of moisture.

### WHEN TO WATER

It is generally reckoned that the time to water is when about half the available water in the soil has gone. To find out this stage exactly is very tricky and requires instruments, but the chart on this page will give some guidance for watering sandy loams or loams.

When watering do not just sprinkle the top of the soil. Always give enough water to wet the soil to a depth of at least a foot, otherwise the water will merely evaporate from the surface and do no
real good. Sprinkling merely encourages
roots to grow to the surface, so that they
will suffer severely during hot spells by
becoming scorched. A dry, sandy soil
needs at least 4 to 5 gal. or 2 large bucket-
fuls per sq. yd. in order to moisten the
soil properly to a depth of 1 ft. It is
impossible to partially wet a soil, whether
it is in open ground or in a pot. The soil
is either wet or dry, since it is wetted
from the top downward in a well-
defined layer. If a pint or so is sprinkled
over a square yard the ground may look
moist on the surface, but it will certainly
be dry below. Watering during hot peri-
ods is usually best done in the evening
when evaporation by the sun will be at
its lowest.

The best way to prevent undue loss of
moisture from dry soil is to mulch it with
some organic material. A mulch is a
layer or blanket of rotted material, lawn
mowings, straw or even polythene,
which is put on the surface of the soil to
prevent evaporation and to conserve
moisture. Its function is primarily to
keep roots cool and moist, but when it
consists of organic material it also acts as
food for the soil.

Hoeing, contrary to popular belief,
does not prevent loss of moisture, except
by killing weeds which use up a tremen-
dous amount of moisture.

**CHEMISTRY OF THE SOIL**

Sixteen chemical elements are known
to be necessary for the growth of plants.
Carbon, hydrogen and oxygen find their
way into the plants from the atmosphere
or from soil water.

Those that occur in compounds in the
soil are nitrogen, phosphorus, potas-
sium, calcium, magnesium and sulphur,
manganese, iron, boron, zinc, copper,
molybdenum and chlorine. Although all
these elements are essential for healthy
growth, some are needed in greater
amounts than others. Boron, manganese
and some others are regarded as trace
elements, because plants need very small
amounts of them, but they are just as
essential as nitrogen, phosphorus and
potassium, which the plants require in
much larger amounts.

The soil is like a bank with large
reserves of nutrients, but these reserves
are not available for immediate use.
They are gradually released by weather-
ing processes, and are then dissolved in
the soil solution, from which plants
obtain most of their food.

Although the exact method whereby
plants take up their nutrients is still a
mystery, it is known that they drink,
rather than eat, by means of root hairs
growing a short distance behind the root
tips. These root hairs make very intimate
contact with soil crumbs—a fact readily
seen when a seedling is lifted from a seed
bed.

The elements most often lacking or
seriously deficient in the soil are nitro-
gen, phosphorus and potassium—the
so-called fertilizer elements. The other
elements are usually present in sufficient
quantities, and it is only in special condi-
tions that they have to be provided.

**SOIL TESTING**

Before using fertilizers it is best to have
soil tested to determine its nutritional
level. A soil test can be arranged with the
county horticultural adviser.

In order to provide a sample of soil
from the garden, take a small amount
from 10 to 12 different places, going down
to a depth of 6 in., using a trowel. Put the
sample into a bucket, mix the whole mass
together and then take enough of
the mixture to fill a pint carton. If any
part of the garden or lawn differs from
the rest, that part should be sampled
separately.

When posting a sample of soil to the
THE SOIL

adviser, give as much information as possible about the previous growth and soil treatment. He will then be better able to give an accurate recommendation for manuring the next crop. It is helpful, too, to say what plants it is intended to grow next.

The autumn is generally considered the best time for sampling, since the soil is then in a more normal condition after cropping, and if an application of lime is recommended it will have all the winter to act in the ground.

SWEET OR SOUR SOIL
At the time the soil is tested for nutrients, tests are also made to find out how sweet or sour it may be.

A sour soil is one that is acid; a sweet soil is alkaline. The degree of acidity or alkalinity is expressed by the scale of pH values, ranging in the case of soils in Great Britain from about 4.0 to 8.5. The neutral point is pH 7.0, that is, the soil is neither acid nor alkaline. All figures lower than 7.0 denote acidity, and all figures higher than 7.0 denote alkalinity.

There is probably a best pH value for each plant species, but most plants will grow well in soils with fairly wide ranges of pH values. There are exceptions, however. The low pH which suits rhododendrons would be disastrous for peas, beans and lettuces. Scabious and anemones like plenty of lime, and prefer a pH value of 7.5. They would fail in acid conditions.

ACID SOILS
Just why crops grow poorly in acid soils is not fully understood. Phosphates become locked up and potassium and magnesium leach more easily from acid soils. Iron and aluminium are released in too large amounts, thus causing toxicity or poisoning, and this, together with the inactivation of most of the beneficial micro-organisms, may be the cause. But soil acidity need be no problem, since liming materials are a simple cure and easy to use.

ALKALINE SOILS
It is much more difficult to accomplish the acidification of an alkaline soil. Flowers of sulphur will help to make the soil acid, but do not use them without first taking expert advice.

LIME
There are many kinds of liming materials, but ground limestone or chalk are probably the best forms to use; they last longest and do not burn growing plants. Hydrated lime is also very popular, being fine and more concentrated than ground limestone.

The rates of application of lime depend upon the soil types. A clay soil needs 1½ times as much lime to correct the same degree of acidity as would a sandy soil. So it is always advisable to have soil tested first and not just to apply lime because a neighbour is doing so. He may be making a great mistake, since over-liming can lead to the locking up of nutrients and can cause deficiency diseases.

Apply lime to the surface of the soil after digging, and then rake in. It can be applied at any time of the year, but is likely to wash into the soil quickest under the autumn rains. To obtain an even application delay raking in until the soil is on the dry side.
General Soil Operations

Man depends on the soil for his living. It is therefore important to know how to cultivate it properly. But there is no value in cultivating land just for the sake of carrying out the operation, for every time the land is worked some humus is lost. Cultivation should, therefore, be carried out with restraint.

It is not advisable to dig soil deeply or, in the summer, even to dig it at all. Nature's plan is to build up humus from above year by year. Therefore the work in the spring and summer should consist of light hoeing only, except where it is necessary to prepare a piece of ground for another crop, when a light forking may be needed followed by a light treading and a light raking.

SINGLE DIGGING
Single digging consists of turning over the soil to a depth of about 10 in., and during this process any weeds that are growing on the surface should be buried.

When digging a plot, first take out a trench at one end of the plot roughly a spade's width and a spade's depth. Put the soil from this trench in a heap at the other end of the plot, so that when the plot has been dug the soil from the first trench can be used to fill in the last trench.

Then, alongside the first trench, mark out, preferably with a line, another strip a spade's width across, and gradually dig the soil over to fill the first trench and to form a new trench of the same width. This is done by first plunging the spade at right angles to the first trench, and then plunging it parallel to the trench so that a rough square chunk of soil the width of the spade is cut out. It is then simple to lift the chunk of soil, invert it and throw it forward into the trench alongside. If desired, put some well-rotted compost or old manure at the bottom of the trench before the soil is

Single digging; the soil is turned over to a depth of 10 in.
thrown in. Apply it at the rate of a bucketful to a yard-run of trench.

DOUBLE DIGGING
OR BASTARD TRENCHING
In double digging, as the name implies, the soil is dug to a depth of two spits. The soil is always left in its original layers: the top spit remains at the top and the second spit remains underneath.

Double digging is sometimes called bastard trenching, and two methods are in use; the first is for cultivated ground and the second for grass land that has not been cultivated before.

CULTIVATED GROUND
Mark with a line and dig out a trench 2 ft. wide and a spade deep at one end of the plot and put the soil from this trench in a heap at the other end of the plot. Next fork over the bottom of the trench well, and if any manure is to be added put it on to the forked soil. Move the line back 2 ft. to mark out another trench. Dig over the soil from this trench into the first trench, taking care to keep the soil level and the trench at an even depth, and to scoop up from the bottom any loose crumbs of soil, which should be put on top of the soil in the first trench. Now fork over the bottom of the second trench well, adding manure if required, and then turn into it the soil from a third trench. Repeat this process until the entire plot has been trenchd, putting the soil from the first trench on top of the forked soil in the last trench. If the soil is heavy, do the work in the autumn, and leave the clods rough as they fall, making no attempt to fork them down. This rough cloddy land exposes the greatest surface to the frosts and cold winds and ensures an easy-to-work soil the following spring.

GRASSLAND
Mark off a trench 2 ft. wide, skim off the turf and dig out the trench to a spade’s depth at one end of the plot. Carry the grass sods and soil to the other end of the plot, making two separate heaps. Then fork over the soil at the bottom of the trench. Next, move the line back 2 ft. and skim off the turf from this 2 ft. strip, placing it grass side downward on the forked-over base of the first trench. Then cut up the turf with the spade into pieces roughly 3 in. across. Do not put any compost or manure into the bottom of the trench, as the grass will supply the necessary organic matter.
help the grass sods to rot down properly, cover them with a fish fertilizer containing 6 per cent potash.

Next, dig out the soil of the skimmed strip to a spade's depth, and put it over the cut-up turf in the first trench, then follow by forking over the soil at the bottom of the second trench. Take care to keep the sides of the trenches vertical. Continue in this manner and finish by putting the turf and soil from the first trench into the last trench.

RIDGING
Ridging or ridge trenching is very useful on heavy soil. The work is carried out in the autumn with the idea of presenting the greatest possible surface of soil to the action of the winter weather. The channels in between the ridges help to remove excess moisture from the soil, so that ridged land is usually easily workable after one or two dry days in spring.

Dig out a trench 2 ft. wide and a spade's depth at one end of the plot, as if bastard trenching. This trench should run the whole length of the plot and preferably down the slope of the land. If the land is level the trench should run north and south. Then mark out a 2 ft. strip along-side the trench. From this strip dig out three separate spadefuls of soil across the width of the strip and put them to one side. Dig out three more spadefuls and put them into the first trench in the manner shown in the diagram on page 96. Spadefuls A and B go in the trench side by side, and spadeful C is put on top. Continue down the strip, digging in this manner, and gradually a ridge will be formed. Mark out another 2-ft. strip, and continue the operation until the whole plot has been ridged. The ridges should be parallel and never more than 2 ft. wide.

Well-rotted compost can be put at the bottom of each trench in exactly the same way as for bastard trenching or double digging, so that ample organic matter will be present when the land comes to be cropped the following year.

FORKING
Although the normal fork is almost entirely used in the spring and summer, a broad, flat-tined fork is best for digging very heavy clay soils in the autumn. The object of forking is to help break
Ridging allows winter weather to act upon the greatest possible surface of soil.

down the soil in the top 4 or 5 in. and thus aerate it. Plunge the fork into the soil at an angle of about 50 degrees, lift the soil and if possible invert it a little when dropping it back. It is useful to put a line across the plot and then to fork over an area about 3 ft. wide right across, then move back the line another 3 ft. and work over this new area, and so on until the whole plot has been forked.

ROLLING OR TREADING
Once the land has been forked in the spring it may be necessary to roll it with a light roller in order to consolidate the soil a little and to prevent it from being "puffy". If land is too loose it may dry out too quickly and the plant roots may be unable to get proper anchorage and to collect the food they need. Forking and light rolling are often both necessary; with a light roller the soil will be left less firm than it was before forking was started.

Rolling also helps to break down any lumps of soil there may be and to leave the soil level, thus making it easier to carry on the next operation, which is raking.

If a light roller is not available, then the plot can be trodden carefully from one end to the other. When doing this, adopt a sideways and shuffling motion so that the whole of the land is evenly trod. This work can be done more easily if squares of wood are strapped on to the boots. Treading done in this way is useful when preparing a seed bed.

RAKING
The purpose of raking is to break down the top half-inch or inch of soil into particles that are finer than grains of wheat. Raking normally follows the light rolling or treading which has already made the soil level, and the fine tilth it should produce is then suitable for seed drills.

The work is done by running the teeth of the rake evenly and at the same depth through the soil, in a backward and forward motion, and also to the left and right if need be. If the work is done carefully no mound of soil will be left when the end of the plot is reached.

HOEING
DUTCH HOE
Dutch hoeing should be done, if possible, every week-end until the end of June. There is no point in waiting until there
are weeds, for if the hoeing is done regularly the weed seedlings will be killed just as they start to germinate.

Move backward while hoeing, so that all footmarks are removed.

Use the Dutch hoe between rows of vegetables and herbs, between plants in the herbaceous beds or between roses, and use it from spring till early winter. It should not, however, be used on heavy soils between the beginning of November and the end of March.

THE DRAW HOE
Whereas the Dutch hoe is used on weed seedlings, the draw hoe is required when weeds are 2 or 3 in. high. Use it with a chopping and dragging action so that it cuts through the soil and the weeds and chops the weeds out.

The draw hoe is also used for getting out seed drills of the right depth. Stretch a line across the plot and keep it taut. Draw the hoe blade along the line so that its corner can scratch out a V-shaped drill half an inch or even an inch deep. Carry out this operation while walking backward.

It may be necessary to "peck" at the soil to make certain that the drill remains at the same depth all the time.

MULCHING
Mulching is generally the application of a thin layer of organic matter over the surface of the ground, first to prevent the evaporation of moisture from the soil, and second to smother annual weed seedlings and so prevent them from growing. Mulches are sometimes used to protect the roots of plants from cold or heat. They may also be put along rows of strawberries to keep the fruit clean.

For soft, bush or cane fruit a mulch in the form of clean straw a foot deep is often used all over the ground. For the flowering shrub border, use leaf mould to a depth of 5 or 6 in. For herbaceous borders, heather beds, primula, iris and Michaelmas daisy gardens use really old compost or sedge peat. Grass mowings can be applied as a mulch along rows of runner beans and peas, but should never be put deeper than ½ in. because they heat up and so cause trouble to the stems of plants.

Wide strips of black plastic film and heavy grade aluminium foil can also be used as mulch, though organic materials are preferable as they gradually decay and so add humus to the soil.

Do not apply a mulch too early in the season or in frosty weather, as it will retard the warming of the soil. It also lowers the night temperature of the air immediately above it, a point of importance where plants of doubtful hardiness are concerned.

Make sure that the soil is moist before applying the mulch. Remember that a mulch, as well as conserving soil moisture, may act as a barrier to light rain.
DRAINAGE

Trees, bushes and plants will not grow in waterlogged soil, and if excess moisture cannot get away because of an impermeable subsoil some form of drainage must be provided.

A simple test is to dig, in the winter, a hole 2 ft. deep; if water soon fills the cavity, then artificial drainage is required.

There are various ways of laying drains, and the layman would be well advised to ask a landscape architect, or perhaps the local authority surveyor, for advice on the most suitable method.

Land can be effectively drained by means of pipes laid below the soil. These pipes are obtainable in fixed lengths and may be either of earthenware, tile or permeable concrete. The lengths of earthenware piping are laid with an 1/2 in. gap between their ends through which the water can seep. But the roots of trees sometimes grow through these gaps between the piping, so that after a time the drains may become completely blocked. This trouble can, however, usually be obviated if permeable concrete piping is used, as the lengths can be laid closer together.

SIZE OF DRAIN PIPES
The main drain, which should be of 6-in. diameter piping, should run the length of the land to be drained from the highest to the lowest part of the plot.

The side or branch drains, which are usually called feathers, are of 3-in. diameter piping, and are put in to meet the main drain at an angle of 60° in a herringbone pattern, but no two feathers should join both sides of the main drain at the same point.

Though the drains can be laid 3 ft. deep, in many cases they need be no more than 20 in. deep. The depth depends to a certain extent on where the impermeable layer of clay lies, and therefore where the water is held up.

Dig V-shaped trenches for the drain pipes, as shown in the illustrations. Lay the main drain first, and then the feathers. Never give a steep slope to the pipes, but incline them very slightly so that the slope is barely perceptible. To check that the pipes have the right fall, put pegs into the bottom of the trenches, and place a board across them with a spirit level laid on it.

The problem in many gardens is where to take the water when it runs down to the end of the drain.

Sometimes there is a ditch at the bottom of the garden into which the water can flow, but under modern building conditions, especially in towns, it is necessary to build a soakaway to accept the water.

A hole should be dug 4 to 5 ft. deep and about 4 ft. wide, and the sides should be loosely bricked to allow the water to seep through into the soil if necessary. Fill the hole with coarse clinker or brick rubble.
As this site slopes directly away from the house, the main drain runs the full length of the garden into a soakaway. Three-in. side drains meet it at an angle of 60°.

This garden slopes across its width, and the main drain—of 6-in. piping—follows the fall of the land. Excess moisture soaks through gaps between the lengths of piping, or through the walls of the pipes themselves if they are of permeable concrete.
A soakaway should be built if there is no ditch or other suitable outlet at the lowest point of the garden. It should be 4 to 5 ft. deep and 4 ft. wide, loosely constructed of bricks and filled for most of its depth with coarse clinker or brick rubble.

Cross-section of drain pipe in position. The V-shaped trench should be at least 20 in. deep, and the pipe should be covered with rough clinker or broken bricks so that water can trickle through quickly.

Cover the drain pipes with rough clinker or broken bricks so as to allow the water to trickle through quickly. Alternatively, brushwood or a 6-in. thickness of heather, if this is available, can be laid over the pipes. Then put the soil back in the same order in which it was dug out, leaving the surface slightly raised to allow the soil to settle at the right level later on.

**ALTERNATIVE METHOD**

If drain pipes are not to be used, then drainage trenches can be dug. These trenches should be 2 ft. deep, the main trench being 1 ft. wide and running to the lowest part of the garden. The side trenches should be narrower and should run obliquely into the main trench. Fill the bottom 6 or 8 in. of all the trenches with large stones, big clinkers, brickbats or similar material through which the water can percolate.

**TIME FOR WORK**

Drainage work in the garden is better done in the winter when more time is available as there are few other gardening jobs to do, and the interference with growing plants will be at a minimum.
Fertilizers and Manures

Fertilizers and manures are materials that are used to improve soil. The words are often used synonymously, but in fact a fertilizer is generally considered to be a substance that supplies only nitrogen, phosphorus, or potassium (the three nutrients) to the soil, and a manure a material supplying it with both nutrients and humus.

Fertilizers are applied at the rate of a few ounces per square yard, manures at the rate of several pounds per square yard.

Both organic and inorganic fertilizers should be used carefully as they can produce unwanted effects. While they supply nutrients that improve crop growth and quality, they also increase the strength of the soil solution, making it more difficult for the roots to absorb the water and nutrients they need. It is therefore important to remember that overdoses can cause serious wilting, and even the death of a plant. So do not give more than the recommended dressing.

INORGANIC FERTILIZERS

Inorganic fertilizers, often referred to as chemical, synthetic, or artificial manures, are manufactured or derived from mineral deposits. They may either be used by themselves to supply a specific nutrient, or mixed together to give a compound, or so-called complete fertilizer.

Fertilizers sold by seedsmen or sundriesmen, are obtainable in the form of crystalline powders (the form in which they are generally sold), or in pellet or granular form, the latter being easier to store and spread.

BUYING

Once the results of a soil test and the needs of the plants to be grown are known, buy the fertilizers that are required to keep the soil account balanced.

Although fertilizers can be obtained at home if animals are kept and there is a good supply of soot and wood ashes, it is generally more convenient to buy the necessary fertilizers and manures from a seedsmen or sundriesman. The analyses shown on the container labels are useful guides as to the effectiveness of some fertilizers, and are the guarantee of the minimum percentages of nitrogen, phosphorus and potassium that they contain. The phosphorus content is expressed as $P_2O_5$ (phosphoric acid), potassium as $K_2O$ (potash) and nitrogen as N. For example, nitrate of soda has an analysis of 16 per cent nitrogen, which means that 100 lb. of this fertilizer has 16 lb. of nitrogen in it.

Urea, however, has 46 per cent nitrogen, so only one-third of the amount of urea is needed to give the same effect as nitrate of soda.

APPLICATION

Inorganic fertilizers are not simply nutrients, but are salts having two portions, namely, the nutrient or wanted portion, and the unwanted portion. One cannot be had without the other. In nitrate of soda the unwanted portion is sodium, which can easily spoil the tilth of heavy soils if this fertilizer is applied too heavily. A reasonable amount of sodium benefits beetroot, but is apt to
spoil the cooking quality of potatoes. To avoid giving plants indigestion it is vital to select the right fertilizer and, when using branded products, to follow the manufacturer’s directions for use.

Some advocates of the use of only organic fertilizers maintain that inorganic fertilizers are harmful to plants and to man who eats the plants, since the nutrient elements are derived from purely mineral substances, often obtained by the combination of strong acids and alkalis. But there is no scientific evidence to show that crops grown with inorganic fertilizers are inferior in quality or lower in nutritional value than those grown with organic fertilizers.

Inorganic fertilizers can be grouped into three classes: nitrogenous, phosphatic and potassic.

NITROGENOUS FERTILIZERS

*Nitrate of Soda* (16 per cent N). This is a quick-acting stimulant for applying to growing crops in spring and summer, particularly when plants have been checked by bad weather or pest attacks. Provided the soil is moist, the effect can usually be seen within a few days of application. Nitrate of soda is good for acid and peaty soils, but may easily spoil the tilth of clay soils if applied too freely. The usual rate of application is ½ to 1 oz. per sq. yd.

*Nitro-chalk* (15-5 per cent N). This has a quick and sustained effect and does not tend to make the soil sour. Use only as a top dressing at the rate of ½ to 1 oz. per sq. yd., when the crops are well up.

*Sulphate of Ammonia* (21 per cent N). This is slightly slower-acting than nitrate of soda, usually taking effect within 10 to 14 days in the summer, but taking rather longer in cold weather. Although suitable for use as a top dressing on a wide range of crops and lawns, it is best used in combination with other fertilizers to make up a compound dressing. It tends to make the soil acid and thus works best on well-limed or chalky soils.

*Chilean Potash Nitrate* (15 per cent N, 10 per cent K₂O). This is a useful top dressing for supplying both nitrogen and potash, and is applied at 1 to 2 oz. per sq. yd. in spring and summer. It is very quick acting and often recommended for use when preparing plants for show. It also makes a useful liquid feed when 1 oz. is dissolved in 2 gal. water.

PHOSPHATIC FERTILIZERS

*Superphosphate of Lime* (18 per cent soluble P₂O₅) (generally called “super”). This is the most popular fertilizer for supplying readily-available phosphates before sowing or planting, and is applied at the rate of 2 to 4 oz. per sq. yd. and usually in combination with other fertilizers. It can be used at any time of the year without fear of it being washed out, but is most usually given during the spring and summer.

*Basic Slag* (14 to 18 per cent P₂O₅). This is a slow-acting phosphatic fertilizer. It gives best results on acid soils in wet districts when applied in the autumn at the rate of 4 oz. per sq. yd. Its lime content helps to correct acidity.

POTASSIC FERTILIZERS

*Sulphate of Potash* (48 per cent K₂O). This is the most popular potassic fertilizer, and is safe for all plants. It can be applied at any time of the year at 1 to 2 oz. per sq. yd. without fear of loss by drainage. It is generally mixed with other fertilizers to give a complete feed before sowing or planting. It is also used as a top dressing for crops that have to occupy the ground for a long time.

*Muriate of Potash* (60 per cent K₂O). This fertilizer is more concentrated than the sulphate form, and although suitable for a wide range of plants may damage strawberries, red currants, gooseberries and
tomatoes. Normal rates of application are 1 to 2 oz. per sq. yd.

ORGANIC FERTILIZERS
Organic fertilizers are usually of animal or vegetable origin, often being derived from slaughterhouse refuse and vegetable wastes such as seed residues. They are mainly used for supplying nitrogen, but some animal products contain bone residue which gives phosphates as well.

The nitrogen in these fertilizers is in the form of protein, which is not accessible to plants. Soil organisms change it into exactly the same nitrates as are available in inorganic fertilizers. This class of fertilizer—dried blood and bone meal, for example—does produce some humus, but not a sufficient amount at normal rates of application.

If the soil is sour, too wet or too cold, organic fertilizers (organics) will not work properly, since these are the conditions that are detested by bacteria, and unless bacteria are working properly, the nitrogen in the fertilizer will not be released.

Although organics are generally thought to be slow acting, dried blood, fish meal and several others may work quite quickly in warm, moist and well-limed soils. But the speed of action also depends upon how finely ground they are. Dusty forms of hoof and horn work almost as quickly as dried blood or even sulphate of ammonia, whereas coarse forms may take years to become exhausted. Among the advantages claimed for organics are, first, that they are longer lasting than inorganics and, second, that they give a steady supply of nitrogen rather than sudden rushes, and so avoid rank growth if applied at the wrong time.

A fairly heavy dressing, say 4 oz. per sq. yd., of nitrogen in the form of hoof and horn can safely be given before sowing, whereas the same amount of nitrate of soda might cause damage.

Nitrogen in organic form is less likely to be washed out of heavily watered soils.

Organics are often preferred to inorganics because they do not scorch foliage—a decided advantage when a top dressing has to be given to crops with creeping stems and rosette leaves which cover the tops of their pots.

But organics are comparatively expensive and have no fixed composition. While sulphate of ammonia always has about 20-6 per cent of nitrogen, the nitrogen content of dried blood may vary from 7 to 14 per cent. Some waste materials may show quite a high percentage of nitrogen, but this may not be of any value in the year of application because of very slow breakdown. Leather wastes and some plastic wastes are of this nature.

USES
Dried Blood (7 to 14 per cent N). This has a quick and sustained action in warm soils. It is very useful for feeding plants with spreading foliage, but is probably most suitable for greenhouse plants. The best samples are fine, dusty and red powders.

Dried blood is used as a rule only for top dressing growing plants at the rate of 1 to 2 oz. per sq. yd. or for feeding pot plants at the rate of about a teaspoonful for a 9-in. pot.

An almost completely soluble form can be used at the rate of 1 tablespoonful to 1 gal. water as a liquid feed.

Hoof and Horn Meal (7 to 13 per cent N). This is available in various grits (particle sizes). Fine grits, that is to say from ½ in. to dust, are quick-acting, but at the same time have a lasting effect. But coarse grits (‡ in.) and hoof parings are very slow acting. Fine grits are used in growing composts for supplying nitrogen. Hoof and horn is generally worked into the
ground before sowing or planting at the rate of 2 to 4 oz. per sq. yd.

Soot (1 to 6 per cent N). The nitrogen in soot is present in ammoniacal form and behaves in the same way as an ammonium salt, therefore acting quickly. It also contains many trace elements. The best soot comes from household chimneys and is light and fluffy in nature. Heavy, dense soot contains ash which is of no value. Fresh soot contains plant poisons, so keep it under cover for three months before use. Scatter it over the soil after digging, and then rake it in at the rate of 4 oz. per sq. yd. It can also be used for top dressing brassicas at the rate of 4 oz. per sq. yd. Never mix soot with lime.

Dried Sewage Sludge (4 to 6 per cent N). Dried sewage sludge is sold in bags by municipal authorities as a fertilizer. It is powdery, and quite inoffensive to handle. It is mainly used for supplying nitrogen and contributes a little organic matter.

Bone Manure (4 to 5 per cent N, 20 to 30 per cent P₂O₅). Bone meal can be obtained in coarse, medium and fine grades, the latter being fairly quick-acting. Bones crushed to ¼- and ½-in. particles are slow in action and will supply phosphates for two years or more; fine bone meal becomes soluble as the organic acids in the soil act upon its dusty particles. The slow and steady availability of nutrients from bone meal, and the absence of harmful unwanted portions, make it a very safe fertilizer for young plants. The usual rate of application is 2 to 4 oz. per sq. yd., and it is used either by itself or with other fertilizers. The small amount of nitrogen that it does contain is as a rule quickly available.

Steamed bone flour, being a fine dusty powder, acts more quickly than bone meal, but its effect is exhausted within a year. It helps to keep fertilizer mixtures in good condition if it is added at the rate of 1 lb. steamed bone flour to 9 lb. fertilizer mixture.

Guano. Guano used to be the term applied to droppings of sea birds, which were collected from uninhabited islands off Peru, but it now applies to various kinds of waste products, including the droppings of bats, fish scraps and even meat residue. Fish guano is obtained from fish wastes, and is usually supplemented with inorganic fertilizers and sold as fish manures under brand names. These fish manures are quick-acting, giving a sustained supply of nitrogen and phosphorus. They are generally used at the rate of 2 to 4 oz. per sq. yd., and are best applied a few days before sowing or planting.

Poultry droppings are called poultry guano, and when dried are supplemented with inorganic fertilizers to form balanced manures that are sold under a variety of brand names. They are similar in action to fish manures and are used at the same rate before sowing or planting, or for feeding growing plants.

Most guano-based manures are normally applied in the spring, two to three weeks before sowing or planting, or as a top dressing. Excess applications do not usually cause damage, but are, of course, wasteful.

Wood Ashes. Wood ashes contain varying amounts of potash according to the materials burnt. The richest wood ashes come from bracken, the haulms of broad beans and the prunings of trees and shrubs. They should be collected and stored as soon as they are cool enough to handle, and then kept perfectly dry, otherwise the potassium carbonate will be washed out. About 4 to 8 oz. per sq. yd. are required to give as much potash as there is in sulphate of potash applied at 1 oz. per sq. yd. Heavier dressings tend to cake the soil surface and destroy tilth. Wood ashes are inclined to make the
FERTILIZERS AND MANURES

soil alkaline, and large dressings should not be given to chalky soils.

BULKY ORGANIC MANURES

Fertilizers are not substitutes for humus-forming manures: they are supplements. Many soils deteriorate when the humus level falls too low, and bulky organic manures have to be used. The fertility of many of the older gardens has been built up by generations of generous manuring with horse or other animal manures. But these manures are difficult to obtain easily or at a reasonable price. Farmyard manure, or F.Y.M. as it is called, is a mixture of the droppings of horses, pigs or cows, the litter used for their bedding and the urine which has been soaked up by it.

Horse or stable manure is the richest and the driest. A heap of horse manure soon starts to steam, thus showing that rapid fermentation is taking place. It is therefore called a hot manure, and is sometimes used for making hot-beds for starting seedlings or growing early salad crops. Fresh horse manure from riding stables or racing stables is often merely urine-soaked straw with a few droppings, which dwindles to a very small heap when it is stacked.

In bullock yards, as straw is added daily and is trodden in to the manure, a very much denser material is obtained. A cubic yard of bullock manure can weigh as much as 15 cwt. in contrast to a similar measure of fresh racing stable manure which may weigh less than half a ton. Cow and bullock manures are wetter and lower in nutrients than horse manure, and decompose more slowly in the soil, which makes them more suitable for sandy soils.

Similarly, pig manure is slow acting and long lasting. As it is slow to ferment it is a cold manure and therefore unsuitable for the making of hot-beds. When fresh it is caustic and liable to burn the roots of young plants. It is best composted with straw or garden refuse and then allowed to decompose for three months before use.

COMPOSTING OF F.Y.M.

The quality of farmyard manure varies according to the kind of food the animals have been eating. Animals fed on rich food produce a richer dung, but breeding animals and those with young retain more of the nutrients in their food, to the detriment of the manure.

Old manure which has been stacked for several months is richer than fresh manure and the nutrients are more readily available. Although farmyard manure is purchased mainly for its humus-forming properties, it supplies plant nutrients. One ton will give about 10 lb. nitrogen, 5 lb. phosphoric acid and 10 lb. potash, much of which is accessible to plants soon after application. Make allowances for these nutrients when working out fertilizer plans.

F.Y.M. also contains quite large amounts of magnesium and calcium and all the trace elements. A good dressing of farmyard manure will remain active for at least three years and probably longer. But after buying it do not leave it in loose heaps; make a solid compact pile, well trampled down, with the centre higher than the edges. This will cut losses to the minimum. But even with the best storage, one-third by bulk will be lost in the first three months of storage, since organisms convert some of the dry matter into gases which blow away.

APPLICATION OF F.Y.M.

F.Y.M. is used to its best advantage when mixed in the top-soil by forking or rotary cultivation. If plenty is available lay it in the bottom of the trench when digging, but do not apply more than can be dug in at any given time. To give a really good
dressing, completely cover the ground with a 2- to 3-in. layer which is equal to about 10 to 15 lb., or a good bucketful, per sq. yd. Composted stable manure can be bought in bags weighing between 80 and 90 lb. It is easier to handle, and mixes better with the soil.

POULTRY MANURE

Poultry and pigeon manures are at least four times as strong as stable manure, but supply very little humus. They tend to make clay stickier and acid. Poultry manure can be used fresh, but is better stored. It should be dried by mixing it with half its bulk of fine dry soil and sand, and can be used for top dressing growing crops. Always keep it under cover to avoid loss of nutrients in the rain. About 5 lb. of the mixture should be sufficient for 1 sq. yd.

If trouble is taken to dry the droppings on a metal plate over the greenhouse boiler, a high-grade fertilizer will be obtained. Apply this after crushing at the rate of 4 to 8 oz. per sq. yd. well in advance of sowing, or as a top dressing. The potash content of poultry manure is low and is best balanced by adding 1 part by weight of sulphate of potash to 12 parts by weight of dried poultry manure.

PEAT

Peat is a useful alternative to F.Y.M. Although it may contain twice as much nitrogen as F.Y.M., most of the nitrogen is inaccessible to plants. The phosphate and potash content is usually one-tenth that of farmyard manure. It can only be regarded, therefore, as a soil conditioner and not as a fertilizer. It breaks down more slowly than F.Y.M., keeping the soil loose and thereby improving the aeration and drainage. As peat is weed-free and easy to spread it is more convenient to use than farmyard manure, particularly in the greenhouse. A natural supply of peat is rarely at hand and a sundriesman must be relied on to provide it. Such peat may be either sedge or moss. The only way to find out which is best is to try both types on the garden and watch the results. It is safe to buy from a well-known peat firm. But there is good and bad peat. Bad peat is black, greasy, and becomes porridge-like when wetted, whereas the best types are brown and spongy or fibrous. Peat can be bought in bales or loose in plastic or paper bags in quantities of up to \( \frac{1}{4} \) cwt.

APPLICATION OF PEAT

For digging, \( \frac{1}{2} \) to 1 bushel or 3 to 6 lb. per sq. yd. of peat are needed to give a good covering. For potting composts it is usually mixed with loam and sand according to the John Innes specification. Never apply dry peat to the soil; it will merely take up the moisture so badly needed by plants. Dry peat swells in potting composts and upsets the firm potting of the plants or seedlings. If spread thinly on the soil surface or on the potting bench, it can be moistened with a can fitted with a rose. A coarse grade, with large particles, is best for a sandy soil and a fine grade for a clay soil.

COMPOSTING

Composting is the predigestion or partial decomposition of organic residues. There are several methods of composting, as described in Composting and Green Manuring. Well-made compost is equal in value to F.Y.M. and is used at the same rate.

HOP MANURES

Spent hops, which may be obtained from breweries, are useful for improving the physical condition of the soil, but are low in nutrients. In a wet state they contain about as much nitrogen as F.Y.M. (0.5 to 0.6 per cent) and from two to four times as much phosphates (1 to 2 per cent \( P_2O_5 \)) but they contain only traces of potash. Their nutrient content can be improved by mixing them with National
Growmore Fertilizer (see next page) or other suitable compounds. Alternatively the sundriesman will supply a branded hop manure—spent hops reinforced with fertilizers. This can be obtained either in wet or dry forms. Use the dry forms on heavy soils. Apply at the rate of $\frac{1}{2}$ to 1 lb. per sq. yd. Bury the manure immediately after application to prevent attacks by slugs and vermin.

OTHER MATERIALS

SHODDY
Shoddy—the waste materials from wool factories—can be bought under brand names in $\frac{1}{4}$- or 1-cwt. bags. It contains up to 14 per cent of nitrogen and should remain active for at least three years. Apply at the rate of $\frac{1}{4}$ to 1 lb. per sq. yd. in the autumn or winter.

SAWDUST
Sawdust, when properly handled, builds up the humus content in the soil, but before being mixed in should always be composted. Never use fresh, undecomposed sawdust, because it robs the soil of nitrogen. To obtain the best results mix three parts by bulk of sawdust with one part bulk of well-rotted F.Y.M. or poultry manure, and leave it in a heap for 12 months. Nitro-chalk may be added to speed up rotting at the rate of 1 lb. per 20 lb. sawdust. Leave the whole heap moist. Sawdust is not a fertilizer, on account of its very low nutrient content. The usual rate of application is 10 to 15 lb. per sq. yd.

Although old sawdust looks unattractive, it is ideal for mulching fruit bushes, shrubs, or other widely spaced plants. It eventually breaks down into humus when dug in at the end of the season.

LEAF MOLD
Leaf mould or leaf soil taken from the top few inches of woodland soils makes good humus, particularly when it is derived from oak and beech trees. The leaves of these trees are more likely to be acid than those of other trees. Compost fallen leaves in heaps and then sandwich them in 6-in. layers between thick layers of soil. If placed in shallow heaps not more than 2 to 3 ft. high, a fibrous mould will result after about a year. Apply this mould at the rate of 5 to 6 lb. per sq. yd. A better product will result if National Growmore Fertilizer is sprinkled on the heap during the process of building.

SEAWEED
For those who live in coastal districts seaweed is a cheap, excellent manure. Spread at the rate of 10 to 12 lb. per sq. yd. and dig in immediately. It will then provide nearly as much nitrogen and up to three times as much potash as an equivalent dressing of farmyard manure. Seaweed breaks down rapidly into humus, and is free from weed seeds and disease organisms.

Dried seaweed meal is a good substitute for bulky manures and is suitable for a wide range of crops when used at the rate of 4 to 8 oz. per sq. yd. Best results will follow if the dried seaweed is worked into the soil in the autumn for crops that are to be planted in the spring.

COMPOUND FERTILIZERS
When preparing the ground for sowing or planting, or making soil compost for pot plants, three things should be done. First make sure that a material sufficiently humus-forming to keep the soil in good condition has been applied; secondly, correct any sourness by liming, and thirdly, ensure that there is a good supply of nitrogen, phosphates and potash. These nutrients can be provided by making separate applications of, say, sulphate of ammonia for nitrogen, superphosphate for phosphates, and sulphate of potash for potash. Alternatively, mix these three fertilizers together and
spread in one application. This is more convenient and generally gives a more even distribution of the nutrients. But a ready-mixed compound fertilizer can be bought. Many manufacturers have their own proprietary brands which are listed for use for various plants. The best are made from the fertilizers already described. Those that include ammonium phosphates are more concentrated than those based on “super” phosphates.

**ANALYSIS**

The chemical analysis of a compound fertilizer should always be shown on the container thus, 5-5-10. The first figure denotes the percentage of nitrogen, the second figure the percentage of soluble phosphoric acid and the third figure the percentage of potash. If one of the three major elements is lacking in a fertilizer a zero appears in its place; thus 5-0-10 means 5 per cent nitrogen, no soluble phosphoric acid and 10 per cent potash.

**WHAT TO BUY**

When selecting compound fertilizers take note of the ratio of N, P and K as well as the actual percentage of each. Fertilizer ratio is the analysis reduced to its simplest terms. For example the 5-5-10 fertilizer has a ratio of 1:1:2. A general fertilizer for outdoor vegetable crops should have a ratio of approximately equal amounts of N, P and K, that is a ratio of 1:1:1, whereas a fertilizer for root-bound plants in pots should be a high nitrogen liquid feed such as the John Innes liquid which has an analysis of 18-65 per cent N, 6-2 per cent P₂O₅, 6-2 per cent K₂O, or a 3:1:1 ratio.

**NATIONAL GROWMORE FERTILIZER** (7 per cent N, 7 per cent P₂O₅, 7 per cent K₂O)

There are 100 or so compound fertilizers available. A good general, all-purpose compound fertilizer is the National Growmore Fertilizer which will probably meet the needs of most outdoor crops, irrespective of their precise requirements.

**JOHN INNES BASE FERTILIZER** (5-1 per cent N, 7-2 per cent P₂O₅, 9-7 per cent K₂O)

The John Innes Base Fertilizer used at the rate of 4 oz. per sq. yd., or at 4 oz. per bushel of potting compost, will certainly supply the needs of most pot plants as well as greenhouse crops in their early stages of growth. It will carry these crops through until quick-acting nitrogenous top dressings become necessary. Once specialization in the growing of particular plants such as chrysanthemums or roses is started, a more serious study of the fertilizer programme can be made.

**LIQUID FEEDS**

Liquid feeds are becoming more popular for supplying nutrients for plants, particularly those grown under glass.

The modern factory-made liquid feeds, marketed as concentrated solutions or as solid mixtures for making into concentrated solutions, are more consistent in composition than the foul-smelling concoctions made by suspending sacks of animal droppings or soot in tubs of water. The main constituents of most liquid fertilizers are potassium nitrate, mono-ammonium phosphate, and ammonium nitrate or urea. These are mixed in various proportions to give a wide range of different analyses to suit the needs of most crops and soils. Liquid manure derived from seaweed and humus extracts supplies useful amounts of trace elements as well.

Liquid feeds are not necessarily better than solid feeds. A gardener who is skilful in using solid fertilizers will no doubt obtain results just as good as those he would get with liquid feeds, and vice-versa. But liquids are popular because of the ease and speed with which nutrients can be applied in balanced form, to meet the changing needs of plants at different stages of growth and weather conditions. They also save time in feeding and water-
FERTILIZERS AND MANURES

ing since these are done in one operation. They sink evenly into the soil, where they are quickly and naturally absorbed by the roots.

APPLICATION

Liquid feeding is more expensive than solid feeding. Concentrates sold in bottles have to be diluted with water according to the maker’s instructions, which should be carefully adhered to. If a dilution of 1 in 200 is recommended, measure 1 fluid oz. (2 standard tablespoonfuls) to 1 1/2 gal. water. One in 500 is equivalent to about 1 fluid oz. to about 3 gal. water. Water the diluted solution on to the soil by means of a watering-can and rose.

If a big area is to be covered, buy a diluter into which the stock solution from the bottle is poured and from which the feed is picked up by a hose when connected to a tap.

FOLIAR FEEDING

Plants can absorb nutrients through their leaves when they are sprayed with dilute solutions of fertilizers. Radioactive tests show that micro-nutrients applied in this way can be in the sap stream within one hour after application. Thus, the long journey from the root to the leaf is avoided and nutrient deficiencies may be corrected rapidly.

It is difficult to say whether leaf sprays can be used to advantage for feeding vegetable crops, but they are preferable to soil dressings for plants with poor or diseased root systems. They are useful for giving a boost to growth during dry weather when there is little soil water in which to dissolve fertilizers. Deficiencies of manganese, iron and other nutrients in plants growing in chalky and other alkaline soils can be quickly corrected by means of suitable substances applied as leaf sprays.

To strengthen and increase leaf growth, a spray containing urea at the rate of 1 oz. per 2 gal. water will be sufficient to cover 25 to 30 sq. ft. of soil fully covered with foliage. Potassium nitrate, when applied at the same rate, will help to harden soft sappy tissues without checking growth.

Buy one of the proprietary products specially designed for foliar feeding. While many of these are based on highly soluble inorganic fertilizers, all-organic seaweed preparations are also available.

Apply the sprays when the plants have developed enough leaves to ensure a reasonable amount of leaf absorption, and then spray once a week or according to the maker’s instructions.

Use a fine mist-like spray to cover both sides of the leaves. Keep the spray moving the whole time to ensure that the plants receive a reasonable and equal amount of liquid. Always add a wetting agent such as Agral (at rates according to the manufacturer’s instructions) when spraying plants with shiny leaves, otherwise the food spray will run off the leaves without being absorbed.

GENERAL HINTS ON USING FERTILIZERS

APPLICATION

1. Apply solid fertilizers as base dressing to the soil before sowing or planting, or as top dressings during the growing period.
2. To make fertilizers effective mix them with a little soil and spread them as evenly as possible all over the soil surface. Small amounts are more easily distributed if mixed with dry, sifted soil or sand.
3. As they will injure most garden seeds do not scatter any fertilizers down the seed drill.
4. Fertilizer distributors mounted on a pair of wheels ensure even distribution.
5. Always hoe or rake in the fertilizer lightly to avoid caking on the surface.
6. The recommended rates of applica-
tion are usually given in terms of oz. per sq. yd., usually 1 to 2 oz. per sq. yd. for top dressings and 4 oz. per sq. yd. for base dressings.

7. It is a good plan to weigh out the required amount for, say, 5 sq. yds., put the fertilizer into a tin and make a mark on the inside to show the level. Then spread the fertilizer evenly over 5 sq. yds., to give a good guide as to the distribution for the rest of the plot. Water in during dry weather.

8. In general the closer the plants are set the more fertilizer should be applied. Some vegetables, however, have sparse root systems that are unable to explore the soil fully and contact the fertilizer that has been mixed in it. Therefore, when the rows are about 2 ft. or more apart the best results will often be obtained by placing the fertilizer in bands a few inches below the level of the seeds or the roots of transplanted plants. About half the normal amount of fertilizer will be required for band placement, as this method is called.

9. Mix phosphatic and potassic fertilizers thoroughly with the top spitt by forking or by rotary cultivation, so that they will be available in the root zone where there is more moisture. These fertilizers do not move appreciably from where they are first placed in the soil. In soils which have been liberally manured in the past the phosphates and potash can be safely reduced in relation to nitrogen.

10. When farmyard manure or compost has been dug in, the amount of fertilizer can be reduced by one-quarter for light dressings of F.Y.M.; by half for medium dressings of F.Y.M.; by three-quarters for very heavy dressings (15 to 20 lb. per sq. yd.) of F.Y.M.

11. Light, sandy soils will generally need more potash than loamy or clay soils, depending on the needs of the plants or crop to be grown. In rainy districts or heavily watered soils some of the nutrients, particularly nitrogen, will wash out into the deeper layers, out of reach of a shallow-rooted plant. Top dressings of nitrogen help to counteract this loss.

TOP DRESSINGS

Top or side dressings should be applied to the surface of the soil in such a position that they can be absorbed by feeding roots. These roots are less numerous near the stem. For crops that are closely spaced in rows, spread the fertilizer in a band on either side of each row on the soil surface, or in between the rows according to the stage of growth. Apply fertilizers in rings round widely spaced plants. Fertilizers work more quickly in moist soils, so water them in or apply them in solution during dry periods.

Never allow inorganic fertilizers—except the special leaf sprays—to touch the foliage of plants, otherwise scorching will follow.

STORING

Most fertilizers are difficult to store as they tend to absorb moisture from the air, and either become a sticky or solid mass or burst their bags. However since fertilizers are cheaper when bought in bulk one tends to buy more than is required immediately so it is a good plan to pour the fertilizer into a plastic bag and label it. Store this inside a tin and keep the tin covered. Do not leave bags of fertilizer touching each other on shelves, against brick walls, or in damp sheds for if the fertilizers go solid or sticky they will never regain their original condition.
Composting and Green Manuring

COMPOSTING

The word "compost" is used by gardeners to denote two quite different substances. The first is a mixture of soil, peat and sand which is used in potting and is generally called a potting compost. The second is vegetable waste of all kinds which has been properly rotted down in a heap or pit together with an activator, and in consequence has formed a blackish-brown crumbling material very near to humus. It is this kind of compost that is dealt with here.

In the past, gardeners were able to buy large quantities of farmyard or stable manure and so composting was not generally practised. But in present-day conditions such manures are no longer readily available.

WHAT TO USE

Many things can go on to the compost heap: the tops of peas and beans, fresh hedge clippings, pea pods, tea leaves and coffee grounds, banana peel, fluff from the vacuum cleaner, straw, lawn mowings, fallen leaves, and even well-soaked newspapers. It is important not to use obviously diseased material.

Whatever the material it must be helped to rot down properly by using some type of activator. This may be excreta from some animal, the droppings from birds such as poultry or, when these are not available, fish manure or a proprietary activator. The compost heap is built up in layers of the vegetable waste with a sprinkling of the activator and soil in between the layers.

It is often easier to make a bottomless bin of old planking or of wire netting into which the vegetable waste can be collected and raked level. The size of the bin will depend on the size of the garden. For a garden of half an acre the bin may be 6 ft. by 6 ft. with perhaps a reserve bin nearby. For a garden of an acre it may be 8 ft. by 8 ft. and have two reserve bins alongside.

There is all the difference in the world between a rubbish heap and a compost heap. A rubbish heap is merely a collection of vegetable waste, and may well be the breeding ground for pests and diseases, as well as a place where weed seeds are stored but not killed. In a properly made up compost heap the temperature will rise to 180° F. (82° C.). It is then that the actinomycetes break down the more resistant proteins and carbohydrates in the heap. The temperature may remain high for a month and then, as the heap cools down, the bacteria complete the task of manufacturing plant foods.

GENERAL METHOD OF MAKING

For a good compost heap, the layers of refuse should be 6 to 8 in. thick and should be trodden down moderately firmly. If the material is very dry, water may be applied before the activator is put on. If it
is necessary to use very tough material such as cabbage stumps it is best to break them up first on a chopping block to pulverize them. They should then be intermingled with grass mowings or similar material to help build up heat. Healthy woody material can be included. Unhealthy woody material should be burnt and the ashes added to the heap. Never burn any soft material. Rhubarb, laurel or elderberry leaves can be added to the heap, even though these three are thought by some people to produce bad effects.

Apply the activator at the rate of 3 oz. per sq. yd. to every 6-in. thickness of waste. If the soil of the garden is known to be acid then activate three of the 6-in. layers with fish manure and treat the fourth 6-in. layer with carbonate of lime at 7 oz. per sq. yd. Build up the heap gradually day by day and week by week as the vegetable waste becomes available. When the heap reaches a height of, say, 6 ft., put a 6-in. layer of soil on the top, thus providing a capping to help keep in the heat.

When very soft materials are used, such as lawn mowings or cabbage leaves, provide a ventilation shaft by driving a post 3 in. across into the ground in the centre of the bin or pit, pile the vegetable waste round it layer by layer and activate in the normal way. When the heap reaches its normal height pull out the post, thus leaving an air shaft through the middle. This is seldom necessary for small heaps but is quite a good thing for heaps that are 12 ft. by 12 ft.

Some gardeners believe that the compost heap should be turned at the end of three months, but the heap should rot satisfactorily without any attention at all. It will probably be ready for use at the end of six months, though it need not be used for six years. If the outsides have not rotted down properly, cut them off with a spade, just as the black part of a burnt cake is cut off with a knife, and put them on the reserve compost heap for rotting down.

When the compost is ready to use, it should look like earthy mould or moist peat. It should be dark brown or black, perfectly sweet smelling and show no traces of the original materials. Eighty-five per cent of it should pass easily through a 1-in. sieve.

When it is properly made, compost can be twice as valuable as dung, for in addition to containing actual plant food it is alive with millions of micro-organisms. It will also contain most of the minor minerals, known as trace elements, which plants require.

These are the principles of compost making. There are two other methods that are often used.

The first is the Indore Method: for the small garden make a bottomless box to contain a heap 4 ft. by 4 ft., and 3 ft. 4 in. high. Such a heap will provide 2 cubic yds. of good compost, weighing 1 ton. Bolt or screw three sides of the box together, and make up the front with loose boards slipped into position as the box is filled. Where possible, make a reserve bin.

Cut all the vegetable waste into lengths of a few inches and put it into the box with one-third or one-quarter of the same volume of manure. Incorporate a little soil at the same time. If poultry or rabbit manure is not available then use hoof and horn meal or dried blood at the rate of 1 to 2 per cent of the dry vegetable waste.

When the box is full, make three holes vertically through the mass with an iron bar to improve the supply of air. Cover the top with sheets of corrugated iron to keep out the rain. After six weeks dig the material out and stack it on a convenient site where it can ripen for another six weeks. Four tons of compost per year can be made in one of these 1-ton boxes.
COMPOSTING AND GREEN MANURING

The second method is to make the bins with old boards (old railway sleepers are excellent as they are thick and help to retain the heat), wire netting or bales of straw. The straw can later be put on the heap.

Make the bins 6 ft. by 6 ft. with open ends for ease of access, and intersperse the 6-in. layers of waste with fish manure at 2 oz. per sq. yd. Whenever available add the urine and excreta from any animals that are kept. Once a week or so, in the summer, give the heap a good watering. When it is 4 ft. high plunge a long-tined fork into it in several places and move it backward and forward to provide aeration.

At the end of six months the heap will be ready for use. Skim off the top 9 in. or so and also the sides, if they are not fully decomposed, and put them into the reserve bin for further rotting.

If the garden soil is acid, use hydrated lime instead of fish manure as the activator, at 4 oz. to the sq. yd. for every 2 cubic ft. of waste.

HOW TO USE COMPOST

Apply compost at the rate of at least a gallon bucketful to the sq. yd. each year.

Do not dig it in deeply, but either fork it or distribute it with a rotary cultivator through the top 3 or 4 in. of soil, or apply it as a top dressing or mulch on the surface of the ground. The worms will pull much of it in, thus aerating the ground. By using compost the soil will not dry out so readily, the tilth will be improved, and there will be ample humus to feed seedling plants.

GREEN MANURING

To give land a rest is a good thing. Even as far back as Old Testament times the practice was to rest the soil every seven years.

In a large garden a good plan is to rest one-seventh of it every year, and to sow this seventh with a green manure which can be dug or ploughed in at the end of the season. This method, known in America as Sheet Composting, consists of spreading green manure over the land like a big sheet, applying an activator over the top, and then digging or ploughing in the material so that the rotting process takes place in the soil.

But green manure methods, if wrongly applied, can have dire results. For when crops are sown and are dug into the land in a fresh condition the soil organisms have to get to work on the green plants and break them down. In doing so they starve the land of nitrogen, for they have to borrow as much of this plant food as possible in order to do their work. Fresh green manure, therefore, normally causes a reduction, at any rate for the time being, in the available nitrogen content of the soil.

One notable exception is the annual lupin, which is used extensively in Germany for green manuring. This plant has nitrogenous nodules on its roots, so that when it is dug in the soil suffers no nitrogen starvation. But even with lupins there are problems of undigested organic substances remaining which may make the roots of subsequent crops quite unhappy.

Because green manure does not give as quick results as good composted vegetable refuse it is not often used in ordinary gardens. It is slow in action
—it usually takes six months before the fresh green matter is properly rotted down and is ready for plant roots to use.

The best results with green manuring are achieved under the following conditions:

1. The land is properly drained so that sufficient air is present.
2. The soil is adequately limed so that it is not acid.
3. An activator is applied in order to provide the energy with which the organisms can start work.
4. The soil is warm.

There are three main systems of green manuring, (a) the temporary ley, (b) the crop to suit the soil and (c) double green manuring.

THE TEMPORARY LEY

This method is to sow a grass mixture over the soil in the spring. The grass that comes up is allowed to establish itself, and is then cut every 10 days, the mowings being allowed to fall back into the soil. In the autumn, before the land gets cold, a fish manure is applied all over the surface of the grass at 3 oz. per sq. yd., or, if poultry are kept, the bird manure can be used at 5 oz. per sq. yd.

A ley mixture which will give good results, both on heavy and lighter soils, is—4 parts by weight perennial rye grass S.23; 4 parts timothy S.51; 1 part clover S.100; 2 parts coltsfoot S.143; 2 parts rough stalked meadow grass; mix them together well and use at the rate of 1 oz. per sq. yd. Sow the seed in March. In very dry years it may be necessary to use some overhead irrigation in order to get the grass growing well. In October, turn in by digging or with a rotary cultivator.

THE CROP TO SUIT THE SOIL

Mustard is a very suitable crop for sandy, gravelly soils. It has the advantage of being a very quick grower, and can be dug in after 7 weeks. Before digging in, knock it about well with a spade and sprinkle it with a fish manure at 7 to 8 oz. per sq. yd.

If poultry manure is used instead, quite heavy quantities will be needed to prevent the mustard from denitrifying the soil. One-eighth of an acre under mustard may need as much as 8 cwt. poultry manure.

For medium loams a number of crops do well. These include rye, vetches, field peas, clovers and lupins. For heavier clay soils red clovers and vetches are good. Cut all these green crops down and smash them up well before digging them into the soil.

Sow mustard at 1 1/2 oz. per sq. yd., rye, vetches and lupins at 1 oz. per sq. yd., field peas at 1 oz. per sq. yd. and clovers at 1 oz. per sq. yd.

DOUBLE GREEN MANURING

It is possible to work out a system of double green manuring with the idea of obviating the difficulties arising from denitrification and of eliminating docks, thistles, nettles, couch grass and other perennial weeds which as a rule last much longer in the soil than normally-grown green manure. If weeds are got rid of in this way, they make a valuable form of humus.

The double system is simply the sowing of two green manure crops in one season instead of one temporary ley. Prepare the land in either the autumn or early spring. Rake it over and sow tares at the rate of 1 oz. per sq. yd. When the tares come into flower in late June or July, smash them with a spade or other implement and then apply dried blood at 3 oz. per sq. yd., or poultry manure at 8 or 9 oz. per sq. yd. Leave the green manure with this activator on top for
eight days before digging in. Allow another three or four days for the soil to settle, and then rake it level. Then sow rye at 1 oz. per sq. yd. and rake it in lightly.

Allow the rye to grow until, say, the end of October. Then cut it with a pair of shears, treat it with dried blood or poultry manure at the same rate as for the tares, and then dig in. In this way two green manures are incorporated into the soil in the one year, and the ground is thoroughly cleaned as a result.

This double green manuring method has given first-class results in new gardens, by ensuring that the ground is clean and by adding humus to the soil to give the new garden a good start. It is difficult to buy and transport dung, but double green manuring does the same work as the dung with the minimum of expense.

Build a bottomless compost box with three fixed sides, and construct the front so that loose boards can be slipped into position as the box is filled with compost.
PROPAGATION

Plant propagation is one of the most fascinating and interesting of the gardening arts, and one from which it is possible to gain much pleasure and a great sense of achievement. Success is often attributed to the possession of “green fingers”—a belief which is not without some foundation. It is true that some people are gifted and have little or no difficulty in propagating young plants, especially by vegetative means such as cuttings or “slips”. But there is no reason why others should not successfully propagate many different kinds of plants, provided certain essentials are borne in mind and applied.

The methods by which plants may be propagated are many, but generally they may be grouped under five main headings: Seeds, Cuttings, Division, Layering, and Budding and Grafting. The first is known as seminal propagation, and the other four as vegetative propagation. Propagation by seeds, cuttings, division

and layering are the methods that mainly concern the beginner, although, with experience, budding and grafting are not beyond the scope of those whose enthusiasm is not damped by early setbacks and failure.

Only by working with plants and observing their habits and modes of growth can the gardener know instinctively which method of propagation to apply to any given plant. Generally, annuals, biennials and most perennials are grown from seed, but established perennials can usually be divided. Shrubs, soft fruit and trees may be started from cuttings, while such plants as the strawberry, which produces stolons or runners, can have their “daughter” plants severed from them in the summer.

Nature’s method of reproduction is by seed and wherever possible it should be used, for not only is it an easy means of securing a large number of young plants, but plants raised from seeds are usually more healthy and less prone to disease. They are completely “new-borns” that have been derived from the fusion of two cells, one male and one female. Seedlings raised from a plant of mixed

parentage (a hybrid), or from one that has been cross-pollinated, will not produce plants that are identical in habit, form and colour of flowers to either parent. The amateur should, therefore, obtain seeds from reliable sources—that is, from seedsmen who are experts and have reliable supplies from certified stocks, or by purchasing seeds in packets which bear a reputable trade name.

Vegetative propagation includes the many and varied methods in which parts of living plants other than seed are used. Plants that are propagated by vegetative means have a separate existence, but they are not completely new plants in the way that seedlings are, because their characteristics are exactly the same as those of the parent plant. For example, if division is used to propagate a given variety of Michaelmas daisy the part divided from the parent will grow in the same way and be identical in habit, form and colour of flowers to the original plant. This is also true of cuttings taken from the varieties of chrysanthemum or carnation. The size of the plants may, however, vary because of the season or the richness or poorness of the soil.

The five methods of propagation—from left to right: Grafting—a grafted chamomile plant, pot-grown before permanent planting. Cutting—pelargonium (geranium) cuttings round the edge of a pot. Division—the simplest method for plants with fibrous roots, such as this heemnon. Seed—after germination, when the first leaves have appeared, seedlings may be transplanted into a box. Layering—strawberry runner layered into a 3-in. pot.
PROPAGATION

SEMINAL PROPAGATION

Seed is the best method of raising quantities of plants required for spring and summer bedding displays, such as antirrhinums, lobelias, marigolds, stocks, asters and petunias. Greenhouse plants such as calceolarias, cinerarias, schizanthus, primulas and cyclamen are also raised in quantity from seeds. It is also the only method of propagation for annuals and biennials, which flower, seed and die in either one or two years.

STORAGE OF SEEDS

If seeds purchased from a seedsman or shop are not sown immediately they should be stored correctly, otherwise the percentage of germination will not be as high as it should be. The seed is a resting stage in the life history of the plant and, although dormant, is alive and capable of promoting growth as soon as it is subjected to warmth and moisture. Under natural conditions seeds fall from the parent plant and spend their resting period among fallen leaves and loose soil, often being frozen or in a fairly low temperature; when warmth and moisture arrive with the spring, germination starts. The storing of seeds under dry and warm conditions is, therefore, unsuitable and can result in loss of viability or growing power. Store packets of bought seeds or any that are home-saved in a cool, airy place away from any form of dry heat, and not in an airtight tin. The ideal place is one that is not subject to great changes of temperature, but warm enough to dispel dampness.

TYPES OF SEED

Seeds vary considerably, not only in size and shape, but also in their formation.

SMALL, DUST-LIKE SEEDS

Begonias, calceolarias and lobelias are examples of these seeds, which should be sown thinly on the surface of firm and even soil in receptacles. If any covering is given it should be a mere sprinkling of fine sand or sandy soil. To make thin sowing easier, mix a small quantity of fine, dry sand or peat with the seeds in the packet to serve as a carrier and to ensure an even spread as the seeds are scattered. After sowing, cover the receptacles with a pane of glass to conserve moisture and put a sheet of paper on top to exclude the light.

FLESHY SEEDS

Acorns, broad beans, runner beans and chestnuts are a few of the fleshy seeds. Some fleshy seeds become hard externally and have a hard skin or seed coat, especially if they have been stored for any length of time. They should be soaked in water, preferably tepid, for 24 hours or more before sowing. This will soften the seed coat and help the process of germination to start.

HARD-COATED SEEDS

Seeds like those of the sweet pea, the various nuts such as the walnut, hazelnut and almond, and others having a hard outer shell, need pre-sowing treatment to ensure reasonably quick germination. If sown without treatment the seeds may remain dormant for a long time or fail to germinate.

To make sure that the hard seed coats do break down and that moisture enters to start the seeds germinating, chip the outer casing of the seeds with a knife, or file or rub them on a rough surface. The filing or chipping should be done carefully and on the opposite side to the “eye” of each seed, or the embryo or “germ” may be damaged.

On most seeds the eye can be seen fairly easily, because it is the point where the seed was attached in the seed-pod.
OILY SEEDS
There are seeds which have an oily content, and because of it do not retain their viability as long as other seeds. Good examples of oily seeds are carrot, parsnip, celery, castor-oil (ricinus), magnolia and camellia. Do not store these seeds in a warm place and for any longer than is necessary, because once the oily content dries up, the seeds shrivel and will fail to germinate. For this reason it is unwise to retain parsnip and carrot seeds for a second year, because old seeds will either fail completely or there will be very poor germination.

COMPOSITE OR MULTIPLE SEEDS
There are plants which produce several seeds together within a dry or fleshy case. The beetroot is a good example of a dry case which contains several seeds. Thin sowing or station-sowing is essential for these seeds as three or four seedlings usually arise from one station.

The cotoneaster, holly, hawthorn and crab apple are some of the shrubby plants and trees that produce fleshy and often highly coloured fruits with a number of seeds embedded in the pulpy mass.

STRATIFICATION
Before sowing the seeds of fleshy fruits, put the fruits in boxes of sand in a cool, shady place. The fleshy covering will rot away to allow the seeds to be separated. This process is known as stratification.

Its purpose is not only to allow the seeds to be separated from the pulpy matter, but also to soften the hard seed coat or “testa” that surrounds each individual seed and prepare it for germination. The stratifying of seeds will often take several months, so leave the fruits of holly, roses and the firethorn (pyracantha) in the boxes of sand throughout the winter. Place them in an exposed position out-of-doors, where the effects of frost will also help to promote quicker germination when sowing takes place in the spring.

SOWING SEEDS
There are four essentials for the successful germination of seeds of all types—darkness, moisture, warmth and air. The depth of sowing is governed by the size of the seed, and, as a general rule, seeds should be covered by a layer of soil that is equal to their own depth. There are some seeds, however, that should be sown deeper because they have a tendency to push up to the surface as they germinate. The broad bean and the runner bean, for example, should be sown 3 in. deep, and the garden or culinary peas should be sown 1 to 2 in. deep. Most small seeds need only a little covering of fine soil, while those of a dust-like nature should be sown on a smooth, prepared surface that is thoroughly damp in pans or pots in a greenhouse or frame.

Outdoor sowing should be in properly prepared soil or seed beds. It is useless to sow seeds in loose, freshly dug soil. Always firm the surface by treading or rolling, then rake it evenly to remove stones and create a fine tilth or surface covering of crumbs. On heavy soils of a clay-like nature, add sand, ashes or other gritty material to the surface to make it friable.

The actual times for sowing vary according to district, season and soil conditions, and no hard and fast rules
can be laid down, but do not sow until the weather is right and the air temperature high enough to have warmed up the soil.

Once the seed bed has been prepared, the seed drills should be drawn. Using a measuring rod graduated in feet and inches, measure off the prescribed distances between the rows on both sides of the plot, and place small sticks to mark the ends of the rows. Then stretch a good strong garden line (a plastic clothes line is ideal) across the plot from stick to stick, and draw out the seed drill on one side of it to the correct depth.

For shallow drills, use a piece of wood, such as a 12-in. wooden label. The pointed end will make an ideal drill for smaller seeds such as cabbage and lettuce. For larger seeds a small draw hoe or a triangular "seed hoe" can be used. Flat-bottomed drills should be drawn, particularly for the larger seeds, because they allow an even distribution. If the drills are V-shaped the seeds will run together at the base of the drill.

Watering is usually unnecessary out-of-doors except during prolonged dry periods. If the ground is very dry, water it well a day or so before the seeds are sown, or water along each drill a short time before scattering the seeds. The latter method is very helpful, especially for seeds that may take some time to germinate. Watering with hot water prior to sowing is often considered a definite aid to germination. Drills which are to be sown with parsley are treated in this way because parsley seed can take as long as six to eight weeks to germinate.

Moisture is essential for germination, but the ultimate success of a crop depends on the thin sowing of the seeds. Thick sowing results in enfeebled seedlings through overcrowding and lack of light; and much time and patience will be required to thin out the overcrowded seedlings in order to leave some at the required growing distance. There are usually far more seeds in a packet than are required, and it is a great mistake to sow them thickly in order to use the whole packet. Successional sowings are an advantage with short-duration crops.

After sowing, cover in the seeds by using the back of a rake, then gently firm along the lines of the drills and rake over the surface to make it even. Always rake in the same direction as the drills, and not across them, so that the seed is not displaced and pushed out of line. Label each kind distinctly and give the date of sowing and any other particulars that may be helpful.

SOWING IN PATCHES

Seeds can be sown by broadcasting or scattering them over a prepared patch of soil, where informal groups of flowering plants such as annuals are grown in a border, or where crops of such vegetables as carrots, lettuces, and radishes are grown in frames. This method is particularly easy and, provided the seeds are
sown thinly and the plants are later thinned out, gives good results. The final result is very natural and pleasing where flowering plants are concerned.

**SOWING SEEDS UNDER GLASS**

There are various methods of seed sowing that apply to plants raised in greenhouses or frames, but the necessary requirements for germination—darkness, moisture, warmth and air are the same as for sowing out-of-doors.

Sowing in a greenhouse or frame is done under controlled conditions so that the question of climatic interference does not arise. Very high temperatures are not essential, nor are they conducive to the best results. Generally speaking, the seeds for many greenhouse plants and also for half-hardy annuals need a temperature of only 55 to 60° F. (13 to 16° C.).

**POTS AND BOXES**

Seeds can be sown into pots, seed pans or boxes. Sheets of glass and pieces of paper (newspaper will do, but thick brown paper is better) are needed to cover the receptacles until germination takes place. The glass is placed over the soil to prevent rapid drying out and lessen the need for frequent watering, and the paper is placed over the glass to exclude light and provide the ideal conditions for germination.

**PREPARATION OF POTS**

Hygiene is most important. Pots or pans that have already been used should be well washed and scrubbed. New pots should be soaked in water for several hours before use, to allow the clay to absorb as much moisture as possible, otherwise new pots will absorb the moisture from the potting medium and the plants will suffer. Some good time before they are needed, treat seed boxes with a wood preservative such as Cuprinol, which will not only preserve the wood but also act as a disinfectant. Do not use the commercial grade of solignum.

**DRAINAGE**

It is very important to provide good drainage. Fill the seed pots to one-third of their capacity with clean crocks and give seed pans a good layer of crocks over the drainage holes. On top of the crocks, use clean moss, dried leaves or loam fibre to prevent the soil clogging the drainage holes. With seed boxes a layer of large crocks over the space between the bottom boards is all that is needed, but the bottom of the box should be covered with leaves or fibre before the box is filled with soil.

![Seed Box Diagram](image)

**SEED BOX**

Cover space between bottom boards with large crocks, then spread leaves over base of box before filling with seed compost to within ¼ in. of the top

**SEED COMPOST**

The seed compost should be an open sandy mixture, consisting of two parts sifted loam and one part each of peat and sand, to which a fertilizer has been added to ensure the health and growth of resulting seedlings. This fertilizer should be composed of 1½ oz. superphosphate and ½ oz. ground chalk or lime for each bushel of soil. Homemixed composts should be sterilized by steam or chemically by formalin. John Innes composts, which are sterilized composts ready mixed to a formula, can be bought from horticultural sundriesmen or nurserymen for seed sowing and for potting.

Fill the receptacles with compost to within ¼ in. of the top, moderately firm
the compost with the fingers (not thumbs) to get an even surface, and finally level it with a pitter or firmer (a flat, circular piece of wood nailed in the centre to a short length of broom handle) or the base of another pot. Then water the pots with a watering-can fitted with a fine rose, or stand them in an old galvanized bath or similar container, and fill the bath with water to just below the rims of the pots. Allow the water to rise through the soil and moisten the surface, then lift out the pots and allow them to drain. A thoroughly moist soil before planting provides the best conditions for germination and prevents the need for frequent watering while the seeds are germinating.

SEED SOWING
The actual sowing is governed by the same rules as for outdoor sowing. Scatter flat seeds—like those of lilies, hippeastrum or amaryllis and grevillea—thinly and evenly over the soil, and press each seed gently on one side with a pencil or pointed stick to set it on edge. This ensures better germination than if the seeds are allowed to lie flat on the soil. Afterwards, gently cover the seeds with fine, sandy soil and firm the surface.

All seeds sown under glass should be sown thinly. Overcrowded seedlings are prone to "damping off", a disease caused by a fungus that spreads rapidly over the surface of the soil, attacking the lower part of the stems and causing the seedlings to collapse and rot. Any seedlings that are allowed to become thin and drawn are apt to succumb to this disease, which can also be caused by a damp atmosphere and general lack of light and air in the greenhouse.

GERMINATION
Watch carefully for the appearance of the seedlings and, as soon as they are plainly visible, remove the glass and paper. At this stage light and the normal air conditions of the greenhouse or frame are essential.

Avoid draughts, as a current of cold air can do a lot of harm and even result in the loss of the seedlings. Shade the seedlings from strong sunshine during the hottest part of the day to prevent them from flagging. Unnecessary exclusion of light is harmful and can only result in spindly growth, so make sure that the shade is supplied by outside blinds or by something erected inside the house well above the seedlings.

SOWING IN COLD FRAMES
If cold frames are used and the seeds are sown in pots, pans or boxes, the procedure is much the same as already described, the only difference being that there is no artificial heating and therefore the germination and growth of the seedlings is slower.

Much depends on the quantity of plants required, but if the seed bed is carefully prepared and the frame is properly ventilated, a great variety of plants can be propagated in this way. The advantage of a cold frame is that the operation is more controlled than when an outdoor bed is used, because there is little interference from the weather and pests, and a much earlier crop can be obtained.

When sowing early crops of vegetables, such as lettuces, carrots or radishes, in a frame, sow the seeds directly into a bed of soil with a reasonably firm, fine tilth, prepared in much the same way as an outdoor seed bed. Seed drills can then be drawn from back to front of the frame, or the seeds can be sown broadcast. A frame can also be used in late summer to raise seeds of biennial plants such as pansies, double daisies, sweet Williams, forget-me-nots and similar flowering plants.
PROPAGATION

TRANSPLANTING OR PRICKING OUT

The next step is the transplanting of the seedlings or, as it is called when done under glass, the pricking out. Do this as soon as the seedlings produce their first true leaf, when they will be large enough to handle. The first "leaves" to appear are the cotyledons or seed-leaves, and their shape is normally simple and more or less rounded. The true leaves appear with a stem from between the cotyledons and can easily be recognized by their more intricate shape, which varies according to the plant, and may be smooth or hairy.

The first transplanting needs to be done carefully, because the seedlings can easily be damaged by careless handling when young and tender. Prick out into boxes or pans filled with a light, sandy compost. Use a small pointed stick or dibber in one hand to make the hole in the soil, pick up the seedling with the other hand and place it carefully in position. Then gently firm the soil round the roots with the dibber. For very small and rather delicate seedlings, such as those of the begonia, a small V-notched stick made from a label can be used to lift up the tiny seedlings and place them in the holes. Space out the seedlings evenly, allowing about 2 in. between them in the row and 3 in. between each row.

Pricking out small seedlings with a V-notched stick

To ensure that the operation checks the growth of the seedlings as little as possible, always prick out seedlings into damp soil and do the work in the greenhouse or in a warm potting shed.

Grow on the seedlings in their boxes under the same conditions and gradually accustom them to more and more air until they are ready to withstand outside conditions.

Most seedling plants can grow in their boxes until the leaves touch, but at this stage it is wise either to pot them singly or to transplant them into outside beds or borders.

VEGETATIVE PROPAGATION

CUTTINGS

For most plants this is the quickest, easiest and cheapest method of propagation, and also provides a sure way of perpetuating a kind or variety in the exact likeness of the parent plant. For this reason the method is in common use, especially for the raising of plants with double flowers and those that have coloured or variegated foliage. Generally the term "cuttings" refers to any portions removed from the stem, leaves or roots of the parent plant. If such cuttings are properly prepared and inserted they will produce new plants with the same characteristics as the parent plant.
EQUIPMENT

Knife: The first priority is a good sharp knife that should not be too large or too small for the hand, and have a thin, straight-edged blade. There are various forms of knife on the market and the long-handled budding knife is, in spite of its name, very useful and the most suitable for making cuttings. A safety razor blade mounted in a suitable handle is useful for making soft cuttings, like those of chrysanthemum, dahlia and similar non-woody plants.

Secateurs: A good pair of secateurs, preferably of the knife-blade type, will be needed, especially where cuttings are to be taken of woody plants, that is, shrubs and trees. Like the knife, the blade of the secateurs must always be sharp to ensure a clean cut.

Dibbers: For the insertion of the cuttings several dibbers of varying size are needed. They should be made of hard wood and not be too sharply pointed.

Propagating frame: This is usually a small wooden frame in a greenhouse with a glass light to close down over it. The light is attached to the back of the frame with hinges so that it does not move out of position when lifted at the front. The frame can vary from an ordinary box covered by a pane or panes of glass to an elaborate span or lean-to type of frame specially constructed by a builder. Whatever its form and size, the purpose of a propagating frame is to provide a close atmosphere that can be controlled to the correct temperature and humidity. Thus the amount of air round the cuttings is reduced in order to keep them in a turgid condition while they root. The other essentials for rooting are sufficient moisture and heat. Place over the base of the frame an ash or shingle covering on which the pots of cuttings can be stood, and keep it damp by spraying. If desired, the frame can be partly filled with the rooting media (sharp, clean sand or a mixture of sand and peat) and the cuttings inserted directly into it.

Rooting media: Sharp silver sand is the best rooting medium for most cuttings, as long as they are removed from it as soon as they are well rooted, because sand contains little or no nourishment.

A mixture of equal parts sand and peat-moss gives good results, particularly if the cuttings have to be left in the frame or receptacles for a time after the roots have formed. Other rooting media available include: vermiculite, various kinds of sand and a powdered volcanic rock known as "Rootine". The John Innes potting compost is also available ready mixed from sundriesmen and nurseriesmen.

Hormone preparations: Scientific research has produced chemical growth substances known as hormones, and these in liquid or powder form can be used as an aid to the quicker and better rooting of cuttings. There are different types for the treatment of soft wood cuttings, half-ripe or ripe wood cuttings. The hormone preparations, under various proprietary trade names, can be obtained from shops selling horticultural goods, and should be used strictly according to the makers' directions.

Various utensils: A conveniently sized watering-can with a set of fine spray roses (flat and round) is essential for watering. A syringe of the "Abol" type with a bent nozzle and several detachable jets of varying sizes should also be available, as a fine spray of some kind is necessary for damping the cuttings and keeping the frame moist. Receptacles (pots, pans and boxes) of varying sizes are needed for different batches of cuttings. The advantage of receptacles is that once the cuttings are inserted in them they can
be rearranged in the frame. Clean the pots and put in a layer of crocks in the same way as for seed sowing. Bell-glasses or solid cloches used to be popular to place over cuttings dilled into pots or a bed, but are not now easy to obtain. Polythene bags can be used to cover individual pots or pans of cuttings, but a wire support or small sticks should be provided to keep the polythene clear of the foliage, and also rubber bands to anchor the polythene to the pots.

**types of cutting**

*Stem cuttings:* These are pieces of growth taken from the aerial parts of the parent plant, and can be either side shoots or the tips of main shoots. They can be of soft wood, half-ripened wood or ripe wood. Soft wood cuttings are made from the young tender growth of the current season; half-ripened cuttings are made from semi-ripened wood that has been growing for some time and become slightly woody or firm (usually about midsummer); ripe wood or hard wood cuttings are made from mature wood at the end of the growing season and are chiefly used for the propagation of trees and shrubs.

All stem cuttings are prepared by removing the lower leaves from the piece that has been cut from the parent plant, and then cutting straight across the stem just below a joint or node. The cuttings should be about 3 in. long. In the case of ripe wood cuttings they can be made with a “heel” of the older wood attached at the base and be up to 10 or 12 in. long. The method of inserting these cuttings and the general rules to be followed when inserting all types of cutting appear on page 128.

*Leaf-bud cuttings:* These are made from half-ripened wood and consist of one leaf with a dormant bud at its base and also a portion of the stem. They are inserted in the same way as stem cuttings, but with
LEAF-BUD CUTTINGS OF BLACKBERRY

Method of removal from parent stem

When inserted the bud is partially covered by soil

LEAF-CUTTING OF BEGONIA REX

Above: Making cuts in the main veins on the back of the leaf

Below: Young plantlets form on top of the leaf above where the veins were cut, and root into soil below
the leaf and bud just above the surface of
the rooting medium. This type of cutting
is used particularly for the propagation of
camellias and some other evergreens;
and has the advantage of providing a
greater number of young plants from
one piece of growth than are provided
by a stem cutting.

_Bud or eye cuttings_: These are similar to
leaf-bud cuttings but with no leaf
attached, and are made from dormant
ripened wood in autumn or winter.
Ornamental and fruiting vines are pro-
gagged from this type of cutting. Make
each cutting of woody stem with a single
dormant bud or eye about 1/4 in. long.
Take off a strip of bark and wood on the
side opposite to the bud, then insert the
cutting on its own in a small pot of pott-
ing compost with the bud just at soil
level. Label and keep it moist and close
until a tiny shoot begins to sprout.

_Leaf cuttings_: Quite a number of plants,
particularly greenhouse plants, can be
propagated from leaf cuttings. Begonias,
gloxinias, saintpaulias, streptocarpus and
echeverias are examples. Remove the
leaves from the parent plant with the
leaf-stem attached and, after cutting the
end of the stem cleanly, insert it into the
soil or sand so that the leaf blade lies flat
along the surface. A young plantlet will
rise from the base of the cut leaf stalk
after little roots have formed. Lay the
leaves of large-leaved begonias of the
_B. rex_ type on boxes of sandy peat after
the main veins on the back of the leaf
have been severed with a sharp knife or
razor blade. The young plantlets will de-
velop where the veins were cut and root
into the soil. By this method a number of
young plants can be obtained from a
single leaf.

_Root cuttings_: There are a number of plants,
both shrubby and herbaceous, that can
be propagated by root cuttings: for ex-
ample, the perennial phlox, verbascum,
hollyhock, romneya, *Anemone japonica*, eryngium, gaillardia, anchusa and oriental poppy. The method is simple. Lift a complete plant during the dormant season and cut sections of the larger and more fleshy roots into pieces, called thongs, about 2 to 3 in. long. Cut the end of the root nearest the crown of the plant (the top) straight across, and cut the other end on the slant. The different types of cut makes it easy to distinguish the top end of the cuttings from the lower.

Insert the root cuttings into pots or boxes of potting compost with the straight cut just at soil level. Then plunge the receptacles into beds of ashes or peat until the cuttings have rooted and growing points or crowns are formed at their top ends.

During early spring plant the cuttings out singly in nursery beds or a border to grow on and form flowering plants for the next year. If desired, large quantities of cuttings of the same kind can be tied in bundles and plunged in sand or soil to root.

It is unnecessary to distinguish the ends of the cuttings of some plants, particularly the perennial phlox. The selected roots can be cut into 1-in. lengths, laid horizontally on sandy soil and lightly covered with sand. If they are placed in a frame or greenhouse, a young plantlet will develop from each piece of root.

**Pipings:** Carnations and pinks are propagated by pieces of the young tip growth called pipings. This type of cutting needs no trimming. Hold the growth or shoot in one hand and then pull out the tip of the shoot with the other hand. Insert the piping in sandy soil in a closed frame or at the edge of a pot of sandy compost and cover it with a polythene bag.

**INSERTING THE CUTTINGS**

It is important to realize that, no matter how well the work of preparing the cuttings is done, they will not root properly unless they are inserted correctly.

The natural healing of a wound in plants is much the same as in animals, because new tissue is formed to grow over and cover the damaged area. Thus, when a cutting is made or prepared by cutting it cleanly just below a joint or node, the cells that are damaged by the knife-cut die and, as a result, a corky layer of tissue, termed "callus", is formed. Under favourable conditions giving warmth and moisture—the callus forms a ring round the edge of the wound. From it roots grow out, anchor themselves into the soil and produce root hairs which absorb moisture and food, thus providing the cutting with the means to continue a separate existence.

Sometimes, however, cuttings will make a lot of callus formation at the expense of roots—in fact they will appear to be growing yet will produce only a drumstick-like end to the part below soil level and no sign of a root. This may be caused by high soil temperature, or a coarse rooting medium which allows too much air to penetrate to the base of the cutting. The use of very coarse sand, such as Cornish sand, has been found to cause excessive callus formation. To overcome this difficulty, shave off the excessive callus with a razor-blade or small, sharp knife. This will often cause roots to form quickly after the cutting is re-inserted.

**Method:** The method of insertion is much the same for all kinds of stem cuttings. The prepared ends should be firmly embedded in the rooting medium, so that the cutting does not hang in the hole made by the dibber. If the soil is pressed round the cutting at the surface and left loose at the base, the cutting will fail to root because of the air space round the lower end. Insertion to a depth of 1 in. or 1½ in. is usually ample for the average cutting, but the larger ones, particularly
those made from hard wood and placed in outdoor beds, need a depth of 4 or 5 in., or about half the length of the cutting.

It is advisable to sprinkle a layer of dry sand over the surface of the compost when preparing the pots, because when the dibber is pushed into the soil it will take a quantity of the sand to the bottom of the hole, and on this the base of the cutting can rest. Use a dibber with a blunt or square end to make the hole. Push it in to the required depth and put the cutting in so that its end rests firmly on the base of the hole. Then fill in by pushing the soil in and gently ramming at the side of the cutting with the dibber. After inserting, always water in with a watering-can fitted with a fine rose, to settle the soil and make it firm round the cutting.

**Cuttings in Outdoor Beds**

Hard wood or ripened cuttings, of which those of rambler or climbing roses, hardy shrubs and bush fruits are typical, are prepared from ripened growth during late summer or early autumn. They should be about 10 to 12 in. long and have a heel of older wood at the base. Heel cuttings are essential for any plants that have pithy wood or stems.

Insertion of this type of cutting into prepared beds is not difficult, but the soil should be fine and firm. Cut out a small narrow trench with a spade and, if the soil is inclined to be heavy, sprinkle some sharp sand along the bottom of the trench. Then space the cuttings 3 or 4 in. apart against the vertical side of the trench with the heel ends firmly on the base, fill in the soil and make it firm by treading or ramming. At least half of each cutting should be in the soil; nurserymen often insert two-thirds.

Leave the cuttings in the bed for a year, by which time they will be well rooted. The bed requires little attention, and need be watered only if the weather is very dry. Growth starts in early spring, and this will generally indicate the success or failure of the cuttings. If they are successful leave the bed undisturbed for the summer, but keep weeds in check. During the autumn transplant the young plants into well-prepared ground, for they must have ample growing space to develop their true habit of growth. Put them in rows 2½ ft. apart and leave 1½ to 2 ft. between the plants, to allow easy access between them for hoeing and cultivating, and for staking and tying if necessary. According to type and variety and its mode of growth, the young plant can remain in the nursery bed for one or two years, but it is unwise to delay transplanting into the permanent position for longer than is necessary.

**Division**

Division is the simplest and most obvious method of increase, particularly when it is not possible or wise to propagate by seeds, because it is only necessary to have a shoot or young growth with roots attached in order to form another plant that will be exactly the same as the parent. The method requires a number or mass of shoots or buds growing together which can be pulled apart or severed with a knife to form individual portions, with roots or rudiments and a crown, that will grow on into complete new plants. Plants which grow from a single stem or crown cannot be propagated in this way. Most plants which have a fibrous root stock, such as Michaelmas daisies, phlox, heleniums and solidago (golden rod), are readily increased by division. But the method is not always so easy with other plants.

The division of most plants is carried out during early spring when growth is active, and it is only necessary to retain sufficient rhizome or underground stem to supply the immediate needs of the
divided portion until it has rooted and is established.

Shrubby plants can be divided only if they have a compact habit and produce new growth by branching or making suckers from below ground. Examples of such shrubs are Kerria japonica, Hypericum calycinum (St. John's wort), Rhus typhina (sumach), vinca (periwinkle), ericas or heaths and some spiraeas.

Other classes of plants can be increased by division, although more skill may be required for success. They are:

**RHIZOMES**

Plants with underground stems or rhizomatous roots that grow on or just below the surface of the soil, such as German irises, Solomon's seal, obedient plant (physostegia), cape gooseberry or Chinese lantern (physalis) and the bee balm (monarda). When dividing plants of this type, select the strong-growing portions from the outside of the clump or group and discard the central portions which are old and worn out. Divide and replant bearded irises soon after the

flowering is over—July is generally the best time. In this class of iris, the new growth is formed at the end of the rhizome, or swollen, creeping stem. It should be removed from the parent plant by cutting with a strong knife about 2 or 3 in. back from the growth. This will provide a section of rhizome with roots attached which, when planted horizontally and just below soil level, will allow for the quick establishment of the new plant. The modern varieties of the bearded and German irises are divided every second year so that strong growth and fine flowers are maintained.

**PLANTS WITH WOODY CROWNS AND GROWTH BUDS**

Of the herbaceous plants with a compact semi-woody crown from which numerous growth buds arise, the lupin and delphinium are perhaps the best-known examples. Division needs to be done carefully in the early spring if it is to be successful.

Lift the parent crown and shake it clear of the soil, if necessary removing the soil by washing the crown in a bucket of water. It is then easier to divide sections from the crown, with buds or shoots attached. Plant the divided portions separately, or first establish them in pots, and then plant out later after a good root action has been formed.

Although division of this class of herbaceous plant can be successful, modern varieties of lupins and delphiniums are more often propagated by cuttings made from individual shoots and inserted during spring. If the shoots are taken off when they are about 3 in. long they will root easily in pots or boxes of sandy soil placed in a frame. They will also root in the open ground in a semi-shaded spot, but it is better and quicker to give them the protection of a frame or cloche.
TUBERS
Tuberous-rooted plants, such as peonies, need special treatment and careful handling when being divided.

Divide peonies during the early autumn. The eyes or growth buds can easily be seen on the tubers, and each division should consist of an eye and a tuber. If large numbers of a certain variety are needed, plant them out in well-prepared soil in a nursery bed with the eye about 2 in. below the soil level. But if only a doubling or trebling of stock is required, lift an established crown and divide it into several portions by using two hand forks back to back pushed well between the roots. Then gently lever them apart to avoid snapping too many rootlets.

Peonies unfortunately dislike root disturbance and several years will often elapse before the divided crowns will flower freely, so do not dig them up unless it is necessary and new or increased stock is required.

The potato is another example of a tuberous plant which can be divided by being cut into pieces with an eye or bud attached.

Few beginners propagate tuberous-rooted begonias by division of the tuber, although the method is simple if the tubers are placed in a greenhouse or warm frame to start them into growth before dividing them. Put them in shallow boxes, barely cover them with peat-moss or sandy leaf-soil, and growth buds will appear, producing stout, strong shoots. It is then easy to see where to cut the tuber into portions, each with growth buds attached. Dip the portions into powdered charcoal to dry up the cut surfaces, and then either pot them singly or space them out in boxes to grow on. The *multiflora* class of tuberous begonia, popular as a summer bedding plant, forms large irregularly shaped tubers that will produce many growing shoots, so that many plants can be obtained by dividing the tubers.

OFFSETS
Another large and varied group of plants, which includes tulips, daffodils, crocuses, gladioli and the bulbous irises, produce their annual growth and flowers from a bulb or corm. These plants do produce seeds and can be propagated by them, but often three to five years elapse before the seedlings reach flowering size. This group has, however, an alternative means of increase by the production of offsets. These are complete but smaller new plants that are produced alongside and attached to the parent bulb, the number of offsets produced varying with different species. Daffodils have what is termed a "mother bulb"; this is one large bulb with two or three offsets which produce a number of shoots and flowers. The offsets on daffodils, tulips and other bulbs can be removed and planted separately to form larger bulbs, but only the larger of them will flower in the first year.

SUCCERS
Suckers are shoots that grow from the roots of some plants and usually appear round the base of the plant. In some cases they are a nuisance: for instance, roses and grafted trees of lilac, plum and apple, and, amongst large trees, the poplar and elm, are notorious for producing unwanted suckers. But in some other plants sucker growths provide a quick and sure means of reproduction. A good example is the raspberry, which produces sucker growths that often appear several feet away from the parent plant. The growths can be severed in the autumn and lifted with roots attached.

The stag's horn sumach (*Rhus typhina*), spiraeas and some roses, such as *Rosa rugosa*, the Japanese rose, are easily increased by suckers.
PROPAGATION

The use of suckers for increasing stock should be exercised with discretion, because certain grafted trees produce sucker growth from the root stock and these suckers ultimately produce plants like the stock. Suckers of the peach, for example, which are often grafted on to a plum rootstock, would produce plum, and suckers of pears which are grafted on to the quince would produce quince.

LAYERING

This is another easy and sure way of propagating a number of flowering and fruiting plants to ensure that they are the same as the parent. Layering occurs naturally in many plants, and is the term used to describe the rooting of a stem while it is still attached to the parent plant. The “runners” of the strawberry and the tip-rooting of loganberry and blackberry are the well-known examples.

Natural layering also occurs with large trees and shrubs, and examples can be seen in public parks and gardens. Beeches and horse chestnuts with low branches sweeping the ground will layer themselves. Generally the rubbing of the branch against the ground causes an injury to the bark. Then, from the healing of the wound and contact with the soil, roots form to anchor the branch, which eventually grows to become a secondary tree beside the parent. The layering of rhododendrons and other ornamental shrubs is sometimes done into large boxes of prepared soil placed beneath the branches to be layered. The advantage of a box is that once the layer is rooted and severed from the parent plant it can be moved without disturbing the new roots.

LAYERING A RHODODENDRON

The stem is cut below a joint where the leaves have been removed and the cut portion brought down to the soil and secured with a layering pin below the cut. Afterwards the point of layering is covered with an inch or so of soil.
Other plants, particularly strawberries and clematis, are layered by pegging the growth into pots filled with gritty soil and plunged into the ground near to the parent plant. Loganberries and blackberries can be treated in the same way.

Border or hardy carnations are propagated by layering. The operation is carried out towards the end of July and during August, except in the north of the British Isles where July is the best time. It is important to remember that it is the new season's growth, or non-flowering shoots, that are layered, and that strong plants are needed to withstand the winter.

If layers are "put down" too early they may grow too tall and soft, especially during a wet season and, following transplanting in early autumn, such plants can be damaged by the first frost.

As long as care is taken, layering carnations or any other type of plant is quite as easy as taking cuttings and, as the layers are still attached to the parent plant, they are more sure of rooting.

**EQUIPMENT**
A good sharp knife with a thin blade is needed, as well as a trowel, a hand-fork, and a supply of layering pins or pegs made from 6-in. lengths of galvanized wire bent double and shaped like a hairpin. Good fresh soil made up with a mixture of loam, peat-moss or sifted leaf-soil, sharp sand and pulverized mortar-rubble is also necessary. The compost should be moist, but not so wet that it will bind together when pressed.

**METHOD**
After midsummer select a strong, healthy plant with good growth that is free from pests and diseases. Lightly loosen the soil round the plant with the hand-fork, being careful not to disturb or break the roots. Then spread a layer of the prepared compost round the plant to form a ridge or mound 2 or 3 in. higher than the normal soil level, and make it fairly firm. This is particularly necessary if the soil is heavy and inclined to be wet. Arrange the soil so that the growths to be layered can readily be anchored into it. On light soils that are well drained, the use of prepared soil is not so necessary, although it is wise to add some peat-moss or sifted leaf-soil, and incorporate it well with the natural soil. This increases the humus content and is good for the layered plant when the roots are formed. Select the best and most suitably placed shoots and prepare them as follows:

Strip off all leaves from the part of the stem to be put in the soil (usually two or three pairs of leaves are removed). Then with a sharp knife cut into the stem to about half its thickness, just below a joint from which the leaves were removed. Extend the cut up the centre of the stem for about an inch so that a tongue is formed, and trim the end of the tongue if the cut is not clean. Then bring the shoot down, keeping the cut open, and press the tongue into the soil. The whole of the cut portion will thus be in contact with the soil and should be secured there with a layering pin placed below the cut and pressed firmly into the soil. Treat each growth to be layered in the same way and then make sure that the cut portions of the layers are covered with soil. Sprinkle another inch of prepared
PROPAGATION

soil round them and thoroughly moisten, preferably with a watering-can fitted with a fine rose. This watering in is essential because it settles the soil round the layers and gives the final firming.

The method used particularly for layering shrubs closely copies the natural process. The shoot or branch is bent or twisted where it is to make contact with the soil so that the bark is damaged and the tissue is split. The splitting of the wood checks the flow of sap and causes the formation of callus or healing tissue from which roots will usually emerge. In addition to pegging down the layered shoot or branch it is advisable to secure the tip to a small stake, tying it as nearly as possible in an upright position. This prevents damage to the shoot, makes sure that it grows straight, and prevents it from swinging up into its old position before the roots have formed.

If the weather is hot, watering is necessary, because it is essential that the ridge or mound of soil does not dry out. After about six weeks inspect one of the layers, by gently lifting it to see if roots have formed. Some layers will be in advance of others, but experience will soon help the gardener to decide when plenty of roots are formed. When all the layers are rooted, sever them from the parent plant by cutting the stem between the layer and its parent, but leave the layered plants in position for a time to recover from the severing and to become fully established on their own roots. After a week or so lift the plants and pot them separately in pots varying in size according to the plants, or plant them out into well-prepared soil in a bed or border.

AIR LAYERING WITH POLYTHENE

Air layering in its original form was practised in China centuries ago. A stem or branch was partly severed by making an upward cut from just below a joint, and after a small wedge had been inserted to keep the cut open, sphagnum moss or some other moisture-holding medium was wrapped round and over the cut and fixed with string. If the moss or other material was kept constantly moist, roots eventually grew out into it and, after a while, the air layer was removed and potted separately to provide a separate plant.

In the past various modifications of this method were used in the British Isles, chiefly to propagate greenhouse plants. But the success of air layering depended on the sphagnum moss or other material being kept constantly moist, and this was only possible in greenhouses where the atmosphere was moist and regular attention could be given to syringing and watering. The necessity for constant damping is now no longer a problem if polythene or plastic film is used to surround the layer and its rooting material. Air layering is therefore a method which can be used with every chance of success, particularly for those plants which are difficult to propagate by the usual methods of seeds or cuttings.

The best time for air layering depends on the season and to some extent on the locality, but most ornamental shrubs and trees growing in the open should be air layered in April when the sap is rising and flowing freely. Plants growing under glass can be air layered from March to July.

Method. The branch to be air layered should not be too tender or too old. Mature one-year-old wood is the most suitable, but there are exceptions with different kinds of plant. Firm wood is better than pithy wood and should usually be about as thick as an ordinary pencil.

The operation is not difficult to perform. Make the cut with a good sharp knife, starting just below a leaf stalk or joint and penetrating half-way through
AIR LAYERING WITH POLYTHENE

A one-year-old stem partly severed

Making an upward cut

Treating the cut surface with hormone powder

Passing the polythene tube over the shoot

Twist of moss inserted to keep cut open

Binding the lower end of the tube with adhesive tape

Packing the tube with sphagnum moss to cover the cut

The top of the tube sealed, and the layer supported by a bamboo cane
the stem, then turning upward for about \( \frac{3}{4} \) in. Treat the cut surfaces with a hormone or root-promoting substance. Wedge open the cut with a twist of moss. Then pass a tube of polythene over the growing part of the branch, slide it over the cut and secure its lower end with adhesive tape. Pack the tube with moist sphagnum moss that has been broken up until it covers the cut portion and extends several inches above it. Then bind the top of the tube with adhesive tape. Support the layer by tying the layered branch to a bamboo cane or to another near-by branch. Inspect the layer from time to time to make sure that the plastic film is unbroken and that the layer itself is secure. If the sealed layer is airtight, the moss surrounding it will remain moist throughout the season and until roots have formed. When these can be seen through the polythene remove the layer from the parent plant, take the polythene and moss carefully away, and pot the new plant in the usual way. Keep the new plant in a frame or greenhouse until well established, and plant it out in the spring.

**BUDDING AND GRAFTING**

This is a method of propagation that differs from other methods in that it is a joining together of two living portions from two separate plants to form a permanent union. One is part of a plant with roots and is called the "stock", and the other is a piece of the previous year's wood of another plant and is called the "scion". When properly joined to the stock, the scion supplies the aerial parts of the new plant, that is, the branches, leaves, buds, etc. It is essential that the stock and scion be compatible. This usually means that they should be of the same genus, but sometimes genera within the same natural order can be grafted.

Although budding and grafting are separate methods of propagation carried out at different times of the year, budding is in fact only a form of grafting, because the principles governing the joining together of the two parts are the same, although the material used to produce the growth part of the new plant is different. A single bud and a small piece of bark or rind to join the stock are used for budding, whereas a piece of growth or shoot (the scion) to join to the stock is used for grafting. Many amateur gardeners propagate their roses or fruit trees by budding or grafting and, once the essentials are understood and after some practice, anyone can become efficient at one or both methods.

**THE STOCK**

Different types of stocks for fruit trees have been developed by research stations for their suitability to various varieties and to the ultimate mode of growth of the tree. The various stocks for apple trees are therefore classified into groups or types. The dwarfing stocks have a restricted root action and, when they are worked with any variety of apple, produce trees that are small and dwarf, which will fruit early in life. Another group produces trees that are semi-dwarf in habit, and those with a vigorous rooting system produce large trees. Root stocks which are immune to pests such as the woolly aphid have recently been developed and selected.

There are various stocks for plums which are used for different varieties of dessert and culinary plums, for peaches and nectarines, and for the various kinds of ornamental flowering prunus.

Quince stock is used for pears because the rooting system is less vigorous than that of the common pear, a stock that is used only when very large trees are needed. The types of quince stock are known as Malling A and Malling C.

Cherries are budded or grafted on to
stocks of the wild cherry or gean—Prunus avium—particularly the Malling selection F.12/1.

For roses various types of stocks are available that are easily raised by either seeds or cuttings. The wild brier or dog rose is widely used, particularly on heavy soils. The stems can be dug out of the hedgerows and, if planted and established in the garden, can be worked on the young wood or growth in the following year to form standard rose trees.

Most of the standard roses are grown on stems of the Japanese rose, Rosa rugosa. There is also the thornless form of Rosa multiflora, known as “Simplex”, that is a specially good stock for light soils. It is propagated by cuttings inserted out-of-doors in autumn, and worked or budded in July of the following year.

It is essential that the stocks be well rooted and fully established before being worked, and also free of pests and diseases. When the stocks have been obtained and have been established in the garden, the method of working and the form of union, that is, budding or grafting, can be decided upon.

BUDDING

Successful budding depends not only on the way the budding is done, but also on when it is done and on the type of materials used.

When to bud: Wood produced in the same season is used. Budding can therefore be carried out between early July and mid-August, when there is an abundance of sap, and the bulk of the season’s growth has been made but has not yet become hard and woody. But no hard and fast rules can be laid down because so much depends on the season.

What to bud: There are several simple tests which enable the right choice of wood to be made. With roses, for example, if the thorns snap off easily and cleanly, leaving a clean, moist scar, the wood and buds should be in the right condition to ensure easy working.

With the stock it is easy to make a trial cut, and if the bark or rind separates readily from the wood and there is plenty of sap, the stock is ready. During a dry season, however, such a condition, particularly with the stock, is not always easy to obtain. Stocks that
are dry at the roots so that the bark will not part or lift from the wood must be thoroughly watered a week or so before they are worked. Whether it is roses, fruit or ornamental trees that are being budded the essentials are the same, except that roses are budded below ground and fruit trees and most ornamentals above ground level.

Materials: For budding and grafting the tools and materials required are:
1. A budding knife with a long, thin handle flattened at the end to lift the bark of the stock.
2. Strong raffia, which should be used damp.
3. A bowl or similar receptacle to hold water into which the prepared buds can be placed to keep them damp.
4. A bucket for keeping the "bud wood" fresh and moist until required.
5. A hand-fork or trowel to remove soil from the base of stocks if they are being worked below or near to ground level, as, for example, bush roses.
6. Wax or rubberized tape.

Method: There are three distinct operations: (a) the preparation or cutting out of the bud, (b) cutting the incision in the stock into which the bud is to be inserted, and (c) the insertion and tying in of the bud with raffia.

(a) Cutting out the bud is perhaps the most difficult job, for unless the bud is properly prepared the whole operation will fail. The best buds are those near the base of the bud stick, which is a piece of the current year's growth. First cut off the leaves, leaving the stalks of the leaves to act as handles for the buds. Starting with the lower bud, cut in about 1/4 in. below the leaf stalk and draw the knife upward to come out about 1 in. above the bud. A little wood is cut out behind the bud and this can be removed or not.

(b) The second operation is simple. A T-shaped cut is made in the bark of the stock at a point where it is smooth. Make a long upward cut with the point of the knife and a short cross cut at the top of it, just deep enough to sever the bark.

(c) Lift the flaps of the T-cut with the knife handle and slide the prepared bud down beneath the flaps of bark so that it fits snugly against the wood of the stock. Then press the bud down until the base of the T-cut begins to split a little, which is a sign that the bud is firmly inserted. Trim off the remaining part of the shield of bark above the bud, level with the top of the T-shaped cut, and tie the bud with a 2 ft. long piece of raffia. Start the tie a little below the bud, binding the cut firmly but not so tight as to cause a strangling effect. Finish just above the T-cut and tie securely. No further protective covering is needed, and the stocks are allowed to grow on without restriction for the rest of the season. The actual cutting back of the stock is not done until early spring of the following year.

After care: Make sure that the stocks do not suffer during the dry weather and
prevent the growth of weeds. About a month after inserting the buds, examine the stocks. If the buds are swelling, as they should be, draw a sharp knife up the back of the raffia tie, cutting it sufficiently to cause it to ease and part.

During early spring examine the buds and, if they are alive, head back the top of the stock to a point about 1 in. above the bud in the case of roses, and some 6 in. above the bud with fruit and other trees. This longer snag of stock can be used as a stake for the new growth when the bud grows out, to prevent damage by wind.

This method is known as shield budding. There are several other methods, such as patch budding, flute budding and ring budding, which are more involved and not commonly practised or recommended for general use.

**GRAFTING**

Many methods of grafting, some of them more elaborate than useful, have been employed to make the cuts on both stock and scion, with the result that the operation appears to be very involved. Therefore only the more simple methods are mentioned here in detail, and the others are listed for reference.

Whichever method is used, the essentials for a successful union are the same. The vital part of both stock and scion is the cambium—a thin layer of tissue lying between the bark and the wood, which is clearly visible as a green line when a young living stem is cut through diagonally. The fusion or joining together of the cells of the cambium layer of both scion and stock makes grafting possible, so that it is essential that these layers are placed in direct contact with each other if the union is to be successful.

**Whip and tongue grafting**: Generally used where the stock and scion are of approximately the same thickness. Nurserymen employ it for grafting young fruit trees. First cut down the stock to about 4 in. above ground level, and on the smoothest side make a slanting upward cut about 1½ in. long, followed by another smaller

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**WHIP AND TONGUE GRAFTING.**

*Left to right: Scion with slanting cut and tongue; Stock with similar cuts; Scion and stock in contact; Secured by tying with raffia; Covered with grafting wax*
downward cut starting just below the top of the upward cut to form the tongue. Prepare the scion, which should be about 4 in. long, by making a corresponding slanting cut at the basal end and a second small upward cut from just above the base of the slanting cut to form a tongue. The cuts on the scion should correspond with those on the stock, but in reverse. Place the tongue of the scion gently into the tongue of the stock, at the same time make sure that the bark and cambium layers of scion and stock are opposite to each other.

Press the scion down until the long, slanting cuts are flush with one another. The tongue will then hold the graft firmly in position.

Make sure that the cut surfaces are in even contact. To form a union the cambium layers must meet on one side, if not on both. Where the stock is larger than the scion careful attention must be given to this point. Then bind the cut surfaces together with moistened raffia and apply grafting wax to cover and seal the graft area to exclude air and moisture. The cut top of the scion should also be given a spot of grafting wax to keep out moisture.

Splice grafting: Similar to whip and tongue grafting, but simpler because no tongue is made. Make two slanting cuts of corresponding size, one on the stock and the other on the scion. Then place the cut surfaces together, making sure that the cambium layers are in contact on one side at least if the stock is larger than the scion. As there is no tongue, hold the splice firmly in place while the tying is done. Afterwards wax the graft as already described. The limitation of this method is that the splice can easily move while it is being tied, with the result that the vital contact of the cambium layers may be lost and the graft fail to grow.

Crown or rind grafting: Chiefly used for reworking or rejuvenating old fruit trees. Its name refers to the appearance of a limb or branch that has been cut back to expose a circle of wood and a ring of bark, which when worked with a number of scions round the edge gives a crown effect.

Head back the larger branches of the tree to a convenient point, usually 1 ft. or so above a crotch. After trimming the bark and wood to make it smooth, prepare a number of scions by making long, slanting cuts of about 1½ in. Then make a cut in the bark of the prepared limb extending down the side for about 2 in. from the edge of the bark. By slightly lifting the edges of the bark where the cut is made, a prepared scion can easily be pushed down inside the bark, with the flat surface of the slanting cut resting against the inner wood of the stock. The scion is held firmly in position by the tension of the thick bark of the limb or branch, and it is easy to bind round the graft with raffia and then cover the whole cut area with grafting wax. The number
of scions inserted round the edge of a headed-back limb will depend on its size, but usually two scions are sufficient, one opposite to the other.

Cleft grafting: A method of crown grafting that used to be popular because, when properly done, it was easy and reliable although rather crude and rough. Cleft grafting is used on cut-back stocks that are considerably larger in section than the scion. Split the stock with a small axe or chisel and use the chisel to keep the split open until the scion (or scions in the case of a large stock) is ready for insertion. Prepare the scion by making two slanting cuts, one on either side to form a wedge-shaped base. Then insert the scion in the cleft or split with one side of the bark of the wedge corresponding to the split bark of the stock. Usually, if the stock is 2 in. or more in diameter, two scions are inserted, one on each side of the cleft, where they are held firmly in position by the pinching effect of the split stock. It is wise, however, to bind round the stock with raffia and then cover the entire surface and sides of the graft with wax. The splitting of the stock across the centre and the insertion of two scions leave an open wound, which must be filled with wax or clay to make the graft airtight and prevent water entering.

Frameworking: Another way of rejuvenating an old fruit tree, but the tree is prepared in a different way and numerous scions are used to provide a new framework of side and tip branches. The main branch system of the tree, with the exception of badly positioned branches, is retained to provide a suitably spaced framework from which all side branches, twigs, etc. are cleared completely and replaced by scions of the new variety to be grafted on the tree.

The various methods of frameworking are known as stub grafting, side grafting, inverted bark grafting and slit grafting.

Stub grafting consists of grafting on to the stubs of spurs or small side branches and as close as possible to the main
branch, whereas in the other three methods the scions are inserted into the main branch itself.

Slit grafting is the easiest of these methods because it involves only one oblique 2-in. cut into the bark with the point of the knife just meeting the wood. The scion, prepared by cutting the basal end to form a wedge with the cuts about 1 in. or more long, is pushed into the slit cut of the bark and, with a little pressure, embeds itself between the bark and the wood. At the same time the scion can be positioned by pushing it up or down to obtain the angle required for the side branch it is to form. As the scion is held firmly in position by the bark no tying is required, but the cut is sealed with grafting wax to make it airtight and waterproof.

Each prepared branch of the tree is worked in this way, the scions are spaced round and along the branch to provide an even and well-positioned framework of side branches. It is wise to put on more than will ultimately be required because unwanted ones can be easily cut out if there is danger of overcrowding.
PROPAGATION

SLIT GRAFTING
Scion inserted in oblique cut in bark. The scion is cut to a wedge shape as shown on the right.

Frameworks by grafting into the bark can be done only where the bark is reasonably thick, usually on wood of 2 in. diameter and over. The extremities of the branches therefore have to be tip grafted by one of the other methods already mentioned, that is, by crown or rind grafting.

With frameworking a large number of scions are required and should be prepared with more buds, preferably seven or eight, as the growth from scions inserted into an old tree probably having a vigorous root system will be strong. If scions containing only three or four growth buds were used, strong growth would result from them and would only overcrowd the tree. Long scions with up to eight buds will not grow so strongly and will only produce growth from the top two or three buds, while the lower buds will produce short spur-like growth bearing fruit buds. In this way the newly grafted tree is productive within a few years.

Inserting scions, one on each side of the split. Use chisel or wedge of wood to keep the split open while the scions are inserted.

Chisel removed

Splitting the stock with chopper and mallet

Scion prepared with two slanting cuts, one on either side

Tie with raffia and completely cover top of stock with grafting wax

CLEFT GRAFTING
ANNUALS

The great merit of true annuals is their adaptability. They can be used to fill gaps in established borders, as trailing plants in hanging baskets, in window-boxes, or to provide quickly grown, gay flowers in a new garden, while the taller kinds will make a temporary screen or background. In addition, they provide an excellent source of cut flowers, and rows can be sown for picking. For all these purposes annuals give quick results at low cost.

A true annual is a plant which completes its life-cycle from seed-sowing to seed-setting within twelve months. Many other plants can, however, be treated as annuals by sowing the seed early in the year in the warmth of the greenhouse to hasten germination and then, after careful hardening off, planting out the seedlings to flower the same summer.

The soil itself may play its part in delaying or hastening flowering. Some plants, for instance, like the annual lupin or the tobacco plant, flower far earlier when there is too much nitrogen in the soil. On the other hand the bedding-out salvia and the ordinary clarkia invariably flower earlier when the soil is lacking in nitrogen. It is possible, therefore, to alter the time of flowering by using different methods of feeding.

PREPARING THE GROUND
Because the great majority of annual seeds are very small, it is necessary to rake the surface of the soil down to as fine a tilth as possible. Start by forking it over to a depth of, say, 4 in. as soon as the soil is dry enough not to pick up on one’s shoes, and at the same time apply well-rotted vegetable compost or Pompost at the rate of one large bucketful per sq. yd. Follow the forking, which helps to let air into the soil, by treading or light rolling. This prevents the ground from being “puffy” and at the same time breaks down the lumps of soil which will undoubtedly have been produced during the forking process. Next, rake the soil backward and forward to break down the smaller lumps, using the head of the rake with the handle held upright to break any obstinate lumps that resist the normal raking.

If the soil is still not sufficiently fine, repeat the whole process of rolling and raking once more.

In cases where the soil is known to be acid give carbonate of lime as an autumn top dressing at from 4 to 7 oz. per sq. yd. depending on the acidity of the soil. This is especially necessary in the case of annuals like candytuft and love-in-a-mist, which need limy soil for success. Do not attempt to rake in the lime but leave it on the surface of the soil where it can be washed in by the rain.

SEED SOWING
WHEN TO SOW
The seeds of all hardy annuals can be sown in April, or sometimes earlier, where the plants are to flower. Some of the hardiest may also be sown in the autumn, in which case they flower much earlier in the following spring. It depends to a certain extent on the situation of the garden which annuals may be autumn sown. Such sowing is more successful in
the south or south-west of Great Britain than in the north or north-east.

The half-hardy varieties are better sown under glass in February or March (see Greenhouse Sowing, page 146), since to sow them in the open means waiting until the soil has warmed up sufficiently (the end of May onward) which in turn delays the time of flowering.

In all cases sow very shallowly since the seeds are small, and lightly rake over the soil to cover them. The depth should be equal to twice the diameter of the seed. Sow the seeds thinly, because if they are thick in the soil the seedlings will be drawn up too much, and when thinning out has to be done many of the young roots will be disturbed.

Soak dry soil the day before sowing, but be sure the water is applied gently, in a fine spray. If the soil is heavy, give a dressing of fine sedge peat at one bucketful per sq. yd. before watering to prevent the wet soil from caking.

In cold soil, such as heavy clay, little seedlings sometimes rot off due to attacks of fungus diseases. This trouble is usually known as pre-emergence rot and may be prevented by the use of thiram dust—obtainable in "puffer packs", containers like toothpaste tubes—or other seed dressing. Puff a little of the dust into the packet of seeds and shake it well.

SOWING BROADCAST
To make a natural and beautiful border, mark out, with a pointed stick, broad, irregularly shaped drifts on the bed where the plants are to flower. Label each drift with the name of the variety within its outline, bearing in mind that the groups should intermingle happily together. Generally speaking, the taller-growing types should be kept to the back of the border, the dwarfer or edging annuals to the front, and those of intermediate size somewhere between the two. Island beds are also attractive.

Sow the seeds of each variety within the confines of the marked-out drift and then carefully rake in the seeds so that they are just buried. Do not disturb the outline of the drift. To make weeding easier, it is best to drill seeds within each area, spacing the rows at such a distance that the plants will grow into each other.

Should the weather remain dry, gentle watering with a spray or square-area rainer is advisable two days after sowing and again a week later.

SOWING FOR CUT FLOWERS
There is no cheaper way of providing cut flowers for a house in summer than by sowing annuals.

Select a border some distance from the house where, if the plants are cut regularly, the appearance of the garden will not be spoiled. Make rows at intervals suitable to the size of plant so that it will be easy to hoe between them later on, and so that the plants will have room for development.

Sow four rows and then allow a space of 3 ft. before sowing another four rows and so on. These spaces form "picking" paths and will become well trodden as picking proceeds.

THINNING AND WEEDING
When the seedlings are about 1 in. high, thin out according to the distances recommended for the varieties being grown. At the same time remove any weeds that have come up. After thinning, firm the soil where it has been disturbed. It is better not to thin autumn-sown seedlings until the following March; where they have come through too thickly (as they may in the warmer southern counties) they should be lightly thinned in October and fully thinned the following March.

HOW TO TELL SEEDLINGS FROM WEEDS
The easiest way to recognize the seedlings of the varieties sown in the garden is to
sow a very small quantity of each in a box in the greenhouse. Label each kind clearly. The seedlings will come up two or three weeks before those sown outside, thus giving the gardener time to become familiar with the look of the plants. If No-Soil or John Innes compost is used and the box is covered with glass, there will be no competition from weeds.

**STAKING**

Stiff-growing annuals, like tagetes and marigolds, require no staking and even the taller ones, like cosmos, will stand unaided. Soft plants, like cornflowers and eschscholzias, need support. Provide this by inserting small twiggy sticks at about 6- or 8-in. intervals all over the area once the seedlings have been thinned.

**GREENHOUSE SOWING**

**HALF-HARDY ANNUALS**

Sow half-hardy annuals in boxes in the greenhouse in late February or early March. Use No-Soil compost, John Innes seed compost or a vermiculite peat mixture, pressed down and levelled 1 in. from the top of the box. Sow the seeds very thinly on the compost, sift some silver sand over just to cover them andfirm it down with a wooden prerester.

Water each box by immersing it carefully and gradually in water with the chill off until the compost is thoroughly moist up to the level of the seeds, then slowly remove the box and place it on the greenhouse staging.

Cover the box with a sheet of glass and place a sheet of newspaper over the glass to exclude the light. Each day remove the glass to wipe off the moisture, then replace it. Alternatively, place the box in a polythene sheet or bag and cover with paper till germination takes place. The temperature of the greenhouse should be 55 to 60°F. (13 to 16°C).

When the seedlings are through, remove the glass and paper or polythene and allow the plants to grow naturally. When they are large enough to handle, prick them out into seed trays containing suitable potting compost at 50 to 60 seedlings per tray.

Prick the seedlings out so that the bottom leaves are lying just above the top of the soil. Then water with a watering-can fitted with a fine rose, and put the boxes on a shelf near the greenhouse glass.

Grow the plants on in the greenhouse until they are well established, and then put the boxes into a cold frame to harden off the plants. Gradually increase the amount of ventilation in the frame until the third week in May the glass light over the plants is taken away.

A week or so later put the plants in the bed where they are to flower, spacing them out as recommended in the following list of plants. Follow the planting instructions in a biennial.

In May, many half-hardy annuals can be bought from nurseriesmen as young plants ready for planting out.

**TENDER ANNUALS**

Some annuals are not hardy enough to be grown out-of-doors and should be grown in the greenhouse in pots. Plants treated in this way include *Primula malacoides*, *Primula sinensis*, *Impatiens* (balsam), *Celosia cristata* and *Celosia plumosa*. Sow the seeds as required by the variety, transfer the seedlings to small pots and gradually move into larger pots until the plants are ready. Celosias can, however, be put out as pot plants in bedding schemes during the height of summer.

**ANNUALS IN POTS**

Several hardy and half-hardy annuals can be sown in September in pots containing John Innes No.1 potting compost, and gradually potted on through the winter to flower in early spring under glass.

Those suitable are *Clarkia*, *Schizanthus*, *Phlox drummondii*, *Rudbeckia hirta*, *Nigella damascena*, *Nicotiana alata*, *Godetia grandiflora* and *Calendula officinalis*. See the plan for a border with the tallest plants at the back (the top in this design).

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**PLAN FOR A BORDER**

Suggested annual border, 2ft. by 8ft.

- *Phlox drummondii grandiflora* July-Sept. 18 in.
- *Clarkia elegans* July-Oct. 2 ft.
- *Rudbeckia hirta* July-Sept. 1 ft.
- *Malope trifida grandiflora* July-Sept. 3 ft.
- *Godetia grandiflora* Summer Autumn 18 in.
- *Nigella damascena* July-Sept. 1 ft.
- *Godetia grandiflora* Summer Autumn 18 in.
- *Clarkia elegans* July-Oct. 2 ft.
- *Nicotiana alata* July-Sept. 2 ft.
- *Godetia grandiflora* Summer Autumn 18 in.
- *Calendula officinalis* Summer Autumn 18 in.
- *Centaura cyanus* July 1 ft.
- *Linaria vulgaris* July 1 ft.
- *Convolvulus tricolor* July-Sept. 18 in.
- *Linaria vulgaris* July 1 ft.
- *Cuphea igna* July-Sept. 18 in.
- *Verbena rigida* July-Sept. 1 ft.
- *Eschscholzia californica* Summer 18 in.
- *Calendula officinalis* Summer Autumn 18 in.
- *Centaura cinerea* early summer onward 6-18 in.
- *Iberis amara* Summer 12 in.
- *Godetia grandiflora* Summer Autumn 18 in.
- *Linaria vulgaris* July 1 ft.
- *Eschscholzia californica* Summer 18 in.
- *Centaura cyanus* July 1 ft.
RECOMMENDED PLANTS

**ADONIS** (pheasant's eye) Hardy
Equally happy in wild or formal gardens but likes a soil with plenty of humus incorporated. Sow seed about ¼ in. deep in March where plants are to flower. Thin plants out to 6 in. apart.

*Adonis aestivalis* (summer adonis), 1½ ft. Single crimson flowers in across, borne in profusion in June and July.

**AGERATUM** (floss flower) Half-hardy
Dwarf, compact and taller varieties are available, carrying attractive fluffy heads of flower in blue, white and pink, from June to September. Likes a sunny position. Often used for bedding out. Sow seed in greenhouse in March, harden off in April; plant out in late May, 6 in. apart.

*Ageratum houstonianum*, up to 2 ft. Most of the new varieties, which are about 6 in. high, are developed from this species and include Blue Mink, a large-flowered powder blue, Blue Ball and Little Blue Star with its mass of small flowers. Little Dorritt, a white, and Fairy Pink are not as good as the blues.

**AGROSTEMMA** (corn cockle) Hardy
The wild corn cockle is an attractive plant but the variety mentioned below is much superior. Sow in September or March where it is to flower and thin out to 9 in. apart.

*Agrostemma githago* Milas, 2½ ft. A tall, slender-growing plant carrying 3-in. diameter flowers of rosy-lilac lightening to the centre, each petal being marked with radial lines of dark dots. Excellent for cutting from July to September.

**ALYSSUM** (madowt) Hardy
Low-growing plants with small white, lilac or purple sweet-scented flowers covering the plant. Grows in any soil but prefers a sunny position, and is extensively used as an edging plant. Sow seed in the flowering position in March or April, and thin out plants to 6 in. apart, or sow in the greenhouse in March, prick out, and plant out 6 in. apart.

*Alyssum maritima* (syn. Lobularia maritima), 8 to 12 in. Varieties from this species flower between June and October and include Lilac Queen, Pink Heather and Little Dorritt, a white.

*A. m. minimum*, 3 in. A very dwarf and compact form much used as an edging.

*A. m. procumbens*, 3 to 4 in. A more spreading type, represented by the white Snow Cloth, purple Royal Carpet and deep pink Rosie O'Day.

**AMARANTHUS** (amaranth) Half-hardy and hardy
A group of plants grown for their ornamental and unusual flowers or foliage. Should be grown in a warm, sunny situation, the seed being sown in a greenhouse in March, hardened off during April and planted out in May.

*Amaranthus caudatus* (love-lies-bleeding), 3 ft. Bears long, drooping tail-like bright red or light green flowers from June to September. Can be sown in flowering position during April.

*A. hybridus* (syn. A. hypochondriacus) (prince's feather), 3 ft. Upright flower spikes of crimson red carried above light green foliage from July to September. Can be sown outdoors in April.

*A. tricolor* (syn. A. gangeticus) (Joseph's coat), 1½ ft. A handsome foliage plant with brightly contrasted yellow, red and green colouring in the *A. t. splendens* form, the colour increasing with age from July to September. Other varieties in varying colours are available.

**ANAGALLIS** (timmernei)
Treat as half-hardy
Scarlet and blue forms of this native plant are available, and are useful on rockeries or at the front of beds in a sunny position on a well-drained soil. Sow seed in March under glass. Harden off in April, and plant out in May, 6 in. apart.

*Anagallis linifolia* (syn. *A. grandiflora*), 1 ft. The best-known form is the *A. l. caerulea*, with deep gentian-blue flowers centred with yellow stamens. Flowers from July till September.
ANCHUSA (ALKANET) Hardy
Truly a biennial, it is best grown as a hardy annual by sowing in flowering positions during April and thinning to 1 ft. apart. A great favourite with bees.

Anchusa capensis. 1½ ft. The variety Blue Bird has attractive blue, white-centred flowers in June, rather like a large forget-me-not in form.

ANTIRRHINUM (SNAPDRAGON) Half-hardy
Really a perennial which is treated as an annual or occasionally a biennial. The plant can be had in a succession of bloom from June to October. Children call them bunny-rabbit or bunny-mouth flowers because when the sides of the flower base are pressed together the mouth of the flower opens. Does best on a light, humus-rich soil in a sunny situation.

Sow the seed in the greenhouse in February, prick the plants out 2 in. apart into boxes, and when 3 in. high pinch out the main shoot to give good side shoots which will give a mass of bloom. Plant out in late April. For earlier flowering, sow seeds in August and prick out into boxes or frames for over-wintering under glass; plant out in April.

Antirrhinum majus. Many varieties have been developed in this flower ranging in height from 9 in. to 3 ft. The classes are divided into: "rock hybrids" 9 in., "Tom Thumb" 12 in., "intermediate" or "semi-dwarf" 15 to 18 in., "rust-resistant" 15 to 18 in., "grandiflorum" or "tall" 3 ft., "tetraploid" 2 ft., "hyacinth-flowered" 2 ft., "double-flowered" 1½ ft. Since each class has many varieties, selection is best made from a seedman's catalogue. Recently a number of F1 Hybrids have been introduced in tall, intermediate and dwarf classes giving excellent colours and evenness of form; the rust-resistant types now have a good colour range.

ARCTOTIS (AFRICAN DAISY) Half-hardy
A South African plant with woolly, white leaves and daisy-like flowers in a range of rich colours, well suited for bedding in warm, sunny situations and also good for cutting. Sow seed in a greenhouse in March, harden off in April and plant out in May, 1 ft. apart, to flower from July to October.

Arctotis acuta (syn. A. scapigera), 1 to 1½ ft. Has a range of colour from yellow and orange to blood red in the new mixtures such as the Harlequin Hybrids.

A. grandis (syn. A. stoechadifolia), 2 ft. Silver-white flowers with lilac centres surrounded by a gold ring, the backs of the petals shaded with lavender.

BEGONIA Half-hardy
Truly a perennial but usually treated as a half-hardy annual and sown under glass in a temperature of 65° F. (18° C.) from December to February. The seed is very fine and needs careful handling when sowing and prickling out. Grow the plants on in warm conditions, and harden off during late April for planting out in late May and June.

Begonia semperflorens, 6 to 12 in. Fibrous-rooted and nowadays represented by a number of very good F1 Hybrid varieties which are unbeatable for making a brilliant summer display, and are very weather-resistant. The Organdie Mixture and Thousand Wonder colours, together with Andy and Pandy, will give a wonderful show in summer and autumn.

CALCEOLARIA (SLIPPER FLOWER) Half-hardy
These attractive flowers are generally grown for greenhouse decoration, but the species listed as C. rugosa is useful for bedding outdoors in the summer. Sow in the greenhouse from December, to February, harden off in April. Plant out after the risk of frost is over, 1 ft. apart.

Calceolaria integrifolia (syn. C. rugosa), 4 ft. Carries masses of the typical though small slipper-shaped flowers in August, and can be obtained in a range of colours in the C. rugosa hybrids or as single colours in the Farthest North varieties.

CALENDULA (POT MARIGOLD) Hardy
Produces large, flat, disk-like flowers in many beautiful shades from deep orange through yellow to cream. Thrives in a poor soil. Sow mid-September for early summer flowering or mid-March for
flowers from early July onward. Thin out to about 1 ft. apart.

*Calendula officinalis*, 1½ to 2 ft. There are many varieties available including the following:

Apricot, Cream and Lemon Beauty, all varieties of the Pacific type, also represented by Pacific Beauty Mixed.

Art Shades Mixed, attractive range of soft pastel shades.

Indian Maid, pale orange with dark maroon centre.

Orange King, good, compact, broad-petalled, deep orange.

Radar, quilled petals of bright orange.

**CALLISTEPHUS (CHINA ASTER)** Half-hardy Double and single disk- and daisy-like flowers in varying brilliant pinks, whites, reds, yellows, blues, purples and mauves from late July onward. Does well in rich soil and a sunny position, while damp spots are likely to encourage wilt and blackleg diseases. Sow seed in greenhouse in March, harden off in April, and plant out in May, 9 in. to 2 ft. apart according to variety. Seed may also be sown in flowering positions in April.

*Callistephus chinensis*. Has an incredible number of varieties and forms, ranging from the very dwarf, 8-in. high, bedding
varieties to the 2½-ft. high, single and
double varieties. Recommended are:
Californian Giant, 2 ft. Broad-petalled
shaggy flowers. Later flowering and taller
than Ostrich Feather.
Dwarf Queen, 10 in. Compact plant
with a mass of double flowers.
Giant Comet, 2 ft. Upright growth and
broad flat curling petals.
Ostrich Feather, 1½ ft. Large double
feather-petalled flowers on moderately
long stems.
Pompon, 1 ft. Smallish, fully double
flowers on long stems; an upright plant.
Super Chinensis, 2½ ft. An excellent
development of the old single, with large
flowers of substance.
Super Princess, 2½ ft. Very double with
yellow-quilled contrasting centres, very
good for cutting.
Each class has a large range of colours
and very good mixtures.

**CELOSIA (COCKSCOMB)** Half-hardy
There are two main types, the plumed
forms and the crested types, known as
cockscobm. Both these plants are at
their best in a greenhouse, but may be
planted out in a warm sheltered spot on
good soil in the south of England. Sow
seed in March under glass, plant out late
May or early June, 1 ft. apart.

*Celosia argentea* (syn. *C. plumosa* or *C. pyramidalis*). Available in tall (1½ ft.) and dwarf
(9 in.) strains. The dwarf is the most
generally useful, and flowers most of the
summer in a rich range of colours in-
cluding orange, yellow, crimson, scarlet
and purple, or as a mixture.

*C. a. cristata*. These dwarf cockscobs
have heavily crested heads which flower
all summer. Available in an excellent
colour range in the new varieties such
as Jewel Box Mixed and Chanticleer.

**CENTAUREA (CORNFLOWER, SWEET
SULTAN)** Hardy
Tall and dwarf plants with attractive
blue, purple, yellow, white, pink and red
tubular double flower heads. Good for
cutting. Sow seed where the plants are to
flower in September or March, and thin
out to 9 to 12 in. apart.

*Centaurea cyanus* (cornflower). Tall vari-
eties 2½ ft., dwarf 1 ft. A number of good
garden varieties are available in single
colours of red, blue, pink and white, but
usually grown as a mixture, as in the
dwarf form Polka Dot which gives a
very good colour range. Flowers in July.

*C. moschata* (sweet sultan) 2½ ft. Attract-
ive fluffy flower heads, purple, yellow or
white vanilla-scented flowers from June
to September.

**CHRYSANTHEMUM**
(ANNUAL CHRYSANTHEMUM) Hardy
The annual chrysanthemums represent
a range of self- and multi-coloured daisy
flowers from midsummer onward. A
plant unexcelled for use at the back of a
border, or for cutting in midsummer. Sow
¾ in. deep in April, where the plants are
to flower, and thin out to 1 ft. apart.

*Chrysanthemum carinatum* (syn. *C. tricolor*),
2 ft. Deeply cut leaves, and flowers which
usually have three colour markings on
the petals, giving a triple ring effect.
There are many named varieties in a
range of red, orange, purple, yellow and
white combinations, but the mixtures
will give a very colourful display.

*C. coronarium*, 3 ft. Very finely cut foliage
and white, yellow or cream flowers,
single or double according to variety.

*C. multicaule*, 6 in. Attractive buttecup-
yellow flowers are borne above the
spreading fleshy foliage from July to
September, and make a very good edging.

*C. segetum*, 1½ ft. A number of interesting
varieties have been developed from the
native corn marigold, bearing sprays of
flowers in shades of yellow, including
Eastern Star and Morning Star.

**CLARKIA** Hardy
Very popular and showy plants with
their attractive rose, purple, lilac, pink
or white double flowers. They prefer a
well-manured soil. Sow seed in March or
April, where the plants are to flower, and
thin out to about 9 in. apart.

*Clarkia elegans*, 2 ft. Many named varieties
are available in the colours mentioned
above including Enchantress, Lady Satin
Rose, Firebrand and Salmon Queen. Can
be used as a cut flower from July to October, but must be put in water immediately.

*C. pulchella*, 1½ ft. The semi-double flowers have a less extensive colour range than *C. elegans*, but the habit is more bushy and flowering period longer.

**CLEOME (SPIDER PLANT)** Half-hardy
Interesting and often showy flowers with long spidery stamens which can be used for cutting from July to September. Prefers a light, rich soil and sunny spot. Sow seed in a greenhouse in March, harden off in April, and plant out in late May or June, 1½ ft. apart.

* Cleome spinosa, 3 ft. A number of varieties are available, but none excel the Pink or Rose Queen, whose dense terminal spikes of spidery flowers have a strange and strong scent.

**CONVOLVULUS (BINDWEED)** Hardy
This flower must not be confused with the disliked garden weed, for it is purely an annual which flowers from July to September. Likes a sunny position. Sow in flowering positions in September or April and thin out to 1 ft. apart.

*Convolvulus tricolor* (syn. *C. minor*), 1 ft. Beautiful spreading plant, up to 2 ft. across, covered in convolvulus-like flowers of varying colour which open in the morning and fade by evening and include red, white, pink and blue in the mixtures; Royal Ensign, a vivid ultramarine blue with white and yellow throat makes a wonderful display.

**COREOPSIS (TICKSEED)** Hardy
Summer-flowering daisy-like flowers, usually listed in catalogues as *Calliopsis*, while *C. stillmanii* is listed as *Leptosyne*. Sow under glass in March, harden off in April, and plant out in May, 1 ft. apart; or sow in flowering positions in April and thin out.

*Coreopsis drummondii*, 1½ ft. Large-flowered golden-yellow form with maroon markings at the base of the petals.

* C. tinctoria, tall varieties 2½ ft., dwarf 1 ft. Both tall and dwarf varieties are available in a range of yellow and crimson combinations, also in single and double forms.

**COSMOS (COSMEA)** Half-hardy
Erect plants with finely-cut ferny foliage and large single disk-like flowers in several different colours according to the species. Plants do well in a poor soil and sunny spot. Sow seeds under glass in mid-March, harden off mid-April, and plant out in border 1½ ft. apart late May. They may also be sown in their flowering positions outdoors in late April.

*C. hispinitus*, 3 ft. Bushy erect plants with fine foliage and white, pink, crimson and rose flowers into late summer. The Sensation mixed and Sensation Gloria, a bicoulo red rose with crimson centre zone, are among the best varieties.

**CUPHEA** Half-hardy
Striking plants with vivid and unusual flowers from June to September. Sow seed in greenhouse in late February, harden off during late April and May after pinching out the growing points. Plant out in June in a warm, sunny spot.

*Cuphea ignea* (syn. *C. platycentra*) (cigar plant), 1 ft. Bright scarlet, black tipped, tubular flowers, 1 in. long, on a bushy, compact plant.

*C. llavea miniata*, 1 ft. Firefly, the best-known variety, has open flowers with scarlet petals, purple bases and white eyes.

**CYNOGLOSSUM (HOUND’S TONGUE)** Hardy
A pretty border plant with coarse hairy leaves and small blue flowers. Does well on a light soil in partial shade or sun. Sow seed in mid-September where plants are to flower, and thin to 1 ft. apart in the following March, or sow in flowering position during March or April.

*Cynoglossum amabile*. Small, pale blue, sweetly-scented flowers are produced freely from late June. Blue Bird, 2 ft., and the compact Firmament, 1½ ft., are very good varieties.

**DELFNINHUM (LARKSPUR)** Hardy
Erect branching plants with long spikes of purple, blue, red, pink or white flowers in summer. Sow a deep, rich soil in September for early flowering, or in March and April, and thin to 1 ft. apart.
ANNUALS

ANTIRRHINUM MAJUS
(intermediate)

CENTAUREA CYANUS

ALYSSUM DESERTORUM
ANNUALS

_Delphinium ajacis_ (rocket larkspur), 1 ft. and 3 ft. The hyacinth-flowered types have been developed from this species in both tall and dwarf forms.

_D. consolida_ (branching larkspur), 3 ft. In this class the branching stock-flowered and Giant Imperial forms are the best known; in the latter, branching occurs from the base and the plants are compact. Many varieties are available as well as good mixtures.

_D. grandiflorum_ (syn. _D. sinense_), 1 ft. Dwarf type with large single flowers, Blue Mirror and Blue Butterfly being outstanding. May be sown under glass in March and planted out in May.

_Dianthus_ (pinks) Half-hardy

This class covers the annual pinks and carnations. The pinks are mostly smaller flowered, more profuse and compact, while the carnations are double and well scented. Both will make a wonderful show in the garden in a warm, sunny spot. Sow under glass in February, harden off in April, and plant out during early May.

_Dianthus caryophyllus_ (carnation), 1½ ft. The carnations are divided into several groups, the Camellia-Flowered, with very double smooth petalled flowers, Enfant de Nice, an early-flowering strain with slightly frilled petals and the Chabaud with heavily frilled petals. All types are well scented, good for cutting and available in a range of colours.

_D. chinensis_ (Chinese or Indian pink), 1 to 1½ ft. Fairly tall double- and single-flowered mixtures are available in this type, which can be used in borders.

_D. c. hedewigii_ (Japanese pink), 6 to 12 in. Dwarf single and double mixtures are available, very well suited to bedding and edging. There are also single colour selections, especially in the single forms.

_D. c. laciniatus_ (fringed pink), 12 in. The large flowers have petals which are deeply cut and fringed, giving the plants an open and light appearance. Very good in a rockery.

_DIMORPHOTHECA_ (STAR OF THE VELDT) Hardy

Daisy-like, brilliant, dazzling flowers of orange, white, yellow and pastel shades with shiny petals which close at night or in dull weather. Sow seed in greenhouse in March, harden off in April, and plant out late May; or sow outdoors in flowering positions in April.

_Dimorphotheca sinuata_, 1 ft. Usually listed as _D. aurantiaca_ hybrids, makes a wonderful show from July till the frosts. Beautiful mixtures available, while the single-colour Orange Glory and Goliath are particularly good.

_ECHIUM_ (VIPER'S BUGLOSS) Hardy

These showy, erect, hairy, greyish-leaved plants, with blue, purple, rose and white flowers well liked by bees, do well in a poor, dry soil. Sow seed late March where plants are to flower, thin out to 1 ft. apart.

_Echium plantagineum_, 1 ft. The best variety is Blue Bedder, which has spikes of bright blue flowers in June, while the dwarf hybrids have an attractive colour range.

_ESCHSCHOLZIA_ (CALIFORNIAN POPPY) Hardy

Finely cut blue-green leaves with masses of glossy vivid flowers of orange, red, yellow, white and pink from June onward. Likes a poor, sandy soil in a sunny position. Sow seed early April where plants are to grow, thin out to 9 in. apart. For earlier flowering, sow in September. Frequently seed themselves in the garden.

_Eschscholzia californica_, 1 ft. Deeply saucer-shaped flowers in many colours, bloom in profusion all summer. Many named varieties, single and semi-double, exist and the Monarch Art Shade mixture is one of the most effective semi-doubles.

_FELICIA_ Half-hardy

A small plant carrying a mass of little daisy-like blue flowers from June onward. Can be used for bedding out and makes a good pot plant in the greenhouse. Sow seed in greenhouse in March, harden off mid-April, plant out late May, 9 in. apart.

_F. bergeriana_ (kingfisher daisy), 6 in. Has a low creeping habit, and yellow-centred blue flowers on 4 in. stems. The petals curl back on themselves in dull weather and at night.
**ANNUALS**

**GAillardia (Blanket Flower)**
Half-hardy
Showy, daisy-like, single or double flowers very useful in the border and for cutting. The colours are mostly yellow and red or variations of them. Sow seed in the greenhouse in March, harden off in April, and plant out in May, 1 ft. apart.

*Gaillardia pulchella*, 1½ ft. Many varieties have been developed from the species; the *G. p. picta* Indian Chief, a coppery red single, and *G. p. picta lorenziana* double mixed are particularly well worth growing. Flowers from July to October.

**GODETIA** Hardy
Charming and valuable garden plants. Grey-green foliage, covered from summer to autumn with pink, purple, crimson, white or lavender slightly scented blooms. Likes a sunny, sheltered spot. Sow seed in early April where plants are to flower. Thin out to 1 ft. apart.

*Godezia grandiflora*, 2 to 3 ft. and 9 to 18 in. The taller varieties are the tall doubles which are well suited to cutting, while the dwarfer are most useful for bedding out. The dwarf forms are divided into dwarf singles, semi-dwarf singles and the double or azalea-flowered, and the last, in particular, make a very good show.

**Gypsophila (Cloud Plant)** Hardy
Stems and leaves are grey-green, and the small, white, pink and deep red flowers produced in light, graceful sprays in June are very useful in flower arrangements. Sow in an open, sunny spot, in drifts in September or mid-March. Thin out to 9 in. apart.

*Gypsophila elegans*, 1½ ft. The large-flowered Covent Garden white is a very good plant, and the crimson and rosea forms have delicate cloud-like flowers.

**Helianthus (Sunflower)** Hardy
Huge disk-like flowers from July to September, usually yellow, but also available in other colours. Sow seed early April in a sunny spot where plants are to flower, and thin to 2 ft. apart.

*Helianthus annuus* (common sunflower), up to 10 ft., with huge, single yellow flowers with a dark disk from July to September. Varieties of varying heights and colours are available.

*H. debilis* (syn. *H. cucumerifolius*) (cucumber leaf or miniature sunflower), 3½ ft. Has a dwarf bushy habit and smaller flowers in a range of colours which make it useful for the border.

**Helichrysum (Strawflower, Everlasting Flower)** Hardy
Showy clustered flowers, red, orange, mauve, yellow and white in colour and papery in texture when mature. Sow seed in early April where plants are to flower, and thin out to 9 in. apart. Cut flowers when half open, and hang in bunches to dry for 2 or 3 weeks in a dry, dust-proof place to provide flowers for decoration all winter.

*Helichrysum bracteatum*, 3 ft. Erect plant with flowers up to 2 in. across from July to August. Many varieties available, and there is a dwarfer 18-in. mixture.

**Heliotropium (Cherry Pie, Heliotrope)** Half-hardy
A half-hardy perennial often treated as an annual. The large attractively scented flower heads are useful for bedding in a mass or using as dot plants. Sow in a greenhouse in February or March, harden off in late April for planting out in late May.

*Heliotropium arborescens*, 1 to 1½ ft. A number of single-colour summer-flowering varieties are available: among the best is Marine, deep violet, with massive heads. Regale Hybrids make a good mixture.

**Helipterum (Imorteille)** Half-hardy
A group of everlasting flowers, the two best types normally being listed in catalogues as *Rhodanthe* and *Acrolineum*. Both bear white, red and rose-coloured flowers, which are papery-petalled and can be dried. Does well in a sunny position on a poor soil. Sow seed in greenhouse in March, harden off in April, plant out in late May, 1 ft. apart.

ANNUALS

LINUM GRANDIFLORUM

MIMULUS TIGRINUS
H. roseum (syn. Acrolineum roseum), 1½ ft. Pink, rose and white flowers, at their best in the double mixtures, on long stems on bushy plants; useful in the garden and for cutting.

**IBERIS (CANDYTUFT)** Hardy
Brilliant, sweet-scented flowers of white, red, pink, purple or lilac from early summer onward. Plants do best on light, well-drained soils in open, sunny spot. Sow seed early April in the open, and often they will seed themselves for the following year. Thin out to 6 in. apart.

*I. amara* (hyacinth-flowered candytuft), 15 in. Upright-growing plants with long 6-in. spikes of white flowers, good for cutting.

**I. umbellata**, 6 to 12 in. There are many good named varieties and of the mixtures the Dwarf Fairy Mixed is the best.

**IMPATIENS (BALSAM)** Half-hardy
Two forms of balsam are commonly grown in this country: the camellia-flowered type and the busy Lizzie. Both make good pot plants, and the latter is good also for bedding in shady damp spots outdoors. Sow seed in the greenhouse during March or April, harden off, and plant out in late May, 1 ft. apart.

*Impatiens balsamina* (garden balsam), 14 ft. The camellia-flowered type is the most important form, and bears large double camellia-like flowers close to the thick fleshy stems. A bushy form holding the flowers above the leaves is also available.

*I. holstii* (busy Lizzie), 2 to 3 ft. The new F.1 Hybrid “Baby” forms, 1 to 1½ ft., are a great improvement in this class both as pot plants and for bedding out. They are compact, floriferous and have a good colour range with attractive foliage. Summer-flowering.

** Ipomea (Morning Glory)**
Half-hardy and hardy
Climbers which grow well in warm, sunny situations on fences and other supports outdoors, or in the greenhouse. The flowers are large and trumpet-like. Sow seed in the greenhouse in March or April, after soaking the seed overnight and chipping any unsown hard seeds. Harden off, and plant out in late May.

*Ipomea purpurea* (syn. Convolvulus major) is the hardiest species and a number of varieties and mixtures are available which have heart-shaped leaves, hairy stems, and make a good covering on trellis work with flowers all summer. Can be sown outdoors in April.

* I. tricolor* (syn. *I. rubra-caerulea*), Heavenly Blue has beautiful sky-blue flowers 4 in. across, which will cover the plant each morning from July to August in a good summer, only to fade in the afternoon, ready for the next morning’s flowers. Other colours are now available.

**KoCHIA (Burning Bush, Summer Cypress)** Half-hardy
This feathery, light green, shrubby-looking plant is often used as a dot plant in bedding schemes. Sow seed in a greenhouse in March, harden off in April, plant out in late May 1¼ ft. apart or where they are required. May also be sown outdoors in April.

*Koehia scoparia*, 2 ft. An oval or rounded bush with finely divided light green foliage.

*K. arvensis* trichophylla gradually deepens to red in autumn.

*K. childhood* is green throughout its life.

**LAVATERA (MALLOW)** Hardy
A tall-growing plant covered with attractive trumpet-shaped flowers, which makes an interesting show at the back of a border or as temporary screening. Sow seed in the flowering position in early April, and thin out to 1½ ft. apart.

*Lavatera trimestris*, 3 ft. A strong branching plant with light green leaves and pink and white flowers from summer to autumn in the varieties Loveliness and Splendens alba.

**LEPTOSYNE** Hardy
Leptosyne stillmanii (syn. Coreopsis stillmanii), 1½ ft. Has large daisy-like yellow flowers on long stems in summer and early autumn, Golden Rosette, a double, is the best form, and makes a good cut flower. Sow in April, thin out to 1 ft. apart. Flowers about 10 weeks after sowing.
**LINARIA (TOADFLAX) HARDY**
An attractive annual which looks like a small spurred snapdragon. A bushy plant well suited for edging or blocking in borders. Remove dead flower heads to promote prolonged flowering. Sow in flowering positions in March or April, and thin out to 6 in. apart. Flowers in June.

*Linaria maroccana*, 9 to 15 in. Available in a dwarf form of excellent colour range known as Fairy Bouquet, and also a taller Excelsior mixture. Both contain rose, red, orange, yellow, mauve and white flowers.

**LINUM** (FLAX) HARDY
Beautifully showy plants which do well in a light soil and sunny spot. Sow seed in September, March or April in flowering positions. Thin out to 9 in. apart.

*Linum grandiflorum* (scarlet flax), 1 ft. An erect plant with pointed leaves, and 1-in. diameter scarlet flowers in the *L. rubrum* variety. Other colours are available. Flowers in June and July.

*L. usitatisissimum* (common flax), 2 ft. A plant with thin wand-like growth, and small sky-blue flowers in July and August.

**LOBELIA** Half-hardy
This biennial or perennial is widely grown for edging or bedding, and is thus treated as a half-hardy annual. Excellent for edging when used in combination with other plants, or in its own varied colours. Sow seed in February or March in a heated greenhouse, harden off during late April, plant out in late May.

*Lobelia erinus* 4 to 6 in. and trailing. Two groups of varieties have been developed: the compact varieties such as Blue Stone, Cambridge Blue, White Lady and Mrs. Cilbran (a deep blue with white eye), which are well suited to bedding and edging; and trailing varieties like Sapphire, which are good for window-boxes and hanging baskets. Summer-flowering.

**LYCHNIS** (CAMPION) HARDY
*Lychnis coeli-rosa* is usually listed as *Agrostemma coeli-rosa*, while *L. c-r. occulata* is found as *Viscaria occulata*. Both are showy annuals for a sunny border, and should be sown in flowering positions in March or April and thinned out to 9 in. apart.

*Lychnis coeli-rosa* (rose of heaven), 1 ft. Plants covered with rose-coloured white-centred flowers from June to August.

*L. c-r. occulata* (viscaria), 8 to 15 in. A number of dwarf and tall varieties are available in an excellent colour range which includes blue, red, white and pink.

**MALCOMIA** (VIRGINIAN STOCK) HARDY
*Malcomia maritima*, 6 in. Usually grown as a mixture of colours. Small flowers of crimson, mauve, red, yellow and white cover the plants, which grow easily on any soil. Sow in April where they are to flower in summer. May be mixed with night-scented stock (*Matthiola bicornis*).

**MALOPE** HARDY
Produces showy trumpet-like flowers of pink, red, rose and white from July to September; good for cutting. Likes a sunny situation and a rich soil. Sow seed early April out-of-doors where plants are to flower. Thin out to 12 in. apart.

*Malope trifida*, 3 ft. A branching plant with attractive leaves and a number of different-coloured varieties, including *M. l. grandiflora*, a rose-red. Flowers from July to September.

**MATRICARIA** Half-hardy
Really a form of *Chrysanthemum parthenium*, but is usually listed as *Matricaria*. Is grown for both foliage and flower. Likes a warm, sunny situation and a good rich soil. Sow in greenhouse in March, and plant out in May, 9 in. apart.

*Matricaria exima*, 1 ft. Dwarf bushy plants that flower for a long time, with quilled button-like blooms. Excellent for bedding and edging, especially the Silver and Golden Ball varieties.

**MATTHIOLA** (STOCK) HARDY and half-hardy
The popular sweetly-scented stocks, and the night-scented stocks belong to this class. They flower in summer, the former in shades of red, pink, yellow, blue, mauve and white, and like a deep well-manured soil and sunny position.

*Matthiola bicornis* (night-scented stock), 1 ft. Pretty single lilac flowers. Good for edging, especially when mixed with
ANNUALS

RUDBECKIA BICOLOR

TAGETES PATULA

PHLOX DRUMMONDII
Virginia stock. Flowers open in evening and are strongly fragrant. Sow seed in April where plants are to flower, and thin to 6 in. apart.

*M. incana* (stock), 1 to 2½ ft. A number of classes have been developed, including:

Large-Flowered Dwarf Ten-Week, 1 ft. Compact branching plants in large colour range. The fully double forms are germinated in a greenhouse, the seedlings then put in a frame for 3 days, and the light green seedlings pricked out and the dark green discarded. This will yield all double plants.

Giant Excelsior Column, 2½ ft. Non-branching type in a good colour range, well suited to cutting.

Giant Perfection Ten-Week, 2 ft. Erect plants good for bedding and cutting.

All the above types may be sown in the spring in the greenhouse and planted out; or sown outdoors in April.

East Lothian or Intermediate, 15 in. Dwarf bushy plants, seed of which can be sown in summer for flowering the following year, or in early spring for bloom the same year.

Brompton Stocks, see Biennials.

**MESEMBRYANTHEMUM** Hardy

A great many species make up this class.

*MeSEMBryanthemum crisiflorum* (Livingstone daisy), 4 in. The best-known species and one of the most brilliant annuals, with 1-in. diameter daisy flowers with glowing petals of red, yellow, pink, orange and salmon, which cover the thick succulent foliage. The flowers close at night and in dull weather. Sow seed in its flowering position in April or May, or sow in the greenhouse in March and plant out in late May to flower in summer.

**MIMULUS** (MONKEY FLOWER) Half-hardy

Thickly covered with two-lipped, often bicoloured and spotted flowers from July to August. Sow seed in greenhouse in March, harden off in April and plant out late May 12 in. apart.

*M. tigrinus* (syn. *Hybridus grandiflorus*), 1 ft. The name usually given to the hybrid forms listed in catalogues, among which the Monarch Mixed and Queen’s Prize give a good colour range. Plants do well in a damp spot on good soil.

**NEMESIA** Half-hardy

Used for bedding out; brilliant and dainty flowers of orange, red, yellow and blue from July to September. Sow seed in greenhouse in March, harden off in April, plant out in late May, 6 in. apart.

*Nemesia strumosa*, 6 to 12 in. The dwarf compacta varieties are good for bedding, have an upright habit and good colour range, especially the Triumph mixed; the Carnival type has larger flowers. The taller Suttoni types are more straggly.

**NEMOPHILA** Hardy

Narrow leaves, and deeply saucer-shaped white or blue flowers in summer. Does well on a sandy soil rich in humus, and in a slightly shaded position. Cut flowers last well in water. Sow seed in mid-March where plants are to flower, thin out to 6 in. apart. In the south of Great Britain they can be sown in September.

*Nemophila menziesii* (baby blue eyes), 6 in. Often listed as *N. insignis*. A pretty annual covered in masses of white-centred, sky-blue flowers.

**NICOTIANA** (TOBACCO PLANT) Half-hardy

Largish hairy leaves, and purple, red, pink and white flowers from July to September. The flowers are sweetly scented, and therefore often placed near the house. Does well on a rich soil in a sunny, sheltered spot. Sow seed in greenhouse in March, harden off in April, plant out mid-May, 1½ ft. apart.

*Nicotiana alata*, 2 to 5 ft. *N. a. grandiflora* is usually listed as *N. affinis*, and the present hybrids do not close their flowers in the daytime as did the older varieties. The tubular 2-in. diameter flowers are borne in clusters of various colours, from white to yellow, mauve, rose, red or crimson in the Sensation Mixed, and are also available as separate colours.

**NIGELLA** (LOVE-IN-A-MIST, DEVIL-IN-THE-BUSH) Hardy

Peculiar rose, white or blue flowers, in July and August. Good for cutting. Sow
seed late in March in open sunny spot where plants are to flower, or sow in mid-September and thin out to 9 in. apart. The balloon-like seed heads and spiky leaves can be used for floral decorations, and when dried may be gilded.

*Nigella damascena*, 1½ to 2 ft. Finely divided leaves and showy blue, white or rose double flowers on a bushy plant. Miss Jekyll is a very attractive blue.

**PAPAVER (Popp) Hardy**
Showy plant with large, somewhat soft open flowers in summer. Prefers a good sunny spot and light soil, but will succeed almost anywhere. Sow mid-March where plants are to flower. Thin out to 1 ft. apart. Plants will seed themselves.

*Papaver rhoas* (Shirley poppy), 2 ft. A development of the scarlet cornfield poppy. The single and double Shirley types are most attractive and popular, with their delicate range of colours.

*P. somniferum* (opium poppy), 3 ft. Pearl-grey lobed leaves, with large, double 5-in. blooms in carnation and peony-flowered forms, which last better than the singles.

**PETUNIA Half-hardy**
Very extensively used for bedding, making a wonderful show of trumpet-shaped flowers in many different colours from July to September. Prefers a well-drained soil in a sunny spot. Does best in a hot, dry summer. Sow seed early March in greenhouse, harden off in April, plant out late May, 1 ft. apart.

*Petunia hybrida*. Many types and sizes of bloom are available under this heading, including:

- Balcony or Pendula, trailing. Large- and small-bloomed types, excellent for window boxes.
- Giant of California, 5- to 7-in. diameter ruffled blooms in tall (15 in.) and dwarf (10 in.) varieties. Good for pots.
- Grandiflora, 1 ft. Large, slightly ruffled blooms, good for bedding.
- Grandiflora Double, 1 ft. Large double flowers like a carnation, excellent in pots.
- Multiflora, 1 ft. Excellent for bedding, very floriferous, especially the new F.1 Hybrids. Large colour range.

Superbissima, 1½ in. Large-flowered with veined throat-markings.

**PHACELIA Hardy**
Produces attractive bell-shaped flowers in profusion from July to September, in a sheltered, sunny spot. A great favourite of the bees. Sow in September or early April where plants are to flower. Thin to 9 in. apart.

*Phacelia campanulata*, 9 in. Compact early-flowering plants with royal-blue bell-shaped flowers 1 in. across.

**PHLOX Half-hardy**
Beautiful plant for bedding out. Produces flat heads of flower in red, pink, purple, blue or white from July onward. Likes a rich soil in a sunny spot. Sow seed in greenhouse in March, harden off in April, plant out late May, 9 in. apart.

*Phlox drummondii*, 6 to 18 in. The P. *grandiflora* varieties are tall and rather open-growing. For bedding or edging the *P. d. nudiflora* compacta forms are preferable, the Cecily mixed and Dwarf Globe being very good forms. There are also a number of single-colour selections, and the star-like stellatas, such as Twinkle mixed.

**PORTULACA (Purslane) Half-hardy**
Low-growing, fleshy plants with red, yellow, rose or white single or double flowers from July to September. Likes a dry and even poor soil. Thrives in a sunny position. Sow seed in greenhouse in late March, harden off in May and plant out in June.

*Portulaca grandiflora* (rose moss, sun plant), 4 in. A creeping plant with narrow cylindrical leaves, and bright flowers opening as the sun rises. The double forms are the most showy. Excellent for edging.

**RESEDA (Mignonette) Hardy**
Grown for its unusual and distinctive scent, it also attracts bees. Sow seed in early April in a soil which is not short of lime. Thin out to 9 in. apart.

*Reseda odorata*, 15 in. A number of varieties varying from bright red to light yellow are available, and all have loose spikes of heavily scented flowers, June to October.
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RICINUS (CASTOR OIL PLANT) Half-hardy
A useful foliage plant with large leaves, unusual flowers and seed pods. Sow the bean-like seeds in the greenhouse in March and plant out where required in late May, or sow outdoors in late April.

Rudbeckia (cone flower) Half-hardy
Striking plants with daisy-like flowers and a prominent, dark, raised centre. Likes a rich soil and a sunny spot. Sow seed in greenhouse in March, harden off in April, plant out 1 ft. apart in May.

Rudbeckia bicolor, 1½ to 2 ft. A number of varieties in various colours are available, all flowering in July on long stems suitable for cut flower arrangements.

R. hirta (black-eyed Susan), 2 ft. A biennial usually grown as an annual, the hybrid mixture and golden-yellow My Joy are good varieties. The very large-flowered Gloriosa types are excellent for the back of a border. Summer-flowering.

SALPICOLLUS (PAINTED TONGUE) Half-hardy
Beautiful trumpet-shaped flowers, splendid for cutting. Likes rich soil and sunny, sheltered spot outdoors, though often flowered in the greenhouse. Sow seed in greenhouse early March, harden off in April, and plant out late May, 1 ft. apart.

Salpiglossis sinuata, 1½ to 2 ft. Bears pale green, hairy, sticky leaves; its flowers, 2 in. long and 2 in. across, appear in August. The mixed strains such as Emperor Glosinialloa or Bolero have blooms of crimson, scarlet, blue, yellow and primrose, often veined, margined and slashed with gold.

SALVIA (SAGE) Hardy
A very large genus of which the hardy Salvia horminum (often listed as clary) and the half-hardy S. splendens are best known.

Salvia horminum (clary), 1½ ft. Makes a bushy plant, with spikes of showy bracts useful for cut flower arrangements from June to August. Pink, purple, blue and white forms are available, and all are found in the Monarch Bouquet Mixed.

Salvia splendens (scarlet sage), 8 to 12 in. Well-known brilliant scarlet bedding plant. At its best in the Blaze of Fire (1 ft.) and dwarf Scarlet Pigmy (6 in.). Salmon, pink and violet forms are also available. Summer-flowering.

SCABIOSA (ANNUAL SCABIOUS, PINCUSHION FLOWER) Hardy
A lovely flower, in a number of colours, from late July to September. Good for cutting. Likes light soil, sunny position. Sow seed early April where plants are to flower and thin out to 1 ft. apart, or sow in the greenhouse in March and plant out in May for earlier flowering.

Scabiosa atropurpurea, 2 to 3 ft. Long-stemmed flowers of blue, crimson, pink, maroon, salmon, yellow, pink and white in separate colours or as a mixture, of which the cone-shaped Cockade is best. A dwarf 1½ ft. mixture is also available.

TAGETES (AFRICAN AND FRENCH MARIGOLDS) Half-hardy
Brilliantly coloured yellow, golden, orange or red-bronze flowers, with a pungent scent some people find objectionable. Often used for bedding. Sow seed in greenhouse in March, harden off in April and plant out late May.

Tagetes erecta (African marigold), 1 to 2½ ft. Tall, intermediate and dwarf varieties available in a range of chrysanthemum, carnation, quilled and regular double forms. A selection is best made from a catalogue. The tall varieties are ideal for the back of a border and the dwarf, such as Spun Gold, for edging. Flowers in July.

T. patula (French marigold), 9 to 15 in. A dwarf range of plants with double and single flowers in August on compact plants; ideal for bedding out and edging. The Petie range are very good dwarf doubles; Dwarf and Dainty Marietta are excellent singles in yellow and crimson.

T. signata, 8 in. Normally listed simply as tagetes; the pumila varieties such as Golden Gem, Gnome and Lulu (canary yellow) cannot be excelled as edging or bedding plants. Summer-flowering.
**Tropaeolum (Nasturtium)** Hardy
Has brilliant, showy, scented flowers, in both dwarf and climbing types. The latter are used to cover fences and sheds. Sow seed in April where plants are to flower, thin out to 1 ft. apart.

_Tropaeolum majus_, 1 ft. and climbing. The popular summer-flowering garden nasturtium, climbing and trailing, with yellow, orange and scarlet spurred flowers. Many dwarf and compact types have been developed, and they are divided into dwarf Tom Thumb, semi-tall Gleam, and dwarf double or Globe. All are best on a poor, dry soil otherwise the flowers are hidden by the foliage. On rich soil, the varieties Cherry Rose and Jewel Mixed are good, as their flowers are held above the leaves.


**Ursinia (Jewel of the Veldt)** Half-hardy
Members of the daisy family with brilliant colours of orange and yellow. Plants flower at their best from July to September in full sun. Sow seed in greenhouse in mid-March, harden off in April, plant out early May, 9 in. apart, or sow outdoors in late April.

_Ursinia anethoides_, 15 in. Finely cut foliage and vivid orange daisy-like, purple-centred flowers on thin stems.

**Vernidium (Namaqualand Daisy)** Half-hardy
Brilliant orange, daisy-like flowers borne in profusion from July to September. Good for cutting. Sow seed in greenhouse in April, harden off and plant out in late May, 1½ ft. apart, or sow in flowering positions in late April.

_Vernidium fastuosum_, 2 to 2½ ft. Brilliant orange flowers 4 in. across, with a large shiny black disk. Leaves and buds covered with silvery white hairs. A number of hybrids and varieties are available.

**Verbena (Vervain)** Half-hardy
Good bedding-out plant with brilliant red, blue, pink, lilac or white flowers from July to October. Sow seed in greenhouse in late February, harden off in April and plant out late May in well-manured soil.

_Verbena canadensis_ (syn. _V. aubletia_), 1 ft. The compacta form has rosy-mauve heads of flower on a neat, open plant.

_V. hybrida_ is really a perennial but is usually grown as an annual. Bushy plants with clusters of flowers 1 ft. high in the _V. h. grandiflora_ Mammoth types, and 9 in. high in the Sparkle forms, which are the neatest and best for edging and bedding.

**Zinnia** Half-hardy
Brilliant, tall and dwarf varieties for bedding and cutting, with yellow, red, pink, lilac, mauve, orange and white flowers. Sow seed in greenhouse in March, harden off in May and plant out in early June, or sow outdoors in early May, after treating the seed with a seed dressing.

_Zinnia angustifolia_ (syn. _Z. mexicana_, _Z. haageana_), 1 ft. A number of attractive free-flowing types which do well from an outdoor sowing, especially the double-flowered Persian Carpet Mixed, which has many unusual bicolours.

_Z. elegans_, 6 in. to 2½ ft. A number of types flowering in summer and autumn have been developed; these include three divisions: “tall” 2½ to 3 ft.; “intermediate” 1½ to 2 ft.; “dwarf” 6 to 18 in.

Tall: Giant dahlia-flowered, a regular double form. Giant of California, larger and more domed than giant dahlia type. Super Giants have quilled petals and chrysanthemum-like flowers.


Dwarf: Pumila, 1¼ ft., regular double flowers. Lilliput, 1 ft., dwarf with double regular flowers. Thumbelina, 6 in., very dwarf form excellent for edging.
BIENNIALS

Biennials are plants which occupy two growing seasons from the seedling stage to the production of ripe seed; they grow during the first season and flower, fruit and die in the second. In the garden the seeds of biennials are sown in the open any time from about the middle of May to the end of August. The earlier sowings give the better results because good plants are established before the winter. The seeds of biennials are sown in rows and the seedlings are either thinned out or put into reserve beds; finally the plants are moved into their permanent quarters before the winter.

SEED SOWING
Prepare a seed bed as for annuals or vegetables and, once the seed bed is level and the surface of the soil is fine, use the corner of the draw hoe against a tight line to make little drills of suitable depth and 9 in. apart. Sow the seed thinly in these drills, then use the rake to cover them. If the weather is very dry, it may be necessary to water the rows after sowing. Soak the soil thoroughly by using a sprinkler, leaving it in position for at least an hour; to water for less than this is of very little value.

CARE OF SEEDLINGS
The moment the seedlings come through, hoe lightly between the rows to keep down the weeds and, when the plants are about 1 in. high, thin them out to 6 in. apart. Transplant the thinnings 6 in. apart into nursery beds, which should be prepared in the same way as the seed bed. Never allow the seedlings to grow thickly in the rows, or the plants will be "drawn" and will not survive the winter.

During the early growing stages, pests may attack the plants. There is the little black, hopping flea-beetle which invariably attacks wallflowers and there are aphids of various kinds, which may attack other plants. Use Lindex as a seed dressing and after germination as a spray against the flea-beetles, but for the aphids liquid derris is good as well. If the plants are somewhat yellow in colour when they are about 3 in. high, apply a little fish manure along the rows at 1 oz. per yd. and lightly hoe it in.

PLANTING OUT
When the time comes for planting out, dig up the plants from their nursery beds with as big a ball of soil as possible. This is easier to do if the ground is well watered the day before. Put the plants with their balls of soil into shallow trays so that they can be carried without breaking up the soil. Prepare good-sized holes with the trowel so that the ball of soil may be inserted with the minimum of disturbance. Water the plants in well with a can or hose, watering the side of the hole before covering in, to settle the soil round the roots, or give them artificial rain with a sprinkler for at least half an hour. It may be necessary to water again three days later if the weather is dry.

If the season proves dry, mulch the bed with sedge peat or leaf mould. This mulch not only holds the moisture in the ground but also smothers weeds and provides humus for the soil. Do not allow
biennials to remain in the bed after they have finished flowering. Pull them up and put them on the compost heap.

**POPULAR BIENNIALS**

**CAMPANULA (BELL FLOWER)**
There are many kinds of campanula, the most popular being the Canterbury bell. All prefer a deep soil rich in humus, and an open semi-sunny spot. Fork in bone meal lightly at 4 oz. per sq. yd. Sow the seed in June in a reserve bed and plant out in September.

*C. medium* (Canterbury bell), 1 to 4 ft., flowers in July. There are a number of varieties, usually listed under their colours; some have cup-and-saucer-like flowers and some bear double blooms in mixed shades of blue, pink and white.

*C. pyramidalis* (chimney bell flower), may grow to 4 ft. when planted in a sheltered spot. Produces pale blue saucer-shaped flowers each measuring 1 in. or more in diameter, blooming in succession from July to September.

**CHEIRANTHUS (WALLFLOWER)**
Shrubby plants up to 1 ft. high, with spikes of velvety flowers in reds or yellows. There are many different types—dwarf, tall and winter-flowering. All are very widely grown as spring bedding plants. Sow seed in May in rows 9 in. apart and plant out in the reserve bed, 1 ft. apart, about July, during showery weather. Early in October put the plants out where they are to flower. Pinch out the growing points of the plants when they are 4 in. high to encourage bushy growth.

*C. allionii* (Siberian wallflower), 1 ft. One of the most popular plants for early summer bedding, flowering a little later than the true wallflower and lasting longer.

*C. cheiri* (the true wallflower), 1 to 2 ft. Used extensively for spring bedding; very sweetly scented. Named varieties have orange, yellow, red, pink and brown
flowers in spring and early summer. They prefer well-limed soils and will grow in partial shade or full sun. The dwarf Tom Thumb type is suitable for window boxes.

**CYNOGLOSSUM (CHINESE FORGET-ME-NOT, HOUND’S TONGUE)**

Similar to the forget-me-not but taller, with arching sprays of tiny flowers and rough leaves. It thrives in any ordinary soil. Sow the seed in June and plant out in September or April.

*Cynoglossum amabile*, 2 ft., produces masses of bright blue, pink or white flowers in June and July.

**DIANTHUS (SWEET WILLIAM)**

Plants produce largish groups of small, sweet scented, velvety flowers in flat flowerheads. They do equally well in partial shade or sun. Sow the seed in June, plant out in September 1 ft. apart.

*Diathus barbatus* (the true sweet William), 1 to 2 ft. Many varieties, such as Crimson Beauty, Pink Beauty, Scarlet Beauty, and the auricula-eyed strain. Good for cutting.

**DIGITALIS (FOXGLOVE)**

Tall erect plants, bearing long tubular white, purple or rose-coloured flowers. They prefer a moderately rich, partially shaded position and often seed themselves. Sow the seed in a reserve bed late in May, and plant out 8 in. apart in September where the plants are to flower. There is no need to sow seed each year to maintain a continuity of display, as digitalis seed themselves very freely.

*D. purpurea* (common English foxglove), 3 ft., bears large purple- or red-spotted flowers in June and July. There are some excellent hybrids (Excelsior) with florets carried all round the stem, and white, yellow or red flowers. The Shirley strain is magnificent and produces blotched and spotted flowers of great beauty.

**HESPERIS (SWEET ROCKET, THE DAME’S VIOLET)**

Grown for its beautifully scented white or purple flowers that are at their best from June until September. The most commonly grown is *Hesperis matronalis*. Sow seeds in late May, plant out in September 1 ft. apart.

*Hesperis matronalis*, strictly a perennial but always grown as a biennial. 3 ft., beautiful erect plant of which there are a number of varieties.

*H.m. alba*, 1½ to 2 ft., pure white.

*H.m. purpurea*, 1½ to 2 ft., deep mauve.

**LUNARIA (HONESTY, MOONWORT)**

Erect plants, 2½ to 3 ft. high, with attractive large purple or violet flowers, followed by flat disk-shaped seed pods which, when stripped, are silver and are widely used for winter decoration. Sow seed early in June, plant out in September 1 ft. apart.

*Lunaria annua*, quick-growing, with pink or purple sweet-scented flowers.

*La. alba*, white.

*La. Munstead Purple*.

**MATTHIOLA (STOCK) (see also under Annuals)**

Brompton stocks are biennials. Sow seed in June or July, and prick out the young plants 6 in. apart into a frame. They normally grow on until they are planted out in September where they are to flower the following summer. In the north of Great Britain it is necessary to overwinter in a frame for planting out in early May.

**MYOSOTIS (FORGET-ME-NOT)**

A much-used bedding plant because it produces a dense carpet of small sky-blue flowers. Prefers an open position or partial shade. Likes a slightly acid soil, rich in humus. Sow seed late in May, plant out in mid-September or early October, 6 in. apart.

*Myosotis alpestris*, 6 in., summer-flowering; good varieties are Blue Ball and Royal Blue.

**PAPAVER**

The poppies are mostly perennials but some are treated as biennials. Sow the seed in May where the plants are required to flower, because these plants resent disturbance. Thin the seedlings in two stages; thin them to about 3 or 4 in. apart.
as soon as they are big enough to handle, and, a fortnight later, to 9 in. apart.

_Papaver alpinum_, 6 to 8 in. An attractive rock garden or edging plant with white flowers. Sow seed at mid-summer and thin as required.

_P. nudicaule_ (Iceland poppy), is the most important species grown, and is treated as a biennial. It bears flower stems 1 ft. high and flowers in a range of colours from white, through yellow to orange. The Coonara varieties are very good, with excellent colours.

_VERBASCUM_ (mullein, blanket weed)
Tall, erect plants with woolly leaves and spikes of yellow, red, purple or white flowers. Prefer a moderately rich soil and, with the exception of the purple mullein, a sunny spot. Sow seed in June in a reserve bed, plant out in early September.

_Verbascum blattaria_ (moth mullein), 4 ft., huge spikes of bright yellow flowers with purple stamens and flowers in summer.

_V. hybridum_, 6 ft., pure yellow flowers all summer; the best known form is the Harkness Hybrid.
WITH their almost limitless variety of kinds, heights, colours and seasons of flower, hardy perennials offer the gardener a most satisfying return for his time, trouble and outlay. Although they are more expensive initially than bedding plants or other annuals, they are less expensive in the long run for, once planted, they live on from year to year. If a reasonably large selection is grown, flowers will be in bloom from February to November. Perennials make their greatest display during the period June to September, and although there is not a great blaze of colour during the winter months, it is a joy to see their modest displays while the majority of plants are lying low.

To achieve complete satisfaction, early, mid-season and late-flowering kinds should be planted. Either choose kinds that can adapt themselves to a given site, or choose a site suitable for the plants selected.

Until Victorian times there had been little scope for hardy perennials, which, being so varied, could not be confined and restricted in the then current formal styles of decorative gardening. So the herbaceous border emerged as a compromise, with plants growing more freely, but within straight lines. Though this became the conventional means of growing perennials, recent developments in design or layout have proved to be more satisfying.
HARDY PERENNIALS

It was not realized that, for freedom from trouble and for the most rewarding display, the conventional herbaceous border was not the best way to grow hardy perennials. An open situation is natural for the majority of plants since ample light and air are necessary for sturdy growth. Many will grow and flower where these essentials are lacking in some respect, but, depending on their adaptability, they are likely to fall short of the natural perfection of which they are capable.

LIGHT AND AIR
Many conventional herbaceous borders are conducive to weak growth. A hedge or fence as backing, the presence of trees or shrubs, and overcrowding among the plants themselves are all harmful. Not only is light often restricted by such overshadowing, but so is the free circulation of air. These restrictions make for stem weakness.

Another disadvantage of the conventional border is that many plants may be much too tall for so narrow a strip. In an open place with adequate spacing, such plants increase the number of their stems from year to year and keep to their normal height; in a narrow strip, with a wall, hedge or tree backing, they grow taller in their search for sun and air, and the result proves detrimental to shorter plants in the same border. But if this type of border is planted with discrimination it can be most satisfying.

SOIL
Most hardy perennials are very adaptable as to soil. Some plants like it to be richer or moister than others, but there is sufficient variety available from which to make the right selection for almost any situation. It is therefore possible to have perennials flourishing in any garden, even in closely built-up areas.

PREPARATION OF SITE
If possible choose a site where sun and air are not restricted, and aim for the maximum width possible. Destroy all perennial weeds. Couch, ground elder and nettles can be eliminated by chemicals or by thorough and repeated digging to expose them to sun and wind. Alternatively, they can be effectively buried. This involves trenching but is worth doing. With a spade skim off the few inches of top-soil that contain the roots of such weeds, upturn it in the bottom of the trench, tread in and then cover with 9 to 12 in. of weed-free soil.

MANURE
In general, hardy perennials do not demand richness, but if the soil is poor they do respond to manure. Farmyard manure, rotted compost or peat with fertilizer added are all of value. If the natural soil is dark with humus or is of good loamy texture, use only organic fertilizer at the rate of 2 or 3 oz. per sq. yd. to give the plants the good start that is important to them.

THE NARROW BORDER

ASPECT
As conventional borders face one way only, aspect is very important, especially if the backing is taller than most plants are likely to grow. Since most hardy perennials are sun-loving plants, choose a position facing more or less south. If only a northerly-facing border is possible it could be filled with plants that prefer shade. There is a sufficiently wide range to choose from, but these may be more difficult to obtain as most nurserymen tend to stock only the more popular sun-loving varieties.

WIND
Another factor to consider is wind, particularly the sudden storm or gale in
early summer which can play havoc with plants. A border sited along what might prove to be a funnel for strong winds—such as an east-west opening between buildings or a screen of trees or evergreens—needs more staking than a border in either a completely open or a completely sheltered position. Far less staking is needed if island beds are used for perennials.

HEIGHTS OF PLANTS
If only a narrow strip is available select plants accordingly, making allowance for whatever serves as a backing.

A hedge demands more space than a wall or fence, and some hedges, as well as spreading above the ground, have voracious roots that can take nutriment and moisture from 3 ft. or more on either side. On a light, sandy soil especially, a hedge will affect the border plants during a dry spell, so that, depending on the size or vigour of the hedge, 2 ft. might have to be allowed in a 5-ft. border, thus reducing the effective width to only 3 ft. when the time comes for planting.

A fence or wall is harmful only in its drawing or weakening effect on plant growth. Plants that are taller than a foot or two naturally lean away from any kind of backing as they run up to flower, and the closer they are planted to the backing the more they will lean. Take this factor into account when gauging the effective width of a border.

Dwarf plants look better than tall kinds in a narrow border.

A safe guide is to limit the selection of plants to those whose height is half the effective width of the border. For example, if the effective width of the border is 6 ft., it should contain nothing taller than varieties which grow to only 3 ft. Apply this ratio to all borders less than 12 ft. wide and place the plants in order of height, with the shorter-growing ones in front.

ISLAND BEDS
Island borders or beds are those that can be approached and viewed more or less all round. Growing hardy perennials in island beds is most satisfactory as it is more in keeping with their natural requirements. Light and air are not restricted, growth is therefore stronger, and normal height is maintained. Given adequate spacing and reasonable planning, perfection can be attained with the least effort and maintenance, and the fact that the beds can be viewed from all sides adds greatly to the charm. If mainly straight lines exist in the garden, a formal shape, such as oblong or oval, is best. But introduce informal shapes if these will fit in with the surrounding trees and shrubs. An island bed sometimes fits in perfectly with a group of shrubs, such as a promontory into a lawn, with only a narrow path between the shrubs and the plants in the bed.

SCALE
Island beds and conventional borders can be made to almost any scale. While they can be any length that is convenient, width should be limited to 30 ft. to allow access for maintenance.

MIDGET BORDERS
Midget beds or borders, which can be as little as 5 ft. wide, offer considerable scope to those with small gardens. Many hardy perennials are normally seen only in rock gardens, but they can be used as frontal groups in small beds. With heights ranging from 6 in. to 2½ ft. in a bed or border about 5 ft. wide, the effect can be both varied and very charming.

THE MIXED BORDER
It is possible to select perennials not only for different soils and situations, for flowering at required periods and for cutting, but for fragrance, for flowers
attractive to bees and for silver or grey variegated foliage.

Some plants will merge quite well with certain shrubs but should be chosen carefully. There is a fairly wide range of perennials available to plant as ground cover between flowering shrubs or trees. Some, especially those with an overall symmetry or stateliness, such as kniphofias and heucheras, look well between or in front of shrubs, but indiscriminate planting will result in harmful competition for light, space and nutriment.

**IMPROVING AN EXISTING BORDER**

Borders that were irrationally planned in the first place and which have since deteriorated can usually be improved. Very often the cause of trouble is that the border is too narrow for the tall plants it contains; that competition from trees, shrubs or a backing hedge is too fierce; or that light and air are restricted. The remedy may be simply to take out over-tall plants and replace them with others of lower stature; but the border may need a complete overhaul, with thorough digging and manuring, using again only those plants that are adaptable to the site, and making up with fresh and more suitable kinds. If possible, increase the width of a too-narrow border. If it adjoins a lawn, take in part of the lawn and dig in the turf, as this adds richness to the soil. When converting grass, whether lawn or rough, for plant cultivation, chop it up, dig in the top 3 or 4 in. of chopped turf, and cover with 10 to 12 in. of soil taken from below the turf so that the grass will not grow through.

If the only means of widening a border is by digging up a gravel path, this can be done quite successfully. Often a path that runs between the border and the lawn is not really necessary as the lawn itself provides suitable access. In many instances it would be far more rewarding to have a strip for access at the back of the border, between the tallest plants and the backing hedge or wall. This would also overcome the problem of plants growing too close to the backing. Provided the effective width is more than 8 ft., low-growing, early-flowering plants, such as *Veronica gentianoides*, could be grown in the front of this path, and would show to real advantage before the plants in the border itself grew tall enough to hide them from view. Arrange access by stepping-stones made from bricks or pieces of paving. A good maximum width for a one-sided border is 15 ft. with a rear strip in addition to provide access for maintenance work. With this width no height restrictions apply, but careful planning is necessary.
SELECTING PLANTS

Because hardy perennials as a whole are so adaptable and of such infinite variety, they offer enormous possibilities. But the right selection of plants is important, as it is through lack of attention to this point that failures occur or troublesome maintenance chores ensue. Lack of knowledge need not be a deterrent, as knowledge is something that grows with interest and experience, and foreknowledge of height, spread, colour and time of flowering can be gained from the list of suggested plants which follows.

Do not buy cheap plants, as these may well consist of divisions of older, less vigorous stock, or be immature and nondescript, all of which will certainly prove disappointing. Visit a good nurseryman to make a selection of quality plants, or study a hardy plant catalogue.

Although it may prove to be a little more expensive, it is well worth buying from a reliable nurseryman, as his plants will have been grown with skill and care and will give a good display in the first season. He has, or can obtain, the best varieties in the widest range.

Most specialists make up collections for border planting; but be sure that a collection made to fit a stereotyped plan is quite suitable to particular needs, soil and situation.

PLANNING

When a selection has been made, make a rough plan to scale on graph paper, then attach the names or reference numbers of each group to canes or sticks, or better still make permanent labels. Arrange these in position on the site in keeping with the plan. If no plan has been attempted, juggle the tags or labels about until satisfied that when the plants are ready to go in they will occupy the correct space, with all their growing factors accounted for.

Avoid flatness or too regular grading from dwarf to tall, as the best effect is gained from having adjoining groups of somewhat irregular heights. With plants that differ widely in form or shape when in flower, intersperse the bushy or flat-topped varieties with spiky plants, such as delphiniums, lythums or sidalces.

SEASON FOR EFFECT

The flowering season for perennials for effect extends from April to November, so it is possible to make a selection for any given period. Though this would provide a blaze of colour at the chosen time, most people prefer to aim for maximum continuity and particularly like plants with a long flowering period. Some kinds flower for three months while others, such as irises or paeonies, are past their best after three weeks.
Planning for continuity calls for careful placing. Do not plant kinds that flower about the same time in adjacent groups. Place those that make a brief show and then have to be cut back or remain untidy behind or beside such plants as Michaelmas daisies, which become bushes and flower later.

Some people plan to have adjoining groups which give effective colour contrast or blend, while others prefer an overall effect of colour blending. Very few colours clash amongst perennials, and discordant effects are even less likely if plants of similar habit and time of flowering are well interspersed with others of different form flowering later or earlier.

**Spread**

Some kinds grow and spread faster than others, and here, too, discretion in selection and planning contributes greatly to success. The more robust kinds such as monardas and many Michaelmas daisies may well have treble the annual surface spread of others, and if planted in adjacent groups will give trouble later on. They are better avoided if space is limited, particularly if variety and continuity are desired. In the second season after planting, a fast spreader may encroach beyond its allotted space into that occupied by something less robust, and such harmful aggression may call for annual curbing. The slowest spreading kinds are often the choicest. Vigorous spread is not confined to the taller kinds.

**Planting**

The best time for planting most hardy perennials is early autumn, up to about mid-October, when the soil is warm and quick establishment is easy. This will allow a full display the following year.

There are some plants, such as scabious, pyrethrums and *Aster amellus*, which are better put in in spring. However, a good nurseryman will deliver plants at the correct time for planting.

Avoid too much treading on damp soil, otherwise forking over will be necessary. If planting is not possible till spring some danger from over-dry soil may occur, though this seldom applies in autumn. If a fine sprinkler is available use it after planting, but if the soil is very dry and clotty or dusty, give the site a reasonable soaking a day or so before planting. If no sprinkler is available puddle in the plants, even in dry soil. Make holes with a trowel, insert the plants and cover the roots, fill the holes with water and when it has soaked in, replace the soil, making sure the plants are firm. Do not splash water from a can after planting. The drier the soil the heavier the firming should be, but on no account should wet, sticky soil be tightly jammed.

**Spacing and Grouping**

The best method is to plant groups containing several of each kind. Allow a greater distance between groups than between the individual plants comprising each group. The smaller bed or border needs three of a kind as a group, but the larger the scheme the larger the groups need to be. In a scheme 9 ft. wide by 50 ft. long, each group should have four to seven plants. If, for example, five plants comprise a group occupying 1 sq. yd., the spacing between the plants should be about 14 in. But between the groups in any direction there should be at least 20 in. This practice not only assists the natural spread, it also makes for easier hoeing etc., and allows freer access of light and air, which give strength to the stems, the plants stand more strongly and boldly as a group, and in many cases the need for supports is obviated. Slow-growing or dwarf plants need less space than those that are taller or more robust so choose between two alternatives—either have larger group spaces for the
robust kinds at the expense of the slow-growing ones, or, if equal group spacing is preferred, have fewer robust plants and more slower-growing kinds.

Some easy soils may need only pricking up with a fork in autumn and winter, but soils that are liable to pack tightly may need turning over in autumn or early winter. Avoid deep digging except in open spaces, and use a small flat-tined fork, or what is known as a border fork, rather than a spade.

**Weed Control**

Weed control is essential and is more likely to be necessary during the first season after planting than in successive seasons. Hoe annual weeds when they are tiny. Perennial weeds should not appear at all if the site has been thoroughly prepared, but sacrifice a plant or two rather than allow a really pernicious perennial weed, which may have been missed, to gain a hold. Couch, ground elder, creeping forms of sorrel, cress and buttercup are the most pernicious. Dig in annual grass, chickweed and other free-seeding weeds during winter, and never let them seed. Hoe any weeds that appear after planting. Annual weeds can thus be easily destroyed, and the less troublesome perennial weeds such as creeping thistle and bindweed will be weakened. Do not use chemical weed-killer when plants are in position.

**Staking**

Nothing detracts more from the beauty of the plants than sticks and stakes, and as no chore is more troublesome than staking, support only those plants that become floppy or top-heavy when in flower, putting in the stakes well before growth reaches that stage. Do not try to impose rigidity on plants that are naturally a little floppy. For tall plants, such as delphiniums, use a cane for each spike, otherwise use pea-sticks of varying heights; these are much more effective and less obtrusive. Well before buds open, place the pea-sticks in position, in and around groups that are likely to sag.

**Feeding**

Perennials vary in their response to nutrient. Give them a good start and they should not need manuring for at least two seasons. After that, depending on the quality of the natural soil, fork in old manure, rotted compost, or peat with added organic fertilizer any time between November and March. Apply a mulch when the soil has begun to warm up in April. Peat makes an excellent mulch, but if using it first scatter organic fertilizer at 2 oz. per sq. yd. between the plants. The covering of peat helps to retain moisture and keep down weeds.

Mulching is also helpful to certain plants that tend to lift out of the ground. Every three or four years it may be necessary to dig up, divide and replant them deeply; especially such plants as monarda and Michaelmas daisy, which make a rapid surface spread and exhaust their vigour in the process. Use only the outer, livelier portions for replanting and discard the rest.

The seemingly easy or cheap way into any garden venture often results in having to take the hard or expensive way out. Experience gained in this way is costly, yet if only foreknowledge with the discrimination it allows can be put into practice, so much more interest and satisfaction can be obtained. A few initial errors may be made, but these can so easily be remedied. A misplaced group, for example, will show itself in the first flowering season, and the remedy is simply to make a transfer in autumn or spring. No one yet knows everything about the behaviour, cultivation or arrangement of plants so do not be afraid to make cautious experiments to test the adaptability of perennials. Juggling with groups is part of the pleasure.
HARDY PERENNIALS

RECOMMENDED HARDY PERENNIALS

Each of the plants in this list is graded for spread and should be planted as shown in the following chart. These gradings apply to the spread of summer-flowering growth as well as to that of the plant itself.

Unless some regard is paid to the important factor of spread, unfair competition may result in losses or trouble. Though it should be borne in mind that both soil and climate play an important part in growth spread, these gradings can be taken comparatively. The main thing is to avoid adjoining groups of kinds having more than one degree of variation in growth spread. For example, it is safe enough to place S/2 next to either S/1 or S/3 but not next to S/4 or S/5.

ACANTHUS (BEAR’S BREECHES)
Fine for isolated positions where the handsome foliage and tapering spikes

<table>
<thead>
<tr>
<th>Grading</th>
<th>Plants per sq. yd.</th>
<th>Approx. spacing in group</th>
<th>Space required between adjoining groups</th>
</tr>
</thead>
<tbody>
<tr>
<td>S/1</td>
<td>6-9</td>
<td>6-10</td>
<td>12-18</td>
</tr>
<tr>
<td>S/2</td>
<td>5</td>
<td>10-12</td>
<td>18-20</td>
</tr>
<tr>
<td>S/3</td>
<td>4</td>
<td>12-14</td>
<td>20-24</td>
</tr>
<tr>
<td>S/4</td>
<td>3-4</td>
<td>14-16</td>
<td>24-28</td>
</tr>
<tr>
<td>S/5</td>
<td>3</td>
<td>16-18</td>
<td>28-30</td>
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</tbody>
</table>

PLANTINGS FOR A BORDER In this one-sided border, 2½ ft. by 9 ft., there are five plants in each group:

Anthemis 'Mrs. Buxton'
May–Sept.
2½ ft.

Aconitum 'Bressingham Spire'
July–Aug.
3 ft.

Anthemis 'Mabel Reeves'
Autumn
3 ft.

Aster amplexicaule atrosanguineum
June–Sept.
4 ft.

Achillea 'Gold Plate'
July–Aug.
5 ft.

Aconitum 'Bressingham Spire'
July–Aug.
3 ft.

Hemerocallis Orange
June onward
3-4 ft.

Scabiosa 'Clive Greaves'
June–Sept.
2½-3 ft.

Anaphalis yedoensis
Summer
2½ ft.

Phlox 'Red Indian'
July–Sept.
3 ft.

Geranium grandiflorum
June–July
1 ft.

Erigeron 'Darkest of All'
May–June
2½ ft.

Heuchera 'Oakington Jewel'
May–July
1½–2 ft.

Potentilla 'Yellow Queen'
June–Sept.
1½ ft.

Aster 'Blue Bouquet'
Autumn
15 in.

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can be seen entire. They associate well with shrubs, are drought resistant, deep rooting and long lived. They like sun or partial shade and cannot tolerate damp, heavy soil. In the coldest districts may need a covering of bracken or leaves as winter protection.

Acanthus mollis, S/4. Large, dark green leaves and 3- to 4-ft. spikes of whitish, hooded flowers in July and August.

A. spinosus, S/4. Freer flowering than A. mollis. Purple-white flowers, each protected by a sharp spine, on 3- to 4-ft. spikes from June to August. Leaves appear prickly, but are not so. Divide in spring. Achillea (Yarrow, Milfoil)
Vary greatly in height and appearance but all have pungent foliage and do best in sun and well-drained soil. Divide in spring. Good for cutting.

Achillea clypeolata, S/3. Forms clumpy plants of silver-grey leaves, with flat heads of deep yellow flowers on about 20-in. stems for many weeks between June and August. Likes dry places in sun. Not worth attempting in damp districts or in damp soil, as over-exuberant growth in summer leads to rotting off in winter.

A. filipendulina (syn. A. eupatorium), S/3-4. One of the most reliable of tall border plants, reaching 3 ft. without supports. Deep yellow, plate-head flowers between June and September, continuity being encouraged by cutting. Green filigree leaves. Not fussy as to soil and seldom needs replanting.

‘Coronation Gold’, S/3-4. 3 ft. An excellent hybrid. Bright golden-yellow flower heads, smaller than ‘Gold Plate’, are produced very freely from July to August, and are equally good for cutting.

‘Gold Plate’, S/3-4. 5 ft. The best-known variety. Has deep golden-yellow flowers from July to August.

A. ‘Moonshine’, S/3-4. 2 ft. Rather like a more robust A. taygetea, with much broader heads of glistening light yellow between May and July.

A. ptarmica ‘Perry’s White’, S/4. Double,

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Green areas indicate early- or late-flowering subjects

<table>
<thead>
<tr>
<th>Plant</th>
<th>Flowers</th>
<th>Height</th>
<th>Season</th>
</tr>
</thead>
<tbody>
<tr>
<td>Salvia haematodes</td>
<td>June-Aug.</td>
<td>4 ft.</td>
<td></td>
</tr>
<tr>
<td>Helenium 'Goldfox'</td>
<td>June-Aug.</td>
<td>3½ ft.</td>
<td></td>
</tr>
<tr>
<td>Sidalcea 'Wensleydale'</td>
<td>June-Aug.</td>
<td>4 ft.</td>
<td></td>
</tr>
<tr>
<td>Campanula lactiflora</td>
<td>June-Sept.</td>
<td>2½-4 ft.</td>
<td></td>
</tr>
<tr>
<td>Aster acris</td>
<td>Aug.-Sept.</td>
<td>2½ ft.</td>
<td></td>
</tr>
<tr>
<td>Erigeron 'Festivity'</td>
<td>May-June</td>
<td>6-8½ ft.</td>
<td></td>
</tr>
<tr>
<td>Solidago 'Golden Mosa'</td>
<td>Late summer</td>
<td>2-3 ft.</td>
<td></td>
</tr>
<tr>
<td>Philox 'Marlborough'</td>
<td>July-Sept.</td>
<td>2½-3 ft.</td>
<td></td>
</tr>
<tr>
<td>Coreopsis verticillata</td>
<td>June-Aug.</td>
<td>1½ ft.</td>
<td></td>
</tr>
<tr>
<td>Sedum 'Autumn Sun'</td>
<td>Autumn</td>
<td>2 ft.</td>
<td></td>
</tr>
<tr>
<td>Cynoglossum nervosum</td>
<td>June-Aug.</td>
<td>1½-2 ft.</td>
<td></td>
</tr>
<tr>
<td>Incarvillea delavayi</td>
<td>Midsummer</td>
<td>18-20 in.</td>
<td></td>
</tr>
<tr>
<td>Eryngium bourgati</td>
<td>July-Aug.</td>
<td>2 ft.</td>
<td></td>
</tr>
</tbody>
</table>
White flowers ½ in. across on 3-ft. stems, which branch near the top, from June to August. Good for cutting. Often needs staking. Divide every three or four years or flowers will deteriorate. Roots are like congested couch but not dangerously invasive.

'The Pearl', S/4. Similar to A. ptarmica.

A. taygetea, S/2. Grey foliage, stiff 1½-ft. stems of light yellow flowers on broad heads from late May to July. Divide and replant every three to four years. Some named varieties and some crosses between the species mentioned above are good garden plants.

ACONITUM (MONKSHOOD)
The following are all adaptable for a wide range of soils. Most of them will grow in semi-shade as well as sun, and though finer spikes come when replanting in enriched soil every three or four years, they can remain without attention for a long time. Staking is not usually needed. Roots are poisonous if eaten, and care should be taken in the handling of these plants, especially if there are cuts or abrasions on the hands. Good for cutting.

Aconitum arenstsi, S/2-3. An intermediate cross with A. wilsonii and A. fischeri combining the best features of both. Blue flowers from August to early October. Spikes are erect, reaching 4 to 4½ ft. on unbranched stems.

A. fischeri (syn. A. caricmichaelii), S/2. A fine autumn-flowering plant with sturdy 3- to 4-ft. spikes carrying large hooded flowers of amethyst-blue near the top. Stems are well clothed with shiny, jagged leaves. Needs good, moist soil.

A. napellus bicolor, S/2. 3½ ft. A first-rate plant with branching spikes carrying very pretty blue and white flowers in June and July.

'Bressingham Spire', S/2. 3 ft. Deep violet-blue flowers on tapering spikes in July and August, and dark green varnished leaves covering the stem.

'Newry Blue', S/2-3. Similar in colour to 'Bressingham Spire' but a little taller and earlier to flower, with spikes more loosely branched.

'Spark's Variety', S/2-3. 4 ft. Even more branching habit than 'Newry Blue'. Deep violet-blue flowers in June and July.

A. wilsonii, S/2-3. Best in 'Barker's Variety'. Spikes often exceed 6 ft. and need supports. Large, glistening, lavender-blue flowers in September and October.

AGAPANTHUS
These are fully hardy and worthy border perennials. Strap-like or rushy leaves appear in spring, and from July to September come smooth stems carrying heads of blue trumpet-shaped flowers, long lasting both on the plant and in water. In good soil, not too dry, stems are 2½ to 3 ft. tall. Plants become massive in time and flowering is improved by feeding and watering when dry. Severe winters may retard spring growth, so do not disturb plants until this appears. All are better in sun. Good for cutting.

Agapanthus umbellatus, S/3. The older, more usual name for the type most often seen, although it is sometimes listed as A. africans. It has several variations.

A. u. morelensis (syn. A. u. campanulatus), S/2. One of the best. Strong stems and good heads of mid-blue flowers.

A. u. minor, S/2, 20 in. A dwarf form of A. u. morelensis. Flowers very freely in late summer.

'Blue Giant', S/2, Larger blue flowers than A. u. minor, often on 3-ft. stems.

AJUGA (BUGLE)
These plants make excellent ground cover, the tallest being only about 1 ft. high in flower. Ajugas flourish even in dry, shady places and need very little attention in any position. They may also be effectively used in the front of open beds or borders. If vigour flags after a few years top dress with soil.

Ajuga genevensis, S/4. 6 to 12 in. Blue, rose or white flowers in June and July.

A. multicolor 'Rainbow', S/4. Leaves are bronze with buff and purple markings. Blue flowers on 6-in. spikes in spring.

A. pyramidalis, S/2-3. The finest for flowering, having 9-in. spikes of gentian-blue from May to July. Likes some shade and prefers soil not too dry.

A. reptans purpurea, S/5. 6 to 12 in. Bronzy-purple flowers in June and July.

ALTHAEA

Althaea rosea (hollyhock), S/4. 8 ft. or more. Being very tall, hollyhocks are best planted against a background wall or fence where there is ample space. Choose a sunny position. Hollyhocks are short lived, and replacements will probably be needed after the first flowering, which takes place in July. Use young plants for replacements, since old ones do not move well.

During a damp season, or if planted in rich soil, hollyhocks are prone to rust disease; badly affected plants should be burnt. Both double and single hollyhocks are available in many colours.

ANAPHALIS

Grey- or silver-leaved plants, easy to grow, carrying heads or sprays of whitish daisy flowers of crisp, everlasting texture. Though flowering best in sun and drier soils, they will grow quite happily in some shade. Surface spread makes quite effective ground cover. Heights vary. Good for cutting.


A. yedoensis, S/4. 2 to 2½ ft. This has slowly-creeping, underground shoots which run to flower quite erectly in a flat head of white crisp flowers, useful for cutting in summer. Stems become massed and are pleasing with their silvery leaves from spring onward. Divide in spring.

ANCHUSA (ALKANET)
The brightest of the anchusas are the least reliable. Though the italicica varieties are popular, they are not very long lived, and are best in sun and dry soils. Roots are thick and fleshy, leaves and stems roughly hairy and often need supporting.

The bright show they make in early summer is apt to leave an unsightly gap when flowering is over in July.


‘Morning Glory’, S/3. 4 ft. Heavy, branched spikes of bright blue flowers in early summer. Has superseded the old ‘Dropmore’.


A. angustifolia (syn. A. caespitosa), S/2. Not long lived nor easy to increase, but still worth while for the sheer brilliance and continuity of its display of blue for much of the summer. Flowers are small but come in their hundreds on 12-in. sprays arching out from a compact deep-rooting plant. Much the best and longer lived in poor, dry soil in full sun.


ANTHEMIS

These members of the daisy family need full sun and well-drained soil. Bright, free flowering and good for cutting, some are untidy in growth. Cut hard back after flowering to encourage basal growth for over-wintering.

Anthemis cupaniana, S/3. 6 in. White marguerite flowers on silvered filigree foliage from May to August.


A. ‘Sancti-Johannis’, S/3, 1½ ft. Bright gold flowers between June and September, but smaller flowered, more compact and longer lived than ‘Beauty of Gllagh’ and ‘Grallagh Gold’.

A. tinctoria, S/4. The parent of several varieties, the brightest of which are:

HARDY PERENNIALS

'Gallagh Gold', S/A. Rich yellow and gold flowers, 2 in. across, carried loosely on rather flabby bushy growth to 2 ft. or so for many weeks between June and September. Not reliably perennial, though behaviour seems to vary according to district.

'Mrs. Buxton', S/3. 1 ft. The best of the light yellow varieties, flowering from May to September. Reasonably erect and needs much less frequent division and replanting than others to maintain perennial vigour.

ANTHERICUM

Anthericum lilio (St. Bernard's lily), S/1, and the closely related Parthenium liliostrum (St. Bernard's lily), S/2. Both have narrow, rusky leaves from a compact, trouble-free plant and small white trumpet flowers from smooth stems about 2 ft. high in June. Pretty, easy in sun or half shade but soon over with a rather long period of dormancy.

ANTHOLYZA

Antholyza pamialata, S/3. Grows like a stout montbretia with good rusky foliage. Gives no trouble and provides fine sprays of dark orange flowers on 3 ft. wiry stems in July and August. Corms are quite hardy and can be left alone for several years. Good for cutting.

AQUILEGIA (COLUMBINE)

Though many species exist, interbreeding makes it difficult to keep aquilegias true to name or character since they can be increased only by seed. Seedlings flower in their second year, and having once flowered, vitality decreases, so be prepared with replacements. Good mixed strains exist as well as selected varieties, which come almost true from seed. Groups of any of the following add much to the gaiety of early summer flowers. Plant in sun or partial shade. Good for cutting.

'Blue King', 'Celestial Blue', 'Coral Pink', S/A. Similar height and form to 'Crimson Star'.

'Crimson Star', S/2. 1 ft. Large red and pale pink flowers.

McKana Hybrids, S/2. 3 ft. Have now ousted the once-popular Scott Elliott's,

From mixed strain, they have a wide variation in colour and long-spurred flowers. Plant in good soil.

ARMERIA (THrift)

These are reliable for the front of a border. All form tufts, evergreen clumps or mats from which come drumstick heads of flowers in early summer. Plant in a sunny position. Good for cutting.

Armeria 'Bee's Ruby', S/2. 15 in. First rate in every respect, with heads of glistening pink from early June till late August.

A. maritima alba, S/3. White, similar in growth to A. m. 'Vindictive'.

A.m. 'Vindictive', S/3. 6 to 8 in. Rosy-red flowers. Makes a fine edging plant.

ARTEMISIA

Only one of these, Artemisia lactiflora, is of value as a flowering plant, but others are most effective for foliage in late summer. All are of easy culture and have aromatic foliage. The silver-leaved species prefer sun or poor or dry soil and can be used effectively as foils to flowering plants.

Artemisia abrotanum 'Lambrook Silver', S/3. 4 ft. Makes a sizeable bush up to 3 ft., but dies back to a compact woody root in winter.


A. lactiflora, S/2. Ranks highly because of its stately plumes of creamy-white flowers which reach 4 or 5 ft. Stems are well clothed with jagged leaves. No supports are needed. Plant in good, moist soil.


ARUNCUS

Arnica sylvestris (syn. Spiraea aruncus), S/4. 3 ft. A plant of noble appearance, having strong, erect plumes of tiny milk-white flowers in June. Although this is an adaptable plant, it prefers good moist soil with some shade.

A.t. 'Kneiffii', S/2. 1 ft. Needs shade and moisture to show off its drooping plumes of creamy flowers to full advantage in June. Leaves also droop and are very prety laced.

ASTER

These include Michaelmas daisies as well as several popular garden plants, most of which are easy to grow. All prefer sun. Good for cutting.

PLANTINGS FOR AN ISLAND BED

Campion

Solidago 'VNextage'

Dianthus

ToT 'Tom Thumb'

Gypsophila

'Pink Star'

Penstemon

diffusus

Anchusa

angustifolia

Erysimum

calloglossum

Dierama

divinum

Dentonia

cissiflora

This island bed, approximately 18 ft. is suitable for a sunny spot. In each group there are three plants. Green areas show early- or late-flowering subjects
Aster acris, S/2, 2½ ft. in the type, rather less in the dwarf form namus, S/1. Makes an effective, neat, bushy mound of small, light blue, starry flowers in August and September. Likes sun.

A. alpellus 'Triumph', S/2, 6 to 12 in. hybrid. Blue flowers all summer.

A. alpinus, S/1, 6 to 9 in. Single blue, mauve or pinkish flowers in May and June. Useful near front of border but not spectacular.

A. amellus, S/2-3. This is an important group of real value for late summer and autumn. Stems are dwarfer but more erect than Michaelmas daisies; flowers are often 2 in. across with rayed petals from a yellow centre. Heights vary from 20 to 30 in. Plants grow very compactly and once established should be allowed to remain a few years. Divide in spring.

Good blue varieties are:

'Advance', 'Bessie Chapman', 'King George', 'Moerheim Gem', all S/2-3; 'Frikartii', S/2, is a hybrid with flowers of similar size and form but stems that branch profusely to about 3 ft., carrying light blue flowers for weeks between July and September.

'Mauve Beauty' and 'Nocturne', a deep lavender. Both S/2-3, good and robust in growth.

Best pink shades include:

'Lady Hindlip', 'Mrs. Ralph Woods' and 'Sonia', all S/2-3.

A. cordifolius, S/2. 4 ft. Grows compactly as a plant but stems are willowy and often need support. Small, graceful flowers in September and October. Stake carefully.

'Ideal', S/2, blue.

'Silver Spray', S/2, whitish-lilac.


'Blue Star' and 'Ringedove', both S/2-3, have slightly blue flowers.

'Brimstone', S/2-3, yellowish.

'Delight', S/2-3, white with yellow centre.

A. fareri, yunnanensis and tongolensis (syn. A. subcaeruleus), all S/2-3, are the best known of early-flowering asters. Large blue, orange-centred rayed flowers on 1- to 1½-ft. stems from mat-like growth in late May and June. The best known is 'Napsbury', S/2-3, and this, more than others, needs dividing and replanting every second year to retain vitality. A more reliable variety is 'Berggarten', S/2-3, with fine violet-blue flowers in June.

A. linosyris (Goldilocks), S/2. A neat plant carrying heads of pretty golden fluffy flowers on willowy 2-ft. stems in August and September. Gives no trouble.

A. novae-belgii, S/3-4. Generally accepted as the true Michaelmas daisy, varieties of which have come much to the fore in recent years. Needs rather frequent attention to give of their best. Finer flowers come from young plants. To overcome the deterioration that sets in after the first season or two, replant vigorous outer shoots and discard the remainders of old plants. Destroy plants if verticillium wilt appears. Symptoms are wilting leaves and distorted growth well before the flowering season. In some localities and seasons mildew is liable to attack many varieties of Michaelmas daisy, so spray them with flowers of sulphur or a similar preparation. Great advances have been made in range of height and colour and in size of flower. Flowers in autumn. The tallest varieties give most trouble, but several varieties exist in the 1- to 2½-ft. height range which need no staking. Those of 3 ft. or more in height, all S/3-4, include:

'Blandie', white.

'Blue Bonnet', blue.

'Elegance', purple-blue.

'Fair Lady', lilac-mauve.

'Fellowship', clear pink.

'Mabel Reeves', deep pink.

'Marie Ballard', light blue.

'Orchid Pink', pink.

'Pride of Colwall', claret-red.

'Sarah Ballard', deep mauve.

'Tudor Rose', bright pink.

Some good varieties under 3 ft. which need little or no staking include:

'Blue Radiance', S/3. 2½ ft., blue, large flowered.

'Crimson Brocade', S/2. 2½ ft., crimson.
‘Royal Velvet’, S/2. 2½ ft., deep blue near-double flowers.
‘White Swan’, S/3. 2½ to 3 ft., white, compact.

The really dwarf varieties are indispensable for frontal positions. Some have considerable outward spread, forming wide bushes covered in flower during autumn. These include:

‘Alice Haslam’, S/3. 9 in., bright rose flowers.
‘Dandy’, S/3. 9 to 15 in., purple-red.
‘Little Red Boy’, S/3. 1 ft., red, very good.
‘Margaret Rose’, S/3. 9 in., pink.
‘Pink Lace’, S/3. 1 ft., pink.
‘Rose Bonnet’, S/3. 1 ft., pink.
‘Rosebud’, S/2. 10 in., mauve.
‘Snowsprite’, S/3. 15 in., white.

**ASTILBE**

These superb plants prefer shade and moisture. They are fully hardy, long lived, with graceful spikes of flowers, often brilliantly-coloured, and very attractive foliage. Plants form woody crowns and may become quite massive where happy in good, moist soil. Deeply cut leaves emerge in spring, bronze or purplish in some varieties, and by June the plants make graceful but dense mounds, with stems that spray out into delicate tapering or pendant spikes of countless tiny flowers. They are excellent waterside plants and can be left undisturbed for years when happy. Provide extra moisture by sinking a deep tin or a drain-pipe into the soil between the plants, and fill this occasionally with water to percolate to the roots of the plants. It is possible to obtain varieties to be in flower from June to September.

Astilbes vary in height from a few inches to several feet. The taller ones are easiest to grow and the following 3- to 4-ft. varieties are all strong growing:

‘Salmon Queen’, S/3-4, salmon-pink.
‘Venus’, S/3-4, pale pink.

Good varieties in the 2½ to 3 ft. range include:

‘Amethyst’, S/3, lilac-rose.
‘Federsee’, S/2, rose-red.
‘Granat’, S/3, deep pink.
‘Ostrich Plume’, S/3, pink.
‘Spinell’, S/3, bright red.

Dwarf varieties, between 10 and 20 in., are more partial to moisture for a good display. These include:

‘Cobulence’, S/2, fiery carmine.
‘Deutschland’, S/2, white.
‘Fanal’, S/2, deep red.
‘Irlicht’, S/2, white.
‘Red Sentinel’, S/2, deep red.
‘Rhineland’, S/2, early, clear pink.

*Astilbe simplicifolia atro rosea*, S/2-3. 5 in.

Makes a very fine plant and is not so fussy about moisture as the other dwarf varieties.

**ASTRANTIA (MASTERWORT)**

These are curious but charming plants although they lack colour. They are suitable for any but dry situations, adaptable for shade, and flower from June to August. Good for cutting.

*Astrantia carnélica*, S/3; *A. major*, S/3-4.

Greenish starry flowers, tinged with pink, on erect stems branching at about 2 ft. to form a loose head.

*A. maxima*, S/3-4. 3 ft. Heads of rosy flowers of considerable appeal.

**BERGENIA (ELEPHANT EAR)**

The chief attractions of bergenias are their stumpy spikes of mainly pink flowers in very early spring and their quite large dark green leaves. They are fine for shady places but will do just as well in sun, and remain, slowly spreading for several years. Best for frontal positions. Most bergenias are difficult to obtain but are well worth seeking.
The number of plants in each group varies according to the size of each kind. Green areas indicate early-flowering perennials.

**Ageratum houstonianum**, S/3, 9 in. The species most often seen. Large reddish flowers in March and April, and heart-shaped leaves 9 in. across.

**Aster beckwithianus**, S/3, 2 ft. Also known as A. beckwithii. Lilac-blue flowers in June and July. A firstrate plant which has no special needs. Suitable for sun or partial shade.

**Campanula carpatica**, S/2, 9 to 18 in. Ideal for the front of the border. Varieties, all S/2 and all having sizeable cup-and-saucer-shaped flowers on neat bushy growth from June to August, include:

- **'Blue Moonlight',** pale blue.
- **'Bressingham White',** white.
- **'Chewton Joy',** pale blue.
- **'Convexity',** mid-blue.
- **'Isabel',** mid-blue.
- **'Mrs. Froot',** mid-blue.
- **'Wheatley Violet',** 6 to 8 in., deep-coloured, is a representative of the generally dwarfed varieties.
- **'White Star',** white.
- Other useful dwarfs are: **'Hannah',** S/2, white.
- **'Molly Finnsen',** S/2, lavender-mauve.
- **'Norman Grove',** S/1, mauve-blue with golden-green leaves.
- **C. muralis**, S/2, 6 in. Deep blue, very long flowering.

In the 1- to 2-ft. range, the following varieties are recommended:

- **C. allionii**, S/2, 2 ft. Creamy-white flowers from late May to August. Very free flowering, happy in sun and even hungry soil. May not live for more than two or three years, but self-sown seedlings usually appear.
- **C. glomerata**, S/2. Variable. Flowers between late May and August and needs no staking or special soil, though it grows best in sunny position. Varieties specially recommended are:
  - **C. glomerata**, S/1. Stumpy spikes only 6 in. high.
  - **C. acutifolia**, S/3, white. Similar to **C. acutifolia**.
  - **C. amplus**, S/2, 14 to 2 ft. Similar to **C. superba**.
  - **C. lactea**, S/2-3. Heights vary from 2 to 4 ft. Quite happy in sun but does not mind some shade. A very good deep-rooted plant with somewhat willowy stems carrying lavender open-petalled bells in terminal sprays between June and September. Good for cutting.
  - **Pritchard's Variety**, S/2. The deepest shade and obtainable true to colour. Grows compactly to 2 ft.
  - **Loddon Anna**, S/3, 4 ft. or more. Flesh-pink flowers. Distinctive.
  - **C. latifolia** (syn. **C. macrantha**), S/3. Stems come densely from a stocky root that gives no trouble at all. Pendant bells on clustered spikes reaching 2 to 3 ft. in June and July. Less continuous than some campanulas, but more adaptable and does not mind shade. Good for cutting.
- Variations include:
  - **C. latifolia**, S/3, white.
  - **C. latifolia**, S/4, pale mauve.
- **Brantwood**, S/3. One of the best violet-blue varieties.

**C. latifolia** (syn. **C. grandiflora**), S/3, 3 ft. Surface rooting, with quite erect stalks carrying 2-in. saucer-shaped flowers along most of their length in June and July. Best in sun, may need curbing after a time. Good for cutting.

**Highclere**, S/4, deep blue. Mat-like growth sometimes becomes patchy.


**C. lachnus**, S/4, white, not so free flowering.

**C. persicifolia**, S/2-3. Thin stems carrying wide-open flowers along most of their length from mid-June to August. Leaves are narrow and pointed from surface-rooting tufts which spread and often deteriorate with age, so that replanting is needed every two to three years. Colour varies and some varieties under 3 ft. are
more or less double flowered. Under the generic name alone may come white, pale and deeper blues, but all shades in both double and single can be obtained in named varieties from most catalogues. Though gay and graceful, damage occurs from high wind, and excessive wet may tarnish the double-flowered varieties especially. They are also sometimes attacked by rust disease which is difficult to check. Good for cutting.

**Catananche (Cupid's Dart)**

These are like perennial cornflowers, the petals being papery in texture though not everlasting. Flowers come in great profusion on wiry 2-ft. stems from June to September. Full sun and very well-drained soil are essential for longevity. Flower spread is considerable and often needs tying in. Cut back hard in September. Good for cutting.


*C. major*, S/3. Light cornflower-blue flowers. Is the finest variety, but can be increased only by root cuttings in spring, which will flower in the first year.

**Centaurea (Centaury, Knapweed)**

All centaureas love sun and are generally best in well-drained soil. Some varieties are aggressive.

*Centaurea dealbata*, S/4. 2-ft. stems carrying pink cornflower-type flowers from June to August emerge from ample greyish foliage. Robust. Good for cutting.

*C. steenbergei*, S/4. 2½ ft. A showy, long-lived plant, rather more robust than *C. dealbata* and with deeper pink flowers in June, July, August.

*C. glastifolia*, S/4. 4 ft. Yellow puffy flowers with scaly calyces in June and July. Stems and leaves are greyish. Quite handsome and out of the ordinary. Has less spread than *C. dealbata*.

*C. hypoleuca*, S/2–3. 6 in. Dwarf and dainty, like a midget *C. steenbergei*. Big pink flowers arch from silvery leaves in early summer. Needs sun and dryish soil.


*C. montana*, S/4–5. 1¼ ft. Makes spreading mats of grey leaves and has shaggy fork-rayed flowers that loll and are not easy to keep tidy. Pretty, easy to grow, and early flowering. Variations are pink, violet-purple, white and deep rose.

*C. ruthenica*, S/3. Slender but strong stems often 4 ft. tall, branching to carry five lemon-yellow flowers from June to late August. Foliage is deep green and shiny. A good species, deep rooted, not invasive and reliable. Good for cutting.

**Centranthus (Valerian, French Lilac)**

*Centranthus ruber*, S/4. 2 to 3 ft. Deep pink or reddish flowers which keep coming for weeks on end between May and August. Plants themselves may not live more than two or three years, but seedlings usually appear within or beyond the group. Bright, likes sun and poor soil.

**Cephalaria (Giant Yellow Scabious)**

*Cephalaria tatarica* (syn. *C. gigantea*), S/4–5, 6 ft., is the species usually available. Pale yellow, pin-cushion flowers from July to September. Rather too large for small gardens, but useful where something tall, massive and erect is needed. Long lived. Likes ordinary soil and sun or partial shade. Good for cutting.

**Chelone**

These are closely related to penstemons, especially

*Chelone barbata* (syn. *Penstemon barbatus*), S/3. Drooping, bright pink or scarlet tubular flowers along 2- to 3-ft. stems from June to August. Plants flower so freely in sunny positions that they tend to exhaust themselves. Encourage longevity by cutting back hard after flowering, or by dividing and replanting more deeply in spring.


*C. obliqua*, S/2. 2 ft. Pretty lilac-rose flowers on erect stems in late summer. Long lived, spreading by underground shoots that come through in spring. An unusual plant and even less common in the white form *alba*. Good for cutting.
CHRYSANTHEMUM
Chrysanthemum maximum (Shasta or moon daisy). 2 to 3 ft. White, double or single flowers from June to August. Prefers sun and well-drained soil. Divide and replant every two or three years. Good for cutting. Most reliable doubles, all S/2-3, are:
‘Esther Read’; ‘Jennifer Read’; ‘Moonlight’, very pale yellow flushed; ‘Wirral Supreme’.
Semi-doubles, all S/2-3 and all large flowered, include:
Good singles, all S/3, are:

CIMICIFUGA (BUGBANE)
These are really worth-while plants for not-too-dry soil. Slender, tapering spikes set closely with small, fluffy, white flowers in late summer or autumn make a perfect foil for Michaelmas daisies, etc. Jagged, dark green leaves show prettily for months before flowers appear. Stems are strong and wiry. Slow-growing and need no attention for years. Adaptable, but happiest in partial shade and good deep soil. They are all S/2-3 and good for cutting.
Cimicifuga cordifolia, 3 to 4 ft. Dainty spikes of creamy-white flowers from late August to October.
C. dahurica, Up to 7 ft. where moist. Later than C. cordifolia.

C. japonica, 4 to 5 ft. Has more foliage and thicker poker spikes than some cimicifugas. Flowers September and October.

C. racemosa, 4 ft. Abundant shiny foliage, with gracefully erect plumes from August to September. The varieties ‘Elstead White’ and ‘White Pearl’ are improvements and are those most likely to be available in nurseries.

C. ramosa, Similar to C. dahurica, but fuller spiked.

C Ricopeps
These are very popular plants with bright yellow flowers of the daisy type for many weeks in summer.

Coreopsis auriculata, S/4. Growth spreads out and up from a smallish rootstock to 1½ ft. or so. The 2-in. flowers often have a maroon blotch at the base of each fringed petal. Low-growing with a long succession of flowers, but not very reliably perennial. It prefers sun and light soil. Losses often occur in damp winters.

C. grandiflora, S/4, and C. lanceolata, S/4, 1 to 2 ft., and their variations are easily raised from seed but with the exception of ‘Badengold’ seldom survive more than two seasons. Growth is dark green and vigorous, and flowers are carried singly on wiry stems from June to September. Best in full sun.


C.v. grandiflora (golden shower), S/4. Similar to C. verticillata, but 6 in. taller and with flowers of deeper gold.

Crambe (seakale)
Crambe cordifolia, S/5. 5 to 6 ft. Too large for small gardens. Demands space and is magnificent where its clouds of white flowers can be seen against a background of trees or shrubs. Roots are massive, and leaves are cabbage-like. Flowering lasts only three to four weeks in late May and June.

Crinum

Crinum powellii, S/3-4. Large pink lily-like flowers on heavy 2-ft. stems from a massive bulb formed well below ground. Leaves are rushy and green and a little untidy. Hardy, but best in light soil.

Crocosmia

Crocosmia masonorum, S/1. From a corm, which needs to be planted 4 in. deep, growth is like that of a slender gladiolus. The intense orange flowers appear along the arching tip of the 2½-ft. stem in July and August. Akin to montbretia and antholyza but quite distinct and most attractive. Needs light soil and sun and may need winter protection in cold districts either by lifting and storing or by covering with leaves or bracken. Good for cutting.

Cynoglossum

Cynoglossum nervosum, S/2-3. 1½ to 2 ft. A stocky plant with abundant deep green, slightly hairy leaves through which unfurl a long succession of intense blue flowers from June to August. A long-lived relative of forget-me-not, this is a useful plant, adaptable for sun or partial shade and not fussy as to soil.

Delphinium

Considerable care is needed to achieve the perfection of which these noble plants are capable. They like rich soil but quickly exhaust it, so dig deeply and manure before planting, and mulch in subsequent seasons. Thin out the weaker shoots in April or May on older, larger plants; if they are left there will be too many spikes, resulting in poor ones and prematurely withered lower leaves. Do not allow weeds to grow as they may cause a rot to set in, especially in winter, or become a harbourage for slugs, which will damage early growth.

If massive spikes are to be grown, support each spike with a strong stake well before flowering. To allow the plants to
mature, carefully remove old spikes after flowering. Vigour is usually maintained for three to four years after planting seedlings; it is then worth renewing with young plants. Division is tricky but can be done with a sharp knife, reducing plants in March to strong shoots with young roots attached. Named varieties can be increased only by this means or from cuttings, but the latter method calls for much skill and the use of glass for protection.

Named varieties are expensive. Good plants raised from seed are less expensive but are not so effective in groups. Seed-raised plants are always of mixed shades, ranging from pale to deep blue, rosy-lilac or mauve to deep purple, and occasionally white. Heights vary from $\frac{3}{4}$ to 7 ft. depending on fertility as well as the strain of seed. The tendency nowadays is to breed dwarf types, available as named varieties.

A smaller-flowered type exists under the name Belladonna and this is less demanding than the larger-flowered. Leaves are smaller and more deeply cut and spikes are shorter and more branched. It has grace and charm of a less massive kind. Well-tried varieties, all S/3, are:

- 'Blue Bees', $\frac{3}{4}$ ft., sky-blue.
- 'Isis', 4 ft., deep blue.
- 'Semi plena', 3 ft., light blue, semidouble flowers.
- 'Theodora', 4 ft., electric blue.
- 'Wendy', $\frac{4}{2}$ ft., gentian-blue.
- Delphinium *rustii* 'Pink Sensation', S/2. $\frac{3}{4}$ ft. Akin to Belladonna delphinium in growth but is less branched. Not a clear pink, but unusual, with spikes well clothed with leaves. Likes full sun and well-drained soil, and is liable to damp off in wet, cold districts.

**Dianthus (Pinks)**

There are many varieties of border pinks but few can be said to be reliable everywhere. For this reason it may be necessary to try out a range of varieties for adaptability for the garden. All varieties are, however, best in full sun and well-drained soil, sandy or chalky rather than heavy clay. Cutting back is effective for some varieties, and mulching with a mixture of light soil with added bone meal is good practice. Increase by cuttings rather than by dividing old plants, though some respond to division and replanting more deeply in autumn. Some good mixtures can be raised from seed to give a colourful and long-lasting display.

**Dicentra (Bleeding Heart, Lady-in-the-Bath, Dutchman's Breeches)**

*Dicentra eximia*, S/4. 1 1/2 ft. Sends up an abundance of feathery glaucous leaves and provides a long succession of pinkish flowers from April to June. Not fussy about soil or position and quite reliable. An improved variety 'Bountiful' is deeper coloured and sometimes flowers again in autumn.

*D. e. alba*, S/3. 10 to 12 in. White, very dainty with a long flowering season.

*D. formosa*, S/4. Similar to *D. eximia*.

*D. spectabilis*, S/3. 2 ft. The intriguing common names apply chiefly to this lovely species. In spring and early summer pink and red locket-shaped flowers dangle from arching stems decked in delightful greenery. Plants have deep fleshy roots and need good deep soil, as well as a fairly sheltered position for protection from strong winds. More difficult to grow than the other species, but most rewarding. Good for cutting.

**Dictamnus (Burning Bush)**

*Dictamnus fraxinella* (syn. *D. albus*), S/2-3. 2 1/2 ft., with spikes of lilac or rosy-mauve flowers on stiff stems in June and July. The dark, shiny leaves are of ash-tree form. A well-proportioned, long-lived plant which needs full sun and good drainage. A white variation exists.

**Digitalis (Foxglove)**

Most foxgloves are biennial and are useful for odd corners rather than in the border. A few, however, are perennial:

*Digitalis ambiguа*, S/2. 2 ft. One of the best. Soft yellow flowers from June to August. Not likely to live for more than about three years, but seedlings are easy.

*D. lutea*, S/2. 2 ft. Yellowish flowers (smaller than *D. ambiguа*) close to the stem in July.
HARDY PERENNIALS

CATANANCHE CAERULEA
BICOLOR

CROCOSMIA

CHLONE
'Mertonensis', S/3. An attractive hybrid with fresh green leaves and stout 2½-ft. flower spikes of crushed-strawberry shade from June to September.

**DORONICUM (LEOPARD'S BANE)**
These yellow daisy-flowered plants are bright and useful for early colour. Easy to grow in ordinary soil in sun or partial shade, they begin flowering long before reaching the heights given, and are good for cutting. Divide and replant every two years in late summer or autumn.

'Gold Bunch', S/3, 2½ ft. Golden-rayed flowers from late April to June.

'Harpur Crewe' (syn. *D. plantagineum excelsum*), S/3, 5 ft. The largest-flowered of all, with golden-yellow flowers from April to May.

'Miss Mason', S/3. Pale yellow flowers 3 in. across on 1½-ft. stems from March to late May. Unlike the other varieties this seldom needs dividing.

**ECHINOPS (GLOBE THISTLE)**
These are easy to grow, but some are rather coarse and over-large for small gardens. All are deep rooted with greyish, spreading, thistly leaves and globular drumstick heads on stiff stems from June to August. Prefer sun and soil that is not too rich or moist. Good for cutting.

*Echinops humilis*. Best in 'Taplow Blue', S/3, or 'Veitch's Blue', S/3, both reaching about 4 ft. when established.

*E. nivalis*, S/4-5, 5 to 6 ft. Whitish flowers.


*E. sphaerocephalus*, S/5, 5 to 6 ft. Similar to *E. nivalis* but with silver-grey flowers.

**ERIGERON (FLEABANE)**
These popular members of the daisy family are rather like summer-flowering Michaelmas daisies. The earliest flower in May, and though some continue on and off all summer their best period is June. Not fussy as to soil, they prefer sun and good drainage. Cut back hard after flowering. Recommended varieties are:

'Charity', S/3, 2 to 2½ ft., pink.

'Darkest of All', S/2, 2 ft. Blue, yellow-centred, single-rayed flowers, excellent.

'Dignity', S/2, 2 to 2½ ft., dark blue.

'Festivity', S/2, 2 to 2½ ft., pink.

'Foerster's Liebling', S/2, 20 in., deep pink, semi-double.

'Liloee', S/2, 2½ ft., lavender-blue, semi-double.

'Prosperity', S/2, 1½ ft., lavender, semi-double.

'Quakeress', S/3, 2 ft., pinkish-lilac.

'Sincerity', S/3, 2 to 2½ ft., lavender.


'Unity', S/2. Less than 2 ft., pink.

'Wupperthal', S/2, 2½ ft., lavender-blue, semi-double.

**ERYNGIUM (SEA HOLLY)**
These are striking plants with blue teazle-like flowers of varying size. In some kinds the blue colouring extends down the stems. All have deep fleshy roots and are best in sun and well-drained soil. Good for cutting.

*Eryngium alpinum*, S/3, 2 ft. Large bristly light blue flowers on heavy stems from June to August. Leaves are deeply jagged.


*E. planum*, S/2-3, 2½ to 3½ ft. Blue flowers in July and August. This and the slightly smaller 'Blue Dwarf' are very leafy and have branching stems which may need supporting. The blue colour is confined to the flowers.

*E. tripartitum*, S/2-3, 3 ft. Green leaved. Flowers are small, but the stem branches widely and attractively, giving a real show in July and August.

**EUPATORIUM**
*Eupatorium ageratoides* (syn. *E. fraseri*), S/4, 4 ft. Makes a stout, erect, very leafy bush which is smothered with flatish heads of white, fluffy flowers in July and August. An easy, vigorous plant, best where not too dry. Likes sun or partial shade.

*E. purpureum*, S/3, 5 to 6 ft. Broad, deep purple-lilac flower-heads in autumn, on stiff strong stems which are well-clothed in greenery. A statuesque plant which likes space, depth and not too dry soil.
EUPHORBIA (SAPGE)

Euphorbia epithymoides (syn. E. polychroma), S/3. Sulphur-yellow bract flowers appear just above ground in March and within a month make a bright little bush, 1 ½ ft. high, which gradually fades to green for the rest of the summer. A first-class plant, easy and reliable in ordinary soil and sun or partial shade.

E. griffithii 'Fireglow', S/3-4. 2½ ft. In this variety flame-red flowers are at their best in May and early June. Flowers fade to green and the whole plant, which spreads slowly outward, remains green and tidy till frosts come.

E. palustris, S/4. 3 ft. Large sulphur-yellow flowers in early summer. Showy, easy and out of the ordinary, prefers somewhat moister conditions than the other euphorbias.

E. sikkimensis, S/3. 3 to 4 ft. Sulphur-yellow flowers in June. This is attractive when the reddish-purple shoots first appear in early spring. As stems develop this colouring gives way to green.

FILIPENDULA (HERBACEOUS SPIRAEAS)

Most filipendulas are moisture lovers and prefer a little shade, but will grow quite well in soil that does not dry out quickly. All have the general characteristics of the wild meadowsweet (Filipendula ulmaria).


F. rubra (formerly Spiraea venusta magnifica), S/3-4. 4 to 5 ft. Wide heads of glistening pink flowers from June to August. Needs moist soil.

GAILLARDIA (BLANKET FLOWER)

These showy flowers need full sun and light or well-drained soil, and grow from 2 to 3 ft. according to soil and season. Losses may occur after three or four years, so replace with named varieties or seedlings which vary in colour. If cut regularly, gaillardias flower for many weeks between June and November. Usually need supporting. Good for cutting. Good varieties, all S/2-3, are:

‘Croftway Yellow’, self-coloured.
‘Ipswich Beauty’, deep yellow, crimson zoned flowers 3 in. across.
‘Mandarin’, suffused orange-flame.
‘Wirral Flame’, brown-orange.

GALEGA (GOAT’S RUE)

These make hefty, bushy, pea-green growth up to 4 ft., with short spikes of pea-type flowers in June and July. Sun and good drainage and even poor soil give best results. Named varieties, all S/4, include:

Galago officinalis ‘Hartlandi’, lilac and white.
‘Her Majesty’, lilac-blue.
G. orientalis, S/4-5. 3 ft. Deep blue flowers, a pretty species.

GALTONIA (GIANT SUMMER HYACINTH)

Galtonia candicans, S/1. This is a hardy bulb which has a place amongst perennials. Dangling white bells, candelabra fashion, on 3- to 4-ft. stems.

GENTIANA (GENTIAN)

The following two summer-flowering species can be well recommended for the border:

Gentiana asclepiadea, S/1, 20 to 24 in. Azure blue trumpets on slender, willowy stems in July and August. Prefers some shade. Good for cutting.

G. mackinii, S/1. Clusters of rich blue flowers on erect 15 in. stems in June and July.

G. septemfida, S/1. 6 to 9 in. Brilliant blue trumpets for several weeks from June, make a fine show in frontal positions. Easy to grow, prefers sun.

GERANIUM (CRANESBILL)

Hardy geraniums are amongst the most adaptable garden perennials and are quite distinct from what are generally known as geraniums. All thrive in sun or partial shade and are long lived.

Geranium cranesburs, S/3. The tallest, reaching 3 ft. in moist soil, but less where dry. Flowers are vivid magenta, continuing from June to August.
HARDY PERENNIALS

ERIGERON

GERANIUM

DICENTRA
G. endressii, S/4. Best in named varieties. All make bushy mounds 15 to 20 in. high and flower for a long time from early June.

'A. T. Johnson', S/3, light pink.

'Johnson's Blue', S/3, a bright, showy hybrid. Does not flower so continuously as 'A. T. Johnson' or 'Wargrave Pink'.

'Wargrave Pink', S/3, light pink.

G. grandiflorum, S/4. 1 ft. The blue, salver-shaped flowers are often veined and zoned with deeper shades. Flowers June to July, has a fairly quick spread.


G. renardii, S/3. 10 in. Has pretty lobed and puckered greyish leaves and a rather brief show of silvery lavender-blue flowers in early summer.

G. sanguineum, S/4. Low-growing and spreading with a long succession of purple-red flowers in summer.

G. s. lancastriense, S/3. Light pink, makes low mounds only a few inches high.

G. vlassiianum, S/3. 15 in. Dense mounds and blue flowers from July to September.

GEUM (AVENS)

These make tufty, leafy clumps flowering in early summer, but those with the largest flowers and brightest colours are often the shortest lived. The best known, easy to grow from seed, are the short-lived:


G.c. 'Mrs. Bradshaw', S/1-2, red. Similar to 'Lady Stratheden'.

Longer-living species, best in sun and well-drained soil, include:


G. bulgaricum, S/2, 15 to 18 in. Orange flowers from May to July.

G. heldreichii, S/2. Similar to G. bulgaricum, but more vigorous.

Recommended named varieties include:

'Dolly North', S/3, 2 ft. Orange-gold flowers from May to July. Sturdy and longer lived than 'Fire Opal' and 'Red Wings'.

'Fire Opal', S/3. 2 ft. Brilliant flame, semi-double flowers from May till late summer. Not reliably long lived.

'Princess Juliana', S/3. Similar to 'Dolly North'.


GYPSOPHILA

All gypsophilas like sun, and light, preferably limy, soil.

Gypsophila paniculata (baby's breath), S/5, 2½ ft. Has clouds of tiny white flowers from June to August. Not easy to fit in with other flowers because of its expansive branching habit. The summer spread, from deep fangy roots, is considerable but dies back each autumn. Very reliable. Good for cutting.

'Bristol Fairy', S/4-5. 2½ ft. Double white flowers. Makes a better show than G. paniculata.


'Pink Star', S/3-4. Newer and neater than 'Rosy Veil'. Makes a low mound 1 ft. high and is quite charming.

'Rosy Veil', S/4. 1½ to 2 ft. Light pink double flowers from June to August. Makes considerable surface spread.

HELENIUM (SNEEZEWORT)

Rich yellow, orange and crimson-brown flowers from June to October. Heights vary from 2 to 5 ft. Easy to grow, long lived. Produces better heads of flowers if shoots are thinned out from older plants in May. Lower leaves wither if too dry. Support for taller kinds may be needed in wet weather. Good for cutting. Recommended kinds, all S/3-4, are:

'Bruno', 3½ ft. Dark brown-red flowers in September.


'Copper Spray', 3½ ft. Coppery-orange-red flowers from June to August.

'Crimson Beauty', less than 2 ft., the dwarfest variety of all. The dull brown flowers bloom in August.
'Golden Youth', 2½ to 3 ft. Yellow flowers from June to August.

'Goldfox', 3½ ft. Orange-flame flowers from June to August.

'Mahogany', 3½ ft. Mahogany-coloured flowers in August.

'Mme. Canivet', 2¼ to 3 ft. Yellow flowers with blackish-brown centres from June to August.

'Moerheim Beauty', 3 ft. Crimson-brown flowers from June to August.

'Pumilum magnificum', 2½ to 3 ft. Yellow flowers from June to August.

'The Bishop', 2½ to 3 ft. Golden-orange flowers from June to August.

'Waltraud', 3½ ft. Golden-brown flowers in August.

'Wyndley', 2½ ft. Orange flowers streaked with brown in July. Very good.

**HELIANTHUS (SUNFLOWER)**
The following are fully perennial, some making tidy but massive bushes, others with rather too much spread from running roots. Leaves wither when dry. In small gardens avoid the running types *Helianthus sparsifolius* and *H. rigida*.

'Capenoch Supreme', S/4-5. Single flowered, similar to 'Loddon Gold'.

'Loddon Gold', S/3-4. 4 to 5 ft. Erectly bushy, with fine golden-yellow, double flowers 3 to 4 in. across from July to September. The finest double variety.

'Soleil d'Or', S/4. Similar to 'Loddon Gold', but less fully double.

*H. sparsifolius* 'Monarch', S/5. 5 to 6 ft. with 4- to 6-in. golden flowers on leafy stems in September and October.

**HELIOPSIS**
Akin to sunflowers, these long-lived plants are really valuable for sun and almost any soil. All have yellow flowers from midsummer to September and a moderate S/3 spread. Damp weather tends to tarnish flowers of double varieties and sometimes makes branches sag.


'Golden Plume', 3 ft. Gorgeous double flowers 3 in. across on branching stems.

'Gold Greenheart', 3 ft. The lemon-yellow double flowers are tinged with green in the centre.

'Incomparabilis', 2½ to 3 ft. Deep gold double flowers with overlapping zinnia-like petals.


'Patula', 3 ft. Single yellow-gold flowers.

**HEMEROCALLIS (DAY-LILY)**
These plants make a fine show for many weeks from June onward. They are adaptable and trouble free, with close branching heads of flowers which last only a day, on graceful 3- to 4-ft. stems, and plenty of fresh green, rushy leaves. Several species exist, but these have given way to many named varieties, especially in recent years. From the original orange and yellow types, colours now include near pink and near red shades. The latter are mostly ruby, purple, mahogany or copper rather than real red. The list of varieties is so wide that no specific recommendations are made, but all are good, and average S/3 in growth spread. The newer shades are quite expensive.

**HEUCHERA (CORAL FLOWER)**
These very long-lived, drought-resistant plants make good ground cover. Dainty, small, bell-shaped flowers on wiry 1½- to 2½-ft. stems come in every shade from white through pink to bright red from May to July and often later, and are good for cutting. Their only need is well-drained, reasonably good soil. They tend to lift out of the ground with age, but this can be remedied by replanting more deeply, or by mulching between the crowns to encourage fibrous roots to form so as to renew vigour and freedom of flowering. Modern varieties flower more freely than older sorts and the freest to flower are the Bressingham Hybrids. These also provide the best range of colours.

A selection of the large-flowered *sanguinea* type, S/2-3, 1¼ to 2 ft., should include:

'Carmen', carmine-pink.

'Oakington Jewell', coral-rose.

'Red Spangles', crimson-scarlet.

'Rhapsody', glowing pink.

'Scintillation', pink-tipped crimson.
'Snowflake', white.
The hteucaides type, S/2-3, are a little taller, but smaller-flowered and daintier for cutting, otherwise of equal garden merit. Recommended are:
'Cloud', red.
'Coral Cloud', red.
'Field', white.
'Field', carmine-pink.
'Gloriana', carmine-pink.
'Kelly Rose', pink.
'Mary Rose', pink.
'Pearl Drops', pearly-white.
'Sparkler', carmine-red.

HEUCHERELLA
This is the cross between heuchera and its relative tiarella.

Heucherella tiarelloides, S/4. A useful plant, makes excellent ground cover, but has a rather short season, 10-in. sprays of light pink flowers in May and June and golden-green foliage. Good for cutting.

'Bridget Bloom', S/2. 15 to 20 in. Sprays of clear pink flowers in summer and good foliage. Often flowers for months in good soil and a little shade. Good for cutting.

HOSTA (PLANTAIN LILY, FUNKIA)
These hardy, long-lived plants are grown chiefly for foliage. Adaptable for shade or sun they are not very fussy as to soil, but grow luxuriantly where fairly moist. Most hostas have smallish, mauve or lavender lily-like flowers in late summer on smooth 14-to-2 ft. stems. Good for cutting. All are capable of making quite large clumps in time, but most would have to be left alone in good soil for three years to reach S/3 in spread. Some have green leaves but there are also many variegated forms. Confusion still exists in their naming, and where possible they should be seen before ordering. Recommended kinds are:

Hosta albo-marginata. Dwarf. Leaves have a marginal strip of white or buff.

H. fortunei. Glaucous green leaves. Robust. The variety picta is more yellow than green in spring and early summer.

H. undulata. Wavy-edged leaves. Has a variegated form, blotched or streaked light yellow.

H. ventricosa. 24 ft. Especially fine purplish flowers.

INCARVILLEA
These are exotic-looking plants with reddish-pink, trumpet-like flowers in early summer. Easy to grow in sun and well-drained soil. Roots are fangy and though new growth is slow to appear in spring they quickly come into flower.

Incarvillea delavayi, S/2. Flowers and leaves reach up to 18 to 20 in. by mid-summer.

I. grandiflora, S/1. Flowers begin about ground level in May before dark green toothed leaves appear. Never attains more than 10 in. high in flower.

INULA
These members of the daisy family are all yellow-flowered and easy to grow. All prefer sun.

Inula afghanica magnifica, S/4-5. 6 to 7 ft. Deep yellow, rayed daisies on strong stems in July and August and large dock-like leaves. Massive and imposing, good for wild gardens, too large for small gardens.

I. ensifolia compacta, S/2. Makes a neat bush only 1 ft. high, well set with golden daisies for many weeks from July to September.


I. hookeri, S/4. 1 to 2 ft. Lemon-yellow, rayed flowers, 2 in. across from August to October. Growth is dense, leafy and spreading.

I. orientalis, S/2. The orange-yellow flowers are wide-rayed and bloom on stiff 14-ft. stems in June and July.

IRIS
This is a vast genus and only the principal types are mentioned. The most popular is Iris germanica (bearded or June-flowering), of which there are hundreds of named varieties all S/2-3. Improvements have been made both in range of colour and size of flower, but because of their infinite variety no recommendations are made. They have a short flowering season, but in most gardens give no trouble. Where rotting disease occurs radical measures have to be taken; cut away diseased material and burn it. But given sun, good drainage and no-humus manuring, health can be maintained. They like lime and respond best to bone
meal as fertilizer. Plant after flowering during July and August, or till late autumn provided the rhizome is barely covered, with only the smaller feeding roots well down. Late- or spring-planted iris are unlikely to flower in the first season. This applies also to the dwarfer, earlier bearded iris. Some varieties of *I. pumila*, usually miniatures of the others, produce blue, pale yellow or white flowers on 6- to 12-in. stems in April and May. There is also a range of May-flowering hybrid iris, *I. intermedia*, which fills the gap between *I. pumila* and *I. germanica*.

Iris lovers may wish to collect some of the many species existing, but the only other types of easy culture generally available are the *sibirica* varieties. These have small flowers carried erectly and gracefully to 3 ft. above slender, rushy leaves. They make excellent waterside plants growing into large clumps, but will flower in ordinary soil and sun. Few iris prefer shade, but for a dry, shady place the green-leaved *I. foetidissima* is useful, having few flowers but brilliant seed pods in winter. It has a fine variegated-leaved form.

**Kniphofia** (Red Hot Poker)

These deservedly popular plants give their best display where the whole plant can be seen, and are especially handsome against a background of evergreens. They are drought-resistant and grow best in light soil and full sun and are good for cutting. In severe or damp winters they are best left alone till new growth begins. A selection of pokers can be had to flower in every month between May and October, but never cram them in amongst the taller, bushier plants or shrubs, as this weakens growth and spoils their appearance.

The least expensive are the mixed varieties from seed, usually including red, orange and yellow shades. Named varieties and species are slow to increase and are therefore fairly costly. Heights vary from about 1½ to 5 ft. Among the named varieties are some very graceful dwarfs, growing 20 to 30 in. high and usually flowering in late summer.

*Kniphofia galpinii*, S/2, and *K. macowanii*, S/2, both 2 ft., are specially good dwarfs. Both have orange flowers in August.


**Lathyrus**

*Lathyrus vernus*, S/2. An easy, early-flowering plant which grows bushily to 12 to 15 in. and is covered with little creamy-white, pink, purple or blue lupin-like flowers in April and May.

**Lavatera (Tree Mallow)**

*Lavatera olbia*, S/5. Makes a big bush to 5 ft. in a short time and has pink, salver-shaped flowers continuously from June to October. Ideal for sun and dry soil. Makes an excellent screen or background.

**Liatris (Gay Feather)**

These striking plants are easy to grow in sun and well-drained soil. They have dark, sprey leaves and brightly coloured lilac poker-spikes which begin flowering at the top. Good for cutting. Roots are fleshy and corm-like just below surface.

*Liatris callilepis*, S/1-2. 2½ ft. The most reliable, flowering from June to August.

*L. pycnostachya*, S/1-2. 3 to 4 ft. Flowers from July to September. Less erect than *L. callilepis*.

*L. spicata*, S/1-2. 2 ft. Flowers in September.

‘Kobold’, S/1-2. 2 ft. Similar to *L. spicata*.

**Ligularia**

These are a section of the genus Senecio. They are very ornamental, growing massively with big, cabbagey leaves and branching spikes of yellow or orange flowers in July and August. They dislike dry conditions and space.

*Ligularia clivorum*. Varieties of this are best known, such as:


‘Othello’, S/5. 4 ft. Orange-gold flowers and purplish leaves.

**Limonium (Sea Lavender) (syn. Statice)**

*Limonium incanum*, S/3. 15 in. Greyish foliage and flattish broad heads of small, pale pink flowers from July to September. Good for cutting.
L. latifolium, S/4. 3 ft. Has widely branching sprays of tiny lavender-blue flowers from July to September, which can be cut and dried when at their best. Leaves are long and leathery. Tough, deep roots withstand drought and dislike being moved when old. Likes sun and light soil, and established plants need space to grow well. Good for cutting.

L. tataricum. Similar to L. incanum but a little taller.

LINUM (FLAX)

All linums are sun lovers and prefer light soil.

Linum flavum, S/2. 10 to 15 in. Golden-yellow, short-stemmed flowers from evergreen bushes from June to August. Bright and good in full sun and dryish soil.


L. paniculatum, S/2. Similar to L. flavum, but foliage bluish-green.

L. perenne, S/2. The least perennial of linums in general cultivation. Easy and pretty with a profusion of slender, arching 20-in. sprays of sky-blue flowers from June to September. Best from seed.

LUPIN

Modern lupins are indispensable in not-too-limy gardens, though longevity is not a strong point. They do not care for rich manuring and are adaptable for town gardens and partial shade. Self-seeding tends to produce inferior colours so if a mixture is preferred choose plants raised from selected seed. Named varieties are expensive since lupins can only be reproduced true to colour by cuttings or division in early spring. There are ample varieties, all S/3, varying in height from 2½ to 3 ft. and colours range from white to shades of pale pink, yellow, orange and red as well as blue and purple. The blue, purple and pale pinks predominate in time if seed is indiscriminately saved or allowed to self-germinate. To avoid this remove flower spikes as soon as colour has gone. This will encourage secondary spikes to flower over a longer period. They flower in June and July and seed sown early will often produce plants to flower the same year.

LYCHNIS (CAMPION)

Included here are the sections sometimes listed under agrostemma, melandrium and viscaria.

Lycnhis chalcedonica, S/2–3. This has heads of small, scarlet flowers on leafy 3-ft. stems in June and July. Compact, easy to grow. Best where not starved or dry.


L. dioica, S/3. A leafy plant with purple-red flowers, rather like pinks, on 1½-ft. stems from May to September. Far showier in the double than the single-flowered variety. Pink and rose-red variations exist, of which ‘Red Admiral’ is outstanding. Likes full sun and light soil.

LYSIMACHIA (LOOSESTRIFE)

Lysimachia clethroides, S/4. Pretty curved spikes of white flowers on erect 3-ft. stems in late summer, and slowly creeping roots.


L. punctata, S/4–5. Whorls of yellow flowers for much of the summer on leafy 3-ft. spikes. Robust and easy.

MACLEAYA

Macleaya cordata (syn. Bocconia cordata), S/5. Tiny white or buff flowers on 6-ft. stems in late summer, and pretty leaves. Roots are apt to spread widely. Impressing in a spacious setting such as a wide border or with a background of trees, but less suitable for small gardens.

MERTENSIA

Some of these are delightful; most prefer cool, semi-shady positions.

Mertensia ciliata, S/2–3. 2 ft. Small, bright blue, tubular flowers on branching sprays from May to June, and blue-green leaves.

M. echinodes, S/3. 9 in. Makes a mat of leaves and has short spikes of tiny, deep blue flowers in May. Suitable for the front of the border.

M. virginica, S/2. 20 in. A lovely but rather
tricky plant with larger, more pendant sprays of blue in April and May. Dormant from July to February.

**MONARDA (BERGAMOT)**
These make stout 3-ft. bushes of aromatic foliage rising from spreading, mat-like roots for many weeks from June to August. Not difficult to curb but replanting every two or three years is advised. Flowers are bright but of curious form. Stem leaves wither where too dry. Recommended varieties, all S/4-5, are:

- 'Adam', scarlet. Has now superseded 'Cambridge Scarlet'.
- 'Blue Stocking', purple-blue.
- 'Cambridge Scarlet', scarlet.
- 'Croftway Pink', cerise-pink.
- 'Magnifica', purple-blue.
- 'Melissa', cerise-pink.
- 'Prairie Glow', salmon.
- 'Snow Witch', white.

**OENOThERA (EVENING PRIMROSE)**
Those with bright yellow cup or salver-shaped flowers make a fine show and are long lived. Recommended are:

- *O. fruticosa*, S/2, 15 in. Flowers 2 to 3 in. wide from June to August. The variety 'Yellow River', S/2, is first rate.
- *O. missouriensis*, S/4. Best on a fairly dry slope, but must have room to trail. Spreads out from a fangy root and gives a long succession of large lemon-yellow, salver-like flowers in summer.

- *O. tetragona* 'Fireworks', S/2-1½ ft. Bronzy-green, tufty leaves and fine yellow flowers following red buds from June to August. Similar in growth to *O. fruticosa*.

**PAEONIA (PAONY)**
Paeonies are among the most permanent of plants and need careful siting, preparation and planting. For best results plant in rich deep soil in full sun between September and November with the new shoots only 2 in. below the surface when firmed and settled. They need space and airiness, for an old plant may cover a square yard when in flower. Nursery-grown plants will succeed where cut-up pieces often fail.

*Paonia lactiflora* (Chinese or scented peony), S/4, 2 to 3 ft., flowering in June. There are many varieties, mainly with double flowers, in white, lilac-rose, and every shade of pink to deep crimson. Many are fragrant and good for cutting, but do not cut until they are well established. It is advisable to choose varieties from the catalogue or show plants of a reliable firm.

- *P. officinalis*, S/4, 2 to 3 ft. This is the old-fashioned type, flowering in May. Its double varieties are *alba plena*, white; *rubra plena*, red; and *rosa superba*, pink.

**PAPAVER (POPPY)**
Only the varieties of *Papaver orientale*, all S/3, can be recommended as hardy and perennial, but even these are apt to suffer rot damage in over-rich or over-moist soil. Their big resplendent flowers make a brave show in early summer, but are apt to leave a gap afterwards and therefore need careful siting. Some grow only 20 in. high, others reach 3 ft. but often need staking. A few good varieties are:

- 'Border Beauty', 2 ft., double, signal-red.
- 'Indian Chief', 3 ft., single, mahogany-red.
- 'Marcus Perry', 3 ft., single, scarlet.
- 'May Queen', dwarf double, orange-scarlet.
- 'Mrs. Stobart', 3 ft., single, salmon-rose.
- 'Perry's White', 2½ ft., single, white.
- 'Peter Pan', dwarf double, orange-scarlet.
- 'Salmon Glow', 2½ ft., double, salmon.
- 'Sultana', 3 ft., single, clear pink.

**PENSTEMON**
Perennial penstemons include both sub-shrubby and mat-forming kinds, some having brilliant colours and all with tubular-shaped flowers of varying size. One of the best mat-like types is *Penstemon barbatus*, a synonym of *Cheilone barbata*, described under the heading *Cheilone*.

*Penstemon diffusus*, S/3. Makes ample bushy growth with spikes of lilac-blue...
flowers, 1½ ft. tall, from June to August. Is longer lived than most.


PHLOX
No garden is complete without these, with their gay panicles or heads of bright, delicately fragrant flowers from July to September. They range widely in colour, are not expensive to buy, are virtually trouble free, and fit in perfectly amongst other plants. Important and adaptable as they are, phlox do show the benefits or lack of good cultivation. They do best in light soil and respond to richness and moisture. Where soil is dry, heavy or poor, apply a mulch of fertilized peat or compost in early summer. In good conditions they can remain undisturbed for years, but when old thin out some of the shoots in May. All are S/3.

Recommended varieties in orange-scarlet shades include:
- 'Brigadier', 3 ft.
- 'Gleneagles Glory', 2 ft.
- 'Leo Schlager', 3 ft.
- 'Orange', 2½ ft.
- 'Spitfire', 3 ft.

Red and crimson shades include:
- 'Emain Macha', 2 ft., red.
- 'Otley Ideal', 2 ft., cherry-red.
- 'Red Indian', 3 ft., crimson.

Purple and magenta-red shades include:
- 'Aida', 2½ ft., purple.
- 'Border Gem', 3 ft., deep violet.
- 'Flamboyant', 2½ ft., petunia-crimson.
- 'Marlborough', 2½ ft., light purple.

Lavender- and lilac-blues include:
- 'Bleu de Pervanche', 2½ ft., near blue.
- 'Caroline van den Berg', 3 ft., light blue.
- 'Hampton Court', 2½ ft., heliotrope.
- 'Little Lovely', 2½ ft., violet-blue.

Pink shades include:
- 'Duchess of Gloucester', 2½ ft., late, salmon-pink.
- 'Glamis', 2 ft., pink, purple eye.
- 'Holyrood', 3 ft., carmine.
- 'Mies Copijn', 2½ ft., pure light pink.
- 'Sir John Falstaff', 3 ft., carmine-rose.
- 'Windsor', 3½ ft., deep carmine.

White or near whites include:
- 'Fidelio', 3½ ft., with a red eye.
- 'Mia Ruys', 2½ ft., dwarf, early, white.
- 'Mother of Pearl', 2½ ft., white suffused with pink.
- 'Rembrandt', 2½ ft., pure white.

Phlox maculata 'Alpha', S/3, 3 ft., is a fine lilac-rose. The long, tapering spikes are distinctive and effective.

PHYSOSTEGIA (OBEYDIENT PLANT)
These plants produce tapering spikes set closely with lipped flowers, well-foliaged with dark green, pointed leaves. They are easily grown in almost any soil and do not mind some shade. Good for cutting.

Physostegia virginiana, S/4. Up to 4 ft. Flesh-coloured or purple flowers from July to September. Roots tend to run, forming close mats.

- 'Summer Snow', S/4, 3½ ft. Pretty white flowers in July and August.
- 'Summer Spire', S/4, 2½ ft. Lilac-purple flowers in July and August.
- P. × speciosa 'Rose Bouquet', S/4, 3 ft. Rose-purple flowers in August and September.

- 'Vivid', S/4. Shorter, later and deeper coloured than 'Rose Bouquet'. Wandering roots make annual replanting advisable.

POLEMONIUM (JACOB’S LADDER)
These charming plants have pretty leaves and blue bird’s-eye flowers, but are not always very long lived.

- 'Blue Pearl', S/3. Makes a low mound set with deep blue flowers from May to June. Dwarfier than 'Sapphire'.
- 'Sapphire', S/3, 1½ ft. Reliable, flowering in May and June.


POLYGONUM
This is a large genus of wide variation, the best of which deserve to be more widely grown. Most polygonums like fairly moist conditions, but are surprisingly adaptable. Some, not mentioned, are weedy and caution is advised.

Polygonum affine 'Darjeeling Red', S/5, 9 in. Stubby spikes of bright pink flowers on and off from August to October.
Makes a quick surface spread and excellent ground cover even on poor soil.


P. historiae superbum, S/3-4. Makes a clump of sorrel-like leaves, with a profusion of clear pink, stumpy pokers on 3-ft. wiry stems in early summer.

P. carneum, S/3. 20 in. Long flowering. Erect, deep pink poker spikes from May to August.


**POTENTILLA (CINQUEFOIL)**

A genus offering a wide selection of brightly flowered, mostly dwarfish plants. All like sun but are not fussy as to soil. Many show their kinship to the strawberry when in flower.

Potentilla arbuscula, S/4, and others under P. fruticosa, are shrubby, set prettily with flowers of yellow, gold or white all summer. Up to 3 ft. but not out of place amongst dwarf perennials.

P. argyrophylla, S/3-4. 2 to 3 ft. Good silvery foliage and floppy masses of bright red flowers in May and June.

P. atrosanguinea, very like P. argyrophylla.

P. aurea, S/3, 4 to 6 in. Tufty, with golden flowers in July and August. Good for midget beds and borders.


'Roxana', Similar to 'Miss Willmott', with buff-rose flowers.

P. recta, S/2. 1½ ft. More erect than P. nepalensis, with ample foliage and yellow flowers from June to August.

Many hybrids exist, some with quite large and often near-double flowers in rich colours. Recommended kinds flowering from June to September are:

'Etna', S/3, 2 ft., deep crimson.

'Gibson's Scarlet', S/2, 1½ ft., single, red.

'M. Rouillard', S/2. 2 ft., orange and crimson.

'Wm. Rollinson', S/2, 1½ ft., flame-orange.

Yellow Queen', S/2, 1 ft., semi-double, pure yellow.

**PULMONARIA (LUNGWORT)**

These thrive best in some shade but are quite adaptable, needing only ordinary soil and the minimum of attention. Their chief value is their early-flowering habit, being at their best in March and April.


'Munstead Blue', 9 in. Like P. a. azurea.


P. saccharata, S/4, 1 ft. Variable, some having blue and pink flowers (due to fading) on the same plant from April to June. Others are almost red as in P.s. rubra and 'Munstead Red'.

P. s. picta, S/3, 9 in. Pinkish flowers and pretty leaves spotted with white.

**PULSATILLA (PASQUE FLOWER)**

Pulsatilla vulgaris, 8 to 12 in. Hoary but very lovely soft-lavender, chalice-like flowers appear in early spring before the ferny leaves. Seed heads are also attractive. Long lived and reliable, given light soil, good drainage and sun. Likes lime. All S/1-2. Variations include white, violet and near red shades. All have golden anthers and some may grow up to 15 in. where suited.

**PYRETHRUM**

These early-summer-flowering daisies with their caroty leaves are indispensable. All are S/2-3 and attain 2 to 3 ft. in height but sometimes need supporting, and where this is necessary stake well before flowering time. Plant in ordinary soil in March, July or August—rich or moist soil is not advised. An open position and good drainage are essential to avoid floppiness and winter rotting. Cutting back after flowering often produces a second crop. Named varieties are available in every shade from white to pink, magenta and crimson-red, in both double and single flowers, but the doubles are usually less vigorous and erect. Good for cutting.
RANUNCULUS
These include the buttercup, and the following species are well worth cultivating. All like sun and good drainage. Good for cutting.

*Ranunculus acris plenus*, S/3. A bright, trouble-free plant for sun, with fully double, yellow flowers ½ in. across on 2-ft. branching stems in May and June.

*R. bulbosus speciosus plenus*, S/2. 1 ft. Double, yellow flowers in May and June. Leafier and larger-flowered than *R. a. plenus*.

*R. gramineus*, S/1. 6 to 12 in. Brilliant golden, single flowers in spring, and greyish, narrow leaves. Grows in a neat clump.

RUDBECKIA (cone flower)
Most rudbeckias, except a few fully double-flowered kinds, are distinguished by a central cone, above rayed petals. They are easy to grow in sun, but best where not too dry.

*Rudbeckia deamii*, S/3, 2½ ft.; ‘Goldsturm’, S/3, 20 in.; *R. speciosa*, S/3, 2 ft. These can be grouped as the Black-eyed Susan range; where space permits all three may be grown, as they are sufficiently distinct. They have mat growth of moderate spread and erect stems carrying fine rayed, golden flowers with a black core from late summer into autumn.

*R. purpurea*, S/2. Purplish-rose flowers, with petals often drooping, on stiff 2½- to 3-ft. stems in late summer.


‘Herbstsonne’, S/4-5. 6 ft. Large, rich golden-yellow flowers from July to September. Too tall for narrow beds or borders.

**SALVIA** (sage)
There are over 300 species of salvia and the following are recommended hardy plants, easy to grow in ordinary soil, in sun or half shade;

*Salvia haematodes*, S/3. 4 ft. A handsome plant with light blue flowers on sturdy branching stems from June to August.

*S. nutans*, S/3. 2 ft. Dark blue, dead-nettle flowers from June to August, of rather drooping habit.

*S. pratensis*. Similar to *S. nutans* but a little taller and bushier.

*S. superba*, S/3. 3½ ft. The finest of all. In the type, erect tapering spikes are massed in bush form, each carrying many tiny violet-purple flowers from June to August. Even when faded these are not unattractive.


*S. alpina*, S/4. 3 to 5 ft. Spikes of light blue flowers mass bushily in autumn. This would be really good but sometimes becomes top heavy, and dislikes very severe winters.

**SCABIOSA** (scabious)

‘Clive Greaves’, S/2-3. 2½ to 3 ft. This variety has become almost synonymous with *Scabiosa caucasica* and is the most reliable of the many existing varieties. Blue, open flowers on wiry stems come freely from June to September. The more they are cut the more they flower. They do best in light soil and sun and like lime. Plant in spring from young plants, not pieces of old, unthrifty clumps, and divide a third of the group each year to maintain vigour.

‘Bressingham White’, S/2. 2 ft. Flowers from June to September, the best white variety.

*S. graminifolia*, S/2. 10 in. A delightful little species with silvery leaves and pink flowers from June to September.


**SEDUM**
All the following sedums like sun and light soil. They are all S/2-3 and grow to about 20 in.

‘Autumn Sun’, S/3. 2 ft. A hybrid of similar form to *Sedum spectabile*, with salmon-pink flowers between early
September and late October. A beautiful plant in which colour changes as flowers develop. Easy to grow.

*Spectabile* (ice plant), all S/3. Attractive fleshy blue-green foliage. In late summer each stem opens out into a wide plate head of glistening pink.

'Brilliant', 1½ ft. Bright pink flowers.

'Carmen', 1½ ft. Deeper pink flowers than S.s. 'Brilliant'.

'Meteor', 1½ ft. Rosy-red flowers.

**Senecio (Ragged)** See also under Ligularia.

*Senecio doronicum*, S/2. Makes neat, slowly forming surface mats set with orange-gold daisies on 10-in. stems in May and June.

*S. pzywalskii*, S/3-4. 4 ft. Has tapering spikes of small, shaggy, golden flowers on stiff black stems in July and August, and deeply jagged leaves. A noble plant, but needs moisture for perfection.

**Sidalcea**

These near relatives of mallow make well-foliaged spikes in the mass, set with 1-in. open flowers along much of each stem between June and August. Easy and reasonably long lived, but best in open positions where not bone-dry. They are all S/2-3.

'Croftway Red', 3 ft., red.

'Elsie Heugh', 'Mrs. Alderson', 'Rev. Page Roberts', 'Sussex Beauty'. These are all in shades of light pink on slender 4-ft. spikes.

'Wensleydale', 4 ft., deep rose.

'Wm. Smith', 3 ft., rose-tinged salmon.

**Solidago (Golden Rod)**

Solidagos range from 6 in. to 7 ft. Obsolete tall kinds often dominate old borders, but much better ones, mostly under 3 ft. high, exist in the modern varieties; no garden should be without a selection of them. Available in colours from primrose-yellow to deep gold. Good for cutting.


'Mimosa', S/3. 4 ft. Has handsome golden plumes in July and August. One of the better tall varieties.

'Peter Pan', S/3. Has spreading heads on stiff 3-ft. stems in July.

The following neat-growing varieties all grow between 2 and 3 ft., flower in late summer and have good foliage and habit.

'Golden Falls', S/2.

'Goldenmosa', S/2.

'Golden Shower', S/2.

'Lesmore', S/2.

'Lena', S/2.

'Lesden', S/2.

Good varieties, growing only 10 to 12 in. high: 'Queenie', S/1; 'Tom Thumb', S/1.

**Stachys**

*Stachys lanata* (donkey's ears), S/3-4. Thickly felted silver leaves and 14-ft. stems carrying deep pink flowers in July.

A good plant for hot dry places.

*S. nivea*, S/2. 9 in. Pretty creamy-white spikes in early summer. Much neater than *S. lanata*.


**Stokesia (Stoke's Aster)**

*Stokesia laevis* (syn. *S. cyannea*), S/1. Less than 1 ft. Has dark leathery leaves close to the ground and very large mauve-blue flowers with quilled centres for many weeks between June and September. Best in sun. Good for cutting.


**Thalictrum (Meadow-Rue)**

All thalictrums have dainty foliage, but the best are the least easy to grow. None of them likes hot, dry positions. Good for cutting.

*Thalictrum aquilegiifolium purpureum*, S/2-3. Up to 4 ft. Clouds of fluffy mauve flower heads on fairly erect branching stems in May and June. Shiny blue-green foliage. This plant and the following varieties are easy to grow in fairly good soil and a little shade.

'Album', 3 ft., white.

'Bee's Purple', 3 ft.

'Dwarf Purple', 3 ft.

'Purple Cloud', a little taller and deeper in colour.

*T. dipterocarpum*, all S/1-2. A fine array of small, mauve, yellow-centred flowers
appears from July to September. Given good, deep soil, this is a superb plant though needs support for the 4- to 5-ft. stems. The varieties are:

*T. d. album*, 3 to 4 ft. where happy. Pretty white flowers in August and September.

'Hewitt's Double', 3 to 4 ft., with violet-mauve flowers in August and September. Really choice but demands richer soil than *T. dipterocarpum*.

*T. flavum*, S/2, 4 ft. Lemon-yellow fluffs on strong stems in June and July. Handsome deep green foliage.

*T. glaucum*, S/2. Rather similar to *T. flavum* but with glaucous leaves.

**TRADESCANTIA (SPIDER-WORT, TRINITY FLOWER)**

*Tradescantia virginica*, 1½ to 2 ft. Rushy leaves topped by three-petalled flowers from June to September. Not a spectacular plant but decidedly useful and accommodating.

Varieties, all S/2-3, include:

'Blue Stone', mid-blue.

'Iris Prichard', white, flecked blue.

'Isis', large flowered, Oxford blue.

'Leonora', mid-blue.

'Osprey', white with a central blue crest.

'Purewell Giant', reddish-purple.

'Purple Dome', purple.

Double blue and double red-purple varieties exist, but flowers are smaller than in the singles.

**TROLLIUS (GLOBE FLOWER)**

These plants make a fine show with their big, globular buttercup flowers in May and June. They are moisture-loving but will flourish in good, deep soil. Good for cutting. The following varieties, all about 2½ ft. high and all S/2, are recommended:

'Canary Bird', light yellow.

'Earliest of All', golden-yellow, strong-growing.

'Feuertrroll', orange-yellow.

'Goldquelle', fine pure yellow.

'Lemon Queen', light yellow.

'Orange Princess', orange-yellow.

'Prichard's Giant', golden-yellow, strong growing.

*Trollius ledebourii* 'Golden Queen', 2½ to 3 ft. Flowers in July, with prominent deep orange stamens on more open orange flowers.

**VERBASCUM (MULLEIN)**

These plants make big rosettes of woody foliage and have tapering spikes set closely with cup-shaped flowers often more than 1 in. across in early summer. They are very decorative and do best in sun and well-drained, or even dry, soil.


*V. thapsiforme*, 4½ ft. Very erect, with deep yellow flowers. Similar to *V. chaixii*, but spikes more closely set.

There are many hybrid varieties and recommended are:

'Cotswold', S/3, 4 ft. The three variations have flowers of biscuit-yellow, lilac and amber-purple shades on much-branched stems.

'Gainsborough', S/2, 3½ ft. Spikes of light yellow flowers and grey leaves.


**VERONICA**

*Veronica exaltata*, S/3, 5 ft. Has countless small, light blue flowers in late summer and autumn, on fine tapering spikes which are well covered with pointed leaves. Easy to grow. Does not need staking.

*V. gentianoides*, S/2-3. Makes a fine, if rather brief, show in May with dainty 2-ft. spikes of light blue flowers from close-growing, laurel-leaved plants. Easy to grow in sun or part shade.

*V. incana*, S/2, 1½ ft. Violet-blue flowers in June and July, and charming ash-grey leaves close to the ground. Best in sun and drier places.

'Wendy', S/3, 1½ ft. Deep blue flowers in June. Less compact and less silvered, but freer to flower than *V. incana*.

*V. longifolia*, S/2, and its varieties carry no foliage over winter. Has blue or white
flowers on 2-ft., fairly erect spikes from July to September. Likes good soil not too dry.

*V. l. hendersonii*, S/2. Rich violet-blue flowers on spikes that grow at a tangent from 1½ ft. bushes of dark green pointed leaves from July to September.

*V. spicata*, S/2. These summer-flowering plants are surface-rooting, and best divided every two to three years. They need sun and good drainage or winter losses may ensue. Recommended varieties are:


'Minuet', S/2. 1½ ft. Pink flowers and grey foliage. Very effective.

*V. spicata nana*, S/2, 9 in. Blue.

'Romily Purple', S/2. 2 ft., dark blue.

*V. teucrium*. This species and its varieties lose all foliage over winter. In spring they send up massed new shoots developing into loose mounds covered in short spikes and bright blue flowers. They are easy in ordinary soil, sun or part shade and flower in May and June. Recommended varieties are:

'Crater Lake Blue', S/3, 15 in.

'Royal Blue', S/3, 1½ ft.

'Shirley Blue', S/2, 1 ft.

'True Blue', S/3, 9 in. More spreading than the others.


*V. x alba*, S/3. Tall and graceful, with white flowers in autumn. Easy to grow, needs no staking.

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**PERENNIALS FOR WINDY AND EXPOSED POSITIONS**

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<th>Agapanthus</th>
<th>Echinops</th>
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**PERENNIALS FOR TOWN GARDENS**

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# Hardy Perennials

## Perennials for Chalky Soil

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## Perennials for Clay or Heavy Soil

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Chrysanthemums

The chrysanthemum hails from the Far East, where it has been in cultivation for more than 2,000 years. It was brought to Britain at the close of the eighteenth century, but many years passed before an appreciable number of varieties was developed, and, as far as the outdoor or border varieties are concerned, it was not until the present century that real progress was made. The most exciting developments have taken place in the last 20 or 30 years, and at present there are hundreds of distinct varieties, and many more are being added ever year.

New varieties are obtained by cross-pollination or as a result of natural sporting by which a plant may produce flowers of a different colour or form from the normal crop.

Sports do sometimes occur even in an amateur's collection.
BORDER CHRYSANTHEMUMS

There are five popularly-grown types of border chrysanthemum—the incurved, the incurving, the reflexed, the pompon and the single. All are early flowering, and bloom, according to variety, from early August to late September.

Since chrysanthemums cannot be relied upon to come true from seed and are propagated by vegetative means, it is best to start growing them from rooted cuttings obtained either from a nurseryman or from a friend’s collection.

PROPAGATION

There are two principal ways of propagating chrysanthemums—by the division of roots or by the rooting of cuttings.

At the close of the flowering season, leave the plants for several weeks so that matured sap in the stems may dry back into the rootstock. Then, in late October, cut back the main stem of each plant to some 6 to 9 in. from the base. In some areas it is possible to leave the plants in the garden throughout the winter, but for the best results with modern varieties it is far better to lift them and put them under some slight cover to keep them from frost. It is not dry cold which must be guarded against, but dampness, which has a disastrous effect.

LIFTING

Lift the rootstocks carefully and shake off most of the soil. They are then known as stools. Wash them in a weak solution of Jeyes Fluid. If it is intended to divide the stools in the spring, do not prune the roots at all, and leave any small green shoots that may appear. If, however, cuttings are going to be taken later, or where a large number of stools have to be accommodated in a small space, it is quite safe to prune the roots back until the whole ball will pass through a ring of 4 in. diameter. Put the stools into a box of fresh soil, preferably John Innes No. 1, covering the roots just a little deeper than they were in the garden. Place the box in a cold frame or unheated greenhouse, and give only sufficient water to keep the roots from drying out. Expose to full air at every opportunity in order to keep the plants dormant until the lighter days of spring. Once growth can be seen above the soil, give water according to weather conditions and the state of the stools. Slugs will be a constant danger, so take preventive action early.

DIVISION

In March, early to late according to district, take the stocks intended for division outside, and remove young growths from the outer portions of the stools, making sure that each growth has a number of roots attached. In the more sheltered districts these young plants can be put out into permanent quarters, but in exposed areas it is better to plant them out in boxes or protected nursery beds until they are stronger. Although the chrysanthemum is fairly hardy, young plants do not thrive in cold winds or when their roots are continually cold and wet.

CUTTINGS

Better results are usually obtained from cuttings. Stools intended for cuttings may be left in cold frames, or brought into a cool greenhouse during February. Slight warmth is helpful though not essential, and a temperature of 45 to 50° F. (7 to 10° C.) should be maintained. In all but the very favoured districts plants from cold frames cannot be propagated until March, but in a heated
greenhouse cuttings can be taken from February to early April.

Prepare boxes or a bed of soil about 3 in. deep, using either John Innes No. 1 compost or a mixture of equal parts of soil, peat and sharp sand with a dusting of superphosphate mixed in. Since it is good practice to have the base of each cutting resting in pure sand, sprinkle about ¼ in. of dry sand on top of the soil before work begins; as the hole is made for each cutting the sand will trickle in.

With a sharp knife or razor blade carefully cut off the growths just below a leaf joint and trim them so as to make cuttings 2 to 3 in. long. Remove the lower leaves and insert the cuttings in the soil. The cuttings can be put in the boxes or the bed quite close to one another, but do not let the foliage overlap. To settle the cuttings in, water thoroughly using a can fitted with a rose. It should not be necessary to water again until rooting takes place three to four weeks later.

ROOTING CUTTINGS
Since the cuttings have to live for a few weeks on their own sap it is essential to reduce evaporation from the leaves. This can be done by covering the boxes or bed with glass or polythene, but there is then the danger of air being excluded. A safer way is to stretch butter muslin a few inches over and above the cuttings. This keeps the air around them sufficiently close but also permits it to circulate.

Although heat is not essential, gentle bottom heat will hasten the process of rooting and lessen the risk of damping-off; in a cold frame the heat can be provided by a soil-warming cable.

The time the cuttings take to root varies according to conditions, but the signs are unmistakable. When there is a new green in the foliage and the growing point has obviously developed, working roots have formed. Thenceforth, each day for a week or so, expose the young plants to increasing periods of light and full air, then transplant them into boxes 4 in. deep filled with John Innes No. 1 compost. Boxes are better than pots, particularly if the plants are left untended during the day, for the larger body of soil retains moisture longer and eases the watering problem. Lift the plants carefully with moist soil attached to the roots, which should be about 1 in. long, and set them 4 in. apart in the new boxes. Do not make them too firm. Withhold water for a few days and at the same time shade the cuttings by means of paper supported on small canes and, when the weather is bright, spray water over the plants. This enables them to get the moisture they need without letting water penetrate to their roots.

Gradually admit more air. When the plants are firm and start to grow, those in the greenhouse can be moved to the frame.

The aim from that time until late April is to encourage firm growth and the development of a strong root system. Harden off the plants slowly, protecting them always from frost, heavy rain and cold draughts.

Keep an eye open for greenfly, and constantly bait against slugs. In the first week in May it should be possible to leave the frame lights off altogether to prepare the plants for their final move into the open garden on about May 10.

Since chrysanthemums bloom quite late for outdoor flowers, they may make flowerless patches in the border throughout the summer. This can be avoided by growing the plants in pots or nursery beds until, say, July, when they can be transferred to their permanent sites. The nursery bed is suitable for only the dwarf varieties, but even these are safer in pots, for transference from one bed to another can be risky.
PLANTING SITES
The arrangement of planting sites depends upon the purpose for which the plants are being grown. The two main purposes for which chrysanthemums are grown are, first, to form part of a planned border to give colour and interest after the summer flowers have faded, and second, to provide cut blooms for the house.

Do not set the plants singly in the border, but in groups of at least three of the same variety. This not only gives a more solid patch of colour but also maintains the colour for a longer period; one plant may be several days earlier or later than its neighbours in producing its main crop of flowers, and there will be variations in the dates at which individual stems will flower.

In addition to groups of chrysanthemums in the border, there is much to be said for a bed devoted to them alone. Before they flower their foliage is quite attractive and any tendency to dullness can be relieved by an edging of summer-flowering annuals and taller plants dotted here and there among the chrysanthemums themselves. A good edging is the dwarf perennial matricaria, which is easily raised from seed, and looks very like a miniature chrysanthemum.

Plants grown to provide cut flowers for the house are best grown in a convenient, separate bed.

SOIL
Chrysanthemums are very adaptable. They prefer a slightly acid soil, although exhibition blooms are often grown on ground which is highly alkaline. More important is the physical state of the soil, and half the secret of growing chrysanthemums lies in its preparation. In the three warmest and driest months of the year they have to develop from small, comparatively soft plants into well-branched specimens with adequate rooting systems. The soil must, therefore, be retentive of moisture and contain enough body to give the plants a firm root-run; shallow, sandy soils should be built up over the years by the systematic addition of organic material. The soil must also be well supplied with plant foods.

The two outstanding needs of chrysanthemums are an adequate reserve of moisture and sufficient slow-acting fertilizer, preferably both chemical and organic.

PREPARATION OF THE SOIL
Dig the ground over in the autumn, incorporating a bucketful of rotted manure to every sq. yd. and working in a liberal dusting of bone meal. If manure is not available, rotted garden compost or peat will provide sufficient humus to hold the moisture. Leave the soil to weather throughout the winter. Three weeks before planting give the ground a dressing of the balanced fertilizer sold specially for chrysanthemums. Apply 4 oz. to the sq. yd. and work the fertilizer into the top few inches. Do not add lime if the ground is already on the alkaline side, since the aim is to keep the bed slightly acid. Be guided by what is known about the soil.

PLANTING OUT
The ideal time for planting out chrysanthemums is during quiet, showery weather when the soil crumbles nicely to the touch but is not moist enough to stick to trowel or shoes. Good seed-sowing weather is just right.

There are two preliminaries to planting out. First, plan carefully, taking into account the height and habit on maturity of the different varieties. Then, where each plant is to grow, put in a stake of the height to which it will grow, setting the stakes 1 ft. apart in each group.

Secondly, water the stock well the day
Plant the complete root ball close to the stake. Give the plant support immediately by tying it to the stake.

As the plant grows make new tying loops—but not so tightly that the plant cannot move with the breeze.

before planting; it will already have been exposed to the weather for at least a week.

It is vital, in planting young chrysanthemums, to give them a good start by encouraging their roots to run quickly into the new soil. Take out a hole, therefore, just a little bigger than the root ball of the plant, and stir into its base a little compound fertilizer specially prepared for chrysanthemums or some hop manure. Do not overdo it; follow the instructions on the fertilizer packet.

Place the plant slightly lower in the soil than it was originally in the box, then gently work fine soil round the roots, firming it as the hole is filled. Have a few buckets of sifted soil handy for this purpose in case the garden soil is lumpy. Plant close up to the stake and make the soil firm. Medium and heavy soils can be firmed sufficiently by finger pressure; light soils need gentle foot pressure. Loop the plant at once to the stake in such a way that it is supported but not constricted. At every stage of growth it is important for plants to be able to move with the breeze. If they are tied too tightly they may snap.

WATERING

If the chrysanthemums have been planted in showery weather on a still day they do not need to be watered. It is better to let the roots run in moist soil than to drown them with copious applications of water. If the plants begin to droop, resort to gentle ball-watering; that is, give them water close to the stem, and only sufficient to moisten the roots without souring the unoccupied soil round them.

In very dry summers it may be necessary to water the whole site soon after planting and then at regular intervals, depending on weather conditions. On these occasions, water heavily, wetting the soil to a depth of 6 to 9 in. Do not water again until the next occasion for a
CHRYSANTHEMUMS

HOW A CHRYSANTHEMUM GROWS
Without disbudding, a chrysanthemum grows as a bushy plant, producing many small flowers.

DISBUDDING TO PRODUCE SINGLE BLOOMS

The small growths between the leaves and the stem—side shoots—are removed to regulate growth.

With only one bud on each stem the plant's strength is concentrated into producing a few fine blooms.
thorough wetting. Dribbles of water every evening are harmful, for they bring the roots near to the surface of the soil, where they are more vulnerable than ever to drought and scorching. Chrysanthemums need water only when their lower leaves begin to flag.

Overhead spraying is an excellent way of sustaining the plants and helping newly planted specimens to take hold in the soil. The top of the plant benefits, it ceases to lose moisture through the leaves and the roots are not pushed into activity. Contrary to the old belief, overhead spraying is beneficial even when the sun is shining on the plants, but it is better to wait until the sun is just setting, for then most of the moisture is retained on the foliage, fortifying the plant against a drying air the following morning.

Another way to avoid heavy watering of large areas is to sink 5-in. pots up to their rims in the bed, 6 to 12 in. to one side of each group of chrysanthemums. Water poured into these percolates to the roots well out of reach of sun and wind. This is a good way, also, to give the plants liquid feeding later on.

**FEEDING**

If the soil is properly prepared, feeding is not really necessary, but within reasonable limits it can be helpful. Use one of the special chrysanthemum fertilizers, although any balanced fertilizer will be safe if it is used according to the maker’s instructions. Apply either a dry or liquid fertilizer once a fortnight until the flower buds begin to swell. Then give no more.

**WEEDING**

For the first month use a Dutch hoe to get rid of weeds and to keep a mulch of dust on the surface. But cease hoeing about the middle of June. By then the roots will have spread over the whole site, many of them will be in the top few inches of the soil, and a hoe might damage them.

Weeding should then be done by hand. Better still, especially on light soil, spread a mulch of rotted manure, peat, compost or rotted straw. This not only chokes the weeds but keeps the soil cool and moist, and has an excellent effect on the chrysanthemums.

**GROWTH AND DEVELOPMENT**

For a few weeks after planting, little change will be seen. The plants’ activity is mostly underground. As well as keeping a close watch for slugs, in built-up areas watch also for birds, which seem to have a week or so of madness when they nip off the tops of the plants and sometimes defoliate them completely.

When growth does start the plants branch rapidly and need tying up. Loop each growth to the central stake every 9 in. or so. Later, they may need tying more securely to prevent the flowers from bruising.

Chrysanthemums can be grown either as bushy plants carrying many small flowers, or as thinner plants with a few much larger and finer blooms. If a chrysanthemum is left to develop naturally it will extend itself on a single stem until, at the growing point, a bud is produced which prevents the stem from growing any longer. This is called the “break bud” because it induces the plant to break out into growth from the leaf axils. The branches from the leaf axils grow until they also produce a bud at the point. This is called the “first crown bud”, and is surrounded by leafy shoots. If the plant is left alone these shoots extend as a cluster and, after a few weeks, produce a mass of “second crown buds” which bloom together as a spray of small but pretty flowers. The first crown bud, partly overcome by the strength of the leafy growth round it, struggles into
belated bloom in a network of twiggy stems. Many people prefer these sprays of small chrysanthemum flowers in a mixed border.

STopping
Even if sprays of this kind are wanted it is advisable to pinch out the growing point and an inch or so of stem below it at a certain stage of growth. This pinching is usually termed "stopping". It causes the plant to branch, encourages late-flowering varieties to bloom rather earlier and thus avoid frosts, and helps to form a nicely balanced plant.

If the aim is to grow fewer but much finer blooms instead of clusters of small flowers, the plant must not only be pinched at the due time, but kept under strict control. Early in its growth reduce the number of stems to not more than six by removing all the others. The plant should then yield only six blooms, for only one will be allowed to form on each stem.

The single bloom is developed from a first crown bud. When this bud appears, usually in late July or early August, remove all the leafy shoots surrounding it, so as to channel the energy of the plant into the flower. But do not remove them all at once; take off one every other day. The plant will then probably send out fresh shoots from almost every leaf axil and will thrust suckers up through the soil. Remove all the fresh shoots and suckers as soon as they are seen. The whole strength of the plant's growth is thus concentrated into the first bloom buds, and so large blooms of fine quality are produced.

PESTS
Pests are not a great worry, but during the summer chrysanthemums may be attacked by greenfly and other sucking insects. As prevention is better than cure, spray every fortnight whether these pests can be seen or not. Use a mixture of D.D.T. and B.H.C. (Sybol or Lindex), or the newer malathion. Liquid sprays are better than applications of powder. Pay particular attention to the growing points, for it is here that pests congregate and where the greatest injury can be inflicted.

Slugs can be a nuisance if the weather turns wet for they often climb to the softer parts of the plants. Baiting them is the remedy.

Earwigs can do untold damage. To keep them from eating the florets, smear a small ring of Vaseline round each stem a few inches below the developing bud.

Normally chrysanthemums can be grown on the same site year after year, provided the fertility of the soil is kept up. But if the plants suffer a rapid loss of foliage from the base upward, this is probably due to eelworm. To prevent this pest from being perpetuated on the site, burn the plants and plant new stock in another part of the garden.

STAKING
Towards the end of July the plants will stop growing and need to be staked more securely to face the high winds which often blow in August and September. Give extra staking to border plants, but make it as unobtrusive as possible. If the plants are being grown for cut blooms, support each stem firmly enough to prevent the blooms from touching either the stakes or each other in a strong wind.

PROTECTING THE FLOWERS
According to variety, the plants will bloom in August and continue until the end of September. There is no need to protect sprays of chrysanthemums growing in the border from the weather; any damage that is done will scarcely be noticed among the mass of colour they produce.
But some of the larger blooms repay the trouble taken to reduce weather hazards. It is said that all modern varieties have to be coddled and covered to bloom in safety. This is untrue. Most of the varieties recommended in the lists that follow will come through severe weather with very little damage, and some of them are hardy enough to stand almost any weather conditions. An indication of weather-resisting qualities is given in the lists.

Some of the loveliest of modern outdoor chrysanthemums, however, particularly incurving types and white ones, do need covering to protect the blooms from rain and soot-laden air. The blooms can be as fine as those produced under glass in November, but the price of such excellence is sometimes a slight loss of hardiness.

Protection is best given either by polythene or by paper bags.

Fit heavy-grade polythene on light wooden frameworks and secure them a foot or so above the plants, just as the buds begin to open and show their true colour. Well-made frames will last for years, and can serve also as extra frame lights in spring. Polythene cover may be used for all colours of chrysanthemums, for most of the light passes through it and there is little or no bleaching, even of the most delicate tints.

Paper bags are suitable only for white and yellow blooms, since those of most other colours lose character and intensity when thus protected. For instance, a bronze flower enclosed in a paper bag will probably turn out amber or yellow.

Use special bags of greaseproof paper secured at one side with waterproof glue; they are quite cheap and easily obtainable. It is better (though not essential) to use two bags, one inside the other, for each bloom.

Wait until the bud begins to open and show the true colour of the bloom. Then give it a thorough spray against pests, and make sure it has dried again completely before it is covered. Once the bud has been enclosed it cannot be inspected, so write the date on the outer bag; the flower inside will be ready to cut for the house about three weeks later.

Soften with water a few inches of the open ends of the two bags (placed one inside the other), then blow them up like a balloon. Place this "balloon" over the bud and secure the open ends firmly to the stem with two twists or, less handily, two ties of string, about 1 in. apart. The "balloon" should be so placed that the bud is at its centre. As the wetted part of the bags dries out it becomes rigid and thus supports them firmly in the correct position. The advantage of using the double bag is that, although the outer one absorbs rain and becomes limp, the inner one remains dry, retains its shape and preserves free space round the developing bud.

Chrysanthemums that are to be covered in order to get first-quality blooms should, of course, be grown in some inconspicuous spot. Both bags and polythene on frames are too unsightly for the main garden.

CUTTING THE BLOOMS
Chrysanthemum blooms will last in the house for at least three weeks if they are cut in the following manner:

Choose blooms that are about three-quarters out, with a firm centre still to open. Cut them in the morning while the stems are full of sap, and bruise the ends of the stems with a hammer. Stand them in deep water, preferably in a tub in which the water level is some 6 to 9 in. below the flower itself. Place the container in a cool place such as a garage for 24 hours before bringing the flowers into the house.
RECOMMENDED VARIETIES
The following list contains only a small proportion of the large number of varieties available. They are mainly those which will need little fussing, and many difficult but excellent sorts have been excluded. Normally it will be wise to wait until a plant has produced a break bud before removing the top inch or so of stem to promote even branching, but in a few cases it will be best to pinch out the top at an earlier date. Where such treatment is advised, a date is given.

New varieties are being introduced every season, and it is, therefore, wise to study the catalogues of the leading growers before buying.

INCURVED
In this type the florets turn inward and upward to form a tight ball. Though this formation of florets tends to hold the rain, the following will come through most seasons satisfactorily. All the varieties in this section should be kept down to about six blooms per plant and disbudded to one bloom per stem.

Dorothy Else, only about 2½ ft., so suitable for the front of a border. White, very firm and long lasting. Pinch in mid-May.

Enid Walters, rarely taller than 2¼ ft. Pale pink, but sporting has produced three excellent new colours—Golden Enid Walters, bright yellow; Amber Enid Walters, light bronze; and White Enid Walters. Can be relied upon for early September.

George McLeod, about 3¾ ft., first introduced in 1934 but still popular. A rich yellow which blooms in August in the south.

Globemaster, 2¼ ft., white and not too strong in growth. The blooms are of perfect shape and are produced in August.

John Woolman, 4 ft., lovely pink blooms over a period of weeks. Stands up
well to bad weather. White John Woolman and Rose John Woolman are useful sports. The family can be a little late in blooming, so pinch in mid-May.

**INCURVING**

These varieties also have florets that turn inward and upward, but not as tightly as the incurved sorts, and sometimes irregularly. The result is an open centre and a slightly looser flower that often reveals a pleasing contrast between colours of the inner and outer florets.

The best results are obtained when the plants are kept to not more than six stems and each stem is disbudded to one bloom.

Evelyn Bush, about 4 ft., chalk-white, quite strong. Does very well in bags.

Harry James, 4 ft., new, but established as a fine dark red variety with broad florets, and a constitution that enables it to stand hard weather and remain fresh in vases for a long period. Pinch in mid-May.

Invicta, 3 ft., bronze. Not the brightest of colours but of easy dwarf habit and withstands rain. Quite pleasing when left to flower in sprays.

Silver Dollar, 4 ft., outstanding bicolour with a pleasing mixture of purple and silver. Highly weather resistant. Needs pinching as soon as it is established after planting out.

**REFLEXED**

These varieties have flowers like open umbrellas, in that the florets strike outward and downward.

This is the largest section of the classification of chrysanthemums, and the one from which border plants are most commonly chosen. It contains hundreds of varieties.

Although these are generally divided according to size, the following list contains more medium-flowered than large, since the former are more suitable for the non-specialist. For convenient reference the varieties are listed according to colour.
WHITE

Brumas, about 4 ft., but a strong grower. Semi-incurving, blooms from mid-September. Protect with bags, not only to prevent damage but to increase the size of the blooms. Pinch in mid-May.
Cresta, 3 ft., new. Valuable since the flower is a fully reflexing type and highly resistant to bad weather. Of bushy habit so very suitable for bedding.
Dorothea, 3 ft., of easy cultivation. Large blooms which bag well though they might succeed unprotected in the border. Pinch in mid-May.

YELLOW

Golden Rule, large and good, reaching 3½ to 4 ft. Will give 6-in. flowers even when carrying six per plant. Pinch at beginning of June.
Leonora, 3½ ft., not a strong grower but sturdy stems carry delightful blooms of fully reflexing type. Very full centres so a heavy crop can be carried. Useful in the centre of the border.
Starbright, 2½ ft. Not very popular because of fairly heavy foliage and short stems, but the starry flowers are very attractive in the border.
Sunavon, 3½ ft., a “must” for the border. Very vigorous, sending up a profusion of suckers and side shoots, and blooming in late August and early September. Good either in sprays or disbudded.

PINK

Brenda Talbot, 4 ft., a beautiful carnation-pink. Suitable only for cut flowers as it rarely has more than three stems. Weather resistant, pinch in mid-May.
Catherine Porter, about 3 ft., sturdy grower. Blooms a little flatterish but of excellent colour in late August.
Daydream, 2½ ft., a veteran of dwarf habit, very suitable for borders. Pale pink flowers in late August.
Peach Blossom, 4 ft., strong, bold, peach-coloured blooms.
Picardy, 3¼ ft., new, but worth extended trial because of its rich colour and wonderful form. A strong grower and carries a good crop.
Sylvia Riley, 3½ ft., good for the border; of dwarf compact habit, it produces a profusion of stems and suckers. Blooms may be grown as sprays or disbudded with equal success.
Sweetheart, 3¼ ft., an old variety but a rejuvenated stock is now available. Very popular with market gardeners.

RED

Escort, often reaches 4½ ft. Excellent for cutting but poor for the border. Strong grower and heavy cropper. Weather resistant, pinch mid-May.
Red Flare, dwarf, red with gold reverse to the florets. Blooms early September.
Starfire, 2½ ft., similar to Red Flare but with richer and deeper colour. Fairly vigorous so suitable for border.

BRONZE

Joseph Reid Johnson, 3 ft. Free-branching, producing in early September light bronze flowers which slowly fade to amber as they age. Quite proof against rain and excellent for border or cutting.
William Dodd, 4 ft., beautiful honey-bronze with fluted florets. Prolific and upright habit.

PURPLE


SPORTS OF REFLEXED VARIETIES

Many of the reflexed varieties listed above have sports of different colours which can be tried with confidence. They behave exactly as do the parents, so follow the same cultural instructions.

Some of the finest sports are those of Brenda Talbot, Sylvia Riley and Sweetheart. Sports always carry the name of the original variety, preceded by the colour of the sport; for example, Apricot Sylvia Riley or Bronze Sweetheart.

SMALL-FLOWERED REFLEXED VARIETIES FOR BORDERS

There are many reflexed varieties which, being smaller flowered, are best grown in sprays in the border and need the minimum of attention.
CHRYSANTHEMUMS

Chatsworth, 2½ ft., bronze, bushy habit.
Cotswold White, 3 ft.
Golden Orfe, 3 ft., bright yellow.
Wendy, 3 ft., light bronze.
Yellow Wendy, a bright yellow sport of Wendy.

POMPONS

Pompon chrysanthemums are becoming increasingly popular as new varieties become available. They need pinching only once when about 6 in. high, and produce a large crop of small blooms most welcome in the autumn border. They are best classified according to height. The following will all bloom in the period August to September before the frosts begin.

Dwarf for front rows—1 to 2 ft.
   Cameo, solid white.
   Cindie, white with yellow centre.
   Denise, yellow.
   Fairie, pink.
   Imp, deep dark red.
   Orange Lad, orange with reddish centre.
   Tiptoe, golden yellow.
   Woking Bouquet, light pink.

For middle rows and cutting—2 to 3 ft.
   Dandy, bronze.
   Eve, purple.
   Gala, pale pink.
   Lustre, coppery-bronze.
   Mitzie, white.
   Poppet, yellow.
   White Bouquet.

SINGLES

Garden singles are somewhat disappointing. They are short (not above 2½ ft.) and not very striking.

There is, however, a large selection of Korean chrysanthemums which contain single as well as double forms. Some of the best are:

   Cardinal, 2¼ ft., single, deep blood-red. August onward.
   Charmain, 2 ft., single, bright yellow with green eye. September to October.
   Dawn Pink, 2½ ft., single, pink. September.
   Ember Day, 2 ft., double, cerise-pink. August to September.
CHrysanthemums

Falstaff, 2½ ft., bright strawberry-red. Opens like a double flower but develops a central eye later. August onward.

Fuchsine, 2½ ft., single, branching sprays of cyclamen-rose flowers in September.

Gold Dust, 1½ ft., double, small button-type flowers on a bushy plant. Mid-September onward.

Golden Arrow, 2½ ft., single, chrome-yellow. September.

Goldilocks, 1½ ft., double, yellow dwarf with cushion-like habit. September.

Hey-Day, 2½ ft., single, cerise-red with gold centre. Early September.

Jante Wells, 1½ ft., double, dwarf, bushy plant giving large crop of yellow pompon flowers. Late September onward. Suitable also for growing in pots.

Little Miss Muffet, 1 ft., single pink flowers. August and September.

Margery Daw, 2 ft., single red flowers. Early September.

Polly Flinders, 1½ ft., dwarf cushion type single of mandarin-red, September.

Polly Peachum, 1½ ft., double, rose-pink with a long season of blooming. August to October.

Tapestry Rose, 2 ft., semi-double, rose-pink with a green centre. Late September.


GREENHOUSE CHrysanthemums

The cultural programme for this section of the chrysanthemum family is much the same as that for border chrysanthemums. General advice on propagation, pest control, staking, stopping and disbudding is largely common to both, but such variations of treatment as there are arise from the fact that greenhouse chrysanthemums are normally grown in pots and that their season of blooming is later—from late October to Christmas or even beyond. This means that some source of gentle warmth will be required in the greenhouse if blooms are to be safe after the end of October.

POT CULTURE

Propagate as for the garden types but start a little earlier—in January. When the cuttings are rooted, put the young plants into 3-in. pots and gradually harden off. As the roots grow and fill the pots, move the plants to larger pots, first to 5- or 6-in. sizes, using a slightly stronger soil mixture. John Innes No. 2 is best at this stage. Towards the end of May these pots will become full of root and a further move to 8- to 10-in. pots, containing John Innes No. 4, will be necessary. Using a short piece of old broom handle as a ramming stick, firm the soil as the plants are potted, finally adding a bamboo stake to each pot and tying the plants to the stakes. Stand these final pots outside, generously spaced in lines on a sunny site, and secure the stakes to a strong wire run along the length of each row about 3 ft. from the ground and fastened to a strong post at each end.

During the summer watering is the most important job; do this carefully, letting the root system dry out almost to flagging-point between each watering.

About six weeks after the final potting, begin feeding with a fertilizer sold specially for chrysanthemums and continue until the buds begin to show colour. Either dry or liquid forms of fertilizer may be used. Bring the plants into the greenhouse at the end of September and after a week or so of full ventilation, regulate the ventilation and heating systems to maintain a dry, buoyant atmosphere at approximately 50° F. (10° C.). This temperature may be increased a little as the flowers reach maturity.
Alternatively, instead of putting the plants into the largest pots, put them out into the open ground at the end of May. Then carefully lift them in late September and plant them in old tomato beds in the greenhouse. This saves much labour in watering and is often successful, particularly with the dwarfer growing varieties which re-establish more quickly after root disturbance.

Buds will appear from mid-August to mid-September and, except in the case of American Spray varieties it is essential to reduce the buds to one per stem to get the finest results.

The time at which the buds are formed has some effect on the size and quality of the flowers, so adhere to the pinching dates given in the list that follows, or in specialists' catalogues.

With the Christmas-flowering varieties it is usual to give two pinches, the first when the plant is about 9 in. tall and the other in mid-July.

Restrict the plant to four or five stems if top-sized flowers are required, but most varieties will carry from eight to 12 satisfactorily if quantity is the aim.

RECOMMENDED VARIETIES

November flowering

LARGE EXHIBITION

These should be restricted to not more than three flowers per plant if a large size of flower is to be obtained.

Albert Shoesmith, 4 ft., incurving yellow. Allow the break bud to form, then pinch and secure the first buds to appear for flowering.
Amethyst, 4½ ft., rosy-purple. Pinch end of May.
Charles Shoesmith, 4 ft., reflexing amber. Pinch end of May.
Charles Woolman, 4½ ft., huge pink reflexing flower. Pinch mid-April.
Duke of Kent, 3½ ft., magnificent white. Pinch beginning of May.
Indian Chief, 3 ft., bright red. Pinch in mid-May.
Majestic, 3 ft., golden-amber. Pinch beginning of May.
Orpheus, 4 ft., lilac-pink with silvery reverse. Pinch beginning of May.
Surrey White, 3½ ft., incurring white. Pinch beginning of May.
Winn Quinn, 4 ft., incurring yellow, capable of carrying up to four blooms of good size. Pinch twice, end of May and end of June.
All the above, with the exception of Winn Quinn, are thus flowered on the first crown bud (see explanation on page 227).

INCURVES
Audrey Shoesmith, 5 ft., deep pink. Pinch beginning of June.
Maylen, 4 ft., creamy-white. Best on second crown buds so pinch at end of May and early July.
Ron Shoesmith, 4 ft., white. Root cuttings in late March and pinch end of June. Yellow Ron Shoesmith is also good.
Silver Crest, 4 ft., pale pink. Root cuttings in March and pinch end of June.
Vera Woolman, 5 ft., long-lasting yellow. Pinch end of June.
Victor Shoesmith, 3½ ft. Yellow, strong growing. Pinch early June and in mid-July.

DECORATIVES
Balcombe Perfection, 4½ ft., in-curving bronze. Tie carefully. Pinch end of May. Red Balcombe and Golden Balcombe are also recommended.
Beacon, 5 ft., in-curving, red. Pinch end of May.
Diplomat, 5 ft., white. Pinch in early June.
Leslie Tandy, 4 ft., beautiful silver and purple. Pinch in early June.
Princess Anne, 4 ft., pink. Despite a spreading habit of growth, this pink variety and its cream and yellow sports are “musts”. Pinch in mid-June and early July.
Town Talk, 5 ft., a recent reflexed red. Pinch end of June.
Woking Scarlet, 4½ ft., medium-sized red; will carry up to ten blooms. Pinch mid-June and end of July.
Tawny Queen, 4½ ft., reflexed light bronze. Pinch end of May.

SINGLES
These are best pinched twice—in mid-May and at the end of June.
Broadacre, 3 ft., white, the largest flower.
Albert Cooper, 4½ ft., chrome-yellow of large size.
Chesswood Beauty, 5 ft., medium-sized red.
Golden Seal, 3 ft., rich yellow. Very long lasting.
Jinx, 4½ ft., medium-sized white.
Mason’s Bronze, 5 ft., light orange-bronze. Other members of this family are Golden Mason’s, Mason’s Pink, Mason’s Flame and Mason’s Orange, the colours of which are indicated by the names.
Pretty, 4 ft., delightful pink.
Uranus, 4 ft., chestnut-red.

ANEMONE-FLOWERED
Like the singles but with a central cushion of tubular florets instead of the more usual daisy-like disk. All 2 to 3 ft. high and flower in November. Pinch in mid-April and mid-June.
Caleb Cox, light bronze.
Grace Land, white with yellow cushion.
Long Island Beauty, white with yellow cushion.
Raymond Mounsey, an unusual red.

POMPONS
These need pinching only once, when about 9 in. tall, and no disbudding is necessary. All are about 4 ft.
Atco, large deep pink.
CHRYSANTHEMUMS

Dresden China, shell-pink suffused with lavender and gold.
Madame E. Dordon, a lovely pink.

December flowering

Flowers are welcome late in the year and particularly at Christmas. Any of the following varieties should give satisfaction.

Agnes Ford, 4½ ft., old rose with gold reverse.
Christmas Wine, 3 ft., deep wine.
Favourite, 3½ ft., white, very popular for Christmas. Several sports are available and Golden Favourite and Cherry Favourite are strongly recommended.
Fred Shosmith, 5 ft., incurving white.
Yellow Fred Shosmith is also good.
Henry Pope, 4½ ft., purple with silver reverse.
Loula, 5 ft., deep crimson.

AMERICAN SPRAYS

These are a recent introduction. They are excellent for the production of beautiful sprays of small flowers in November and December. They are grown in either of the two ways described under POT CULTURE and need to be pinched only once, about late June. No disbudding need be done as the beauty is in the spray formation.

American Snow, 4½ ft., pompon type, white.
Christmas Greeting, 5 ft., small reflexed, bright red.
Galaxy, 5 ft., single type orange-bronze flowers. Early December.
Merrymaker, 4½ ft., single type. Red florets round a golden disk.
Minstrel, 5 ft., fully double, a pleasing pink.
Paramount, 5 ft., pure white pompon.
Vibrant, 5 ft., double, clear yellow.

REFLEXED VARIETY
DAHLIAS

A collection of dahlias is probably without equal among garden plants both for garden decoration and indoor flower arrangement. They can adapt themselves to a variety of soil and weather conditions, and the hybridists have developed a wide range of colours and forms.

The dahlia, named in honour of Dr. Andreas Dahl, a Swedish botanist and pupil of Linnaeus, originated in Mexico and was first introduced into the British Isles from Spain in about 1798. Many new varieties have recently been raised in England, Holland, Germany, America and Australia, and it is now a truly cosmopolitan flower.

TYPES
The dahlias first introduced into the British Isles were wild species such as Dahlia coccinea, D. imperialis, D. merciitii and D. juarezi. The latter is probably a hybrid of the D. variabilis type, into which class all the present-day varieties are grouped. Continuous crossing and selection between varieties, and originally between species, have resulted in the present large and exotic range of dahlias.

A classification of the various forms of dahlia has been adopted by the Royal Horticultural Society and the National Dahlia Society and, although there are a number of border-line cases, most new varieties fall quite readily into one of the classes, each of which has certain common characteristics. There are eleven distinct classes, which are decided on the basis of the shape and formation of flower and petal, and the size of the bloom. Some of the classes are sub-divided according to the size of their flowers.

CLASSIFICATION

CLASS 1
SINGLE-FLOWERED DAHLIAS
Single blooms, up to 4 in. in diameter, having one row of smooth ray florets surrounding a central disk. This class is sub-divided into:
(a) Show Singles, with round-ended, overlapping petals.
(b) Singles, with more pointed petals which do not overlap as much.
DAHLIAS

CLASS 2
STAR-FLOWERED DAHLIAS
Small flowers, having two or three rows of pointed petals which overlap very slightly, are somewhat recurved at the edges and form a shallow cup-shaped flower round a central disk.

CLASS 3
ANEMONE-FLOWERED DAHLIAS
This class has an outer row of ray florets surrounding a central zone of comparatively long, tubular florets, which gives the flower an attractive, domed centre, often of a contrasting colour.

CLASS 4
COLLARETTE DAHLIAS
An unusual and brightly coloured class, with one or more rings of flat ray florets, and a ring or collar of smaller florets about half the length of the ray florets, usually contrasting in colour with both the ray florets and the disk.

CLASS 5
PAEONY-FLOWERED DAHLIAS
This class is sub-divided into three groups, all of which have two or three rows of broad and usually flat petals surrounding a central disk:
(a) **Large-flowered**, diameter of flowers over 7 in.
(b) **Medium-flowered**, diameter of flowers 5 to 7 in.
(c) **Small-flowered**, diameter of flowers up to 5 in.

CLASS 6
DECORATIVE DAHLIAS
This class covers a wide range, from near pompon to near cactus forms. The fully double flowers have broad petals which are normally flat (though they are sometimes slightly twisted) and bluntly pointed or rounded at their flattened tips. This class is sub-divided into four groups:
(a) **Large-flowered**, diameter over 8 in.
(b) **Medium-flowered**, diameter 6 to 8 in.
(c) **Small-flowered**, diameter 4 to 6 in.
(d) **Miniature**, diameter up to 4 in.

CLASS 7
DOUBLE SHOW AND FANCY DAHLIAS
Fully double, very regular, almost globular flowers, 4 in. or more in diameter, the central florets being slightly smaller than the outer ones, with blunt mouths and incurved edges. The show types are self-coloured, and the fancy types are bi-coloured or variegated. It is one of the oldest classes, and some varieties are still popular in spite of their tendency to produce weak stems.

CLASS 8
POMPON DAHLIAS
This class has the same characteristics as Class 7, except that the blooms are smaller and often more globular and are usually borne on strong stems. The class is subdivided into:
(a) **Large-flowered**, diameter 3 to 4 in.
(b) **Medium-flowered**, diameter 2 to 3 in.
(c) **Small-flowered**, diameter up to 2 in.

CLASS 9
CACTUS DAHLIAS
Cactus dahlias show no disk unless the weather is unfavourable or the blooms are old. The fully double flowers have straight or incurving petals which are partially revolute (inturned along their length), and tend to be narrow and pointed, which gives the flowers a star-like appearance. The tips of the petals of several new varieties are laciniated or split, thus giving the flowers an added lacy charm which makes them popular for flower arrangements. This class is subdivided into:
(a) **Large-flowered**, diameter over 8 in.
(b) **Medium-flowered**, diameter 6 to 8 in.
(c) **Small-flowered**, diameter 4 to 6 in.
(d) **Miniature**, diameter up to 4 in.
DAHLIAS

CLASS 10
MISCELLANEOUS
Several of the varieties in this class (types which do not fit easily into any other class) are also useful for flower arrangement, such as the double orchid-flowered Giraffe and the smaller-flowered Disneyland.

CLASS II
DWARF BEDDING
The flower type in this section can be any of the foregoing ten classes. Good varieties are found in single, decorative, paony-flowered, cactus and anemone-flowered forms, the common factor being that they do not usually exceed 24 in. in height and are therefore well suited for bedding purposes. A strain known as Topmix, recently introduced from Holland, carries small flowers of 1 to 2 in. in diameter on plants about 12 to 15 in. high.

PROPAGATION
The plants can be bought as pot or ground tubers, a tuber being the thickened storage root which can be stored over the winter in a frost-free place and planted out the following spring. The ground tubers are not easy to obtain, but the pot tubers can be bought from a nurseryman who specializes in dahlias. Pot tubers are raised by keeping rooted cuttings growing in 3- or 5-in. pots for a season, then harvesting and retailing the resulting compact tubers in the following dormant season.

If the gardener has no greenhouse, rooted cuttings can be bought in May or June, each plant being grown separately in a 3-in. pot and planted out as explained on page 244.

There are also three ways in which a gardener can raise his own plants, from seed, from striking cuttings and by division of mother ground tubers.

SEED
Plants of the single Coltness Gem type which can be obtained in mixture or in strains coming reasonably true to colour, and other mixed bedding types, such as Unwin’s Dwarf Hybrids, which have a range of variously coloured semi-double blooms, can be grown from seed. Seeds saved from named varieties produce very few plants which even approach the form or colour of the parent plant, but it is interesting to grow on and test out seedlings from good varieties in the hope that a seedling worth perpetuating will result.

Sow all types of seed in late March or April in a pot, pan or box containing John Innes seed compost, or one of the recently introduced composts of peat and sand or peat and vermiculite, which are blended with a balanced base fertilizer and can be obtained from a sundriesman. These new composts can be stored in a dry state for any length of time, and only require a thorough soaking before use—the peat and vermiculite mixture soaks more easily than the peat and sand mixture.

Distribute the seed thinly on the levelled surface of the well-moistened compost and cover the seeds with a further layer of compost or sand about ½ in. deep. No water need be added after the seed has been sown.

Cover the containers with paper to keep them moist and to prevent them from becoming overheated if they stand in direct sunlight.

If the pots, pans or boxes stand in a greenhouse, place them in a polythene bag before covering them with paper, to preserve the moisture and encourage germination. Dahlia seeds germinate rapidly, though sometimes erratically. Therefore keep a close watch over them and remove the paper as soon as there is any sign of growth.
DAHLIAS

PROPAGATION BY CUTTINGS

Raise the seed in a steady temperature of 60 to 65°F. (16 to 18° C.) to ensure an even germination. If the greenhouse or frame is not normally heated to this temperature, a useful propagating unit can be constructed with a wooden-sided frame and polythene-covered lights over the top. Bury mains or low-voltage heating wires in the middle of a layer of sand 2 to 3 in. deep on the bottom of the frame. These will make it possible to maintain an ideal temperature for the germination of all seeds and for the striking of cuttings.

Prick off the seedlings as soon as they can be handled, and, to ensure good plants, put 6 rows of 5 plants into each seed box containing any of the recommended potting comports.

Once the seedlings are established and there is no danger of frost, remove the trays to a cold frame to harden off the plants.

If there is no heat in the greenhouse, sow the seeds in April. Plants from the seedlings will flower slightly later than those grown from seed which is sown in March.

CUTTINGS

Cuttings are obtained from the previous year's ground or pot tubers, which have been stored through the winter in a frost-free place. At about the beginning of March take the old tubers out of store, clean away any old soil and cut out any diseased parts.

Place the tubers in a suitable container, such as an old kipper box, on a layer of light soil, peat or compost. Cover them with the soil, peat or compost to just below the level of the crown, and water gently so that they are kept moist but not too wet.

Put the box in a greenhouse which is heated to a temperature of 60 to 65°F. (16 to 18° C.) to induce immediate growth. Although the tubers are easier to handle in boxes, they can also be placed on a greenhouse bench and covered directly with soil.
DAHLIAS

Moisten the cuttings and dip them in rooting powder

Pot the cuttings, four to a 3-in. pot

When rooted, pot singly in 3-in. pots

After a time shoots begin to grow from the crowns of the tubers. When the shoots reach a length of 3 to 4 in., take cuttings by severing the shoots just below the bottom pair of leaves. Trim each cutting, leaving only the top pair of leaves and the central growing point, and sever the cutting again with a sharp knife or razor blade immediately below a node. Further shoots will develop from the dormant buds on the tubers at the base of the first shoots and provide an ample supply of fresh cuttings.

To encourage the rooting of the prepared cuttings dip them in water to a depth of ½ in. and then into one of the proprietary hormone rooting powders. Shake off any surplus powder before inserting the cuttings in the rooting medium.

The rooting medium can be either a mixture of equal parts peat and sand, the peat and vermiculite mixture already mentioned, or just sand or vermiculite. Put the chosen rooting medium in a container which will accommodate the cuttings—a 3-in. pot for example will take four—and place each cutting in a hole made against the side of the pot with a small stick or pencil. Firm the compost up to the cutting with the stick.

During propagation make sure that each batch of cuttings is correctly labelled with the varietal names and the date the cuttings were made. Then place the cuttings in a propagating frame and keep them moist. Avoid excessive moisture and condensation, which can cause severe damping off and the consequent failure of the cuttings, by allowing the cuttings a little ventilation, especially at night.

The cuttings do not usually take more than 2 to 3 weeks to root, although the time taken does vary according to the variety and the conditions for growth. When the young leaves start to grow again, which is a reliable sign that rooting has taken place, pot the rooted cuttings singly in 3-in. pots, using either John Innes No. 1 potting compost, peat-sand or peat-vermiculite compost.

Peat pots are invaluable for young plants such as dahlias. If the rooted cuttings are potted into them the plants in their pots can be planted out into the
DAHLIAS

soil with a minimum of root disturbance, and the pots eventually disintegrate. Peat pots can also be used for striking cuttings, since they can be inserted singly in jiffy-strips or in small-sized pots filled with the vermiculite-peat compost, and each plant, when rooted, can be potted on into a 3-in. peat or clay pot.

After potting shade the plants for about two days and then keep them in a well-ventilated greenhouse or frame until the end of April, when they should be removed to a cold frame and hardened off.

The lights need not be used unless there is likely to be a frost, when it will probably also be necessary to cover the frame with matting or sacks.

From the time the plants are potted until they are planted out they must be kept well watered, but never allowed to become waterlogged.

TUBER DIVISION

The third method of propagation is by division of the tubers. Each division must have an eye (an alternative name for a bud) attached, because if a fang of the tuber is removed without a bud no amount of care will make it grow. If it is difficult to see the buds, place the tuber in a warm spot in peat or soil until the buds just begin to develop.

Use a sharp knife to cut through and separate as many sections of the tuber with a bud as possible, and in the case of those varieties which produce very small and thin tubers take care not to damage the eyes. It is advisable to pot or box the divided tubers and grow them on for planting out in the garden as green plants at the end of May.

PLANTING OUT

SITE

Remember that the native home of the dahlia is Mexico and that, although many advances have been made in breeding new types, the dahlia is still at its best in a warm, sunny position where it will get plenty of air.

Dahlias will, however, thrive in a semi-shaded place if it is not in the immediate

PROPAGATION BY TUBER DIVISION

With a sharp knife cut the tuber into clumps, taking care not to damage the small buds or eyes

Then cut off individual fangs for potting, ensuring that each one contains a bud

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vicinity of a tree, as the tree will tend to draw the dahlias up and make them grow soft, so that they are liable to attacks by pests and diseases. Do not plant them where they will be exposed to cold or frost. Low-lying areas of the garden are likely to suffer most severely from frost because the cold air, which is heavier than warm air, collects in the lowest parts of the garden.

SOIL

Dahlias prefer a good medium loamy soil, although they will thrive in practically any soil which does not dry out rapidly and does not become easily waterlogged. Both these factors can be partially controlled by careful soil preparation. Dahlias are gross feeders, and it is therefore advisable in the autumn to dig into the soil a heavy dressing of decayed farmyard manure, compost or other organic matter, adding a dressing of 4 oz. bone meal to a square yard. Leave the surface of the soil in a rough condition so that the action of frost and the winter weather will make the soil easy to deal with at planting time.

As the soil of every garden differs from that of its neighbours a combination of common sense, observation and experience must guide the gardener in his treatment of his own soil. Some soil may give the best results if lightly forked over in spring when sufficiently dry, and if so, this is a good time to put on a light dressing of an all-round fertilizer, such as one of the specially prepared mixtures made for dahlias or the John Innes base fertilizer. Do not exceed the amount which is recommended in the manufacturer's instructions, for too much fertilizer can kill or injure the plants.

TUBERS

Dahlias look very effective if a variety of forms and colours are planted together, and the bedding types form a colourful display if they are planted in a single colour block.

Plant tubers in the middle of April, as soon as the ground is in a workable condition, and place them in holes 6 in. deep. If a mixture of types is being planted, first insert stakes in the bed so that the layout can be visualized. The stakes should be shorter than the eventual height of the plants and inserted in such a way that the fully grown plants will hide them from view. The spacing between the plants is determined by the height of the dahlias when fully grown. Generally the tall-growing types need to be 3 ft. apart, the medium types 2½ ft., and the bedding types should be spaced 1½ ft. each way, to ensure that they give a solid display of colour. Plant any varieties which are to be grown for exhibition in double rows in a separate part of the garden, allowing about 3 ft. between the rows.

Insert the canes or wooden stakes firmly in the ground at one side of the hole so that the tuber can be planted against it, and cover the tuber with fine
soil. If the weather has been very wet and so made it difficult to obtain a good tilth, cover in with some well-rotted compost or old potting soil to give the roots a good start.

**POT GROWN PLANTS**
Plant out rooted cuttings in late May or early June when there is no risk of frost. Make sure that the pots are well watered an hour before they are taken to the site, which can be marked out as for tubers. Dig the hole slightly larger than the ball of soil on the plant, and water in each plant by playing a hose or watering-can on the side of the hole, so that the soil is well washed round the roots and the plant is given enough water to start it growing even in a dry period.

**MANAGEMENT**

**MULCHING**
Immediately after a heavy rain or watering mulch all round the plant, about 1 in. deep, but not right up to the stem, with clean dry straw, grass mowings, very old farm-yard manure or peat in order to keep the soil moist.

**WATERING**
Dahlias can probably withstand a drought better than most flowers, but the size of the blooms and the length of blooming will be reduced if the soil becomes excessively dry. Therefore, if the dahlias are being grown for exhibition or for a good garden display keep the soil moist by soaking it to a depth of 5 to 6 in., without waterlogging it. A light sprinkling of water on the surface often does more harm than good as it does not penetrate to the roots.

**TOP DRESSING**
Soil that has been well prepared and is in good heart will not need much additional food during the growing season, but if the soil is light and needs feeding, or first-class show blooms are required, a mulch of decayed farm-yard manure will help the plants. Special diluters can be fitted into the hose-pipe used for watering and the necessary liquid food can then be applied with the water. If top dressings of solid fertilizer are given, make sure that they are well watered in so that they reach the roots. The proprietary brands of dahlia fertilizer are properly balanced to the plants' requirements, and will give good results. Avoid high nitrogen foods as they will lessen the storage quality of the tubers and make the blooms coarse.

**TYING**
The dahlia tends to make a soft type of growth which should be carefully supported at all times to prevent weather damage, and this is best done from the very youngest stages, by looping ties of soft string from the dahlia stake round each main stem. With varieties which make large, bushy plants it may be necessary to add extra smaller canes to support the outer growths of the plant. The ties should be loose and care should be taken to allow enough room for the expansion of the stems as they grow.

The stems of some of the large decorative type may be too weak to carry the weight if battered by wind and rain, therefore a small thin cane of some 2 to 3 ft. long, tied alongside the main stem, and up to the base of the flower, will help to prevent any damage. When the first ties are made, care should be taken to allow sufficient room for the increasing size of the stem as it grows.

**DISBUDDING AND SIDE SHOOTING**
Dahlias which are being grown for exhibition must be extensively disbudded, and have their side shoots removed to ensure good blooms. On the large decorative and other large-flowered types, leave only 4 or 5 main stems on each plant, each carrying one bloom, all other buds and side shoots being removed at an early
stage. Other classes of dahlia grown for exhibition must also be disbudded, but if they are grown for cutting or for garden decoration the extent of the disbudding depends on the type of bloom required. Remove the two small flower buds which appear on each side of, and below, the main terminal bud, as well as the side shoots which arise in the axil or angle between the leaf stalk and the main stem. These laterals are removed to give a stem of sufficient length for cutting, and the lower shoots are retained to give a succession of blooms.

PESTS
Aphids (greenfly and blackfly), capsid bugs, caterpillars, earwigs, red spiders, slugs, thrips and wasps are the main pests which attack dahlias, while wireworms can damage the roots in the ground and woodlice can damage them while they are in store.

Aphids normally attack the young foliage and cause twisting and distortion, and, like thrips (another sucking type of insect which lives on plant sap), they spread virus diseases from one plant to another. Capsid bugs, which are also sucking insects, feed on the foliage and flower buds and distort them. A routine spraying every fortnight with B.H.C., malathion or derris will control aphids and capsid bugs, while caterpillars are eradicated by D.D.T. Earwigs attack the leaves and flowers and can be controlled by dusting round the plant with B.H.C. Red spider may be a very serious pest in hot, dry weather, causing the leaves to wither, yellow and fall, and can only be controlled by malathion and derris.

Slugs can cause a lot of trouble to young plants, but are easily kept in check by the use of a pre-prepared metaldehyde and bran bait, or the more persistent pellets which are thrown on the ground at planting time and afterwards. Thrips usually attack late in the season, causing mottling of the leaves and flower petals, and can be controlled in the same way as aphids and capsid bugs. Wasps may do considerable damage to the stems but can be controlled by B.H.C. or derris dust applied to the nest. Wireworms and
woodlice are controlled by a dusting of B.H.C. in the infected areas.

**DISEASES**

Apart from certain virus infections, diseases are not as troublesome to dahlias as pests. Spotted wilt is the most serious of these infections. It causes a mottling and spotting of the foliage, occasional black spots on the stem, weak stems and poor flowers. Remove and burn immediately any plants showing some or all of these symptoms, as thrips and aphids may carry the infection to healthy plants.

Dahlia smut, which usually attacks the plants in cool, damp weather, causes light coloured spots on the leaves, which eventually turn brown. Spraying with colloidal copper or Bordeaux mixture helps to control this trouble.

Crown gall is the least serious disease and causes a cauliflower-like growth at the base of the stem and the top of the tuber. It is not highly infectious. The best control is to burn all the infected plants.

**LIFTING AND STORING GROUND TUBERS**

Lift the tubers in the autumn after the first frost, which often damages the parts of the plant above ground and blackens them. Cut off the main stems, about 6 in. above the ground, and with a fork carefully lift the tubers so that they are not damaged. Then remove any surplus soil from the roots and lay them upside down in a warm room or shed so that surplus water will drain out of the stems and the tubers dry off. Once the roots are dried and labelled store them in trays of dry sand or peat in a cool, frost-free place, such as a cool greenhouse, cellar, cupboard or slightly heated shed. Alternatively, place a layer of roots between two layers of straw in a large sack.

If there are a great many roots a clamp, like that used for potatoes, can be made.

Put down a layer of dry, clean straw on the soil in a sheltered position in the garden, heap the tubers on the straw, add more straw to a depth of 8 in. or so and finally cover with a layer of soil to protect the clamp from the rain.

Remember to label the plants when they are lifted. Write the name of each plant with a waterproof ink or pencil on a label made of metal, plastic or wood, and tie the label firmly to the stem. Alternatively, write the name in indelible pencil on the surface of a clean part of each tuber.

**RECOMMENDED VARIETIES**

Descriptions of the blooms in each class appear on pages 239 to 241.

**SINGLE DAHLIAS**

Both the following varieties will flower for a long period if the dead flower heads are removed.

- Kokette, 3½ ft., a red bicourlor.
- Liebenswert, 3½ ft., an orange bicourlor.

**STAR DAHLIAS**

- White Star, 3 ft., white.

**ANEMONE-FLOWERED DAHLIAS**

- Comet, 3 ft., dark dahlias.

**COLLARETTE DAHLIAS**

The following three varieties grow to a height of 2½ to 4 ft.

- Aureoline, brilliant yellow.
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Geerings Elite, a red and yellow bicolour.
Scarlet Queen, scarlet and gold.

PAEONY-FLOWERING DAHLIAS
Bishop of Llandaff, 3 ft., scarlet blooms, with deeply cut bronze foliage, is very effective in a border.

DECORATIVE DAHLIAS
The following varieties are popular with exhibitors and are useful for garden decoration at the back of borders.

(a) Large-flowered
Cover Girl, 4 ft., mauve tipped with white.
Croydon Masterpiece, 4 ft., reddish-brown.
Croydon Snowtop, 4½ ft., white, very formal flowers.
Frieda Gaylord, 4 ft., very large blooms, clear pink on a cream ground.
Liberator, 4 ft., deep crimson blooms, not exceptionally large but very good.
Peter Ramsey, 4½ ft., rich yellow.

(b) Medium-flowered
Arc de Triomphe, 4½ ft., deep golden-orange.
Ballesto's Glory, 4 ft., deep crimson, edged with gold.
Brandaris, 4½ ft., red with a gold centre, makes a good show in the garden.
Deuil du Roi Albert, 4 ft., purple flowers tipped with white.
House of Orange, 3 ft. 9 in., very bright orange.
Yellow Elegance, 4 ft., yellow.

(c) Small-flowered
These are good for garden decoration and for use in flower arrangements.
Brumas, 4 ft., pure white, with dark green foliage.
Chinese Lantern, 4 ft., bright orange-red, gold reverse.
Edinburgh, 3½ ft., maroon-purple tipped with white, an unusual and decorative flower.
Gerrie Hoek, 4½ ft., shell-pink with gold shading, a popular cut-flower variety.
Glorie van Heemstede, 4 ft., lemon-yellow, reverse apricot, is good for cutting as it has wide petals and lasts well in water.
Reedley, 3½ ft., rich apricot, good for cutting.

(d) Miniature-flowered
Doris Duke, 3½ ft., deep flesh-pink, perfect form, very floriferous.
Dr. John Grainger, 3 ft., amber-orange, with near pompon type flowers.
Kolchelsea, 3 ft., scarlet.
Newby, 3½ ft., peach-salmon.
Willy den Ouden, 3½ ft., apricot and yellow.

SHOW AND FANCY DAHLIAS
Good examples of the very regular round form of bloom in this class are:
Model, 3½ ft., a bicoloured light pink.
Rondkop, 3½ ft., fawn with salmon edges.
Standard, 3½ ft., dark crimson.
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POMPON DAHLIAS
(a) Large-flowered
   Ascog, 3 1/2 ft., rosy-pink.
   Jean Lister, 3 1/2 ft., pure white, good for cutting and garden decoration.
   Nellie Birch, 3 ft., deep crimson-maroon.
   Rothsay Superb, 3 1/2 ft., bright scarlet-red blooms carried in profusion on long stems.
(b) Medium-flowered
   The following provide good cut flowers.
   Chamois, 3 1/2 ft., salmon and white.
   Leo, 3 1/2 ft., scarlet with yellow base.
   Little David, 3 ft., orange.
   Sulphurea, 3 ft., light yellow.

MINIATURE-FLOWERED CACTUS DAHLIA

CACTUS DAHLIAS
(a) Large-flowered
   The following varieties are usually grown for exhibition and in garden borders.
   Ami Pardieu, 4 ft., golden-orange.
   Arab Queen, 4 ft., amber, with shaded yellow centre.
   Gunyah Glory, 4 ft., deep purple.
   Moonliner, 4 ft., deep yellow.
   Pride of Holland, 4 ft., rose-pink, with long stems.
   Rodeo, 4 ft., rich crimson.
(b) Medium-flowered
   The following make a good show in the border, and are useful in large flower arrangements.
   Eclipse, 4 ft., deep purple or wine-red.
   Gladys, 3 1/2 ft., white and lavender bicolour.
   Kathleen Ferrier, 4 ft., salmon-pink, very good habit.

LARGE-FLOWERED POMPON DAHLIA

SMALL-FLOWERED CACTUS DAHLIA
DAHLIAS

Pioneer, 3½ ft., pure yellow.
Polar Beauty, 4 ft., pure white, free flowering.
Rose Tendre, 4 ft., rose-pink with a touch of white, a very delicate flower.
Top Choice, 3½ ft., orange-scarlet, tipped with yellow.
(c) Small-flowered
The following, as well as the miniature-flowered class, are useful for both flower and garden arrangements.
Cheerio, 3½ ft., cherry-red, tipped with white.
Doris Day, 3½ ft., a well-formed cardinal red, which is particularly good for cutting.
Grace, 3 ft., pure pink.
Klankstad Kerkrade, 3 ft., sulphur-yellow.
Preference, 3 ft., salmon-pink, very free flowering.
White Rays, 3½ ft., pure white.
(d) Miniature-flowered
Andries' Orange, 3 ft., deep orange.
Little Mermaid, 3 ft., white.
Pirouette, 3 ft., pale lemon.

MISCELLANEOUS DAHLIAS
The following are very popular for flower arrangements.
Disneyland, 3 ft., small red flowers, speckled with orange.
Giraffe, 3 ft., light orange with heavier markings, the double orchid-flowered variety, has blooms 4 in. in diameter.
Jean Fairs, 4 ft., buff-apricot, with darker centre.

DWARF BEDDING DAHLIAS
(a) Single
Coltness Gem, 1½ to 2 ft., crimson, scarlet, is the best-known variety.
Northern Gold, deep yellow, and Princess Marie Jose, pink, both grow to 1½ to 2 ft., and make a very bold display when planted in large blocks.
(b) Decorative
All the following make neat, compact plants.
Maureen Creighton, 1½ ft., scarlet.
Rothesay Castle, 1½ ft., rose-pink.
Rothesay Yellow, 2 ft., clear pale yellow.
(c) Cactus
Both the following varieties give an outstanding display when bedded out.
Downham, 2 ft., yellow blooms 4 in. in diameter.
Frank Soeten, 2 ft., pure white.
ROSES

Anyone can grow roses! In the colder, northern counties, in the extreme north of Scotland where very low winter temperatures can be expected, in the drier eastern counties as well as in the kinder climates—in fact, wherever the garden—roses are a practical proposition. Individual varieties do, however, have their likes and dislikes; those with plenty of petals invariably open their blooms perfectly in areas where the rainfall is low; in areas with a high rainfall, such flowers will often be spoilt, whereas those with fewer petals will be unmarked.

Most roses will grow and flower with relatively little attention, provided they are not planted under the shade of overhanging trees or in badly-drained soil. They will, however, give much better results, increasing in both size and beauty for a number of years, if they receive a little extra attention. Such attention is well within the scope of the average gardener, even if he is growing roses for the first time.

A reasonably open position is desirable, although slight shade does not matter. Sound drainage is vital: if surface water
remains for many weeks in winter, rose tree roots tend to rot, and growth will be weak and spindly. Where surface water stays for merely a day or two, as it often does on very heavy soil, there is no need to worry.

FRAGRANCE

Many people want to grow only fragrant roses and one often hears that modern varieties are scentless. There have always been roses with little or no scent and many present-day varieties are just as fragrant as the old timers. Almost all rose blooms will seem scentless unless the weather and atmospheric conditions are just right, for fragrance depends on the volatilization of essential oils, which occurs chiefly in a warm, humid atmosphere. During cold, wet spells even the most highly scented varieties may have little or no fragrance.

Rose hybridists do not ignore fragrance when breeding new varieties, but unfortunately fragrance is a recessive not a dominant characteristic.

If a new seedling has vigour, colour, freedom of bloom and all the other virtues but is merely lacking in scent, the hybridist would be foolish to pass it over. On the other hand, if he has one which is strongly scented but is a weak grower he will not offer it to the public.

WHAT TO GROW

First decide on the types of roses to be grown. Nowadays the colour range is very wide, probably greater than in any other flower. Self-colours, bicoulours and multicolours are available in innumerable shades and one can choose from bush roses, standards, climbers, ramblers, miniatures, or shrub roses. The latter are dealt with in Trees and Shrubs.

There are many new varieties of roses each year, the reason being that since modern roses are propagated vegetatively and not by seed their working lives are limited. Eventually every variety starts to deteriorate, especially those with complicated ancestries, such as the hybrid teas and floribundas. After about 25 years many varieties no longer give of their best.

There are, of course, honourable exceptions such as the rose-pink Picture (which was introduced in 1932) or McCreedy's Yellow (1933), both of which are still reliable.

The original species or wild roses and the old-fashioned shrub kinds, like the Bourbons, have simple ancestries. They were not propagated to the same extent as the modern roses. Such roses often still retain their pristine vigour.
Hybridists must continue to offer new rose varieties regularly, if only to replace those that fall by the wayside, but it is also important to remember that most contemporary varieties are better in every way than their predecessors. They are more vigorous, with better-formed blooms in a much wider range of colours, and they flower more freely.

**BUSH ROSES**

These vary in height from 1½ to 5 ft. or so, according to variety and method of pruning. They are represented by hybrid teas and floribundas, as well as the informal shrub type or species which are usually grown as single specimens and not in formal beds.

Hybrid teas were the mainstay of gardens until the last few years. Their blooms are borne either singly or in twos and threes. Where roses of real quality are required they are still the first choice. They vary in height between 1½ and 4 ft.

The floribundas, formerly known as hybrid polyanthas, carry their blooms in clusters or trusses. They flower profusely, are excellent for cutting, and are exceptionally hardy even where prolonged near-freezing temperatures are experienced. Heights differ considerably, from moderately vigorous varieties up to 2 ft., which are suitable for fronts of borders, to the taller kinds which may reach 4 ft. or so with light pruning.

Floribunda dwarfs are bushy, unusually low-growing varieties. They vary in height from about 8 to 15 in. and some are ideal for edging.

**STANDARDS**

Hybrid teas and floribundas are also grown in standard form. Buds or “eyes” are taken from the chosen variety and budded on to briar or Rosa rugosa stems about 3½ ft. tall (see Budding of Standards). Only the more vigorous hybrid teas, such as Ena Harkness, Gail Borden, Peace and Perfecta, make really effective standards, especially if they have a bushy, spreading habit of growth.

**RAMBLERS AND CLIMBERS**

These are often slow starters and will not produce a profusion of flowers for at least two years. They are, however, very long-lived. They can be grown on pillars,
MINIATURE ROSES

These range from 6 to 15 in. high. The tiny individual blooms are often perfect replicas of hybrid teas. The foliage is also proportionately smaller. All varieties are excellent for edgings to beds of floribundas or hybrid teas, as well as for window boxes, rock gardens or sink gardens.

They can be grown in the living-room in pots or troughs with some success for limited periods. They dislike a dry atmosphere and abhor central heating. One method is to bring them on in a greenhouse or frame until the buds are showing, then transfer them to a really cool room and spray them night and morning with clear water. Directly the first crop of bloom is over, return them to the greenhouse or frame and grow on again. As an experiment in keeping them indoors all the year, stand each pot in a large pan or saucer containing at least 1 in. of damp peat. Keep the peat fairly moist except in winter and stand the pots out-of-doors during summer showers.

ROSE BEDS

These may be of any shape. The length is immaterial, but the width is determined by practical considerations. Avoid excessively wide beds, otherwise frequent treading is inescapable. A bed 6 ft. wide holds three rows of most hybrid teas or floribundas comfortably. In large beds, standards set in the middle, and elsewhere according to taste, improve the over-all effect.

PLANTING

WHEN TO PLANT

Rose trees of all types can be planted from late October to late March provided the ground is neither frozen nor sodden with rain. On heavy soils, which usually contain good reserves of moisture, planting in early spring is often more successful. On light, sandy soils, however, spring planting is seldom as successful as November planting, because March winds plus prolonged drought often lead to serious die-back.

PREPARATION FOR PLANTING

Roses thrive on any type of soil provided it is given careful initial preparation. Complete the soil preparation about three weeks before planting in order to allow the ground to settle.

The whole area should be dug two spits deep; if there is clay in the bottom spit, mix hydrated lime freely with the soil to break it up. In light or medium soil the bottom spit must be broken up thoroughly. Always be careful not to mix the two spits during digging.

The top spit needs careful preparation and such humus-forming material as rotted compost, hop manure, damp peat, old leaf mould or chopped-up old turves should be added in generous quantities. As long as the various materials used are well mixed in the soil and not left in layers or lumps, what is used matters little. Bone meal or fish manure is useful on any
ROSES

soil, and sulphate of potash is beneficial to sandy soils, which are usually lacking in potash. If farmyard manure is added it must always be well rotted and free from weed seeds. Mix it freely with the top soil so that the roots of the roses do not come into contact with slabs of manure, otherwise they may "burn".

ARRIVAL OF PLANTS

Plants may be delivered by the nurseryman as a pyramidal straw bundle with damp moss round the roots, in a cardboard box with polythene sheeting covering the roots, or in three- or four-ply paper sacks with straw, hay or polythene for root protection. Do not worry if the trees cannot be dealt with immediately. Leave the packages intact in any unheated, frost-proof shed, garage or cellar, or under the greenhouse staging, and they will be perfectly safe for about ten days.

If the trees cannot be planted in 10 to 14 days after delivery, unpack them and find a sheltered spot in the garden. Dig a trench and place the trees in it in a single row so that they can eventually be lifted a few at a time without disturbing the remainder. Cover the roots and lower portions of the stems with soil. Do not set the trees firmly in the ground but place them on a slight slant, making sure that they are unlikely to become loose in the soil. This is called heeling-in, and with this treatment the trees can safely be left for weeks or even months.

HOW TO PLANT

Never let the roots dry out before planting. Plunge the roots of each tree in a pail of water. Cut off any foliage, buds or flowers, and decayed or twiggy shoots. If the stems are at all shrivelled, leave the whole plant in water for several hours, when it will usually freshen up.

Make the planting hole about 15 in. in diameter and, except for standards, no deeper than will be required to bring the budding union (a bulge where the main stem starts) about level with the surface soil. Place a double handful of mixed moist peat, bone meal and fine soil in a mound in the middle of the hole. Hold the bush in the centre of the hole and spread the roots out without bending or twisting them. Work in plenty of fine soil, shaking the bush a little so that the soil falls through the roots and there are no air gaps left. Press the soil down firmly all round with the foot—when this has been done the budding union should be level with the surface or not more than 1 in. beneath it. Always plant firmly, because loose planting encourages the development of suckers or wild growths from the stock on which the rose was budded. On light ground the soil round each bush should be pressed down firmly as the hole is filled. Deep planting is detrimental because subsequent manuring, feeding and mulching will gradually raise the soil level.

PLANTING BUSH ROSES

Most kinds can be spaced 20 in. apart, the compact growers rather closer, say 16 to 18 in., and the very vigorous varieties farther apart, say up to 2 ft. Bush roses are more effective when staggered.

PLANTING STANDARDS

Before planting the trees, drive stakes firmly into the ground at least 3 ft. apart. After planting, tie each tree to its stake in three places, making one tie just below the budding union, another half-way up the stem, and a third towards the base. Stakes should always be treated with a proprietary wood preservative from the base of the support to a couple of inches above ground level.

PLANTING RAMBLERS AND CLIMBERS

If the plants are to be grown on garden walls or fences, place them not less than 10 ft. apart so that their long shoots can
PLANTING A BUSH ROSE
Bush roses are planted firmly with the union just about level with the soil. Spread out the roots and work in plenty of fine soil before treading firm.

PRUNING A HYBRID TEA ROSE
Prune established hybrid tea roses by cutting back all shoots to about half the length of the previous year's growth. Endeavour to cut back to an outward-pointing bud.

PLANTING A STANDARD ROSE
When a standard rose is to be planted, drive in the stake firmly, spread out the roots of the plant and cover them with friable soil, working it well between the roots. Firm the soil until it is slightly higher than the surrounding earth. Tie the stem to the stake, protecting it from rubbing with pieces of cloth.

spread out properly. If climbers are to grow on house walls, plant them 15 in. away from the house, as the height of the walls tends to prevent moisture from reaching the roots if planted closer. Keep the surrounding soil clear for about 18 in. in all directions. If a rose is to be grown up a pillar, first put the pillar in position, then plant the rose 12 in. away from it, and tie it loosely to the post.
PLANTING MINIATURE ROSES
Choose a sunny position, and soil which is reasonably retentive of moisture but is perfectly drained. If the soil is on the dry side, work in plenty of damp peat and compost.

FILLING GAPS IN OLD ROSE BEDS
Countless disappointments have been caused by planting new rose bushes in an established bed without changing the existing soil. Preparing a hole as just described is not sufficient. Soil which has grown roses for many years gradually becomes "rose sick" since all roses take considerable quantities of plant nutrients from the soil. The existing roses will, however, continue to flourish for many years because their roots are all the time spreading to new areas with untapped supplies of plant foods.

If a gap is to be filled, first remove the soil for each new tree to at least 12 in. deep and 18 in. across and exchange it for soil from another part of the garden where roses have not been grown. (In the case of well-established climbers and ramblers make the hole 18 in. deep and not less than 2 ft. across.) Then prepare the ground in the usual way. This is laborious work but it is a basic necessity and not a counsel of perfection.

MOVING ROSES OUT OF SEASON
Roses may be successfully moved at any time of the year, even in full flower and when the soil is bone dry, provided certain precautions are taken.

Remove all buds and flowers, but do not cut them with long stems. Lift each tree carefully, cutting back any extra long roots. There is no need to lift with a ball of soil, but cover the roots and lower portions of the stems with damp sacking since it is even more important in the summer than during the normal planting season that the roots are never allowed to become dry.

Replant the roses in their new position as soon as possible, having first removed all leaves and "puddled" the roots. (This means dipping the roots in a bucket containing water and enough fine soil to form mud.)

Firm planting is vital. Water freely if the soil is dry and continue watering if dry weather persists. Spray the entire plant with clear water two or three times a week until fresh growth is apparent. A 2-in. mulch of damp peat spread round the base of the plant is also helpful.

Do not prune until new growth appears, then cut away any dead shoots. Some die-back invariably occurs, but there is no cause for anxiety.

PRUNING
For general instructions about pruning see Principles of Pruning.

Always cut above a dormant eye or bud, since an eye which is in full growth may possibly have been injured by frosts some weeks earlier and it will then produce "blind" or flowerless wood.

PRUNING NEWLY PLANTED ROSES
Prune first-year bushes of hybrid teas and floribundas towards the end of February or in early March. Those planted from mid-February onward must be pruned immediately before planting; but in most instances the nurseryman will have done the pruning before delivery.

Winter pruning of both newly planted and established roses is often advocated. In a mild winter, December or January pruning may be successful and lead to a slightly earlier first crop of bloom. But if the winter ends with a spell of really hard weather, the premature growths resulting from the very early pruning may be injured, and when summer comes the leaves may suddenly drop off for no apparent reason.

Since the weather is unpredictable there can be no hard and fast rule
regarding early pruning; one can only experiment.

Prune new trees severely, to within 6 in. of the bud union, thereby stimulating the production of fresh shoots towards the base of the plant, which will ultimately develop into a well-balanced, bushy tree, rather than a leggy specimen with most of the flowers at or near the top.

On thin, sandy soils, postpone this drastic pruning until the second year, otherwise considerable die-back may ensue. Wait until early May when growth is well advanced and then remove any dead wood.

Leave newly planted climbers and ramblers unpruned, except to remove any dead wood in February.

Standards (especially standard hybrid teas) dislike drastic pruning at any time. Remove any weak, sappy shoots and cut back the tips of the remainder.

**Pruning Established Roses**

*Hybrid teas:* Prune hybrid teas towards the end of February. The basic idea is to encourage the growth of a reasonably open, cup-shaped bush. This facilitates free circulation of light and air, thus reducing danger of mildew, which is stimulated by bad air. As black spot often begins on thin, twiggy shoots near the base, always cut these shoots right out.

Remove any diseased, frosted and obviously exhausted or dead wood. Old wood left for several years tends to harbour fungus spores and insect pests. Frosted wood is generally brown or discoloured and must be cut back to healthy tissue, which is indicated by white or greenish-white pith.

Also remove unripe wood. This is easily identified by gently pressing the thorns on the stem; if the wood is unripe, they will break off only after much effort, but on ripe growth they will fly off readily.

Typical unripe shoots are the basal growths which develop after the end of August. These usually produce inferior flowering growths.

Pruning "proper" is quite simple. Cut back to about half the length of the previous season's growth. If it is necessary to encourage fresh basal growth in the third and subsequent years, reduce an occasional old shoot to within 3 or 4 in. of its base.

*Floribundas:* Prune floribundas early in February for the best results. First remove all useless wood. Criss-cross shoots are common and should also be cut right out. Leave the remaining shoots at various lengths to help ensure continuity of bloom.

Cut back some of the previous year's ripe wood a couple of inches only, reduce other shoots to about half their length and prune the remainder to within 3 or 4 in. of the base.

*Ramblers and climbers:* The old type Wichuraiana ramblers and the more modern, late-flowering Crimson Shower flower once only on the previous season's wood. Tie the new basal shoots in lightly as they appear during late spring and summer.

When the old wood has flowered, cut it away to the base, train the new wood carefully in the desired position and wind the shoots round the post to encourage profuse bloom.

With all other ramblers and climbers cut the tops of the laterals a few inches in late February and cut out an occasional old shoot.

Varieties vary a great deal in vigour and freedom and continuity of bloom, but the general rule is to spare the knife. Climbing sports in particular resent hard pruning. Never allow them to grow upward; train the main shoots fan-wise
THE ROSE GARDEN

Choose vigorous climbers or ramblers for rose pergola. They look well above beds of pinks and lavender.

With a wall as background, this informal rose garden provides an opportunity to grow roses of various types. At the back ramblers and climbers are trained against the wall; floribundas take up the middle of the bed and at the front are hybrid tea roses.

A formal rose garden is most effective if it can be separate from the rest of the garden. Ideally there should be only one variety of rose in each bed, but in limited spaces mixed plantings are useful.

Roses make a delightful decoration for a summer house and screen. Scented, climbing varieties are the most suitable, but avoid strong-growing, invasive flowers as companions to roses.
or horizontally, because most blooms are produced on the laterals.

*Miniatures*: Miniature roses need little pruning. Simply trim the plants to the desired shape and cut back any strong shoots which emerge from below soil level to half their length.

**FEEDING, MANURING AND MULCHING**

Most amateurs under-feed rather than over-feed their roses. Never hesitate to give a "fillip" to any rose bush which is at any time reluctant to make fresh growth. It is often said that aphids and other pests thrive on the soft, sappy shoots produced by the heavy use of mineral (artificial) fertilizers, but heavy infestations are by no means confined to such growth. It is quite safe to use artificial fertilizers on newly planted roses.

The main elements concerned with plant growth are nitrogen, phosphorus, potash and, to a lesser extent, magnesium. Roses rarely suffer from nitrogen deficiency, which can be recognized by pale green leaves and weak growth, but use a nitrogen fertilizer where growth is backward.

Typical signs of phosphorus deficiency are bronze or purplish markings on the foliage, as well as fewer, smaller blooms. Apply bone meal at about 3 oz. per sq. yd. This is an excellent slow-acting corrective. On heavy or acid soils use basic slag instead, at 6 oz. per sq. yd.; this is not leached out by rain.

Shortage of available potash is more evident on light, sandy soil. It causes rose trees to develop a scorched appearance, with browning round the edges of the leaves. To counteract it apply sulphate of potash at about 3 oz. per sq. yd. or wood ashes at 6 oz. per sq. yd.

Roses grown on light, sandy soil sometimes show symptoms of magnesium deficiency during periods of prolonged wet weather, when magnesium tends to be leached out of the soil. Signs usually appear on the older leaves, which exhibit purple or yellow discolorations between the veins, starting at the bottom of the tree and progressing upward. Apply magnesium sulphate (Epsom salts), using \( \frac{1}{2} \) to 1 lb. per 10 gal. of water.

**COMPOUND FERTILIZERS**

These usually contain nitrogen, phosphorus and potash in varying proportions, and often magnesium as well. The proportions required by roses are not vital and almost any proprietary fertilizer will give good results if applied according to the maker's instructions. Do not apply during a drought unless the roses are watered regularly afterwards. Spread fertilizer solutions between the bushes, so that they can be washed in by the rain and reach the feeding rootlets which are concentrated away from the base of the stems.

All artificial fertilizers should be regarded as complementary to organic materials like rotted farmyard manure and compost: if used exclusively or to excess, they may tend to exhaust the soil.

**FOLIAR FEEDING**

The spraying of foliage with liquid feed instead of applying the feed to the roots has recently achieved some popularity among rose growers. It is not an alternative to conventional feeding methods, if only because considerably more applications would be needed during the growing season. Young foliage seems to take up nutrients more readily than older leaves. Temporary nutrient deficiencies—of magnesium and iron, for instance—can be corrected, as they appear, by foliar feeding, but concrete recommendations for more general feeding cannot yet be made. Experiment by trying one of the proprietary foliar feeds now available, taking care to follow the manufacturer's
instructions. (See also Fertilizers and Manures.)

MULCHING
Do not spread compost or old farmyard manure round rose trees in winter since this keeps the ground cold and wet. A good way to use it is as a summer mulch to conserve moisture. If the mulching of roses is unsuccessful it is because the mulch has been carelessly applied. Timing is important. Wait until mid-May when the soil is rapidly warming up. Remove all traces of weeds and thoroughly wet the soil immediately before mulching. Spread the manure loosely, to permit free circulation of air, and about 3 in. in depth. Leave it undisturbed until early October, then work it into the top 2 or 3 in. of soil.

Suitable materials for mulching are well-rotted farmyard manure, leaf mould, well-rotted compost, hop manure, bark fibre, damp peat, vermiculite or lawn mowings. Keep lawn mowings very loose and no deeper than ½ in. as they tend to pack down tightly and may introduce weeds.

GENERAL TREATMENT

WATERING
Watering is seldom needed on heavy soils, even in a very dry summer. On light soils watering may be necessary, especially during a long spring drought and where roses are grown alongside walls. Evening watering is often said to be best for all garden plants because it reduces moisture losses caused by evaporation. Nevertheless, if there is little or no sun, roses may be watered at any time of the day. If the watering must be done in full sun, avoid wetting the foliage as such wetting increases the rate of evaporation. Roses will come to no harm if watered straight from the kitchen tap.

Give each tree plenty of water. Do not just sprinkle the surface soil; this will only encourage the feeding rootlets to come to the surface where they can easily become dried up. Where only a few rose trees are grown, a good plan is to sink a flower pot in the soil about 9 in. from each tree, with the rim level with the soil surface. Fill each pot several times and replenish every two or three days until the drought breaks. Give climbers on walls about 3 gal. of water each and standards not less than 1 gal. each.

SUCKERS
These are growths from the stock on which the rose has been budded. They are produced chiefly on bush roses, especially if the orginal planting was insecure, and sometimes on climbers and ramblers. Briar standards produce occasional suckers, but suckers are frequent when Rosa rugosa is the stock, because it is a semi-woodland plant which spreads naturally by means of underground suckers.

As all suckers come from below the budding union they can be easily identified. Colour and number of leaves, thorns, etc., can be ignored. Cut the suckers right out at the point of origin on the roots or neck of the stock. Use a sharp knife, which will make a cleaner cut than secateurs.

PROPAGATION

BUDDING
Roses bought from the nurseryman have all been grown as budded plants.

Budding consists of taking a bud or “eye” of the chosen variety and inserting it in the bark of a selected form of Rosa canina (common briar) or R. multiflora. This is known as the stock and it provides the roots of the new plant which is sold by the nurseryman about 15 months later. The details of budding, described and illustrated in Propagation, can be followed exactly for budding bush roses, climbers and ramblers.
BUDDING OF STANDARDS
Both briar and rugosa stock can be used for standards. For these the actual bud-
ing is the same as for bush roses, although the buds are inserted in a different posi-
tion. When planting briar standards, remove all eyes except two opposite each other at the top. These will produce lateral stems in the spring. Insert one bud into each of these laterals, making the T-cut as close as possible to the main stem. *Rosa rugosa* standards are another matter. Insert the buds in either side of the main stem itself, directly under the top growths. *R. rugosa* stock resists drought better than the briar but is not successful on chalky soils.

CUTTINGS
Propagation by cuttings is not nearly as successful as by budding. Commercially
the method is quite impracticable since a shoot which provides several buds only 
yields one cutting, and budding is much quicker. Even if the cutting should root, it may subsequently die or fail to make a decent-sized bush. Hybrid teas are usually failures, but floribundas are likener to succeed, the crimson-scarlet Frensham in particular making a reasonable plant in most cases. Climbers and ramblers, also many of the old-fashioned varieties such as the albas, centifolias, gallicas and Bourbons, "strike" fairly readily and eventually make satisfactory plants. July and August are the best months for taking cuttings. The procedure is described in *Propagation*. Leave the cuttings in the soil for about 15 months, then move them to their permanent quarters, where they should bloom the following summer.

PESTS AND DISEASES
In the British Isles there are few rose pests, and they are relatively easy to con-
tril. Aphids and thrips or thunder flies are the chief offenders. They are
mainly active during warm, sunny spells, especially in late spring and early sum-
er. Caterpillars and leaf hoppers may also be troublesome, although attacks rarely assume epidemic proportions. Tackle all pests by spraying promptly with a suitable insecticide.

Black spot occurs mainly in country gardens, as the fungus thrives in pure air. No variety is immune, although some are resistant. Spray with a captan fungicide, to anticipate re-infection. Mildew occurs at times in practically every gar-
den, particularly in dry seasons after sudden temperature changes, but varie-
ties with glossy leaves often tend to be fairly resistant. Preventive spraying is again essential to control the disease. Use a Karathane fungicide. Rust is
restricted mainly to south-west England, the Midlands and Northern Ireland. Frequent preventive spraying with a thiram fungicide is imperative since this is the most difficult of all rose disorders to keep in check.

COMPANIONS FOR ROSES
Ideally, roses should be planted in beds or borders where there is little or no com-
petition from other flowers and shrubs, even in winter. If, however, space is lim-
ited, some compromises are inevitable. With care, the results can be very pleasing.
Avoid strong-growing, invasive plants; there are plenty of other intriguing possibilities. For interplanting with beds of hybrid teas and floribundas try dwarf annuals such as the deep blue *Phacelia campanularia*, candytuft in mixed colours, nemophila (sky-blue with white centre), the lavender and white *Gilia tricolor*, or dwarf godetias such as the white Purity or Lavender Queen. *Ageratum Fairy Pink* is a pleasing salmon-rose and *Alyssum Violet Queen* is a compact violet-purple; these two spread rather quickly on light, warm soils, and seedlings frequently
occur, but even so they are both useful for interplanting or even for use as edgings to rose beds.

Pinks are sometimes used for edgings and are also very effective when planted in between standards grown in rows. A ground-work of violas is equally satisfactory.

Tulips are good for planting between bush roses, but choose varieties which flower simultaneously. An advantage is that the tall tulips such as the Darwins, which are sometimes disappointing in a wind-swept garden, can be grown in the protection of the roses, carrying their blooms above the tops of the bushes (unless the roses have had virtually no pruning!). Lift the bulbs when they have finished flowering.

Daffodils and narcissi can also be grown in this way. Lift the bulbs every other year as soon as the foliage can be pulled away easily.

Lilies are also suitable, especially Lilium regale, which is easy to grow, but protect the emerging shoots from late spring frosts.

RECOMMENDED HYBRID TEAS

CRIMSON AND SCARLET

Allegro is a vivid geranium-red, with very long-lasting blooms, borne on firm stems. It is excellent for cutting.

Ena Harkness, happiest on light or medium soils, flowers very freely, holds its colour and is disease-resistant. The stems tend to droop in hot weather. The scent is elusive.

Super Star, a rose of vivid, light vermilion which shows up at a considerable distance. It is very fragrant and is long-lasting when cut.

Chrysler Imperial, Crimson Glory, Josephine Bruce, Milord, Mme. Louise Laperrière and Papa Meilland, all reliable crimsons and scented.

LIGHT PINK

Margaret, a tall plant with very full blooms.

Michèle Meilland, dainty, pearly-pink flowers, first rate for cutting and for buttonholes.

Picture, a short grower bearing numerous perfectly-shaped, rose-pink flowers with reflexed petals.

First Love, Grace de Monaco, Silver Lining and Stella, all distinct and well scented.

DEEP PINK

Eden Rose, extra vigorous but inclined to produce a proportion of split blooms, although others are superb. The scent is elusive.

Mischief, a new deep salmon with long-lasting, high-centred blooms.

Montezuma, salmon-red, taller than most and intolerant of rain.

Pink Favourite, very tolerant of wet weather.

Prima Ballerina, fragrant, and Paris-Match are both good.

Wendy Cussons, richly scented, cerise-

HYBRID TEA ROSE

First Love
pink blooms, indifferent to weather extremes.

YELLOW
McGredy's Yellow, an indispensable variety, fragrant and rarely gives a disappointing flower.
Sutter's Gold, the only strongly-scented yellow variety, produces gorgeous reddish-gold buds, opening to light yellow blooms with pink flushes.
Gertrude Gregory, Golden Giant, Isabel Harkness, Kingcup, King's Ransom, Spek's Yellow and Summer Sunshine, all deep yellows of high merit.

ORANGE
Beauté, Bettina, Cover Girl, Lady Belper, Marigold and Mojave are among the best varieties.

BICOLOURS
Gail Borden, huge, long-lasting flowers of light pink and pale yellow.
Miss Ireland, a biscuit-coloured combination of orange-salmon and creamy-yellow.
Piccadilly, the finest red and yellow, blooms profusely and is unmarked by drenching rain or blazing sun.
Westminster, rosy-crimson and yellow, dependable and pleasantly fragrant.

MULTICOLOURS
Grand'mère Jenny, large, slender blooms of a warm blend of pink and yellow.
Mrs. Sam McGredy, an incomparable mixture of scarlet and coppery-orange heavily flushed with red. Prefers medium-to-heavy soil.
My Choice, a very fragrant newcomer, a combination of salmon-pink and buff yellow.
Peace, a famous variety in which yellow, cream and pink are the predominating shades. Makes big branching plants, best planted about 2½ ft. apart.
Perfecta, extra large, high-centred blooms of cream, rose-pink and yellow, which last nearly a week when cut. Buds are disappointing, but the developing flowers are unsurpassed for quality.
Shot Silk, a mixture of pink and yellow shades and a unique perfume suggesting lemon and verbena.

WHITE AND CREAM
Memoriam, white with pale pink tinges, dislikes rain.
Message and Virgo, both impervious to heavy rain, unlike the older whites.
Ophelia, creamy-white with pale pink flushes and a fragrance reminiscent of honey.

BLUE
At present there is no variety which could be described as a pure blue, but it is probable that hybridists working to this end will produce such a rose eventually. Meanwhile there are several notable hybrid teas in shades of grey, lilac and lavender.

Lilac Time and Sterling Silver are both excellent for cutting and are agreeably fragrant, the latter with a scent which is
suggestive of sweet peas. Sterling Silver tends to open rather quickly in warm weather.

RECOMMENDED FLORIBUNDAS

CRIMSON AND SCARLET

Frensham, 3 to 4 ft., crimson-scarlet, is the best variety. Exceptionally free-flowering, extra hardy and makes an attractive hedge.

Other worth-while reds include Barbecue (2 to 3 ft.), Charlotte Wheatcroft (3 to 4 ft.), Elsinore (3 to 4 ft.), Evelyn Fison (3 to 4 ft.), Firecracker (2 to 3 ft.), Lilli Marlene (2 to 3 ft.) and Red Dandy (2 to 3 ft.).

The brighter scarlets include the orange-scarlet and vermillion shades, which present a bewildering choice. All are notable, particularly Allotria (2 to 3 ft.), Diamant (3 to 4 ft.), Dickson’s Flame (2 to 3 ft.), Korona (3 to 4 ft.), Meteor (2 ft.), Orangeade (2 to 3 ft.) and Orange Sensation (2 to 3 ft.).

Sherry, 2 to 3 ft., is excellent for floral decoration, is brownish-red, like an Oloroso sherry, and does not spoil in heavy rain.

LIGHT PINK

Chanelle (3 to 4 ft.), a delightful buff-pink.

Dearest (2 to 3 ft., fragrant), Queen Elizabeth (5 ft.), Silberlachs (3 to 4 ft.) and Vera Dalton (2 to 3 ft.) are especially commendable.

DEEP PINK

Anna Wheatcroft (2 to 2½ ft.), rosy-salmon and She (2 to 3 ft.), salmon-opal, are very popular for cutting.

Border Coral (2 to 3 ft., fragrant), Elysium (3 to 4 ft., fragrant), Flamenco (2 to 3 ft.), Polka (2 to 3 ft., fragrant), and Ulster Queen (3 to 4 ft.) are outstanding.

Paddy McGrey, 2½ ft., bears numerous
fragrant blooms shaped like miniature hybrid teas.

YELLOW
Unlike the older varieties, the newer yellows hold their colour reasonably well in strong sunlight. Recommended are Allgold (2 to 3 ft.), Gold Cup (2 to 3 ft.), Gold Marie (3 to 4 ft.), Golden Fleece (2 to 3 ft.), Honeymoon (3 to 4 ft.) and Yellowhammer (2 to 2½ ft., fragrant).

BICOLOURS
Dainty Maid, 4 to 5 ft., pale pink and carmine, although an old variety, should not be overlooked.
Sweet Repose, 2 to 3 ft., fragrant, a pleasing confection of pink and gold.
United Nations, 2 to 3 ft., a very beautiful blend of salmon-pink and light yellow. Tends to mildew on occasion.
Daily Sketch (3 to 4 ft., fragrant), plum-red and silver like a small-scale Perfetta; Faust (3 to 4 ft.) is yellow with pink flushes; Golden Slippers (2 to 2½ ft.), a blend of orange and yellow; Summer Song (2 to 2¼ ft.), combines orange and lemon; Tambourine (3 to 4 ft.) is cherried red and yellow; Zambra (2 to 3 ft.), a blend of orange and yellow, but with rather fewer petals than Golden Slippers.

MULTICOLOURS
Circus, 3 to 3½ ft., similar to Masquerade but with more orange.
Masquerade, 3 to 4 ft., fragrant, the most famous “quick-change artist” which starts golden-yellow and ends deep red, is a “must”.
Rumba, 1½ to 2 ft., a mixture of yellow, orange and red, is magnificent for cutting. The old blooms persist for too long on the plant.
Shepherd’s Delight, 3 to 4 ft., blends of yellow and red, makes a gay and unusual hedge to about 4 ft. if spaced about 2 ft. apart and pruned lightly.

WHITE AND CREAM
Iceberg, 3 to 4 ft., the best white, bearing quantities of dainty, long-lasting blooms.
Ivory Fashion, 2 to 3 ft., full, high-centred, ivory-white flowers balanced by dark green foliage.

BLUE
Magenta, 3 to 4 ft., fragrant, a deep mauve self, is the finest of the near-blue
shades. Withstands heavy downpours, and is a challenge to the floral artist.

Lilac Charm, ½ to 2 ft., single flowers, pastel mauve with golden anthers. There are also several varieties with the prefix Lavender, including Lavender Girl and Lavender Lassie, all worth a trial but too new for evaluation. Overture is a lilac-mauve self which is valuable for cutting. Heights differ according to variety.

**FLORIBUNDA DWARFS**
The Walt Disney Compacta roses are in this group. They are named after the Seven Dwarfs—Bashful, Doc, etc. They bear their blooms in compact trusses, reminiscent of a dwarf phlox. All flourish on the driest soils and are markedly resistant to black spot disease.

Baby Masquerade, miniature edition of the famous red, pink and yellow Masquerade.

**RECOMMENDED RAMBLERS AND CLIMBERS**
The following varieties are most suitable for pillars. They are moderate growers and bloom more or less continuously.

Aloha, deep pink, fragrant; Climbing Goldilocks, yellow; Climbing Shot Silk, pink and yellow, fragrant; Coral Dawn, coral-pink; Danse du Feu, orangescarlet; Dortmund, single, red with white eye; Golden Showers, yellow; Hamburger Phoenix, crimson; Maigold, bronze-yellow, fragrant; New Dawn, light pink, fragrant; Norwich Salmon, salmon-pink and gold; Royal Gold, deep yellow; Sander's White, white; Zweibrücken, deep crimson.

Other varieties such as the following, though primarily suited to arches and pergolas as they are very vigorous, will still bloom freely if restricted to a pillar.

Albertine, coppery-pink, fragrant; Crimson Shower, crimson; Dorothy Perkins, light pink; Guinée, blackish-crimson, fragrant; Paul’s Scarlet Climber, scarlet-crimson.

The following are suitable varieties for walls. For an east or north wall the first choice is Mermaid, sulphur-yellow, single. A slow starter which dislikes pruning, usually very vigorous after a year or so. Flowering is continuous and resistance to both black spot and mildew is exceptional.

The climbing sports of hybrid teas and floribundas, especially the deep fleshpink Climbing Lady Sylvia (fragrant), Climbing Crimson Glory (fragrant), and the crimson Climbing Etoile de Hollande are useful for south or west walls, provided that the growths are spread fana-
ROSES

Rose or horizontally. The creamy-yellow Elegance is also suitable.

RECOMMENDED MINIATURES

A representative collection would include Cinderella, pearly-white, tinted carmine; Coralin, coral-red; Dwarf King, blood-red; Dwarf Queen, rose-pink; Mon Petit, cherry-red; Pour Toi, creamy-white; Red Riding Hood, velvety crimson; Rosina (syn. Josephine Wheatcroft), deep yellow, is taller than other varieties, growing to 14 or 15 in.; Simple Simon, deep carmine; Sweet Fairy, apple-blossom pink.
SWEET PEAS

When the sweet pea was first introduced into England from Sicily in 1699, the flowers were not much larger than those of a culinary pea, and there was only one colour—purple-maroon.

It was not till a hundred years later that the first record of any colour range was made, and then only five colours were mentioned—white, pink, carmine, mauve and purple.

No serious attempt was made to improve the sweet pea until about 1870, when Henry Eckford transformed a somewhat commonplace flower into the forerunner of the present sweet pea, but still there was only one popular type, known as Grandiflora.

The greatest advance in size and form came by way of a natural mutation in 1901 when the first waved, or frilled, form appeared. This was classified as the Spencer type. Since then development and progress have been gradual but quite appreciable, and a number of distinct forms and types have been found or developed and the size of the flower has more than doubled.

Now the colour range is very varied and the perfume abundant, despite the
fallacy that sweet peas have almost lost their original scent.

Hardiness, constitutional strength and vigour are as good as they were 50 years ago, and the plants can be grown easily and successfully.

CLASSIFICATION
There is no generally accepted way of classifying sweet peas, but they can be divided into various groups according to height, time of flowering and number of flowers on each stem.

In the first group are the tall-growing types, intermediates and dwarfs.

In the second are the early-flowering, mid-season and late-flowering types.

The third group includes those that produce three, four or five flowers on a stem and the newer races such as Zvolanek’s Pleniflora, which give an average of five to eight flowers on a stem.

TYPES
All modern types produce flowers of Spencer form, and among them are several early or semi-early types. The original early-flowering type was simply called Early Flowering, and was quickly found to be heat resistant and able to succeed in countries with hot, dry climates, where late-flowering Spencers, now the most popular type grown in Britain, were complete failures.

There have been several developments of the early-flowering group.

First came the Cuthbertson type, which had greater vigour, longer stems and bloomed for a slightly longer period than the original. This was followed by the Cuthbertson Floribundas, which possess the Multiflora tendency of producing more than four blooms per stem.

Then there are the somewhat similar Zvolanek Multiflora and Floribunda groups, the former the earlier flowering of the two. The most recent early-

flowering races of Multiflora type are the Galaxy type and the Early Multiflora Gigantea type, both heat resistant and large flowered.

The group called Pleniflora developed by Zvolanek is among the late-flowering Multifloras.

Zvolanek’s Dwarf Pygmy and Burpees’ Dwarf Early are two new low-growing types. These grow 2 to 4 ft. high and produce normal-sized spikes.

There are only two modern forms of truly dwarf-growing types: the Cuthbertson Cupids (Colour Carpet), available in a mixture only, which make compact bushes 3 to 4 in. high and 1 ft. across, with flowers of normal size; and Little Sweetheart, available in mixture and in separate varieties, which produces compact bush-like plants 8 to 12 in. in height and width, with flowers of almost normal size.

NATURAL CHARACTERISTICS
Sweet peas are ordinary hardy annuals with a life span of 12 months or less.

Apart from the true dwarf types, they are of comparatively rapid growth both above and below ground. A single plant, given sufficient room to develop naturally without restriction, is capable of producing nearly 500 flower spikes.

Like most annual flowers, they prefer an open, sunny situation with good deep top-soil which is firm and well drained, but any soil which is capable of producing reasonable vegetable crops is almost certain to produce good sweet peas.

If each individual plant is given enough nutriment and enough room to develop properly it will sustain a lengthy flowering period.

SOIL PREPARATION
If the plants are to be grown in ordinary, unrestricted fashion, prepare the ground as for any ordinary vegetable crop, digging one spit deep as early as possible,
SWEET PEAS

preferably in the autumn. Turn in a dressing of well-decayed animal manure, or good rotted compost, and work in bone meal, which is safe and always beneficial.

If the plants are to be grown by the cordon method, work the soil two spits deep—that is, double dig—mixing well-decayed animal manure or good fully-rotted compost well into the bottom spit and bone meal throughout both spits. Dried seaweed fertilizer is an excellent alternative as it disintegrates slowly, contains all the trace elements and can be used separately or with other feeding agents.

Double dig the sweet pea site all over rather than in strips, and leave the soil quite rough on top to obtain full benefit from winter frosts. Good drainage is essential.

If the soil is deficient in lime, sprinkle a dressing on the surface in mid-winter, for this helps to make heavy soil more workable. A top dressing of old soot at the rate of 1 bucket to 6 sq. yds. has much the same effect, but do not use both soot and lime in the same year.

In spring, a week or two before planting, lightly fork or rake the soil to give a fine surface.

SOWING

Sweet pea seeds can be sown at any time from late September to mid-April depending on locality, but sowing in winter months should be done under glass.

In the south of the British Isles it is better to sow in pots or boxes in a cold frame from late September to mid-October. In the north sow in early spring, keeping the plants under glass, and later move them to a cold frame.

Open ground sowings can be made from the last week of February to mid-April, according to locality.

Sweet peas are hardy and resent being coddled. Keep the seedlings sturdy and hardy from the outset by giving them all the light and air possible and the minimum protection with glass.

When sowing in pots or boxes use an open porous compost, preferably sterilized, obtained from a nurseryman. Sow about \( \frac{1}{4} \) in. deep, allowing one or two seeds to a 3-in. pot and five to seven seeds to a 4- or 5-in. pot. When sowing in boxes, allow about 2 in. either way between seeds.

Make sure that the potting compost is reasonably moist when sowing and keep the frame lights on until the seedlings appear. Then, if the seeds were sown in the autumn, completely remove the lights and only replace them during very severe weather.

When the plants have made their second or third pair of leaves, pinch out the extreme part of the growing tips, as this will encourage the formation of strong basal side shoots, which are less likely to go blind than the original or seed growth.

PLANTING OUT

Seeds sown in boxes or pots in autumn are usually ready for planting out in their permanent positions as early in March as the soil and weather conditions permit. Plants raised from seeds sown in the spring will be ready for planting out from late April to the end of May.

The two main ways of growing sweet peas are the bush method and the cordon. The bush method is simple for it allows the plants to grow in a natural, unrestricted way, but the cordon method is more elaborate and involves much more time and attention.

BUSH METHOD. Plant in groups of two or three, allowing 8 or 9 in. between the groups, or plant singly 6 in. apart.

Always transplant very firmly, getting the roots well down, using a trowel rather than a dibber for this purpose.
THREE METHODS OF SUPPORTING SWEET PEAS

The usual method of supporting plants grown in double rows as cordon for exhibition. Posts are joined by wires drawn taut between the crosspieces at the tops of the posts. Each plant is trained up an 8-ft bamboo cane fastened to one of the wires.

Ordinary pea sticks make satisfactory stakes for sweet peas grown in groups or rows.

Support the plants with long pea sticks, or by wire or cord netting fastened to stakes.

CORDON METHOD. In cordon growing, quantity is sacrificed for quality. An extensive root system is encouraged by deep digging, liberal manuring and the restriction of growth above ground to one or two leaders, or main stems, to each plant.

The result of throwing all the energy from an enlarged root system into such a restricted plant is that all the growth above ground (including the size of the flowers) is very much larger than it would be otherwise, but the number of flowers produced per plant is, of course, proportionately smaller.

Plant 6 in. apart in double rows, allowing 15 in. between the rows. Space the pairs of double rows at least 3 ft. apart.
Support the leaders with 8-ft. bamboo canes fastened to wires drawn taut to posts at the ends of the double rows.

When the plants are 12 or 15 in. high, start restricting their growth by cutting off, with a sharp knife or scissors, all side growths except the strongest basal side growth, or the two strongest in the case of exceptionally vigorous varieties. Rub out between finger and thumb the tiny side shoots as soon as they develop in the leaf axils, and pinch off the tendrils as soon as they can be handled. Do not allow the plants to flower until they are 2½ to 3 ft. high, or until the first flower stems bearing four buds appear.

FEEDING AND WATERING

If the soil has been deeply and liberally prepared, feeding and watering are often quite unnecessary.

A surface mulch of loose decayed manure or sedge peat put round the plants conserves the moisture during summer, but if the plants really need watering, give them a heavy soaking at intervals of not less than 10 days, rather than sprinkling them more frequently.

If they need feeding, liquid animal manure and soot water, well diluted, are excellent. There are also good compound fertilizers which can be used with safety, but do not exceed the dosage recommended on the container.

DISEASES AND PESTS

Sweet pea plants grown naturally are very rarely troubled by disease, but plants grown by the cordon method do occasionally suffer loss from disease carried mainly by greenfly. Keep these pests in check by spraying with an insecticide such as malathion used at half strength, starting when the plants are seedlings.

Slugs and snails can also be destructive, so until the plants are 1 ft. high control these pests with one of the proprietary brands of slug killer, or meta-bran mixture made by crushing a small brick of metaldehyde and mixing it with a pint of bran. Little heaps of this mixture put in frames or along rows will attract and kill any slugs. If wireworms or other soil pests are suspected, dress the soil with a soil fumigant at least a fortnight before sowing or planting out.

Bud-dropping, which again is more likely to happen to cordon-grown plants than those grown naturally, is not a disease but a condition induced by adverse circumstances such as too much moisture at the roots, abnormally cool and sunless weather, or sudden weather changes. There is nothing that can be done about this condition, but it usually lasts for only a few days and the plants then regain their normal balance.

BIRDS

Sparrows often attack the tender growths of seedlings, so suspend strands of black cotton immediately above the plants to discourage the birds. In some localities tits cause havoc, particularly to cordon-grown plants, by mutilating the flower buds before they open. No one seems to know why they do this and no really effective remedy has been discovered.

VARIETIES

There is a very large number of varieties to choose from and the influx of new varieties each year is so considerable that although the newcomers are not always an improvement on the older varieties, they certainly tend to upset any choice made the previous year.

The following really good and reliable varieties are all of Late Spencer type—the type predominantly grown at the present time in Great Britain. Some of these varieties are especially good for exhibition and some are more sweetly scented than others.
SWEET PEAS

Fairy, lemon marbled salmon-pink
Gaiety, rose standard, pink wings
Gertrude Tingay, lavender
Joyce, lavender
Learnington, lavender
Leicester, salmon-pink on cream
Mabel Gower, mid-blue
Monty, pink on white ground
Moonlight Improved, cream
Mrs. C. Kay, lavender
Myosotis, mid-blue
Nocturne, powder-blue
Patience, lavender
Pink Opal, orchid-pink flushed on cream
Pixie, cream marbled salmon
Red Velvet, crimson
Rose Fondant, rose
Rosy Frills, white, rose picotee
Sheila Jean, white
Skylon, pink on white ground
Snocap, white
Tell Tale, white, rose picotee
Twink, cream marbled orange-scarlet
Vogue, light blue
Winsome, shrimp-pink

SWEETLY SCENTED VARIETIES
SUITABLE FOR EXHIBITION

Ballerina, cream, rose picotee
Classic, purple
Cream Gigantic, cream
Crimson Excelsior, crimson
Evensong, mid-blue
Gaiety, rose standard, pink wings
Gertrude Tingay, lavender
Joyce, lavender
Learnington, lavender
Moonlight Improved, cream
Mrs. C. Kay, lavender
Myosotis, mid-blue
Nocturne, powder-blue
Patience, lavender
Pink Opal, orchid-pink flushed on cream
Pixie, cream marbled salmon
Red Velvet, crimson
Rose Fondant, rose
Rosy Frills, white, rose picotee
Sheila Jean, white
Skylon, pink on white ground
Snocap, white
Tell Tale, white, rose picotee
Vogue, light blue

SWEETLY SCENTED VARIETIES

Albatross, white
Ballerina, cream, rose picotee
Blue Ice, flushed blue-lavender
Classic, purple
Cream Elegance, cream
Cream Gigantic, cream
Crimson Excelsior, crimson
Evensong, mid-blue

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Alpines are among the most exciting of plants, having the fascination of intricate embroidery—and their delicate detail, exquisite form and brilliant colours are combined with the wonder of the miniature.

They are at home in mountainous regions, and so will tolerate thin stony soils and drying winds.

Many of them are easy to grow provided their natural conditions of sharp drainage are imitated for them. As well as in the rock garden they can be grown in a raised bed or along the top of a low wall in a small garden, in a trough or sink garden, or anywhere where their beauty can be looked upon from above.

**MANAGEMENT**

There is something very personal about a rock garden, and there is no better way of becoming well acquainted with its
innumerable small inhabitants than by giving it the close attention it needs, and 
which it so well repays. It does not take 
an undue amount of time and trouble 
provided it is properly looked after, but 
if it is neglected it is more difficult to put 
into good order again than other parts 
of the garden.

A rock garden that has become over-
grown with such possessive plants as 
snow-in-summer (Cerastium tomentosum), 
the lovely but invasive creeping speed-
well (Veronica filiformis), or in which weeds 
such as couch-grass, running thistle or 
bindweed have been allowed to secure a 
firm hold, will be difficult to clean and 
much of the stonework may have to 
be removed and the garden rebuilt.

Before building a rock garden remove 
all perennial weeds from the site, and see 
that the soil is free from potential trouble-
makers. Extreme precautions would in-
volve the use of sterilized soil in which 
weed-seeds and pests such as wireworms, 
leatherjackets and other harmful grubs 
have been destroyed. But it would be 
expensive if sterilized soil were pur-
chased, or laborious if the soil were 
sterilized on the site. And in any case, 
sterilization is only a temporary safe-
guard, as seeds will inevitably blow in 
from surrounding areas, and omnivo-
rous grubs will find their way into tender 
roots and succulent shoots.

WHAT NOT TO PLANT
Much trouble can be caused through an 
unwise choice of plants. Many fast-grow-
ing and invasive plants are very decor-
ative and showy, but they should be 
avoided in the early and inexperienced 
stages of rock gardening, or used with 
extreme discretion until their potentiali-
ties are fully appreciated and suitable 
positions can be assigned to them.

The following plants should be regarded 
as probable troublemakers, certain to 
occupy too much territory too quickly 
and likely to smother less vigorous 
neighbours:

Acaenas of all kinds, Achillea tomentosa, 
ajugas of all kinds, Allium moly, Anthemis 
nobilis—single or double flowered, Cam-
panula poscharskyana, Cerastium tomentosum, 
cotulas of all kinds, Helichrysum bellidoides, 
hieraciums of all kinds, Oxalis corniculata—
a pestiferous weed, never to be admitted, 
and Veronica filiformis.

PLANTING
Plant the rock garden in either spring or 
autumn, as there is little to choose be-
tween these two seasons.

Most alpine plants are grown in pots 
and are supplied in them by the nursery-
man, and can therefore be safely planted 
out over a much longer period than 
other plants. But if they are planted 
well out of either of the two recog-
nized planting seasons they will need 
extra care and attention, both with 
regard to watering and to shade, until 
they are established.

WATERING
A rock garden planted in the autumn is 
unlikely to require much watering after 
the initial soaking unless the weather is 
unusually dry for periods of more than a 
week at a time, when it will need a weekly 
soaking until the plants are sufficiently 
established to seek their own moisture.

But spring planting necessitates more 
attention to regular watering.

A mulch of fine grit or gravel spread 
half an inch deep over the entire rock 
garden is much appreciated by the plants 
and, as it conserves the moisture in the 
soil beneath, is a labour-saver.

Apply this layer after planting and 
renew periodically. Work the grit right 
under the plants so that their collars are 
surrounded by it.

The grit discourages slugs, which
shelter in the cover of a plant, and keeps the neck of the plant free from wet soil, which could cause decay.

FROST
The mulch of grit will help to prevent plants being heaved up by frost and left with exposed roots, but plants set out in the autumn are unlikely to achieve a really firm root-hold before the winter, and may be "lifted" by frost. If this happens carefully press them back into the soil as soon as the ground has thawed and is no longer saturated.

RAIN AND WIND
Plants with very soft, hairy leaves which persist through the winter may need slight protection during very wet periods, so provide this by placing a small piece of glass over them, secured by wire clips.

Drifting leaves from deciduous trees can also be a danger, as they often pile up in a corner between rocks, and distress plants which have to endure this soggy blanket. Remove them at intervals, and, after high winds, watch carefully for leaves which may have drifted in from quite far afield.

CUTTING BACK
Perennial plants that make a lot of soft growth, such as aubrietas, alyssums, arabises, helianthemums and saponarias, should be cut back quite hard when they have finished flowering. This applies particularly to aubrietas, which soon grow into leggy, untidy mats and flower less profusely if they are not given an annual trim, and helianthemums, which last for years if properly tended, but which may perish in two or three years if left to straggle into loose bushes.

WEEDS
Never let weeds get a strong hold on any part of the rock garden. A sturdy tuft of grass is a bad neighbour for a small alpine plant, and it may be impossible to remove the weed without uprooting the plant as well.

It does not take long to work over a small rock garden, scuffing and loosening the soil with an appropriate instrument, such as a small hoe, and if this is done regularly weeds will never become a problem.

PESTS
Slugs are a grave menace to spring-flowering alpines, as they like to eat the new leaves, flower stems and buds. They shelter beneath overhanging plants and in crannies between stones.

An occasional inspection of these likely hiding places, and keeping the plants clean and free from weeds, will keep the slugs down to a minimum. An application of one of the several effective slug killers will deal with any which escape notice.

Woodlice also can cause much damage, so sprinkle D.D.T. dust in areas where they are troublesome.

Greenfly rarely attack alpine plants, but if any are found in the rock garden use one of the systemic insecticides, carefully following the instructions on the container.

PROPAGATION OF ALPINE PLANTS

METHODS
There are three methods of propagating alpine plants and these are very similar to those used for other garden plants. They are:

(a) raising from the seed which many alpines produce in copious quantities;
(b) increasing by lifting and dividing old plants;
(c) rooting from cuttings made from soft growth tips, either before or after the plants have flowered.
SEED

Those which are true species may be expected to reproduce themselves true to type from seeds, but named garden forms or hybrids are less likely to do so. Most hybrids are sterile, that is, they do not set seed, but some are occasionally fertile. From these and selected forms, considerable variation must be expected among the seedlings, so that in the case of a hybrid it is best to rely on vegetative methods of propagation, such as cuttings, which ensure that the increase will be the same as the plants from which they were raised.

Example: Aubrieta is a good example of the type of plant which does not come true from seed. It is easy to obtain seed of good strains of aubrieta, and if particular colours are not desired, this is an easy and inexpensive way of obtaining a useful stock of these decorative spring-flowing plants. The best aubrietias, however, are the named varieties, of which there are a couple of score or more. These may be increased by division or by cuttings.

DIVISION

Division is the simplest method of vegetative propagation. In general, the best time to lift and divide a plant is just after it has flowered. Having completed its annual cycle of growth and fulfilled its purpose by blossoming, the plant is about to begin all over again by producing new roots and building up strength to repeat the display the following year. Carefully lift the plant from moistened soil and shake or wash as much as possible of the soil from its roots. Cut back the top growth and gently break the plant into as many pieces with individual roots as it will provide.

These separate plants will establish more quickly if potted into a fairly sandy compost, put in a closed frame for a week to ten days, and kept constantly moist but not saturated. During this time the plants will be making new roots, so the frame should not be too freely ventilated until they have formed a firm root ball. They may then be planted out, or retained in their pots until it is convenient to plant them into permanent places.

If it is not possible to pot the divided plants, plant them immediately into their permanent positions, keeping the plants moist and shaded for a week or two afterwards. Their recovery will not be as rapid as that of separately potted plants, but there is little risk of loss among the more ordinary and easily-grown plants.

Do not treat rarities in this manner; always pot them.

Offsets: Many alpine plants can be easily propagated by detaching pieces which have formed roots and treating them as separate plants, either potting them or planting them directly into new positions. Among the kinds which lend themselves to this easy method are all the alpine phloxes, many dwarf veronicas and all the creeping thymes—in fact, all those that spread by procumbent stems which root as they go along the ground.

CUTTINGS

Some alpine plants cannot be divided, as they tend to grow with one single, indivisible neck, or crown, from which radiate upright or procumbent stems. These plants can be increased by making nodal cuttings of the soft tips of new shoots.

How to make a nodal cutting: Trim off the lower leaves from the shoot with a very sharp knife or old razor blade and make a clean cut exactly beneath a leaf-joint or node, leaving a short, bare stem. Insert this stem in pure sand, or sand with a very little finely granulated peat. Builders' yellow sand is useless: use a sharp gritty sand which will not bind. Place the
cuttings firmly and closely together in small pots or pans and keep them in a closed and shaded frame until they begin to root. Then ventilate them until they are sufficiently well rooted to be potted off separately. If a frame is not available, put the pots in a fairly deep box, covered with a sheet of glass, in a shady position and treat it as a miniature frame.

Which shoots to choose: When selecting shoots to be made into cuttings avoid any which have flower buds, as they will not make good cuttings. They may root, but will seldom grow into bushy, healthy plants. When taking cuttings of violas or pansies, do not use any which have hollow stems as they will not root.

Stopping: A few days after the cuttings have rooted and have been separately potted, nip out the tips of the plants. This will induce them to break from below into branching, bushy specimens. Plants which are not so stopped often form weak, spindly plants with no more than one or two frail stems.

Root cuttings: Several plants, among them Morisia monantha (syn. M. hypogaeae), produce very little seed and do not divide readily, but they can usually be increased by root cuttings. To encourage the formation of the right kind of roots, lift a plant the year before it is to be propagated and pot it into a very deep pot, or even into a three-inch drain pipe, using light, sandy soil.

This encourages the formation of long, thong roots, which can be detached in the spring, cut into approximately inch lengths and laid flat on a surface of pure sand in a box or pan, and lightly covered with sand. Keep them moist and shaded in a close frame and these small pieces of root will quickly sprout and form vigorous young plants, which can be potted and grown in the same way as normal cuttings.

**SUGGESTED PLANTS**

Unless otherwise stated, the plants in the following list are sun-loving and easily grown in any well-drained soil.

**ACANTHOLIMON**

Acantholimon glumaceum, a summer-flowering, cushion-forming plant with short spikes of rose-red blossoms on 4-in. stems.

**ACHILLEA**

A large family, containing tall border plants and a number of carpeting species. These are invaluable spring- and early-summer-flowering plants.

Achillea mureau grandiflora, ferny green leaves and golden flowers on 4- to 6-in. stems.

A. lewissii, sometimes called Achillea 'King Edward', has grey mats and lemon-yellow flowers on 3-in. stems.

A. tomentosa, similar to A. lewissii but a little taller with bright green foliage and deeper yellow flowers.

**AETHIONEMA**

Aethionema pulchellum, similar to A. 'Warley Rose', but grows to 1 ft. or more and has rich pink flowers.

A. 'Warley Rose', 6 in., shrub-like with masses of rich rose-red flowers in the summer.

**ALYSSUM**

Alyssum saxatile (gold dust), up to 1 ft., an invaluable spring-flowering plant. Use with discretion as it can swamp smaller plants. Golden-yellow flowers.

A.S. 'Dudley Neville', a good double-flowered variety, with biscuit-yellow flowers.

**ANDROSACE**

Among the androsaces are some of the loveliest alpine plants, but quite a few are very difficult to grow. Among the easy ones are:

Androsace lanuginosa, trailing, with silver-grey leaves and heads of white flowers just flushed with pink, in summer.

A. sarmentosa, up to 5 in., forms mats of grey-leaved rosettes and carries round heads of deep pink flowers in the spring. One of the hairy-leaved alpines which
ANEMONE
There are many anemones for the rock garden. Recommended for general use is:

*Anemone magellanica*, 6 in., with cream-yellow flowers in the spring. Easy to grow.

ANTENNARIA
These are grey-leaved carpeters as valuable for their foliage as for their tiny tasselled spring flowers of white or pink on 3-in. stems.

*Antennaria aprica*, white flowers.
*A. dioica rosea*, soft pink flowers.

ANTHEMIS

*Anthemis cupaniana*, an imposing, silver-leaved plant with an endless summer-long succession of large white daisy-like flowers on 1-ft. stems. Ideal for a position where there is space for a sprawler which can easily cover a square yard.

ARENARIA (SANDWORT)

*Arenaria montana grandiflora*, hangs over rocks in a cataract of snow-white flowers during the early summer months.

*A. purpurascens*, forms carpets of soft lilac blooms.

ARMERIA

*Armeria caespitosa* (Spanish thrift), studs its dense cushions with stemless rose-red flowers from April onward.

*A. corsica*, 6 to 12 in., with attractive, brick-red flowers.
*A. maritima* 'Vindictive', 6 to 8 in., rosy-red.

ASTER

*Aster alpinus*, large, lavender-blue, golden-eyed flowers on 6- to 9-in. stems in spring.

AUBRIETA

Do not plant aubrietas too thickly, or colourless patches will be left when their spring flowering has finished. Six of the best are:

*Aubrieta* 'Cambria', bright red.
*A. 'Dr. Mules*', violet-blue.
*A. 'Godstone*', violet-purple.
*A. 'Gurgedyke*', deep purple.
*A. 'Mrs. Rodewald*', wallflower-red.
*A. 'Studland*', mauve-blue.

*Androsace lanuginosa*
Suitable for a crevice

may require winter protection in wet districts.

*A. sempervivoides*, resembles *A. sarmentosa* but has glossy leaves in spring.

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CAMPANULA
Many kinds of campanula are available. They are colourful and easy plants to grow, with bell-like flowers which bloom when the spring and early summer flowers are fading. A few of the best are:
  *Campanula carpatica*, 9 to 18 in., blue.
  *C. cochlearifolia* (syn. *C. pusilla*), 4 to 6 in., blue or white.
  *C. garganica*, a tufted prostrate perennial, in many forms in blue or white.
  *C. portenschlagiana* (syn. *C. muralis*), 6 to 9 in., deep purple-blue bells. Is one of the best.
  *C. raddeana*, about 9 in., very graceful with swinging violet bells.

CHEIRANTHUS

CLEMATIS
*Clematis alpina*, a lovely early-summer sprawler with blue or white flowers.

CODONOPSIS
Codonopsis are similar to campanulas and bloom all the summer. Their large blue bells are handsome and beautifully marked within.
  *Codonopsis clematidea*, blue flowers on 9- to 12-in. stems in spring.
  *C. ovata*, 9 to 12 in. Blue bells, beautifully marked within, in spring.

COTONEASTER
Most cotoneasters are too large for a small rock garden, but the following flat-growing kinds are suitable for all but the smallest sites and are red-berried, evergreen, stiff, dwarf shrubs.
  *Cotoneaster congesta*, pinkish flowers in June.
  *C. microphylla*, white flowers in May and June.
  *C. thymifolia*, pinkish flowers in May and June.

CYCLAMEN
There are several kinds of hardy cyclamen suitable for the rock garden. For details see Bulbs.

DIANTHUS
Dianthus love sun and, with very few exceptions, lime, but they will grow
ALPINES FOR THE ROCK GARDEN

DRIYAS

Dryas octopetala (mountain avens), a creeping shrub with small oak-like dark green leaves and large, rounded pure-white, golden-eyed flowers in summer.

EDRAIANTHUS

Edraianthus pumilio, forms a lovely silver-grey hummock studded with pale blue bells in the spring. Requires sun and sharply gritty soil.

ERIGERON

There are some alpine erigerons of dwarf stature, but the most valuable is not an alpine, although well suited to the rock garden. It is:

Erigeron mucronatus, 6 in. Flowers from spring until late autumn with myriads of white, pink or deep mauve daisies on low, bushy plants. Does best in rather poor, sandy soil or rock chinks.

ERODIUM

These plants usually have pretty, rather ferny foliage, either grey or green, and flower right through the summer into autumn. The flowers vary from white to deep pink and are all marked with veinings of deeper colour.

Erodium chamaedryoides roseum, 1 to 3 in., is rather different from the others, and

DIANTHUS NIGLECTUS

Pink petals with buff reverse

quite well without the latter.

Dianthus alpinus, 3 in., has large rose-red flowers from July to September.

D. arvernensis, forms a grey-leaved mat, with small pink flowers on 4-in. stems.

D. deltoides (maiden pink), 6 to 12 in. This is another native species which is seen at its best in one of the named forms, such as 'Huntsman', which displays countless small, bright red flowers for many weeks.

D. gratianopolitanus (syn. D. caesius) (Cheddar pink), 3 to 12 in. This is a declining native species and for this reason should never be collected from its haunts in the Cheddar Gorge. There are several fine garden forms, all with ash-grey leaves and good flowers in varying shades of pink and red, such as 'Baker's Variety', which has deep pink flowers in July.

D. neglectus, 2 to 4 in., hates lime and should be given neutral or acid soil in which to form its low cushions and display its large deep pink flowers. Blooms in July and August.

DRABA

These are spring-flowering cushion plants, mostly with yellow flowers. All love gritty soil and full sun.

Dryas octopetala

Flowers freely if allowed to creep over a flat stone
ALPINES FOR THE ROCK GARDEN

makes a flat mat of dark green, starred continuously with small, deep pink blossoms on very short stems.

Erysimum

Erysimum linifolium, 5 in. or more, is a dwarf alpine wallflower with lilac flowers in May to July.

E. pulchellum (syn. E. rupestre), 2 to 12 in. Yellow flowers in spring. Is also a dwarf alpine wallflower.

Gentiana

Some gentians are difficult to grow. The easier kinds are:

Gentiana acaulis, 2 to 4 in., the big blue trumpet gentian of spring, which often blooms again in summer. Grow in good loam and plant firmly.

G. lagodechiana, flowers in late summer and carries clusters of deep blue flowers on 1-ft. stems.

G. macaulayi is similar to G. sino-ornata but flowers a month earlier.

G. septemfida, similar to G. lagodechiana.

G. sino-ornata, a prostrate plant which must be given a completely lime-free soil. It makes a carpet of deep blue bells from early September until November.

G. verna, 4 in., deep azure blue in May and June, is the bluest of all gentians. Prefers a soil rich in leaf mould and limestone grit.

GERANIUM

This is another good family for the rock garden and there are many from which to choose. Recommended are:

Geranium dalmaticum, one of the best kinds, it has cheerful pink flowers on 4-in. stems in summer.

G. grandiflorum alpinum, bears large clear blue flowers in summer for weeks on end. Flowers in sun or light shade, and may grow to 1 ft.

G. sanguineum lancastriense, grows flat on the ground and spreads wide, saucer-shaped flowers of glowing pink over its foliage from spring to winter.

![Gentiana acaulis](image)

*Plant in good loam in sunny position*

G. subcaulescens, the brightest of all geraniums, with brilliant cerise, black-eyed flowers in profusion in June. This species never reaches a height of more than about 9 in.

G. wallichianum 'Buxton’s Blue', 6 in., has saucer-shaped flowers of nemophila-blue with a white eye, in July and August. Plant in a shaded corner where it can spread its trailing stems.

Geum

Geum montanum, large, rich yellow flowers on 9-in. stems above wide, deep green leaves in spring. Too large for a small rock garden, but handsome where there is space.
GLOBULARIA
These are prostrate-growing, evergreen, woody plants, studded in summer with fluffy blue balls of flowers on very short stems. The following like the fullest sun, and are recommended:
   Gloularia bellidifolia
   G. cordifolia

GYPSOPHILA
Gypsophilas are trailing plants with flowers of pink and white in June. Recommended are:
   Gypsophila dafia
   G. repens
   G. r. fraternis

HELANTHEMUM (SUN ROSE)
These dwarf plants make wiry bushes, rarely more than 1 ft. tall, and are ideal for hot sunny places in a not too rich soil. They produce their large, rose-like flowers over a long period from May onward. Cut hard back at the end of the flowering season.
   Helianthemum nummularium, the many varieties of this kind are the best. A few good ones are:
   'Firedragon', crimson-red.
   'Golden Queen', yellow.
   'Jubilee', double, yellow.
   'Loxboard Gold', old-gold and orange.
   'Mrs. Earl', double, deep red.
   'Rose of Leeswood', double, soft pink.
   'Watergate Rose', port-wine-red.

HYPERICUM (ST. JOHN'S WORT)
These are avid sun-lovers with vivid yellow flowers.
   Hypericum grandiflorum, not more than 9 in. high, is similar to H. polyphyllum but is slightly taller, with larger flowers.
   H. polyphyllum, low perennial herb with almost prostrate stems from 6 to 9 in. long. Flowers from July to September.

IBERIS
Iberis gibraltarica, up to 1 ft. Evergreen sub-shrub with large flat heads of white, mauve-flushed flowers from May to July.
   I. sempervirens 'Little Gem', more dwarf than the type, white flowers in summer.
   I.s. 'Snowflake', a perennial candytuft with pure white flowers on 9-in. stems in spring and summer.

IRIS
There are many dwarf irises for the rock garden. Recommended are:
   Iris chamaetis, 1 to 10 in. Like a pygmy flag iris with blue, purple, yellow or white flowers in April and May.
   I. cristata, about 6 in. Like a tiny orchid with blue and gold flowers in May.
   I. innominata, 9 in., golden flowers with brown pencil markings in June.

LEONTOPodium
Leontopodium alpinum (edelweiss), about 6 in., with silver-grey, flannel-like flowers in June and July. Easy to grow in sun and gritty soil.

LEWISIA
Lewisias grow up to 8 in. and are gay in spring and early summer, with flowers in all shades of pink, red, apricot or salmon. Plant in crevices in lime-free soil.

LINARIA
Linaria alpina (alpine toadflax), 2 to 6 in., with flowers of lavender and gold in summer and autumn. Very lovely. Treat as an annual.

LINUM (FLAX)
Linum alpinum, 9 in., with blue flowers in July and August.
L. monogynum, 9 in., with white flowers in June and July.
L. narbonense, 1½ to 2 ft., with deep blue flowers from May to July.
LITHOSPERMUM
Lithospermum diffusum 'Grace Ward', has dense carpets of gentian-blue flowers the whole summer through. Prostrate. Plant in lime-free soil.

MENTHA
Mentha requienii forms carpets of peppermint-scented green with tiny lilac flowers in summer. Plant in moist soil in the shade.

MIMULUS (MUSK)
There are several alpine musks, all of which like moisture and shade, but they are all rather short lived, and should be replaced frequently by seeds or division. Recommended are:

Mimulus cupreus 'Whitecroft Scarlet', vermillion flowers on 6-in. stems in spring.
M. c. 'Brilliant', 8 to 12 in., deep purple-crimson flowers in summer.
M. c. 'Leopard', 8 to 12 in., large flowers, yellow, spotted red-brown in summer.

MORISIA
Morisia monantha (syn. M. hypogaea), forms rosettes of narrow, jagged leaves filled with stemless golden flowers in early summer. Plant in sandy soil in sun.

OENOTHERA
Oenothera missouriensis, has immense yellow flowers which open in the evening, from June to August. Sprawls over quite a lot of ground.

OMPHALODES
Omphalodes cappadocica, about 6 in. Perennial: blue flowers from June to August.
O. versicolor (blue-eyed Mary), 2 to 8 in., has gentian-blue flowers in spring, and likes a shady corner.

OXALIS
Some oxalis are weeds, but others are delightful rock plants. Among these are:
Oxalis adenophylla, 4 to 6 in., with crinkled grey leaves and funnel-shaped, rich pink flowers in May.
O. chrysanth, is a carpet of gold for months from June. Shelter in winter.
O. magellanica, 1 to 14 in. Creeping perennial with round white flowers in the summer.

PENSTEMON
Rock penstemons are colourful dwarf, shrubby plants, varying in height from 1 or 2 in. to more than 1 ft.
Penstemon pinifolius, 6 in. Scarlet flowers in midsummer.
P. scouleri, up to 1 ft., with rich lavender flowers in July.
P. 'Six-Hills' Hybrid, about 6 in., is very showy, with red-purple flowers in May and June.

OXALIS CHRYSANTHA
A lovely ramp. Give it plenty of room.

PHLOX
The cushion phloxes are most useful for the rock garden. The following named forms of Phlox subulata are all 2 to 6 in., and flower in April and May.
'Appleblossom', soft pink.
'Fairy', lavender with deeper petal markings.
'G. F. Wilson', electric blue.
'Oakington Blue Eyes', deep blue.
'Temescaming', vivid magenta-red; the brightest of all alpine phloxes.

PLATYCODON
Platyodon grandiflorus (balloon bellflower), 6 to 12 in., is a campanula-like plant with large inflated buds and saucer-shaped deep purple-blue, or sometimes white or pink, flowers in late summer.

POLYGONUM
Polygonum vaccinifolium, 6 to 9 in., with
a sheet of deep pink flowers from late August to October, is a mat-forming evergreen. Very easy to grow, flourishing in sun or light shade.

**POTENTILLA**

Potentillas are innumerable. Recommended for the rock garden are:

Potentilla alpestris (syn. P. crantzii), low-growing with golden flowers from mid-summer to autumn.

P. aurea plena is a creeper with double yellow flowers in June.

P. fruticosa, there are several excellent dwarf forms of this shrubby type of potentilla, especially:

P.f. farreri prostrata, prostrate, with yellow flowers in June.

P.f. mandschurica, 1/2 ft., with white flowers in June.

P. tenuiflora, prostrate, with apricot and crimson flowers all summer.

**P. japonica,** 1 1/2 ft., a bog primula, with purplish-red flowers from May to June.

P. 'Mrs. J. H. Wilson', 3 in., with large heads of lilac, white-eyed flowers in spring.

P. marginata, 3 to 4 in., with lavender flowers in March and April, and silver leaves. Plant in rock crevices.

P. pulverulenta, up to 3 ft., a bog primula with rose-red flowers in June.

P. rosea, 1 to 5 in., with rose-red flowers which bloom in spring before all other primulas. Loves wetness.

There are also all the easy and showy-coloured primulas known as the Wanda type.

**PULSATILLA**

Pulsatilla vulgaris (syn. Anemone pulsatilla), has large purple flowers on 1-ft. stems in spring. Plant in chalky soil in a sunny position.

**RAMONDA**

Ramonda myconi (syn. R. pyrenaica), about 3 in., makes flat rosettes of rough leaves, with golden-eyed lilac flowers in early summer. Perfect for north-facing ledges and crevices.

**RANUNCULUS**

Ranunculus crenatus, 3 to 4 in., with white flowers in June and July. Likes sun and very gritty soil.

R. graecinus (grass-leaved buttercup), 6 to 12 in., with large golden flowers from April to June. Non-invasive and very decorative.

R. montanus (syn. R. geraniifolius), 3 in., with yellow flowers from May to July.

**RAOUILIA**

Raouilia australis, forms a silver-leaved carpet with pale yellow flowers in summer.

R. glabra, forms a deep green carpet with white flowers in summer.

**RHODOHYPOXIS**

Rhodohypoxis baurii, about 4 in., with red flowers throughout the summer. Likes sun and moist soil. 'Margaret Rose' is a good form.

R.h. platypetala, a pure white counterpart of R. baurii.
SALIX (WILLOW)
Among the salixes are many dwarf, extremely beautiful catkin-bearing plants. Some of the best are:
Salix arbuscula, 1 to 3 ft. shrub with ½- to 1-in. long catkins in spring.
S. reticulata, 6 in., prostrate shrub with ½- to 1-in. long catkins in spring.
S. serpyllifolia, 6 in., close tufted shrub with tiny catkins in spring.

SAPONARIA
Saponaria ocymoides, trailing perennial with bright red flowers in summer. Easy to grow but rather a spreader.

SAXIFRAGA
There are hundreds of different members of the saxifrage family, all of which are good rock garden plants. They are divided into 16 or 17 sections, the three main ones being first, the kabschia section, which bloom in pre-spring days in gritty, limy soil. These are all neat green or silver-grey hummocks studded with flowers of white, yellow or all shades of red; second, the aizoon section, with silver leaves and white, yellow or pinkish flowers, and third, the mossy section, which are easy carpeters with flowers of white to deepest red (but no yellow) and like protection from hot sun.
Saxifraga aizoon lutea, 4 to 8 in. Yellow flowers in June, is a special gem in the aizoon section.
S. rosea, 4 to 8 in., pink. Grown together with S.a. lutea they blend into a delightful association.
S. fortunei, 1 to 1½ ft., with white flowers in summer. Plant in a shady corner.
S. oppositifolia, has rose-red flowers on carpets of dark green leaves in early spring. Try to obtain the variety called S.o. splendens.

SEDUM
Sedums are scarcely less important than the saxifrages, but there are not so many of them. They are all decorative, largely for their rosettes of fleshy, often brightly coloured leaves, and are useful for filling crevices and crannies with colour. They love hot, dry situations, and are beautiful

SEMPERVIVUM
deplouring flowers in summer.
S. cauticola, a trailer with deep red hanging flowers in autumn.
S. spathulifolium purpureum, has golden flowers on 3- to 5-in. stems at the end of summer, and purple leaves dusted with grey farina. Easy to grow in a sunny spot.
S. spurium ‘Schorbusser Blut’, 6 in., is a blaze of crimson in high summer.

SEMPERVIVUM (HOUSELEEK)
A race of easily-grown, sun-loving plants which will thrive in the poorest of soil as long as it is well drained. Their rosettes of fleshy leaves may be green, purple, or red, or may combine all these colours. The star-shaped flowers may be white, cream, pink or red.
Sempervivum arachnoideum (cobweb houseleek), so-called because the reddish or green rosettes are criss-crossed with grey hairs. Bright rose-red flowers in July.
S. tectorum (common houseleek). Dark or light purplish-red flowers in July.
SILENE ACAULIS
Grows in sparse, gritty soil

SILENE
Silene acaulis, about 2 in., a densely tufted green perennial, with stemless pink blossoms from June to August. Rarely covers itself with flowers.

SISYRINCHIUM (SATIN FLOWER)
Sisyrinchium bellum, has tufts of grassy leaves and blue flowers on 6-in. stems in late June and July.
S. brachypus, 9 in., one of the easiest, with clear golden flowers in July and August.
S. californicum, 6 in., with bright yellow flowers in autumn.
S. grandiflorum (syn. S. douglasii), 8 to 10 in., has swinging bell-like wine-red flowers in summer.

SOLDANELLA
Soldanelles form spreading mats of small dark green rounded leaves, with lavender or lilac flowers in early spring. They are not very easy to grow, and their autumn-produced flower buds, nestling among the leaves, are often eaten by slugs. Plant them in gritty soil rich in humus in a cool corner, and cover with a piece of glass in winter.

THYMUS
Most of the various thymes are easy to grow and showy. Recommended is:
Thymus serpyllum, 1 to 3 in., mat-forming with purplish flowers in summer. There are many forms, some with white, others with pink, red or crimson flowers. Invaluable for planting in chinks between paving stones.

TIARELLA
Tiairello cordifolia, 6 to 12 in., with heart-shaped leaves and fluffy spires of white flowers in April to June. Plant in a shady corner.

VERONICA
Some veronicas creep on the ground, while others make short or tall shrubs, but a selection of them add colour and interest to any rock garden. Recommended are:
Veronica pageana, 1 ft., a stiff little grey-leaved bush with lilac flowers in summer.
V. pectinata rosea, a mat of soft grey leaves smothered with pink flowers in summer.
V. peduncularis, a 6-in. bush with soft blue flowers for months on end during the summer.

VIOLA
Violas are freely-flowering plants and useful for bold effects in the rock garden. Choose carefully among the violas and avoid those which are really pansies and do not seem appropriate on a rock garden.
The best is:
Viola cornuta, 4 to 12 in., with elegant lilac or white flowers in summer.

ZAUSCHNERIA
Zauschneria californica, has scarlet flowers on 9- to 12-in. stems in autumn. Plant in a hot, dry spot.
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<tr>
<td>Edraianthus punicea</td>
<td>pale blue</td>
<td>spring, summer, autumn</td>
</tr>
<tr>
<td>Erigeron macronutus</td>
<td>white, pink, mauve</td>
<td>summer</td>
</tr>
<tr>
<td>Erodium</td>
<td>white to deep pink</td>
<td>summer, autumn</td>
</tr>
<tr>
<td>Eryssimum</td>
<td>lilac, yellow</td>
<td>early summer</td>
</tr>
<tr>
<td>Gentiana</td>
<td>blue</td>
<td>spring, late summer</td>
</tr>
<tr>
<td>Geranium</td>
<td>pink, blue, cerise</td>
<td>spring, summer, winter</td>
</tr>
<tr>
<td>Geum montanum</td>
<td>yellow</td>
<td>spring</td>
</tr>
<tr>
<td>Globularia</td>
<td>blue</td>
<td>summer</td>
</tr>
<tr>
<td>Gypsophila</td>
<td>pink, white</td>
<td>midsummer</td>
</tr>
<tr>
<td>Helianthemum</td>
<td>red, old gold, yellow, orange, pink</td>
<td>spring, summer</td>
</tr>
<tr>
<td>Hypericum</td>
<td>yellow</td>
<td>summer</td>
</tr>
<tr>
<td>Iberis</td>
<td>white</td>
<td>spring, summer</td>
</tr>
<tr>
<td>Iris</td>
<td>blue, white, purple, yellow</td>
<td>spring, summer</td>
</tr>
<tr>
<td>Leontopodium alpinum</td>
<td>silver-grey</td>
<td>summer</td>
</tr>
<tr>
<td>Lewisia</td>
<td>red, apricot, pink, salmon</td>
<td>spring, early summer</td>
</tr>
<tr>
<td>Linaria</td>
<td>lavender, gold</td>
<td>summer</td>
</tr>
<tr>
<td>Linum</td>
<td>blue</td>
<td>spring, summer</td>
</tr>
<tr>
<td>Lithospermum</td>
<td>yellow</td>
<td>summer</td>
</tr>
<tr>
<td>Morista</td>
<td>yellow</td>
<td>early summer</td>
</tr>
<tr>
<td>Oenothera missouriensis</td>
<td>yellow</td>
<td>summer</td>
</tr>
<tr>
<td>Oxalis</td>
<td>pink, gold, white</td>
<td>summer</td>
</tr>
<tr>
<td>Penstemon</td>
<td>scarlet, lavender, red-purple</td>
<td>spring, summer</td>
</tr>
<tr>
<td>Phlox</td>
<td>pink, red, lavender, blue</td>
<td>spring</td>
</tr>
<tr>
<td>Platycodon</td>
<td>blue, white, pink</td>
<td>late summer</td>
</tr>
<tr>
<td>Polygonum vacciniifolium</td>
<td>pink</td>
<td>summer, autumn</td>
</tr>
<tr>
<td>Potentilla</td>
<td>crimson, yellow, apricot, white</td>
<td>spring</td>
</tr>
<tr>
<td>Pulsatilla vulgaris</td>
<td>purple</td>
<td>spring, summer</td>
</tr>
<tr>
<td>Ranunculus</td>
<td>yellow, white</td>
<td>summer</td>
</tr>
<tr>
<td>Raoulia</td>
<td>red</td>
<td>spring, early summer</td>
</tr>
<tr>
<td>Saponaria ocymoides</td>
<td>yellow, white</td>
<td>summer</td>
</tr>
<tr>
<td>Saxifraga</td>
<td>red</td>
<td>spring, autumn</td>
</tr>
<tr>
<td>Sedum</td>
<td>yellow, pink, white, red</td>
<td>summer</td>
</tr>
<tr>
<td>Sempervivum</td>
<td>red, yellow</td>
<td>summer</td>
</tr>
<tr>
<td>Silex acutis</td>
<td>cream, white, pink, red</td>
<td>summer</td>
</tr>
<tr>
<td>Thymus serpyllum</td>
<td>pink</td>
<td>summer</td>
</tr>
<tr>
<td>Veronica</td>
<td>purple, white, pink, red</td>
<td>summer</td>
</tr>
<tr>
<td>Zauschneria californica</td>
<td>lilac, blue, pink</td>
<td>summer</td>
</tr>
<tr>
<td></td>
<td>scarlet</td>
<td>autumn</td>
</tr>
</tbody>
</table>
### SHADE-LOVING ALPINES

<table>
<thead>
<tr>
<th>Plant</th>
<th>Colour</th>
<th>Flowering</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mentha requienii</td>
<td>lilac (too small to see)</td>
<td>summer</td>
</tr>
<tr>
<td>Mimulus</td>
<td>vermilion, crimson, yellow</td>
<td>spring, summer</td>
</tr>
<tr>
<td>Ormaphalodes</td>
<td>blue</td>
<td>spring and summer</td>
</tr>
<tr>
<td>Primula (some)</td>
<td>pink</td>
<td>early summer</td>
</tr>
<tr>
<td>Ramonda mycine</td>
<td>lilac</td>
<td>early summer</td>
</tr>
<tr>
<td>Saxifraga (some)</td>
<td>white, pink</td>
<td>summer, autumn</td>
</tr>
<tr>
<td>Tiarella cordifolia</td>
<td>white</td>
<td>spring, early summer</td>
</tr>
</tbody>
</table>

### ALPINES FOR ACID SOIL

<table>
<thead>
<tr>
<th>Plant</th>
<th>Colour</th>
<th>Flowering</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dianthus neglectus</td>
<td>deep pink</td>
<td>midsummer</td>
</tr>
<tr>
<td>Gentiana sino-ornata</td>
<td>deep blue</td>
<td>autumn</td>
</tr>
<tr>
<td>Lewisia</td>
<td>pink, red, apricot, salmon</td>
<td>spring, early summer</td>
</tr>
<tr>
<td>Lithospermum ‘Grace Ward’</td>
<td>blue</td>
<td>summer</td>
</tr>
</tbody>
</table>

### CREVICE PLANTS

<table>
<thead>
<tr>
<th>Plant</th>
<th>Colour</th>
<th>Flowering</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acantholimon glaucum</td>
<td>rose-red</td>
<td>summer</td>
</tr>
<tr>
<td>Aethionema ‘Warley Rose’</td>
<td>rose-red</td>
<td>summer</td>
</tr>
<tr>
<td>Andromache lanuginosa</td>
<td>white, flushed pink</td>
<td>summer</td>
</tr>
<tr>
<td>Dianthus alpinus</td>
<td>rose-red</td>
<td>summer</td>
</tr>
<tr>
<td>D. neglectus</td>
<td>deep pink, rose, beige</td>
<td>summer</td>
</tr>
<tr>
<td>Dryas octopetala</td>
<td>white</td>
<td>summer</td>
</tr>
<tr>
<td>Erodium chamaeedyoides roseum</td>
<td>deep pink</td>
<td>summer</td>
</tr>
<tr>
<td>Gypsophila dubia</td>
<td>pink, white</td>
<td>summer</td>
</tr>
<tr>
<td>G. frutensis</td>
<td>pink, white</td>
<td>summer</td>
</tr>
<tr>
<td>Hypericum polyphyllum</td>
<td>yellow</td>
<td>summer</td>
</tr>
<tr>
<td>Lewisia</td>
<td>pink, red, apricot, salmon</td>
<td>summer</td>
</tr>
<tr>
<td>Lithospermum ‘Grace Ward’</td>
<td>blue</td>
<td>summer</td>
</tr>
<tr>
<td>Penstemon</td>
<td>scarlet, lavender, red-purple</td>
<td>summer</td>
</tr>
<tr>
<td>Phlox subulata</td>
<td>various varieties, pink, blue, red</td>
<td>summer</td>
</tr>
<tr>
<td>Polygonum vaccinfolium</td>
<td>deep pink, shining green leaves</td>
<td>autumn</td>
</tr>
<tr>
<td>Primula marginata</td>
<td>lavender, silver leaves</td>
<td>spring</td>
</tr>
<tr>
<td>P. ‘Mrs. J. H. Wilson’</td>
<td>lilac</td>
<td>spring</td>
</tr>
<tr>
<td>Saxifraga</td>
<td>pink, white</td>
<td>summer</td>
</tr>
<tr>
<td>Sedum</td>
<td>pink</td>
<td>summer</td>
</tr>
<tr>
<td>Sempervivum</td>
<td>white, cream, red</td>
<td>summer</td>
</tr>
</tbody>
</table>

### LATE-FLOWERING ALPINES

<table>
<thead>
<tr>
<th>Plant</th>
<th>Colour</th>
<th>Flowering</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cheiranthus cheiri ‘Harpur Crewe’</td>
<td>yellow</td>
<td>until December</td>
</tr>
<tr>
<td>Gentiana macaulayi</td>
<td>blue</td>
<td>August to October</td>
</tr>
<tr>
<td>G. sino-ornata</td>
<td>deep blue</td>
<td>September to November</td>
</tr>
<tr>
<td>Lithospermum ‘Grace Ward’</td>
<td>gentian blue</td>
<td>May to October</td>
</tr>
<tr>
<td>Oxalis chrysanthi</td>
<td>gold</td>
<td>June to September</td>
</tr>
<tr>
<td>Polygonum vaccinfolium</td>
<td>deep pink</td>
<td>August to October</td>
</tr>
<tr>
<td>Potentilla tonguet</td>
<td>apricot, crimson</td>
<td>July to September</td>
</tr>
<tr>
<td>Saxifraga fortunei</td>
<td>white</td>
<td>August</td>
</tr>
<tr>
<td>Sedum causticola</td>
<td>deep red, glaucous</td>
<td>September</td>
</tr>
<tr>
<td>Zauschneria californica</td>
<td>scarlet</td>
<td>autumn</td>
</tr>
</tbody>
</table>
### ALPINES FOR THE ROCK GARDEN

#### ALPINES FOR PATHS AND PAVING

<table>
<thead>
<tr>
<th>PLANT</th>
<th>COLOUR</th>
<th>FLOWERING</th>
</tr>
</thead>
<tbody>
<tr>
<td>Achillea aurea grandiflora</td>
<td>yellow</td>
<td>summer</td>
</tr>
<tr>
<td>A. tomentosa</td>
<td>golden-yellow</td>
<td>summer</td>
</tr>
<tr>
<td>Antennaria dioica rosea</td>
<td>soft pink</td>
<td>spring</td>
</tr>
<tr>
<td>Arenaria purpureascens</td>
<td>lilac</td>
<td>early summer</td>
</tr>
<tr>
<td>Armeria maritima</td>
<td>brilliant red</td>
<td>early summer</td>
</tr>
<tr>
<td>Campanula cochlearifolia (patula)</td>
<td>blue, white</td>
<td>summer</td>
</tr>
<tr>
<td>Dianthus deltoides</td>
<td>pink</td>
<td>summer</td>
</tr>
<tr>
<td>Draba</td>
<td>yellow</td>
<td>spring</td>
</tr>
<tr>
<td>Geranium sanguineum lancastriense</td>
<td>pink</td>
<td>spring to winter</td>
</tr>
<tr>
<td>Globularia bellaflora</td>
<td>blue</td>
<td>summer</td>
</tr>
<tr>
<td>Linaria alpina</td>
<td>lavender, tipped gold</td>
<td>summer, autumn</td>
</tr>
<tr>
<td>Potentilla alpestris</td>
<td>golden yellow</td>
<td>summer</td>
</tr>
<tr>
<td>P. tonguei</td>
<td>apricot, crimson</td>
<td>summer</td>
</tr>
<tr>
<td>Ranunculus aquatilis</td>
<td>yellow (very small)</td>
<td>summer</td>
</tr>
<tr>
<td>Saxifraga aizoom (all forms)</td>
<td>white, yellow, pink</td>
<td>summer</td>
</tr>
<tr>
<td>Sedum</td>
<td>white, crimson leaves</td>
<td>summer</td>
</tr>
<tr>
<td>Thymus serpyllum</td>
<td>purple</td>
<td>summer</td>
</tr>
<tr>
<td>Veronica pectinata rosea</td>
<td>pink</td>
<td>summer</td>
</tr>
</tbody>
</table>

#### ALPINES FOR SCREE

<table>
<thead>
<tr>
<th>PLANT</th>
<th>COLOUR</th>
<th>FLOWERING</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aethionema 'Warley Rose'</td>
<td>rose-red</td>
<td>summer</td>
</tr>
<tr>
<td>Androsace</td>
<td>pink, white</td>
<td>spring, early summer</td>
</tr>
<tr>
<td>Arenaria purpureascens</td>
<td>lilac</td>
<td>early summer</td>
</tr>
<tr>
<td>Armeria caespitosa</td>
<td>rose-red</td>
<td>spring, early summer</td>
</tr>
<tr>
<td>Campanula cochlearifolia</td>
<td>white, blue</td>
<td>mid-summer</td>
</tr>
<tr>
<td>Dianthus alpinus</td>
<td>rose-red</td>
<td>summer</td>
</tr>
<tr>
<td>D. arvensist</td>
<td>pink</td>
<td>early summer</td>
</tr>
<tr>
<td>D. neglectus (no lime)</td>
<td>deep pink</td>
<td>early summer</td>
</tr>
<tr>
<td>Draba</td>
<td>yellow</td>
<td>midsummer</td>
</tr>
<tr>
<td>Dryas octopetala</td>
<td>white</td>
<td>spring</td>
</tr>
<tr>
<td>Echiranthus pumilio</td>
<td>pale blue</td>
<td>spring</td>
</tr>
<tr>
<td>Erodium chamaeleonoides roesum</td>
<td>deep pink</td>
<td>spring, autumn</td>
</tr>
<tr>
<td>Gentiana verna</td>
<td>blue</td>
<td>spring</td>
</tr>
<tr>
<td>G. dalmaticum</td>
<td>pink</td>
<td>summer</td>
</tr>
<tr>
<td>G. subcaulescens</td>
<td>cerise, black-eyed</td>
<td>summer</td>
</tr>
<tr>
<td>Globularia</td>
<td>blue</td>
<td>spring</td>
</tr>
<tr>
<td>Iris cristata</td>
<td>blue, golden crests</td>
<td>summer</td>
</tr>
<tr>
<td>Leontopodium alpinum</td>
<td>silver-grey</td>
<td>summer, autumn</td>
</tr>
<tr>
<td>Linaria alpina</td>
<td>lavender, gold</td>
<td>early summer</td>
</tr>
<tr>
<td>Merisia monantha</td>
<td>yellow</td>
<td>spring</td>
</tr>
<tr>
<td>Osiris adenophylla</td>
<td>rich pink</td>
<td>midsomer</td>
</tr>
<tr>
<td>Penstemon pinnifolius</td>
<td>scarlet</td>
<td>early summer</td>
</tr>
<tr>
<td>Primula (some kinds)</td>
<td>mauve, pink</td>
<td>midsomer</td>
</tr>
<tr>
<td>Ranunculus creatus</td>
<td>white</td>
<td>summer</td>
</tr>
<tr>
<td>R. montanus</td>
<td>yellow</td>
<td>summer</td>
</tr>
<tr>
<td>Ranunculus australis</td>
<td>yellow</td>
<td>leaf effect</td>
</tr>
<tr>
<td>Saltx</td>
<td>red, white, yellow</td>
<td>early spring</td>
</tr>
<tr>
<td>Saxifraga (especially the kabschia section)</td>
<td>yellow, leaves powder</td>
<td>late summer</td>
</tr>
<tr>
<td>Sedum spathulifolium purpureum</td>
<td>white, cream, pink, red</td>
<td>summer</td>
</tr>
<tr>
<td>Sempervivum</td>
<td>pink</td>
<td>spring</td>
</tr>
<tr>
<td>Silene acaulis</td>
<td>lavender, lilac</td>
<td></td>
</tr>
</tbody>
</table>

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Rock Garden Construction

A rock garden imitates a natural feature—the wild outcrops of stones and boulders found on the slopes of mountains. To re-create the haphazard grandeur of Nature on the small scale suitable for a garden requires careful planning, not only in the choice of site, design and materials, but also to hide the artificiality of the feature.

Choose a site away from the formal parts of the garden, where the rock garden can blend in with its immediate surroundings. To ensure the success of the alpine plants that will clothe it, the site should be in a sheltered position, but well away from prolonged shade cast by large trees, fences or buildings.

Highly effective rock gardens can be constructed on sites that are naturally uneven or banked and, therefore, they often solve the problem of what to do with oddly contoured and terraced areas. But, if they are carefully planned, they can also be constructed on flat ground.

It is worth visiting well-designed rock gardens to see how the various problems of layout have been coped with, and to walk over a natural outcrop of rock in the country, taking careful note of how the rocks lie. For the success of a rock garden is measured by its naturalness.

The size will depend on the size of the garden as a whole. As rock gardens are so distinctive, it is better that they be on the small side; if they are too large, they become dominating. But a way can usually be found to site one in most gardens, however small. A rock garden incorporating other natural features, such as a waterfall and pool, requires plenty of room; moreover, a complicated design will not be effective on too small a scale.

In the design itself, proportions are very important, so do not use rocks that are too large. Rocks are expensive to buy, and a rock garden of modest proportions is often satisfying both aesthetically and economically.

Try to obtain stone or rocks from a local supplier, not only to obtain the type of stone indigenous to the district.
In a small rock garden, keep the shape simple; a complicated design is not effective on too small a scale.

At the front, this small rock garden ends gradually. The bold effects are at the back, where a dwarf conifer gives added height.

and so help with the natural effect, but to reduce transport costs.

**TYPES OF ROCK**

Select rocks that blend with the immediate surroundings. Quarryed sandstone or Westmorland stone are usually suitable. Sandstone retains moisture and has an attractive finish, but is rather soft and is affected by frost.

Limestone is an excellent rock to use, as it weathers well and has a very good colour. There are several different types, such as Derbyshire, Westmorland and Cotswold.

If bold effects are planned, order large pieces of rock, weighing perhaps several cwt. each. On average, a ton of stone provides 10 or 12 pieces, depending on the type. Smaller stones will also be required to mix in with the larger rocks where necessary to give variety. A piece of sand-
A miniature rock garden for growing alpines can be effectively created in a trough or sink. A layer of stones and broken crocks at the base ensures good drainage; the best soil is equal parts of loam, leaf mould and sand.

There can be a place for alpines and stones in even the most confined town garden. Cultivate the smallest-growing plants in this kind of container, which may also be used for bringing on young plants and cuttings for later transplanting to a larger rock garden.

A stone weighing 3 cwt. would measure about 2 ft. by 1 ft. by 1 ft.; a piece of Westmorland stone of the same weight would be rather smaller.

CONSTRUCTION
The rock garden must have good soil and very good drainage. If the site is heavy, break up the subsoil thoroughly and work in plenty of old rubble. Then put a good mound of small rubble on top, adding a few large stones so that they will protrude after several loads of better soil, preferably loam, have been added.

The best soil mixture is good turf soil, mixed liberally with sharp sand. Incorporate peat or leaf mould at the rate of 4 bucketfuls per barrow-load (approximately 1 cwt.) of loam.

More than any other garden feature, the rock garden depends for success on the constructor's ingenuity. In a natural
Good soil and very good drainage are vital in a rock garden. A rubble base may be necessary and, if the soil is very heavy, break it up, working in plenty of rubble. Then place a few large rocks to protrude after better soil, preferably loam, has been added.

These rocks are incorrectly positioned; they would not lie like this in a natural rock outcrop.

These rocks are correctly positioned; they imitate the natural effect of stone strata.

Rock outcrop, the stones lie in strata, and most of their bulk is buried below soil level. When placing stones in a rock garden, try to imitate this effect by laying the pieces in strata with their broadest and most weathered faces showing. Both for safety and for effect, seat them firmly in the soil, packing where necessary with soil and small stones, and tilt them slightly downward into the bank so that rain will drain inward to keep the roots moist. As the work proceeds, view it frequently from a distance, to get an over-all impression.

Large, bold outcrops can be produced if two or more large pieces are placed on top of each other; but be sure that the pieces fit and do not overhang each other too much, or they may not be stable when in position.

If the rock garden is to be large, plan paths through it so that the plants can be admired and tended. Let the paths twist and turn as they would naturally.

Do not let the rock garden finish abruptly, but allow it to trail off gradually, with occasional rocks here and there. One very good setting for a rock garden is at the end of the lawn, where an effective finish can be made by setting small outcrops in the turf itself.

Where water is incorporated in a large rock garden it is usually allowed to run down into a pool or pools below. The
Stones should lean into the soil so that rainwater will drain inward and keep plant roots moist.

Stones placed like this are unstable and prevent sun getting to the plants growing between them.

Soil will dry out and plants suffer if stones are placed so that water can drain straight off them.

These rocks are unstable and alpines planted between them become "leggy" and drawn in growing towards the sun.

Water feature should, where possible, be situated conveniently close to a power supply and water source. Alkathene tubing is ideal piping to use, as it is easy to install and join together where necessary. The same water can be used over and over again if a waterproof electric pump is fitted.

At the bottom of the lowest pool, an overflow or return pipe will be needed to carry the water back to the top of the rock garden. A specialist pump firm will supply the correct size and type of apparatus if a plan of the feature is provided, showing how high the water has to be pumped and how much will be circulating. For the sake of safety, a competent electrician should install the water pump.

House the pump near the highest part of the rock garden, and arrange the outlet pipe so that it is concealed by overhanging rocks. The water from this pipe can fall into the highest basin and then overflow into the others, creating a series of small waterfalls.

Construct the basins so that they tilt slightly into the rock garden face and will thus retain a proportion of the running water. If the front edge of each basin is perfectly horizontal, the water will flow over the entire edge to give a bolder effect.

The water must not overflow into the
ROCK GARDEN CONSTRUCTION

rock garden itself. Hide the basins' sides with carefully-placed overhanging rocks, and give each basin a rough face so that it has a natural, weathered look.

It is best to make the basins of actual rocks, using carefully selected, flat-faced pieces that can be cemented together. Keep the surface of the cement in the joints well below the top of the rocks so that it is not seen. It does not matter if open cracks or joints are obvious, as these would occur in a natural formation. If suitable rocks are not available, basins may be made of waterproof cement.

Make the pool at the bottom of the waterfall an irregular shape, so that it will look more natural.

There are many variations possible in the design of a water feature: for instance, instead of waterfalls, a winding stream of water can be arranged to flow round the rock garden, starting from the highest point and running down towards a pool at the bottom. But the size of the stream should be kept in proportion to the rock garden itself.

MORAINES AND SCREE
There can be other settings for alpine plants, smaller and easier to produce than a full-scale rock garden, and often more suitable for a confined garden. Interesting and colourful effects can be achieved with a moraine—a bed of small stones and grit which is naturally supplied with water from below; or a scree—a similar but unwatered bed. Both features are found in Nature among mountains.

To form the base of either feature, use stone chippings. These should be at least \( \frac{1}{4} \) in. in size and have a few larger pieces of rock among them. Lay the chippings to a depth of about 1 to 1½ ft. on a slight incline to give good drainage and a natural effect. Cover this with a thin layer of soil mixture for the bed, made of approximately 1 part by bulk good quality loam to 10 parts stone chippings; plus 1 part peat and 1 part very coarse, sharp sand. To provide water below the bed for a moraine, it will be necessary to place perforated Alkathene piping in position first of all and then cover it with the chippings, etc. Make a few holes in the piping. These should be small, as an excess of water should be avoided; the correct amount is enough to keep the soil just moist. Connect the perforated piping to a piece of hose-pipe so that it can be linked with a tap as required.

In the larger rock garden a water feature can be incorporated. This diagram shows the basic elements: a succession of pools faced with rocks to give a waterfall effect, and a pipe from the lowest pool to the top of the feature, so that the water can be used again and again. An electric pump is also necessary. The top of the pipe will be hidden by overhanging rocks.
How a mature water feature might look. An irregular-shaped bottom pool gives the most natural impression; behind each pool face a basin holds part of the running water, and overhanging rocks prevent water overflowing into the rock garden itself. If some of the pool faces are perfectly horizontal, water can flow over the entire edge to give a bolder effect.

Note: In many districts, Water Boards will not allow such an arrangement to be permanently connected to the mains, owing to the danger of "suck back" to the mains if a fault in supply or pressure should occur.

TROUGHS AND SINKS
Another way to grow alpines is in troughs or sinks. Disused natural stone troughs can sometimes be bought, but make sure that there is a drainage hole in each one—preferably at the lower end. Very old troughs may require a thin rendering of cement to a depth of \( \frac{1}{4} \) or \( \frac{1}{2} \) in. to make them waterproof.

Slabs of walling stone can be built into very attractive vessels. Make the base of solid concrete to a depth of 2 in., and secure slabs of stone, which need be only 4 to 6 in. high, into \( \frac{1}{4} \) in. of concrete to make the sides. Insert a piece of round wood in the base concrete while it is still wet, to leave a drainage hole when it is removed.

Make the soil for troughs of equal parts by bulk of loam, leaf mould and sand. (This is a good mixture for plants which require plenty of drainage.) If necessary, add one part of peat to retain moisture.

At the bottom of the trough place a 2-in. layer of broken crocks. Over this place a thin layer of rough leaf mould, and then add the soil mixture, making it reasonably firm. Bury suitably sized stones in the surface, leaving about one-third of their bulk showing. Select and plant a few very small-growing alpines, and top off the soil round them with a layer of chippings of either limestone or granite.
A group of Darwin tulips with two lily-flowered tulips
BULBS

Hardy bulbs are a great asset to the garden, for they provide some of the earliest and the latest blooms, beginning with snowdrops and winter aconites and finishing with autumn cyclamen and meadow saffrons.

The best display is in the spring when crocuses, tulips and narcissi bloom. These are followed by the alliums and camasias in early summer, and then the English, Spanish and Dutch irises. After these come the white Galtonia candidans and the montbretias, and finally the autumn bulbs which give colour to the garden before winter sets in.

Bulbs may be used in many different ways—for bedding out, in flower borders and rock gardens, between shrubs and under small trees. Many can be naturalized in rough grass or on the lawn verges.

The term “bulb” has been used generally in this chapter to include both bulbs and corms.

By cutting a tulip bulb and a crocus corm in half the difference between a bulb and a corm can be seen.

The bulb is made up of a number of fleshy scales like an onion, with a bud at the bottom.

The corm is a solid mass of material, mainly starch, with a bud at the top.

There are, of course, slight variations of this general pattern.

STARTING WITH BULBS

Because it is better to buy the cheaper well-tried bulbs until an idea is formed of what grows best in the garden and what is most pleasing in colour, form and habit, the more expensive bulbs to be found in catalogues are not mentioned in this book. If the garden is small, start with just a few of any particular variety, say a dozen small bulbs such as the crocus and half a dozen larger ones such as the tulip. In this way it will be possible to discover which bulbs thrive best, and the collection can be enlarged year by year.

PLANTING

Bulbs normally like a good, well-drained loam. If the soil in which they are to be grown is not good, add well-rotted manure, well-rotted compost, hop manure or other organic material. Never add fresh farmyard manure because it is not sufficiently decayed. If the soil is very heavy add whatever manure is available, and always add coarse sand or grit. In addition dust the surface with bone meal sufficient to whiten it, and fork in before planting. (Apply bone meal as a top dressing each winter to bulbs which are not lifted.) Proprietary manures, specially compounded for bulbs, can also be added. Do not use peat or leaf mould, except for certain shade-lovers, such as cyclamen. For the wild species bone meal alone is recommended as a manure.

Plant the bulbs, with the exception of the shade-lovers, where they will get all the sun possible, and where they will be sheltered from draughts and cold winds.

Where bulbs are to be planted in grass, or when hundreds are to be planted, use a tool known as a “bulb-planter”. Otherwise make the holes with a trowel, but these holes must be flat at the bottom so
that the bulb sits on the soil and not on a pocket of air.

Most bulbs will increase in number if their conditions of cultivation are satisfactory. After three to five years lift and divide the clumps, otherwise there will be few flowers. Do this as soon as the leaves have died down, or better still, after the leaves have turned half yellow, as it is then easier to see where the bulbs are. Replant some in the same place, and the others where there is room. Dust the ground lightly with bone meal before planting.

All the bulbs mentioned here are easy to grow provided they are given reasonable care.

CROCUS

The golden-yellow crocuses have been in cultivation for nearly 400 years and have never set seed. There are other coloured varieties, the large Dutch, which grow somewhat taller, and a selection of these is invaluable in the spring garden. There are also many wild species, which flower in the autumn, winter or spring.

Plant the spring-flowering species in the autumn, and the autumn-flowering species in August, 1 in. apart and about 2 in. deep. Plant in rough grass as well as at the edge of borders, between shrubs and beneath small trees. Mice love to eat crocuses, so plant a few more than are really needed. Sift naphthalene over the places where the crocuses are planted, or bury a mothball with each crocus when planting.

Although after flowering the foliage is untidy do not cut it off. Divide the plants when they become too crowded, probably after five or six years.

The best of the large crocuses are:
Jeanne d’Arc, pure white.
Kathleen Parlow, pure white.
Little Dorrit, china blue.
Maximilian, china blue.

DIFFERENCE BETWEEN BULB AND CORM

A bulb is composed of fleshy scales, like an onion, protecting a bud at the base

A corm has the bud at the top and is a solid mass of starchy material
Spring-flowering Crocus

Vanguard, light blue.
Remembrance, violet-blue.
Paulus Potter, ruby-purple.
Negro Boy, deep purple-blue.
Purple Beauty, deep purple-blue.
Dutch Yellow, golden-yellow.

Plant the wild species in a choice, sunny, well-drained corner by themselves.
The collection given below will give a lot of pleasure and interest over a long period. Plant as for the garden forms but be still more vigilant for mice.

Autumn-flowering Crocus

C. zonatus (syn. C. kotschyanus), pale lavender-pink.

Spring flowering—early and late

Crocus aureus, dark orange-yellow.
C. biflorus, very variable but all are good.
C. dalmaticus, soft lilac-blue.
C. olivieri, golden-yellow.
C. sieberi, lavender.
C. tomasinianus, pale lavender. Choose the varieties Whitewell Purple or Taplow Ruby for the garden and plant C. tomasinianus itself among shrubs or in rough grass, as it spreads too freely in borders.
C. versicolor picturatus, white.

Daffodil—see Narcissus

Hyacinth

Hyacinths are a doubtful proposition for the outdoor garden as they tend to topple over in rough spring weather. But their colours are good and their perfume exquisite, so for planting in a sunny sheltered position near the house buy the cheaper, less heavy, second-size bulbs. Plant in September or October, 3 in. deep and 6 in. apart, in light well-drained soil. If the soil is in good condition the bulbs need not be lifted, and although their
second-year spikes may not be as large as the first year's, they will still be attractive. There is a wide range of colours from which to choose and the following are recommended:

- L'Innocence, white.
- Perle Brillante, light blue.
- Ostara, blue.
- King of the Blues, dark blue.
- Pink Pearl, pink.
- Jan Bos, red.

Amethyst, purple.
City of Haarlem, yellow.
Oranje Boven, orange.

**IRIS**

The Dutch, English and Spanish irises are essentially plants for the summer border. The Dutch flower about early June, the Spanish, which are scented, about two weeks later and the English at the end of the month and in early July. They all grow to 1½ to 2 ft. high and are excellent for cutting. If cut while in bud they will open in the house to perfect blooms.

Plant in October, 4 in. deep and 6 in. apart, except the smaller bulbs of the Spanish variety which are more effective at 4 in. apart.

The Dutch and Spanish prefer a light, sandy soil, but plant the English iris in a heavier, moister soil. All require an open, fairly sunny place.
DUTCH IRIS
Blue Champion, wedgwood blue.
Bronze Beauty, bronzy shades.
Harmony, blue and yellow.
Lemon Queen, shades of yellow.
King Mauve, pale mauve.
White Excelsior, pure white.

ENGLISH IRIS
Delft's Blue, dark and pale blue.
La Grandesse, pure white.
Queen of the Blues, pure blue.

SPANISH IRIS
Cajanus, clear yellow.
Enchantress, porcelain blue.
Frederika, pure white.
King of the Blues, rich deep blue.
Le Mogol, bronze-purple and brown.
Summer Time, white and canary-yellow.

One or two of the wild species and dwarf hybrids can be grown in the same bed as the wild crocus and will add to the beauty and interest of the garden in early spring. They are:

Iris danfordiae, 6 to 8 in., bright canary yellow. After the first year these bulbs take several years to build up to flowering size again.

I. histrioides major, 9 in., Oxford blue and very early flowering.

Harmony, 9 in., deep velvety blue hybrid, increases well.

I. reticulata, 9 to 12 in., violet scented with violet-blue flowers in February and March.

I. 'Velvet', 6 in., rich purple.

I. tuberosa (syn. Hordodactylus tuberosus), 1 ft., black and green, flowering in April.
NARCISSUS

Narcissus is the generic name for one of the oldest known plants and covers daffodils, jonquils and the flowers generally known as narcissi.

They are as difficult to choose as tulips for although they have not the same variation in colour, they have much more variation in form.

There are nine main classes or divisions of narcissus besides the wild species, with colour varying from white through every shade of yellow to orange and pink. The trumpet is sometimes the same colour as the perianth (the outer part) and sometimes a deeper shade or even a different colour altogether.

Narcissus bulbs prefer moister soil than tulips and they will grow well in partial shade. In fact, the bright orange varieties keep their colour better in semi-shady positions.

They are useful for planting between shrubs and among small trees, and look lovely in grass; but do not cut the grass until the leaves have died down.

Plant in mid-August, in a sheltered position, 6 in. deep and 9 in. apart, preferably in moist, sandy loam.

There is no need to lift narcissi until they become crowded, but keep their positions well weeded and forked over as the foliage decays, because the narcissus fly lays its eggs in the holes left by the dead foliage, or in cracks in the soil near by.

As soon as the leaves are dead, scuffle the ground so that these holes are filled up, and dust with an insecticide to kill the grubs as they hatch.

If any bulbs come up in the spring with discoloured or distorted foliage, dig them up immediately and burn them. Burn also any bulbs which are soft when lifted.

DIVISION I
TRUMPET NARCISSI (DAFFODILS)

About 18 to 24 in., one flower to a stem, with the trumpets as long or longer than the perianth segments.

Beersheba, perianth and trumpet pure white.

King Alfred, perianth and trumpet bright yellow.

Mount Hood, perianth and trumpet pure white.

Mulatto, perianth and trumpet sulphur yellow.

President Lebrun, white perianth, deep cream trumpet.

Queen of Bicolors, white perianth, canary-yellow trumpet.

DIVISION II
LARGE-CUPPED NARCISSI

About 16 to 20 in., one flower to a stem, with the cup, or corona, more than one-third but less than the whole length of the perianth segments.

Aranjuez, perianth clear yellow, cup deep apricot edged orange.

Fortune, perianth soft yellow, cup glowing orange.

John Evelyn, perianth white, cup soft apricot.

Mrs. R. O. Backhouse, 14 in., creamy-white perianth, cup apricot.

Polinda, perianth white, cup clear yellow.

Selma Lagerlof, perianth white, cup creamy-yellow with orange band.

White Nile, perianth white, cup deep cream.
DIVISION III
SMALL-CUPPED NARCISSI
About 16 to 20 in., one flower to a stem, with the cup not more than one-third the length of the perianth segments.
Edward Buxton, perianth soft yellow cup light orange with red margin.
Firetail, perianth creamy-white, cup crimson-scarlet.
La Riente, perianth pure white, cup deep red.
Polar Ice, perianth pure white, cup white with green centre.
Pomona, perianth pure white, cup apricot-orange with red rim.
Verger, perianth pure white, cup bright orange.

DIVISION IV
DOUBLE NARCISSI
Double-flowered narcissi are not, on the whole, good in wet seasons. For garden purposes the best are:
Mary Copeland, 14 in., one flower to a stem, semi-double, creamy-white and orange-red in centre.
Twink, 20 in., one flower to a stem, pale primrose with orange centre.

DIVISION V
TRIANDRUS NARCISSI
These graceful plants, carrying several flowers on one stem, are derived from the various wild Narcissus triandrus. The flowers are pendant, the perianth tending to turn back or reflex. They grow up to 15 in. high:
Shot Silk, creamy-white.
Tresamble, pure white.

DIVISION VI
CYCLAMINEUS NARCISSI
Derived from the wild Narcissus cyclamineus and so called because the perianths turn right back like cyclamen. They are single flowered and grow up to 12 in.
Beryl, primrose flowers and an orange cup.
February Gold, bright yellow.
Garden Princess, bright yellow.
March Sunshine, bright yellow.

DIVISION VII
JONQUILLA NARCISSI
The wild jonquils are grown mostly for their delightful scent.
Narcissus jonquilla, 10 in., 2 to 6 small golden single flowers to a stem. Has a double form.
N. odoratus rugulosus (campernelle), 13 in., 2 to 4 deep yellow single flowers with wrinkled cup to a stem. Has a double form.
Lanarth, 18 in., 2 to 4 flowers with golden perianth and orange cup to a stem.
Orange Queen, 13 in., 2 to 4 deep golden-orange flowers to a stem.
Trevithian, 12 in., 2 to 3 flowers with lemon perianth and clear yellow cup to a stem.

DIVISION VIII
TAZETTA NARCISSI
About 16 to 22 in., all bunch-flowered, that is, with four to six 2-in. flowers on one stem. Some are sweet scented.
Cheerfulness, creamy-white perianth, double pale yellow centre, scented.
Geranium, pure white perianth, orange-scarlet cup.
Laurens Koster, pure white perianth, orange-yellow cup.

DIVISION IX
POETICUS NARCISSI
All these are singles.
Actaea (a hybrid), 17 in., broad snow-white perianth, and orange cup.
N. recurvus (old pheasant's eye), 17 in., white perianth and deep red eye. Good for planting in grass.
Queen of Narcissi, 18 in., white perianth and orange cup.

OTHER NARCISSI
The growing of the wild species and dwarf hybrids is a special interest, as some of them require conditions different from those in the ordinary garden. Two which can be grown in the very front of a border or on a rockery are:
Narcissus ovillaris (Tenby daffodil), 8 in., single flowers, clear golden-yellow.
W. P. Milner, 8 in., single flowers, dainty sulphur-yellow.
TULIPS

There are several classes of tulip. Start with the single and double earlies, flowering from middle to late April, the cottage and lily-flowered for early May, and the darwins and parrots for mid- to late May. Plant in late October, 4 in. deep and 4 in. apart. Tulips are usually lifted annually, but if the soil is good and the bulbs healthy, most tulips, with the exception of the earlies, can be left in the same place for more than a year provided all dead and decaying foliage is removed at the earliest opportunity and burnt.

SCHOONOORD, white.
VUURBAAK, fiery-scarlet.
WILHELM KORDES, orange.

COFFEE TULIPS

Varieties in this class grow up to 2 ft. high, and can be naturalized in rough grass. Provided the garden conditions are suitable, they do not require annual lifting.
CARRARA, pure white.
DIDO, coral-pink, yellow margin.
G. W. LEAK, geranium-scarlet.
INGLESCOMBE YELLOW, canary-yellow.
MARSHAL HAIG, scarlet.
ZOMERSCHOON, salmon-rose.

LILY-FLOWERED TULIPS

This is a most graceful section, with pointed petals slightly turned back at the tip. They vary in height from 1½ to 2 ft., and are particularly good for cutting.

CHINA PINK, satin-pink.
DYANITO, glowing red.
ELLEN WILLMOTT, primrose-yellow.
GOLDEN DUCHESS, golden-yellow.
PICOOTEE, white feathered rose.
WHITE TRiumphant, pure white.

DARWIN TULIPS

These are probably the easiest class of permanent tulip to grow. They have stems up to 2½ ft. high and their flowers are more or less egg-shaped.

BARTIGON, cochineal-red.
CHARLES NEEDHAM, red.
CLAIRA BUTT, delicate pink.
LA TULIPE NOIRE, maroon-black.
NIPHELOS, lemon-yellow.
WHITE GIANT, white.

PARROT TULIPS

These tulips, with their large flamboyant flowers, heavily cut petals and strange mixture of colours, are valuable for cutting for indoor decoration and always attract attention.

ALL ARE ABOUT 2 FT.
BLUE PARROT, bluish-heliotrope.
FANTASY, rose and green.
ORANGE PARROT, deep orange. Sweet scented.
RED PARROT, scarlet.
TENAS GOLDS, yellow and red.
WHITE PARROT, pure white.
WILD SPECIES OF TULIP

These are best grown in raised beds and should be left where planted. Good kinds are:

*Tulipa fosteriana* and its varieties, 8 in., all in some shade of vivid scarlet.

*T. f. 'Madame Lefebre' (Red Emperor), about 15 in., blazing orange-scarlet.

*T. f. 'Rockery Beauty', 8 in., brilliant scarlet, the best of the dwarf varieties.

*T. kaufmanniana* (water-lily tulip), from Central Asia, of dwarf habit—6 to 8 in., early flowering with large ivory-white flowers with a crimson stain on the outer petals.

*T. k. 'The First', creamy-yellow with vivid red exterior.

There are many other wild species but they should be tried only if they can be given good drainage in a raised bed, full sun and no artificial watering in the summer. The easiest to grow are:

*T. chrysantha*, yellow inside, red outside.

*T. eichleri*, pure scarlet.

*T. orphanidea*, bronze and orange.

*T. praestans*, orange-scarlet, several flowers on one stem.

*T. turkestanica*, several creamy flowers together on one stem.

OTHER BULBS

ALLIUM

Some of the members of the onion family, despite their smell, are very decorative in the garden and quite easy to grow in almost any soil. The smaller ones are useful for rock gardens. They flower from May to July and are good for cutting. When cut immerse the stems in plenty of cold water overnight, and the smell will have disappeared by next day.

When buying the plants, get advice from the bulb merchant and choose carefully, as one or two may become weeds and be difficult to eradicate.

Plant anywhere, except in full shade, in October—the large bulbs 3 or 4 in. deep and about 1 ft. apart and the small ones 2 in. deep and 6 in. apart.

*Allium ursinum*, 4 to 6 in., with clear blue flowers. Likes a moister spot than the others.

*A. caeruleum* (syn. *A. azureum*), 2 ft., sky-blue. Plant in as dry a place as possible.

*A. fareri*, 3 in., the smallest of all, with drooping heads of small, red-purple blossoms.

*A. flavum*, grey leaves, golden flowers on 6-in. stems.

*A. karataviense*, 8 in., pink. Lovely leaves, but flowers rather straggly for the garden though good for dry winter decoration.

*A. ostrichianum*, 6 in., rose-pink.

*A. rosenbachianum*, 3 to 4 ft., purple-lilac.

ANEMONE

Anemones are colourful flowers, 6 to 8 in. high and ideal for cutting. The main kind is the de Caen (giant poppy) anemone, and its St. Brigid forms. Plant in October for spring flowering, or in February for summer flowering, 2 in. deep and 4 in. apart in medium loamy soil in a sheltered position. Although the plants can be left in the same position for several years, provided the ground is good and they are fed, it is better to lift them, as in wet seasons they may suffer from rust disease. It is better still to buy new corms each year, since they are cheap. Recommended varieties of the single de Caen type are:

Hollandia, scarlet.

Mr. Fokker, blue.

The Bride, white.

Recommended varieties of the double St. Brigid forms are:

Lord Lieutenant, mauve.

The Admiral, deep pink.

The Governor, scarlet.

Smaller anemones for planting in drifts in October for early spring flowering are:

Anemone apennina, about 6 in., blue. Plant in fully- or partially-shaded positions.

*A. blanda*, 3 in., blue, looks lovely in sunny positions at the edge of borders or among shrubs.

CAMASSIA (QUAMASH)

These plants grow from 1½ to 4 ft. high, with star-shaped flowers of light blue, white or purplish-blue, and are excellent in early summer. Plant in early autumn, 4 in. deep and 4 in. apart in a moist soil, or even heavy clay.
ANEMONE BLANDA

Camassia esculenta, 1½ ft., is a spike of rich blue flowers, each up to 2 in. across.

CHIONODOXA
These dwarf plants, up to 6 in. high, make a wonderful display in the spring. There are blue, pink and white varieties, but start with the blue. Plant in autumn, 2 in. deep and 2 in. apart, in sandy loam, anywhere except in full shade.

The best are:
   Chionodoxa luciliae, blue with white centre, or pink or white.
   C. sardensis, gentian-blue, no white eye.
   C. tuali, dark blue, smaller and later than C. luciliae, very good.

COLCHICUM (AUTUMN CROCUS OR NAKED LADIES)
The flowers appear in autumn, before the leaves which do not appear until late winter or early spring. Four to 6 in. with mauve or lilac flowers they like deep soil and full sun. Plant in August, 6 in. deep and 9 in. apart in light sandy loam. Rather expensive, so start with Colchicum autumnale or C. a. minor. A little more expensive but perhaps better is C. speciosum.

CYCLAMEN
The hardy cyclamen are miniatures of the greenhouse kinds and are most valuable for places in shade or half shade. They grow from 2 to 3 in. high. The flowers are attractive and the leaves often beautifully marbled with silver. Some varieties root from the top of the tuber, and others from the bottom. Plant in August or September in shade or semi-shade in a limy soil with some leaf mould added, 2 in. deep and 6 in. apart, though C. neapolitanum should be particularly well spaced as the tubers may grow to as much as 6 in. across.

Many cyclamen are expensive. Among the cheaper ones are:
   Cyclamen europaeum, 3 in., has sweet-scented deep pink flowers about August, or sometimes earlier. Likes a woodland position. Roots from the top of the tuber.
   C. neapolitanum, 3 in., has rose-pink flowers in September or October. Its marbled leaves follow later and last until May or June. Roots from the top of the tuber.
   C. repandum, 3 in., has bright crimson flowers in April, is not so reliably hardy as the others and needs a warm sheltered position. Roots from the bottom.
ERANTHIS (WINTER ACONITE)
Aconites are hardy plants and grow up to 6 in. Their bright yellow flowers appear in January or February and are long lasting. Plant anywhere in ordinary soil, in August, to let the plants make roots before the hard weather comes, 2 in. deep and in groups of at least half a dozen.
Eranthis cilicica, unlikely to become a nuisance from free seeding.
E. hyemalis, the common winter aconite, may become a nuisance from free seeding.
E. tubergeniana, slowly forms a clump of large fragrant flowers.

ERYTHRONIUM (DOG'S TOOTH VIOLET)
E. dens-canis, the common dog's tooth violet, so called because of the shape of the bulb, is ideal for cool, shady positions where there is plenty of leaf mould, and grows about 3 in. high. The flowers appear in the spring and vary from white to pink and violet. The leaves are blotched with brown. Buy the bulbs in the autumn and plant immediately, 4 in. deep and 6 in. apart, in any good soil. If it is not possible to plant the bulbs immediately, do not let them get dry; put them in damp moss-peat in a polythene bag until they can be planted.

FRITILLARIA
Fritillarias include 2 to 3 ft. high crown imperials and many dwarf species, and all bloom in spring. Plant in autumn in a rich limy soil. Recommended are:
Fritillaria imperialis (crown imperial), many varieties with flowers ranging from yellow to red. Rather expensive and do not flourish in all gardens. Try one at a time. Plant in autumn 6 in. deep and 4 in. apart. Do not plant near the house as they have a foxy odour.
F. meleagris (snake's head), 9 to 12 in., usually with solitary flowers, purple with white chequering or white with green veins. Can be naturalized in rough grass. Plant in autumn 3 in. deep and 2 in. apart. Recommended varieties are:
F.m. 'Aphrodite', white.
F.m. 'Charon', deep purple, chequered.
F.m. 'Poseidon', purple, chequered.
F.m. 'Saturnus', rosy-pink, chequered.

GALANTHUS (SNOWDROP)
Snowdrops are easy to grow and flower
in January and February. The blooms are white, with the ends and sometimes the base of the inner petals marked with green.

Plant in early autumn, 2 to 3 in. deep and 1 to 2 in. apart, in good light soil in groups or drifts, preferably in half-shaded positions. When the plants have increased sufficiently for division, divide them after flowering when the tips of the leaves have become yellow.

**Galanthus elwesii**, 6 to 10 in., a large wild form.

**G. nivalis** (common snowdrop), 3 to 6 in.
**G. n. maximus**, 6 to 10 in.
**G. n. flore plena**, a double variety.

**GALTONIA**

**Galtonia candicans** (syn. *Hyacinthus candicans*), is a stately plant for the summer border. The 3-to 4-ft. stems carry 15 or more drooping, white, fragrant bells which flower in late summer. Plant in the spring, 6 in. deep and 6 in. apart in a well-drained soil in a sunny position.

**HYACINTHUS (HYACINTH)**

**Hyacinthus amethystinus**, a charming May flower like a miniature bluebell or hyacinth, with bright blue or white flowers on 6-in. stems. Plant in the autumn, 2 in. deep and 2 in. apart in a well-drained soil.

**H. azureus**—see *Muscari azureum*.

**IXIOLIRION**

Ixiolirions are best in a well-drained, sunny border with a light, fairly rich soil, grow to about 15 in. and have a number of blue flowers on each stem. The foliage is rather scanty and the plants cannot afford to lose any, so be vigilant for slugs. If the plants fail after being left in the ground during the winter, plant new bulbs in March 3 in. deep and 4 in. apart in a well-drained soil.

Lift in September and store in dry sand in a cool, frost-proof place until planting time. They are hardy but sensitive to winter damp.

**I. montanum** (syn. *I. ledebourii*), porcelain-blue flowers in May.

**I. m. pullatii**, deep blue flowers in June.
LEUCOJUM (SNOWFLAKE)

The snowflakes flower in spring, summer and autumn and are easy to grow in any good soil in sun or half shade. The bell-shaped white petals of the spring and summer ones are spotted on the outside with green. Plant in autumn, 2 in. deep and 3 in. apart.

Leucojum aestivum, 18 in., flowers in April and May, has four or more bells. This is a native plant and the Gravetye form is better than the type. It likes a moist soil and grows well in full shade.

L. autumnale, 4 in., flowers in September and October, has slender grassy foliage and pink-flushed white bells, which appear before the leaves. Plant in light soil.

L. vernum, 6 in., has large single bells, in February and March.

MONTBRETIA

Montbretias are useful as late summer flowers and are ideal for cutting. Their flowers grow to 1½ in. in diameter on 12 to 15-in. stems, and the colours vary from yellow through orange to red. They are not always hardy, particularly in heavy soils in cold districts where they should be lifted in October and kept in boxes of dry soil in a frost-proof place until the following March or April. The old varieties are the hardier and are listed below. Plant in spring, 4 in. deep and 3 in. apart in well-drained loamy soil. In cold districts if left in the ground cover with a 2 to 3-in. layer of moss-peat, leaf mould or bracken. If the plants are happy they soon spread into clumps and appreciate a top dressing of well-rotted manure in summer. Divide the clumps every three or four years.

Recommended are:
- Aurora, pure orange.
- Comet, bronze-maroon centre.
- His Majesty, orange-yellow, crimson tips.
- Lady Oxford, pale yellow.
- Vesuvius, vermilion-red.

MUSCARI (GRAPE HYACINTH)

When buying choose carefully as these plants vary, some growing so vigorously that they may become a nuisance. They will grow anywhere, in almost any soil, except in full shade, and have numerous little pinched bell-shaped flowers in conical heads, often sweet scented. All grow up to 8 in. and flower in April, with the exception of M. azureum, which is only about 4 in. high and flowers in February and March. Plant in September, 3 in. deep and 4 in. apart.

Muscaria argaei album, white.
M. armeniacum, brilliant blue, scented.
M.a. 'Cantab', clear light blue.
M. azureum, light blue. The correct name for this plant is Hyacinthus azureus but it is generally sold as Muscaria azureum.
M.a. album, white.
M. botryoides album, white.
M. tubergenianum, top flowers light blue, lower flowers dark blue.

NERINE

Nerine bowdenii, produces a head of rose-pink lily-like flowers with waved petals on 12-in. stems in September and October. Although not particularly cheap to buy they increase so freely that it is worth investing in at least one bulb. Plant in spring in loamy soil with the neck of the
bulb just level with the surface of the ground. In cold areas, plant close to a south wall or cover in the winter with a 2-to 3-in. layer of moss-peat, leaf mould or bracken and put a cloche over this temporarily to keep it dry.

ORNITHOGALUM

Plant in October, 4 in. deep and 2 to 3 in. apart, in any soil.

Ornithogalum mutans, 6 to 9 in., with flowers white within and green without in April and May. Never plant in a border or rock-garden but always between shrubs or in grass. Can easily become a weed.

O. pyramidale, a good plant for the border, bears spikes of star-shaped white, green-backed flowers on 2-ft. stems in June. Ideal for cutting.

O. umbellatum (Star of Bethlehem), 8 in., flowers white within, green striped white without in May. Similar habit to O. mutans.

PUSCHKHINIA

Puschkinia scilloides (syn. P. libanotica), 4 in., a scilla-like plant that grows anywhere in sun. The whitish hyacinth-like flowers have a deep blue line down the centre of each petal, and bloom in March or April. There is also a pure white form. Plant in October or November, 2 in. deep and about 1 in. apart, in well-drained soil.

SCILLA

Scillas are easy to grow in any reasonable soil. Plant in September, the smaller bulbs 3 in. deep and 2 to 3 in. apart, and the larger bulbs 5 to 6 in. deep and 4 in. apart.

Scilla bifolia, deep blue star-like flowers on 4-in. stems in February.

S. campanulata (syn. S. hispanica) (Spanish bluebell), up to 20 large bell-shaped flowers on 12- to 16-in. stems in May. Good for cutting. Available in many varieties. Recommended are:

Azalea, deep pink.
Myosotis, sky blue.
Peach Blossom, rose.
Queen of the Blues, purple.
White Triumphator, white.

S. peruviana, produces rosettes of large green leaves, 6 or more inches long from the centres of which arise large flat heads of deep blue star-like flowers on 6-in. stems. Blooms in May. Good for the front of the border.

S. pratensis, has pyramidal heads of blue bells on 6- to 8-in. stems in May.

S. p. amethystina, similar to S. pratensis but a little larger.

S. siberica, deep blue flowers on 3- to 6-in. stems in March.

S. s. 'Spring Beauty', deep blue flowers on 3- to 6-in. stems in March. Robust.

S. tubergeniana, light blue flowers with dark median stripes in March.

STERNBERGIA

Sternbergias grow to 8 in. and bear large golden crocus-like flowers in autumn, long before the leaves. They are not particularly cheap but if happy soon increase and give a wonderful show in the late autumn. Plant in August in a somewhat heavy soil, in a sheltered sunny place, 4 to 6 in. deep and 6 in. apart.

Sternbergia lutea, flowers regularly only in very hot dry positions.

S. l. angustifolia, has narrow leaves, an excellent variety producing its flowers every autumn in any reasonably sunny place.

TRITELEIA or IPHEION

This charming little plant forms dwarf tufts of leaves and bears large star-shaped flowers, in April or mid-May. It is sweet scented, but if crushed the leaves smell of onions. Plant in autumn, 2 to 3 in. deep and 1 in. apart, in rich, sandy loam.

Triteleia uniflora, white or violet-tinged flowers.

T. violacea, violet-blue.

ZEPHYRANTHES

Zephyranthes candida, 8 to 18 in., hardy. Has white flowers opening from a pink-tinged bud in autumn, very like a white crocus, and long narrow evergreen leaves. Needs a sheltered place in the sun. Plant in spring, 3 in. deep and 2 in. apart in loamy soil containing sand and leaf mould. When happy it increases freely and makes an ideal edging plant.
Lilies

Many gardeners are pleasantly surprised when they discover the enormous variety of this lovely genus. Besides the classic type of madonna lily and other trumpet lilies, there are lilies with cup-shaped, upright flowers of orange, yellow or red; others, called turkscaps, with small, sharply reflexed petals like a cyclamen, which can be mauve, yellow, white, scarlet, lilac-pink or crimson-purple; and some with great bowl-shaped, fragrant flowers. Some lilies are small enough for the rock garden, while others soar to 8 to 10 ft. Many are gloriously scented.

Lilies have been grown from ancient times, and have always been favourite garden plants, although for hundreds of years only a few kinds were known. The twentieth century has brought a great development of this lovely flower. Not
only have scores of beautiful species been introduced into our gardens, but hybridization has been taken up enthusiastically by professional and amateur growers alike, and it is possible to have lilies of all shapes and sizes, and nearly every colour except blue, flowering between late May and October.

Modern hybrid lilies are vigorous and resistant to disease, increase quickly, often come reasonably true from seed, and are first-class garden plants. They provide a splendid range of colours and shapes midway between the main types of lily.

Because some rare, expensive species are not easy to grow, lilies have gained an undeserved reputation for being difficult. The great majority of lilies offered for sale are no more difficult than any other favourite garden plants once their needs are understood; but lilies that are suited to the particular garden should be chosen.

**BULBS**

A lily bulb consists of a basal disk or very flattened stem from which roots grow below, and overlapping scales above.

These scales are really thickened leaves, modified to store food in the form of starch during the plant's resting period. The lily bulb has no brown outer skin to protect it against excess damp or drying, or against pests, and is, therefore, much more like the resting crown of a herbaceous perennial than an orthodox bulb such as a tulip.

Lily bulbs must never be dried off. On the other hand, good drainage is tremendously important. Even the so-called "bog lilies" will die if they are kept in soggy conditions.

Try to grow lilies on a gently sloping piece of land. If water habitually lies for a long time in the garden after rain,

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**TYPES OF LILY BULB**

- Rhizomatous bulb of *L. PARDALINUM*

make a raised bed, so that the bulbs are never soaking in still water.

**SOIL**

Ordinary well-worked, well-drained garden soil suits most lilies. Some, such as *Lilium henryi*, prefer a little lime in the soil, and there are others, the regal lilies, for instance, which will tolerate it. Most, however, prefer a neutral soil, or one that is slightly acid, and a few lovely and popular kinds cannot grow where there is lime. If the garden has alkaline soil, grow these lime-haters in pots or tubs of lime-free soil and save rain water for them.

**PLANTING**

Many lilies produce roots from the stem above the bulb as well as the basal roots below it. These annual stem roots are important and need to be covered with well-aerated soil, well enriched with humus. It is a good general rule to plant lilies two and a half times their own depth in the soil. As the stem-rooting kinds need to have at least 4 in. of soil above the top of the bulb, plant them 5 to 9 in. deep according to size, but lilies which root
only from the base need not be planted so deeply, though they take longer to establish themselves. It is better to plant too shallowly if in doubt, since the roots have the power to pull the bulb down to its proper depth.

If the lilies' stem roots are seen to be sprouting above ground, draw soil up round the plants. It helps to mark where the bulb is and to keep slugs at bay if each lily bulb is encased in a nest of coarse sand.

**TIME TO PLANT**

The best planting time is in early autumn, but many nurserymen send out the bulbs from the end of November onward. If the weather is bad and unsuitable for planting, pot up the bulbs until the spring and then plant them out.

Some of the Japanese lilies are not available until January or February, and are best grown in pots until the autumn.

**LILIES IN POTS**

Lilies make superb pot plants, and are useful for tubs as well. Plant the stem-rooting kinds well down in the pot, 1 or 2 in. above the drainage material (broken crocks covered with a loose pad of sphagnum moss or fibrous material to keep the soil from clogging them).

Use John Innes potting compost, or a compost of three parts good fibrous loam, one part coarse sand and one part leaf mould or sedge peat.

**WHEN TO POT**

Plant base-rooting lilies in 6- or 7-in. pots in early autumn for flowering the following summer, and stem-rooting lilies in the spring to flower the same year.

**TREATMENT**

Some lilies such as *L. auratum*, *L. longiflorum* and *L. speciosum* may be gently forced, but like other pot-grown bulbs, they should be kept cool and allowed to grow at their own pace until a proper root system has been established. Grow lilies outside until frost threatens, then transfer them to an unheated greenhouse or frame. Do not bring them into the house until the flowers are about to open.

Keep pots of Japanese lilies (*L. auratum*, *L. speciosum*, *L. japonicum* and *L. rubellum*) in the greenhouse throughout the winter.
PROPAGATION

SEED
Most lilies can be grown from seed. This is the slowest method of propagation but the cheapest, and the stock is free from disease. Seeds can be sown as soon as they are ripe, or kept until the following spring. Sow them about ½ in. apart in a well-crocked box of John Innes seed compost, and cover them with about an inch of fine soil.

Some seeds make a little bulb but do not show a sign above ground until the following spring, so do not be in a hurry to throw away apparent failures. Some lilies are fairly quick to flower from seed, others take five to seven years.

SCALES
Lilies can be increased from scales provided the stock is healthy. Take a few scales from a mature bulb (which can afterwards be replanted), and “sow” them in a seed box, in a layer of coarse sand or vermiculite on top of John Innes seed or potting compost. This can be done at any time of the year, but the late summer, when the flowers are over, is the best.

Place the scales, at an angle of about 45°, with the severed edge downward and the hollow side uppermost. Sprinkle over them enough sand to just cover them (or with the tips just peeping through), and keep them moist. Put the box where a temperature of 50 to 55° F. (10 to 13° C.) can be maintained. Little bulbs will form on the broken edges of the scales.

BULBILS
These are little purplish-black or greenish growths like boot buttons growing in the angle between the stem and leaves—the axil. They are produced by L. bulbiferum, L. tigrinum, L. sulphureum (syn. L. myriophyllum) and L. sargentae and some of their hybrids. Treat the little bulbils as if they were seeds, or just lightly press them into the top of the soil in a box. They are ready to sow as soon as they will drop from the stem at the touch of a finger.

BULBETS
Some stem-rooting lilies also produce little bulbets just below the surface of the soil. Sow them in a box or pot them singly in small pots. It is as well to collect these bulbets whether they are needed for propagation or not, as they attract slugs and are more likely to compete with the mother plant if left in place.

FURTHER TREATMENT
Leave lilies from seeds, scales and bulbils in the seed box as long as possible, say 12 months, and plant out in early autumn or spring just as with bought bulbs.

LIFTING
Some strong-growing lilies split into two or more bulbs nearly every year, and propagate themselves. It is often necessary to lift and replant them every four years or so. Since lilies need a year to recover from this kind of disturbance, move a quarter of the stock every year instead of having a grand move every four years with a lean following year. If the roots are very tangled, wash them clean in a bucket of water, and if there is still a tangle resolve it by a few strategic cuts with a sharp knife.

PESTS
Lilies suffer from soil pests, particularly leather-jackets, cutworms and slugs. Regular use of meta baits, pellets or sprays will take care of the slugs, and dusts such as aldrin or gammexane should discourage the other soil pests. Aphids are a serious pest, because they not only spoil the appearance and cripple the leaves and buds of the lily, but also carry the deadly virus diseases. Use D.D.T. dusts or sprays such as malathion for these.
DISEASES

Lily diseases are few but serious. Botrytis is a fungus infection not unlike potato blight or black spot in roses. It produces brownish patches which spread and ruin the whole leaf and stem, and even the buds. Burn the affected leaves, and spray the plant with Bordeaux mixture, or use a fungicide dust. Botrytis is spread by airborne spores originating in grey mildewy patches on the plant. These need damp and warmth to germinate, and can survive the winter as sclerotia or little black seed-like objects in the soil.

Virus diseases stunt and cripple the plant, eventually killing it. Pale streaks, spots and mottles appear on the leaves giving them a variegated appearance, and the petals stick together. Sometimes the top of the plant is bent over like a walking-stick handle; or the stem is shortened between the leaf axils as if it had been shut up like a telescope. As there is no known cure, do everything possible to prevent infection. These diseases are carried in the sap. Biting or piercing insects, such as aphids, can carry them, and they can be carried by scratching or bruising infected plants and handling healthy ones afterwards. They can also be carried on shoes and tools.

Diseased lilies should, therefore, be burnt, but only after making quite sure that they really have got virus disease. Symptoms similar to those of virus diseases may be caused by underground pests, too much or too little water, or growing the lilies in the wrong kind of soil. Even a touch of frost earlier in the year may have caused the trouble.

Fusarium basal rot is a nuisance. The basal plate starts to rot away into a brown mess and the trouble spreads up the scales until the whole bulb falls to pieces. Burn every scrap, and do not plant lilies in the infected soil for four years, unless it is sterilized with formalin. If in doubt, grow the suspect lily in a pot for a year.

If a choice collection of lilies is desired,
grow as many as possible from seed, since lily diseases are not carried by seed. If bulbs are bought, be sure they come from a reputable nurseryman.

**SUGGESTED PLANTS**

*Lilium amabile*, 2 to 3 ft., bright red turks-cap from Korea. Will stand some lime in soil, and likes a little shade; stem-rooting, flowers early in July. There is an orange-yellow form.

*L. auratum* (golden-rayed lily of Japan), 5 to 8 ft. Fragrant bowl-shaped flowers in August, up to 10 in. across, with pure satiny white petals spotted with velvety purplish patches, each with golden-yellow stripe from base to tip. Stem-rooting, will die in alkaline soil. Likes flowers to be in sun but base in shade.

*L. platyphyllum*, stronger, more dependable type. Pink, lavender-spotted and red-rayed selections are available.

*L. aurelianense* (the name given to a number of beautiful hybrids of *L. sargentiae* and *L. henryi*). Up to 8 ft. All flower in summer, and prefer half-shade. The original hybrid was an epoch-making plant. It was fragrant and vigorous, with light orange-yellow flowers. The new *L. aurelianense* (Aurelians) vary in shape and colour. All are beautiful. Recommended are:

- Air Drop, reflexed champagne flowers with orange centres.
- Golden Clarion, superb yellow trumpets.
- Greatheart, cream and white spreading petals. Flower has large bright orange centre.
- Heart’s Desire, spreading flared trumpets in yellow, cream and white.
- Limelight, superb yellow trumpets.

*L. brownii* (Chinese lily), 3 to 4 ft., considered by some enthusiasts to be the loveliest of all. It has huge creamy trumpets, 6 to 7 in. long, shaded on outside with purple and green in July. Rarely sets seed. Stem-rooting, tolerates some lime, not quite hardy.

*L. bulbiferum croceum* (Orange lily), up to 5 ft., easy and strong-growing. Cheerful, bright orange cup-shaped flowers spotted with purple in July. Stem-rooting, tolerates lime and will do well on heavy soil; increases quickly.

*L. Byam’s Ruby* (syn. *L. Ruby*), about 1½ ft., a good strong-growing dwarf lily with large, widely spreading, rich red flowers with metallic sheen and good perfume in June and July. Increases quickly. Stem-rooting, and can tolerate a little lime.

*L. canadense*, 3 to 5 ft., one of the most graceful lilies, with very charming, hanging, bell-shaped flowers, varying in colour from yellow to orange-red from late June onward. Does well in lime-free soil with plenty of humus and comes easily from seed. Plant about 8 in. deep.

*L. candidum* (Madonna lily), 4 to 6 ft., likes fairly heavy soil with some lime. Plant no more than 2 in. deep. Produces rosette of leaves in winter and should not be disturbed; white flowers in June and July. Rather contrary and will not flower
Lilies

everywhere; if difficult, try *L. c. salomikae*, a
variety which is daintier and easier to
grow, flowers earlier and sets seed.

*L. cernuum*, 1½ to 2 ft., pretty little lilac-
pink turkscap with fine, grassy leaves,
suitable for rock garden. Stands some
lime; stem-rooting; likes a little shade
and flowers in July.

*L. chalcedonicum* (scarlet turkscap), 4 ft.
Greek lily with wonderful, bright scarlet
blooms in July. Lime-loving, but needs
soil with some humus. Slight shade
recommended.

*L. c. maculatum*, 5 ft., easier to grow,
blooms black-spotted.

*L. davidi*, 4 ft., from China, with recurved, orange, black-spotted flowers like
small tiger lily in July and August. Stem-
rooting and better without lime. Parent
of many beautiful hybrids and still being
used for this purpose. Recommended
varieties are *L.d. Maxwill* and *L.d. willmotiae*.

*L. formosanum*, 4 ft., graceful, white trump-
et lily, with long, fragrant flowers, in
August and September, on wiry stem.
Not really hardy, but suitable for cool
greenhouse. Dislikes lime, comes very
quickly from seed, very susceptible to
virus disease.

*L.f. pricei*, 1 to 2½ ft.

*L. giganteum* (syn. *Cardocrinum giganteum*),
up to 10 ft., has beautiful, glossy, dark-
green, heart-shaped leaves, and long,
creamy-white, richly perfumed flowers in
August. When flowers are produced, the
bulb collapses leaving offsets which take
four years to reach flowering size, so that
the lily is often sold in sets of bulbs of four
different sizes to maintain yearly display.
Plant the bulbs with their noses just level
with the soil, about 1 ft. apart. The best
position for this lily is in well-drained,
light woodland. It requires fairly rich
soil, and protection from winds.

*L. hansonii*, 3 to 4 ft., yellow turkscap from
Korea with thick, waxy, orange-yellow
petals spotted with brown, and shining
leaves. It flowers in July and is strong and
vigoroulsy growing well in an ordinary
Lilies

garden. Likes shade best (full sun bleaches the flowers) and is stem-rooting.

*L. henryi*, 6 to 8 ft., from China. Has apricot-yellow, recurved flowers on tall, arching stems in August. Likes lime in the soil but is averse to peat and dislikes full sun. Very strongly stem-rooting, and rarely bears seed.

*L. hollandicum*, a name covering a number of useful and attractive hybrids thought to be derived from *L. bulbiferum croceum* and *L. maculatum*, 1½ to 3 ft. The cup-shaped flowers come in many colours and appear in June and July. Stem-rooting, likes fair amount of well-rotted manure.

*L. imperiale*, up to 6 ft., a cross between *L. regale* and *L. sargentiae*, the best being George C. Creelman. A grand white trumpet lily with purplish outer shading, flowers in August. Prefers a well-drained soil rich in leaf mould. Plant the bulbs 5 in. deep.

*L. japonicum*, 2 to 3 ft., a lovely fragrant trumpet lily from Japan. Flowers in June and July. Widespread petals develop from white on opening to pure rose-pink. Not really hardy but makes a good pot plant. Winter in a frost-free greenhouse or frame. Stem-rooting and hates lime.

*L. lancangense*, 2 to 3 ft., a pretty, pink-spotted turkscap. Fragrant flowers in July and August; stem-rooting. Likes light porous soil with not much lime, and prefers semi-shade.

*L. longiflorum*, 2 to 3 ft., the white Easter lily of the florist’s shop. Flowers in July and August; makes a lovely pot plant, but can be grown in well-sheltered gardens in the south of the British Isles. Stem-rooting and tolerates a little lime in soil.

*L. maculatum*, up to 2 ft. These lilies are versatile crosses between *L. concolor* and *L. dauricum* (a red turkscap and an orange cup-shaped lily). They bear cup-shaped flowers in June and July in shades ranging from lemon to crimson. Stem-rooting, very easy to grow but not very tolerant of lime.
L. Martagon, the common turkscap lily, up to 6 ft., with black-spotted, rather dull purplish-pink recurved flowers with unpleasant odour. Thoroughly hardy, strong growing plant with handsome broad leaves growing in whorl on stem. Not fussy about soil, flowers in late June and July.

L. M. album, beautiful white lily though not quite so vigorous.

L. M. cultivari, larger flowers of splendid dark crimson-purple on taller stems.

L. pardalium (panther lily), 3 to 7 ft., a handsome and easily grown American native lily, having red turkscap flowers with yellow centres and darker spots in July. Enjoys a rich moist soil, with plenty of peat or leaf mould mixed with grit or sharp sand, and its rhizomatous bulbs increase very quickly.

L. p. giganteum, is an improved variety.

L. pomponium, up to 3 ft., pretty red turkscap, like a miniature L. chalcedonicum but easier to grow. Summer flowering and suitable for rock garden; likes full sun, and fairly heavy soil with lime.

L. pumilum, up to 1½ ft., a dainty little red turkscap with grassy foliage. Comes quickly and easily from seed, and flowers in June; likes full sun and light soil; stem-rooting.

L. pyrenaicu, about 3 ft., a common old yellow turkscap which flowers very early in June; the first lily to bloom outside. Hardy and not fussy about soil or climate. Pretty individual flowers of greenish-yellow with black spots, but with most unpleasant smell.

L. regale, 4 to 7 ft., a beautiful trumpet lily, flowers in July. Blooms are white shaded with purplish-rose on outside and yellow in throat. A pure white form is obtainable. Stem-rooting, increases quickly, and easily grown from seed. Not fussy about soil, prefers sunny position.

L. Royal Gold, golden-yellow.

L. rubellum, 1 to 2½ ft., beautiful pink trumpet lily from Japan. Not quite hardy and dislikes lime, but makes a very
fragrant pot plant. Can flower in early May in unheated greenhouse, or late May and June out-of-doors.

*L. sargentiae*, 4 to 5 ft., resembles *L. regale* in many respects but more beautiful. Dislikes lime and is not quite so hardy. Flowers in July and August and bears stem bulbs; stem-rooting, likes sunny position but shade for roots.

*L. speciosum*, about 4 ft., with broad, glossy leaves; has large, fragrant, recurved bowl-shaped flowers in August—white, heavily overlaid with rose-crimson with darker raised spots. Can be grown outside but is better in a pot as it is sometimes spoilt by autumn frosts and gales. Stem-rooting and detests lime.

*L. szovitziannum* (syn. *L. monadelphum szovitziannum*), 3 to 5 ft., a Caucasian lily, nicely perfumed. It has large, light yellow, recurved trumpets with small purple-black spots, and flowers in June. Will stand lime but likes some leaf mould in the soil.

*L. testaceum*, 4 to 6 ft., a lovely hybrid between *L. candidum* and *L. chalcedonicum* with pleasant fragrance. Has large recurved flowers of delicate apricot-yellow with scarlet-orange stamens, in early July. Likes lime in soil, and a well-drained position in full sun.

*L. tigrinum* (tiger lily), 3 to 4 ft., comes from China (where the bulbs are eaten). Flowers in August and September—flat, recurved blooms of soft yet glowing orange with purplish-black spots and protruding stamens. The black stem bulbs are a quick means of increase. Dislikes lime, thrives on plenty of well-rotted manure. Recommended are:

*Lt. Cardinal* (*tigrinum* hybrid), bright red flowers.


*Lt. fortunei*, 5 to 6 ft. tall, with salmon-orange blooms sometimes continuing into October.

*Lt. splendens*, rich red blooms, boldly spotted.

There is a double variety, *Lt. flore pleno.*

**HYBRID LILIES**

Backhouse hybrids, 4 to 6 ft. These are crosses between *L. hansonii* and various types of *L. Martagon*, very pretty and vigorous with all their parents’ good points and a wider range of colour, some flowers being overlaid and marbled with different shades, and also spotted. Recommended are:

Mrs. R. O. Backhouse, orange-yellow flowers spotted crimson, reverse pink.

Brocade, orange-yellow flowers marbled with pink and maroon spots.

Indian Chief, dark, glistening, blood-red flowers.

Shantung, distinctive shining mauve-rose flowers. Very vigorous.

Sutton Court, light yellow flowers spotted with purple.

All bloom in June and July, are stem-rooting, and will stand some lime in soil.

Bellingham hybrids, 4 to 8 ft. These are delightful crosses of American native lilies. They increase very quickly and flower in July. Plant 5 in. deep in moist, well-drained soil with peat and coarse sand. Best known is Shuksan, with orange-yellow recurved petals spotted with red.

Fiesta hybrids, 3 to 5 ft. These have been developed from *L. amabile* and *L. davidii* and are gay turkscaps, flowering in June and very vigorous. Recommended are:

Citronella, many flowers of good strong yellow.

Dr. Abel, rich red.

Mid-century hybrids, 3 to 5 ft. Vigorous hybrids of various hardy lilies such as *L. cormum* and *L. tigrinum*, specially bred to be easy to grow in a wide variety of situations. One of the best is Enchantment, with erect, recurved, bowl-shaped flowers of soft nasturtium-red in June and July. Carries bulbs, and increases quickly by natural division.

Patterson hybrids, 2 to 5 ft. Midsummer-flowering lilies of Canadian origin produced from work on particularly
cold-resisting species to endure the bitter winters of Saskatchewan. All have *L. cernuum*, *L. tigrinum* and *L. davidii* in their composition, and are fairly short-stemmed lilies with recurved petals, in delightful soft jewel colours. Stem-rooting; easy to grow although a neutral soil is recommended.

Edith Cecilia, 2½ to 3 ft., rose-lilac with buff centre and dark spots.

Rosalind, 2 to 3 ft., flat flowers with recurved rose-pink petals.

White Princess, 2½ ft., flat flowers with recurved creamy-amber petals which bleach to light cream.

Preston hybrids, 2 to 5 ft. Crosses between *L. davidii willmottiae* and an unnamed seedling of *L. dauricum* and *L. maculatum*. They are pretty, vigorous, free-flowering (in June and July), and quick to increase. Stem-rooting, and like sun or half-shade.

Zwet's hybrids, 3 ft. Useful, vigorous hybrids of Dutch origin, with *L. davidii*, *L. croceum* and *L. tigrinum* and other lilies in their composition. An ordinary garden soil enriched with leaf mould would be suitable. Add peat if soil contains much lime. Grow in sun or very light shade. There are unusual shades of tomato and brownish-red and orange. Recommended are:

John Dix, bright orange.

Mahogany King, dark red overlaid with yellow.

Orange Success, rich orange-yellow.
GLADIOLI

Gladioli give an exotic, intriguing effect to any garden in which they are planted. The colour range of their flowers, which vary considerably in form and size, is exceptionally wide and brilliant. They are among the easiest flowers to grow and are useful both for garden decoration and for cutting.

Gladioli have been cultivated abroad since the days of Ancient Greece and were introduced into the British Isles in 1896. In the wild state about 150 species have been classified, mostly from Africa, but some from Western Asia and Europe. Probably only a few appear in the ancestry of the modern cultivated types, which bear little resemblance to any of the wild species and whose development is a tribute to the skill of plant breeders.

MODERN TYPES
(The measurements which follow are a rough guide only, because the height of the various types of gladiolus and the size of their florets vary considerably, not only among the different varieties of each type, but according to growing conditions.)

LARGE-FLOWERED
The large-flowered type is the most popular. It bears large flowers in the autumn which measure from 4 to 6 in. across, and are arranged closely and symmetrically on long, strong stems, 3 to 5 ft. high.

PRIMULINUS HYBRID
The primulinus hybrids, which bloom in the autumn and are popular for indoor decoration, originated by hybridizing large-flowered varieties with the species primulinus found near the Victoria Falls on the Zambesi River in 1902. They are more light and dainty in appearance than the large-flowered, and the individual florets are more widely spaced on thinner stems. One characteristic is the hooding of the top petal of each floret. They grow from 2½ to 3½ ft. high. The blooms vary considerably in size, but are usually 2 to 3¼ in. across.

MINIATURE
This type of gladiolus, which blooms in the autumn, is not as small as its name implies. The florets are 2½ to 3 in. across and the stems grow to a height of 2½ to 3½ ft., so that, although the average size of the florets is less than half that of the large-flowered, the difference in the height and the width of the stems is not so marked. Many of the miniature varieties have attractively frilled or ruffled petals.

BUTTERFLY
The butterfly type can be considered as a subdivision of the miniature, although the flowers, which bloom in the autumn, are usually a little larger, being 3 to 4 in. across. The height of the stem varies from 2½ to 4 ft. Their main characteristics are their striking and most attractive...
throat markings and their beautiful colour combinations. Like the large-flowered and miniature types their florets open wide and are spaced regularly and closely on the stems.

**FACE-UP**
The face-ups are quaint rather than beautiful, flower in the autumn and are useful for decoration. Their florets are 2 to 2½ in. across, and instead of facing to the side they face upward on comparatively dwarf stems, usually 2 to 3 ft. high.

**COLVILLEI (EARLY FLOWERING)**
The colvillei, and a few distinct types which have been developed from them, flower in spring. Their stems grow from 2 to 2½ ft. high, and they bear small star-shaped florets, 2 to 2¼ in. across. They are popular with market growers for forcing under glass.

**CHARACTER**
Gladioli are perennial plants, and while none of the types mentioned are hardy, some species, such as *Gladiolus byzantinus*, can be left undisturbed in the same position for years. The susceptibility of gladioli to frost is comparable to that of potatoes or dahlias, which means that they are caught by the first frost. They can be propagated from seeds, corms or small cormlets (often called bulblets).

**SOIL**
Gladioli are not fussy about soil and will succeed in almost any position, but to obtain the best results plant them in an open, sunny position where there is a fair depth of good top-soil that contains plenty of humus. Purely organic fertilizers such as bone meal are better than artificial fertilizers. Gladioli like a reasonable amount of moisture at their roots during the whole of the growing period, but good drainage is essential so that the soil does not become sour and water-logged.

**PREPARATION OF THE SITE**
Prepare the site in much the same way as for a vegetable crop. In the autumn, or as long before planting as possible, dig one spît deep and turn in a good dressing of decayed animal manure or rotted compost, and bone meal, leaving the surface rough after digging, particularly if the soil is heavy. In the winter, if the soil is deficient in lime, throw on a dressing of lime and work it into the top few inches, or, if the land is heavy, give it a dressing of old soot. Do not use both soot and lime in the same year.

**PLANTING**
Gladioli can be planted from March until the end of May, the exact time depending mainly on the locality, and particularly on the weather and state of the soil.

If the gladioli are to be grown for exhibition or cutting, plant them in rows. Draw drills with a hoe or trowel 18 in. apart and 4 in. deep in heavy soil or 5 in. deep in light soil. Set the corms in the drills, allowing 6 in. between the corms.

Plant the gladioli in rings or clumps of 5 to 7 corms if they are to be grown mainly for garden decoration. They can also be massed in beds and borders, in conjunction with a dwarf carpeting plant.

Keep the site free of weeds by hoeing.

**DEVELOPMENT AND PROPAGATION**
After the corm has been planted growth starts almost immediately, not only from a bud or buds at the top of the corm but also from the circular root-scar at the base. Just before the flowering stem appears a new corm starts to form at the base of the stem, immediately above the old corm, while a fresh root system develops between the base of the new corm and the top of the old one. Soon afterwards tiny cormlets on short stems begin to form and cluster
GLADIOLI

DEVELOPMENT OF CORMS

As the plump, new corms grow, developing a fresh root system, the old corms shrivel and die. Small cormlets are also formed and they cluster round the new corm's base.

round the base of the new corm. A few weeks after flowering the leaves start to go brown and die. The new corm will then be fully developed and the old corm shrivelled.

The development from bulblets after planting is similar, except that the new corms produced are larger than the original bulblets planted. They rarely produce a flower spike the first season, but many will flower in the second year. Propagation from seed follows much the same pattern. Small corms are produced during the first season, but flowers are not borne for at least 2 years.

Gladioli grown from corms and bulblets come true to the type and colour of the variety which produced them, but those produced from seeds are never true to colour and sometimes not even true to type.

FLOWERING PERIOD

The time of flowering varies widely according to the variety, but most catalogues indicate whether gladioli are "early", "mid-season" or "late" flowering, so that a long flowering period can be planned if the varieties are carefully chosen.

SPROUTING

If sprouted corms are planted at the normal time they will bloom appreciably earlier than unsprouted corms of the same varieties. To sprout gladioli, carefully peel off the brown outer skin of the corms in February or early March, and stand them close together in trays on the bench of a warm greenhouse. Keep the corms quite dry and soon the buds will start to swell and shoots push upward.
GLADIOLI

STAKING
In exposed positions the large-flowered type will sometimes be blown over unless it is staked. If the gladioli are to be exhibited provide a stake or cane for each spike. If separate stakes are used for individual plants, make sure that the ties are loose round the stems to allow for growth and to enable the ties to slide up the stakes as the spikes develop. When the plants are in rows it is usually sufficient to provide stakes at intervals along each row, and to connect the stakes with stout string passed along each side of the plants.
Staking is unnecessary for most of the other types of gladioli, particularly the primulinus hybrids.

WATERING AND FEEDING
Undue dryness of the soil at any time during the growing period can cause a check and thus jeopardize results. If the soil is really dry, start watering in late May. Give the plants a good soaking so that the water penetrates beyond the roots, and then, no matter what dry weather may follow, the plants need only be watered every 10 to 14 days.
Feeding is not necessary for gladioli grown for garden decoration or cutting if the soil has been liberally prepared. If they are to be exhibited, start giving the plants a mild feeding just before the flower spikes appear. A feed of old-fashioned liquid manure and soot water diluted to the colour of lager beer is recommended. If other feeding agents are used, make sure that they are organic rather than artificial, and that they are well watered in if used in powder form. Give the plants mild doses not more frequently than once a fortnight.

CUTTING THE FLOWERS
The best time to cut a spike is when the bottom floret is about half open, as the spike will then open fully in water and possible damage to the petals by wind and rain will be avoided. The flowers must be cut carefully, because when they are ready for cutting the new corms are only half developed, and drastic damage to the leaves will jeopardize future growth. Insert the blade of a sharp penknife through the flower stem, 4 to 6 in. above the ground, then, holding the bottom of the stem firmly with one hand, give the flower spike a gentle downward twist with the other. The spike will snap and can be gently drawn from its sheath of leaves without injuring them.

LIFTING AND STORING
In exceptionally mild winters gladioli corms will survive in the soil, but the risk is considerable. It is wise to lift the plants in the autumn when growth has stopped and the foliage starts to turn brown. Lift the plants carefully with a fork, removing the surplus soil and cutting off the growth about half an inch above the new corms. Leave them in a dry, airy place, like a potting-shed or greenhouse, and when they are perfectly dry store them in a place which is frost-proof as well as dry and airy. During the winter or early spring clean the plants by breaking off the old wilted corms at the base and removing the bulblets. Make certain at each stage that both corms and bulblets are kept in their separate varieties and correctly named.

It has been proved conclusively that the old method of lifting and keeping the stems and foliage intact until they are dried off and cleaned encourages the spread of disease. Damp storage will also cause disease to spread rapidly.

DISEASES AND PESTS
The chances of disease are slight as long as the advice given on lifting and storing is followed. If the foliage of one or two plants yellows prematurely during the
GLADIOLI

growing period, lift these plants and burn them at once to prevent the trouble from spreading.

Few pests attack gladioli, but if there is a risk of wireworms or leather-jackets, which will mutilate the corms, dress the gladiolus site with a good soil fumigant a few weeks before planting.

THRIPS
These tiny black insects have, during the last few years, become unusually troublesome. The symptom of a thrips attack is the silverying of the foliage and petals, which is often mistaken for disease. If the attack is severe the flower buds may shrivel and fail to open. Check the thrips by spraying or dusting the plants every 3 weeks with malathion. Thrips have a habit of wintering on the corms, just underneath the brown outer skin, so after lifting and drying, sprinkle the corms with Gamma B.H.C. or Lindex, before finally storing them.

INDOOR DECORATION
Gladioli are ideal for indoor decoration either by themselves or with other autumn flowers. The different types of gladiolus lend themselves to quite different arrangements. Large-flowered varieties are seen at their best in massive and imposing arrangements, while the primulinus hybrids make a smaller, lighter decoration. Many kinds of foliage, berries, fruits, and seed-heads are plentiful when gladioli are in flower and blend delightfully with their bright and rich colours.

Gladioli are not easy to arrange, for the spikes are a little top-heavy and containers must be sufficiently substantial to hold them upright against draughts. Wire-netting of small mesh, folded or crumpled into the container, makes arrangement easier, while the most useful metal “pin-holders” enable the spikes to be held firmly, and even almost horizontally if necessary.

An indoor gladioli decoration will remain fresh for nearly a fortnight if the faded flowers are removed every 2 or 3 days and 1 or 2 in. cut from the base of the stem. The trouble entailed in dismantling the arrangement is worthwhile because fresh flowers are constantly opening along the spikes and replacing those which have faded.

CHOICE OF VARIETIES
There are many hundreds of varieties of gladiolus available, and each year a number of the older varieties are discarded and newer ones are introduced. Improvement is gradual but constant, and consequently the following list of first-class varieties may quickly become out of date. Keep up to date by visiting leading flower shows and by studying catalogues of firms specializing in gladioli.

LARGE-FLOWERED VARIETIES
FOR EXHIBITION
Albert Schweitzer, salmony-orange.
Broadway Melody, apricot-salmon.
Evangeline, salmon-pink.
Firebrand, orange-scarlet.
Flowersong, golden-yellow.
Flying Dutchman, violet-blue.
Greenland, cream with a greenish sheen.
Kosmos, glowing salmon.
Stradivarius, vermilion-scarlet.
Taberin, biscuit-salmon.
Up to Date, orange-scarlet.
Wembley, pure white.

LARGE-FLOWERED VARIETIES
FOR CUTTING AND GARDEN DECORATION
Aranjuez, apricot-salmon.
Aristocrat, garnet-red.
Benjamin Britten, rosy-mauve.
Circe, orange-salmon.
Dr. Fleming, salmon-pink.
Johan van Konynenburg, salmon-orange.
Jo Wagenaar, blood-scarlet.
Lavender Giant, silverly-lilac.
Pactolus, ivory-yellow.
Palet, orange-salmon.
Salman's Sensation, violet-blue.
Sans Souci, orange-scarlet.

PRIMULINUS HYBRIDS
Dazzler, vermillion-orange.
Attractie, soft coral-pink.
Fiery Knight, reddish-orange.
Janet, cream, flushed apricot.
Pamela Mummery, biscuit-salmon.
Richard Unwin, chestnut-crimson.
Rosy Maid, apricot-salmon.
Violet Maid, reddish-violet.

SMALL-FLOWERED PRIMULINUS HYBRIDS
Harmony, cherry-salmon.
Ivory and Mauve, ivory-cream.
Pink Rival, pinkish-salmon.
Rosella, rosy-lilac.
Scarlet Maid, orange-scarlet.
Strawberry Rival, strawberry-orange.
Sulphur Gem, sulphur-yellow.
Violet Maid, reddish-violet.

MINIATURES
Bo Peep, apricot-salmon.
Crinklette, salmony-orange.
Daintiness, milky-white.
Gremlin, salmon-rose.
Peter Pan, creamy-salmon.
Statuette, yellow.

BUTTERFLIES
Attica, pink flowers with scarlet lines.
Femina, pink with scarlet blotch.
Gipsy Love, orange with chestnut blotch.
Green Woodpecker, greenish-lemon.
Melodie, salmon-pink with scarlet throat.
Queen's Page, yellow with carmine blotch.

COLVILLEI (EARLY FLOWERING)
Amanda Mahy, salmon-pink.
Blushing Bride, ivory-white.
G. byzantinus, purple, hardy.
Peach Blossom, rosy-pink.
Spitfire, scarlet-red.
The Bride, pure white.
Flowers were used as emblems long before their language was formulated, and they were also used for messages because their meaning could be understood by those who could neither read nor write. Ophelia says in Hamlet, "There's rosemary, that's for remembrance ... and there is pansies, that's for thoughts", and John Donne, in the middle of the seventeenth century, wrote of "the Alphabet of flowers". But the language of flowers did not capture the imagination of the western world until the end of the eighteenth century.

The language is oriental in origin and became known in England through a letter written by Lady Mary Wortley Montagu in 1718 and published in her Letters in 1763. She said that in Turkey, "There is no colour, no flower, no weed, no fruit, herb, pebble or feather, that has not a verse belonging to it; and you may quarrel, reproach, or send letters of passion, friendship or civility, or even of news, without inking your fingers". The "verses" were single lines or phrases, rhyming with the name of the flower or object. The love-letter that she described as an example consisted not only of flowers but also a pearl, spices, paper, gold thread, hair, coal and soap—the soap meaning "I am sick with love".

Henry Phillips, in the foreword to his Floral Emblems (1825), describes how Turkish ladies sent messages of invitation or congratulation accompanied by a few symbolic flowers wrapped in an embroidered handkerchief. The freshness of the flowers indicated the speed of the messenger, their selection the sentiment to be conveyed, while the beauty and value of the wrapping denoted the rank of the sender. The advantages of perishable love-letters are obvious, but Henry Phillips insists that this kind of symbolic communication was a survival of a very
ancient practice and not invented solely for the purposes of intrigue.

The eastern flower-code became popular in eighteenth-century France, and Phillips tells the story of a prisoner of the French Revolution who sent his daughter two dried lilies shortly before his execution, "to express both the purity of his heart and the fate which awaited him".

Many books and a great deal of bad poetry were written on this subject, but to what extent the language was used is a matter for speculation. The provident writer of floral letters would have had to plant the most useful varieties in his own garden, and even then he could not compile a message if half of it bloomed in the spring and the rest in the autumn. He would also have had to make sure that the recipient used the same book of flower language as himself. According to Phillips the dahlia stands for instability and the iris for eloquence, whereas in Floral Emblems by "A Lady of Title" the dahlia means "thine for ever" and the iris only "a message". Both she and Phillips agree that basil stands for poverty, but in The Language of Flowers by Kate Greenaway it means hatred. Drawings were sometimes substituted for living flowers, but this entailed a high degree of draughtsmanship and botanical knowledge if misunderstandings were to be avoided.

Phillips enlarged the vocabulary by attaching meanings (of a moral and elevating kind) to a number of flowers not included in the older traditions, such as the recently introduced dahlia and hydrangea, and he also tried to invent a code for dates and numbers, using compound leaves, berries and tendrils. But the language was never designed for any practical purpose—its emblems represented only abstractions and states of mind, and there were no verbs except for a few occurring in short phrases.

There were probably minor revivals of the language of flowers in Victorian times, because vocabularies were still being published in the 1870s, but the language had died out by the end of the century.

The significance of flowers is, however, universal and some at least of their meanings will always hold good. The following list has been compiled from the three books mentioned above:

![Columbine: Folly](image)

- Acacia: friendship; platonic love
- Acanthus: love of the fine arts
- Aconite: crime; misanthropy
- Adonis: painful recollections
- Agrimony: gratitude
- Almond-blossom: hope; indiscretion
- Alyssum, Sweet: worth beyond beauty
- Amaryllis: pride; splendid beauty
- Anemone (garden): forsaken
- Anemone (wild): sickness; expectation
- Angelica: inspiration
- Apple-blossom: preference; fame speaks him great and good
- Arbor-vitea: unchanging friendship; live for me
- Ash: grandeur

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Aspen: lamentation
Asphodel: my regrets follow you to the grave
Aster, China: afterthought; variety
Aster (double): I partake your sentiments
Aster (single): I will think of it
Auricula: painting
Azalea: temperance

Bachelors' Buttons: single blessedness
Balm: sympathy
Balsam: impatience
Barberry: sourness of temper
Basil: poverty; hatred
Bay branch: glory
Bay leaf: I change but in death
Bay wreath: reward of merit
Beech: prosperity
Betony: surprise

Camellia (red): unpretending excellence
Camellia (white): purity; perfected loveliness
Candytuft (perennial): indifference
Canterbury Bell: acknowledgment
Cardamine (Cuckoo-flower): paternal error
Cardinal Flower: distinction
Carnation (deep red): alas! for my poor heart
Carnation (striped): a refusal
Carnation (white): women's love
Carnation (yellow): disdain
Cedar: strength
Celandine: joys to come
Chamomile: energy in adversity
Cherry tree: good education
Chickweed: ingenuousness; rendezvous
Christmas Rose: relieve my anxiety
Chrysanthemum: cheerfulness under adversity
Chrysanthemum (red): I love
Chrysanthemum (white): truth
Chrysanthemum (yellow): slighted love
Cinquefoil: maternal affection
Clematis: mental beauty
Clover (four-leaved): be mine
Clover (red): industry
Clover (white): think of me
Columbine: madness; folly
Columbine (purple): resolved to win
Columbine (red): anxious and trembling

Birch: meekness
Bittersweet (Woody Nightshade): truth
Black Poplar: courage
Blackthorn: difficulty
Bluebell: constancy
Borage: bluntness; energy
Box: firmness; stoicism
Bramble: injustice; envy; remorse
Broom: humility; neatness
Bulrush: indiscretion; docility
Burdock: importunity
Buttercup: childishness

Cabbage: profit
Cactus: warmth; ardour; I burn
Camellia: beauty is your only attraction

Cornflower: Delicacy

Clematis: mental beauty

Coneflower: celebrity

Coneflower: celebrity

Convulvulus: bonds
Coreopsis: love at first sight
Corn: riches
THE LANGUAGE OF FLOWERS

Cornflower: delicacy
Cowslip: pensiveness; winning grace
Crocus: abuse not
Crocus (saffron): mirth
Crocus (spring): youthful gladness
Crown Imperial: majesty
Cyclamen: diffidence
Cypress: death

Daffodil: regard; deceitful hopes
Dahlia: instability; thine for ever
Daisy (double): participation
Daisy (white): I will
Daisy (wild): innocence
Dandelion: rustic oracle
Dead leaves: sadness; melancholy
Day-lily: coquetry; reviving pleasure

Eglantine (Sweetbrier): I wound to heal
Elder: zealousness
Elm: dignity
Everlasting: never forget

Fennel: merit; strength of mind
Fern: fascination; sincerity
Fern, Royal: contemplation

Geranium (dark): melancholy
Geranium (ivy-leaved): bridal favour
Geranium (lemon): unexpected meeting
Geranium (nutmeg): expected meeting
Geranium (oak-leaved): true friendship
Geranium (rose-scented): preference
Geranium (scarlet): consolation
Geranium (wild): steadfast piety

Globe Amaranth: immortality
Golden Rod: precaution
Gooseberry bush: anticipation
Grass: utility
Guelder Rose (Snowball Tree): winter of age
Gum Cistus: I shall die tomorrow

Harebell: submission; grief
Hawthorn: hope
Hazel: reconciliation
Heartsease: happiness
Heath: solitude
Helenium: tears
Heliotrope: intoxicated with pleasure; devotion
Hellebore: wit; scandal
Hemlock: perfidy; you will be my death
Hollyhock: truthfulness; ambition
Honeysuckle: love's tie; generous and devoted affection
Hop: apathy; injustice
Hyacinth: sport; play; cheerfulness
Hydrangea: a boaster; heartlessness
Hyssop: cleanliness

Iris: a message
Iris, German: flame; I burn
Ivy: friendship; assiduous to please; fidelity; marriage
THE LANGUAGE OF FLOWERS

Jacob's Ladder: come down
Jasmine: amiability
Jonquil: I desire a return of affection
Judas-tree: unbelief; betrayal
Juniper: protection; comfort

King-cup: desire of riches

Laburnum: forsaken; pensive beauty
Larch: disguise; audacity; boldness
Larkspur: lightness; levity; read in my heart

MAGNOLIA: Love of nature

Laurel, Cherry (in flower): perfidy
Laurustinus: a token; I die if neglected
Lavender: distrust; diligence
Lettuce: cold hearted
Lilac: memory; brotherly love
Lilac (purple): first love
Lilac (white): youth
Lily (white): purity
Lily of the Valley: return of happiness
Lime tree: conjugal love
London Pride: frivolity
Lords and Ladies: ardour
Love-in-a-Mist: perplexity
Love-lies-Bleeding: hopeless, not heartless
Lupin: I conquer all

Magnolia: love of nature
Mallow, Marsh: beneficence
Mandrake: horror
Maple: reserve
Marigold: anxiety; foreboding; despair; grief

Marigold, African: vulgar minds
Marigold, French: jealousy
Meadow Saffron: my best days are past
Meadowsweet: thou rulest my heart
Mezereon: desire to please
Michaelmas Daisy: afterthought
Mignonette: your qualities surpass your charms
Mint: virtue
Mock Orange: counterfeit
Monkshood: knight-errantry
Morning Glory: repose; night
Mountain Ash: prudence
Mournful Widow: unfortunate attachment; I have lost all
Mulberry (black): I shall not survive you
Mulberry (white): wisdom
Mushroom: suspicion; distrust
Mushroom (on turf): an upstart
Myrtle: love

Narcissus: egotism; self-esteem
Nasturtium: patriotism
Nettle: slander; pain; cruelty

PERIWINKLE: Early friendship

Oak: hospitality
Oats: the witching soul of music
Oleander: beware

Pansy: thoughts
Parsley: entertainment
Pasque Flower: you have no claims
Passion-flower: religious superstition
Patience-dock (Herb Patience): patience
Peach-blossom: I am your captive
THE LANGUAGE OF FLOWERS

Pennyroyal: flee away
Paony: bashful shame; beauty is in the heart, not in the face
Peppermint: warmth of feeling
Perennial Pea: an appointed meeting; lasting pleasure
Periwinkle (blue): early friendship
Periwinkle (white): pleasures of memory
Persimmon: bury me amid nature's beauties
Phlox: unanimity
Pink: boldness
Pink (double red): pure and ardent love
Pink, Indian: aversion
Pink (single red): woman's love
Pink (striped or variegated): refusal
Pink (white): talent; ingenuity
Polyanthus: pride of riches
Polyanthus (crimson): the heart's mystery
Polyanthus (lilac): confidence

\[ Rose: love \]
Rose, Cabbage: ambassador of love
\[ Rose, China (Monthly): beauty always new; departure; transient brilliance \]

\[ ROCK ROSE: Popular favour \]
Rose (deep red): bashful love
Rose, Maiden's Blush: if you love me, you will find it out
Rose, Moss: pleasure without pain; ecstasy of enjoyment
Rose, Musk: affection; capricious beauty
Rose (single): simplicity
Rose (thornless): early attachment
Rose (white): I am worthy of you; candour; ever beautiful
Rose (white, over two buds): secrecy
Rose (white, dried): death preferable to loss of innocence
Rose (yellow): decrease of love, jealousy
Rose, York and Lancaster: war

\[ PRIMROSE: Early youth \]
Poppy (red): consolation to the sick
Poppy (scarlet): fantastic extravagance
Poppy (white): sleep of the heart; my bane; antidote
Primrose: early youth
Primrose (red): unpatronized merit
Privet: prohibition
Pyracantha: solace in adversity

Ragged-robin: wit
Ranunculus: you are rich in attractions
Rhubarb: advice
Rock Rose: popular favour
Rocket: rivalry

\[ SPINDLE-TREE: Your charms are graven on my heart \]
Rosebud, Moss: confession of love
Rosebud (white): girlhood; too young to love
Rosemary: remembrance
THE LANGUAGE OF FLOWERS

Rudbeckia: justice
Rue: disdain; domestic happiness; grace

Sage: domestic virtue
St. John's Wort: animosity; superstition; oblivion of life's troubles
Scabious: see Mournful Widow
Shamrock: lightheartedness
Snapdragon: presumption
Snowdrop: hope; consolation
Southernwood: jest
Spindle-tree: your charms are graven on my heart
Stock: luxury; lasting beauty
Stock, Ten-week: promptitude
Straw (broken): rupture of a contract; a quarrel
Sunflower (dwarf): adoration
Sunflower (tall): haughtiness
Sweet Pea: departure; delicate pleasures
Sweet Sultan: felicity
Sweet Vernal Grass: poor, but happy
Sweet William: gallantry; craftiness
Sycamore: curiosity

Tamarisk: crime
Tansy: I declare war against you
Teasel: misanthropy
Thistle: austerity; retaliation
Thrift: sympathy; dauntlessness
Thyme: activity
Tiger Flower: for once may pride befriend me

Tradescantia: momentary happiness; esteem, not love
Travellers' Joy: safety
Tuberose: dangerous pleasures
Tulip: fame
Tulip (red): declaration of love
Tulip (yellow): hopeless love

Valerian, Greek: rupture
Venus' Fly-trap: fly with me
Venus' Looking-glass: flattery
Verbena: sensibility
Vervain: enchantment
Vine: intoxication
Violet, Sweet: modesty
Violet (yellow): rural happiness
Virgin's Bower: filial love

Wallflower: fidelity in adversity
Water-lily: purity of heart
Wheat: riches
Whin: anger
Willow Herb: pretension; celibacy
Willow, Weeping: mourning
Winter Cherry: deception
Winter Heliotrope: justice shall be done you
Witch Hazel: spell
Wood Sorrel: joy; maternal tenderness
Wormwood: heartache; absence

Yarrow: war

WOOD SORREL: Joy
Plant Diseases

THE NATURE OF PLANT DISEASES

Plants, just as much as animals, may suffer from various diseases which can injure or kill them. All types of plants, from annuals, perennials and bulbous plants to shrubs and large trees of every kind, can be attacked, so that a knowledge of the early signs of infection and the way in which a disease can be combated is a valuable asset.

New varieties of plants are being produced all the time by various methods of selection and inbreeding. Some of these are highly bred, but highly bred plants are not necessarily highly resistant to disease, and with these in particular the prevention of disease can assume great importance. Much research work is, therefore, devoted to the prevention and curing of plant ailments.

Where one particular type of plant is grown in quantity, often on the same ground year after year, an outbreak of disease can cause serious losses. Such a disease finds ample opportunity to live on its particular host plant during the summer, and will usually have some method of persisting through the winter. It may remain in the soil, and although the soil may be only slightly contaminated at first, the trouble may build up to serious proportions. This type of trouble is more likely to arise in greenhouses, garden frames and probably formal beds. Eradication will often necessitate treatment of the soil in the dormant season when the site is vacant.

With growing crops swift action is likely to be needed if serious losses are to be avoided. The more common troubles which can affect plants should be easily recognized and the appropriate remedy applied. Outside advice may be quickly available, but with fast-spreading diseases early treatment has great advantages.

The term "plant disease" refers not only to foreign organisms (parasites) which can injure or kill a plant but also to anything—except insect damage—which may check the growth of a plant, cause abnormal growth or cause the death of part or all of the plant. Consideration must therefore be given not only to ill-health resulting from the invasion of plants by parasitic organisms but also to cases where plants fail to thrive because of unsuitable soil, incorrect temperature, injury from fumes and sprays, excessive liming or even damage from hail or frost. Fruits and vegetables—such as apples, pears, potatoes and carrots—continue to live even when stored, and can suffer from various troubles which either reduce their food value or destroy them entirely.

Plant diseases may be divided into two main groups: A. Non-parasitic diseases, which are not infectious; and B. Parasitic diseases which are infectious. These latter may be subdivided into two classes: 1. Fungus and bacterial diseases; and 2. Virus diseases.

A. NON-PARASITIC DISEASES
This type of plant disorder is often called "functional disorder" or "physiological disturbance". The term is, however, intended to include all those plant troubles
which are not the result of infection by parasitic fungi, bacteria or viruses. It covers, for example, lasting ill-health due to waterlogged soil; excessive lime in the soil; shortage of an essential food element; excess humidity; fume and spray injury; and even short-term damage by lightning, frost, hailstones and drought.

B. PARASITIC DISEASES
1. Fungus diseases are those caused by parasitic fungi, and with them are grouped the very similar bacterial diseases.

FUNGI
Parasitic fungi are mostly microscopic. They invade higher plants and grow in their tissues (cells), which they kill and then absorb the contents for food. They penetrate and grow in the plant cells by means of fine fungal threads, and spread from plant to plant by means of spores (the equivalent of seeds in higher plants). These spores are formed at the ends of special threads, often inside special fruit bodies, and they are produced in enormous numbers. When released they are carried by wind currents or water (by splashing) to healthy plants, where they alight, germinate, grow into the tissue and thus spread the disease again.

Most of the fungus parasites overwinter on the plant or in the soil by forming a type of thick-walled spore, or some other structure which is resistant to adverse weather.

These fungus parasites may be roughly divided into two types. The first—which includes the powdery mildews (common on many plants such as roses, delphiniums, Michaelmas daisies and marigolds)—produces an obvious and superficial whitish growth on the surface of the leaves, stems and petals. This growth is made of fungal threads and spores which cover the leaf surface and feed by sending down a kind of sucker into the surface cells (epidermis) to absorb nourishment. In the second type the parasite grows down deeply into the internal tissues, sending up threads to produce spores at the surface. The first type is easy to check but, unfortunately, most fungus diseases belong to the second.

BACTERIA
Bacteria which attack plants are much smaller than parasitic fungi, but infect in a similar manner by living in, and killing, the tissues. They cannot, however, form resting spores. They are able to persist by remaining in plant debris or in dormant cells in the tissue of seeds, corms, bulbs, etc.—a method often used by some fungus parasites as well, despite their ability to form resting spores.

VIRUSES
2. With virus diseases, the exact identification of the parasite is difficult. Viruses are so small that they cannot be seen through the ordinary microscopes used to detect and study fungus and bacterial parasites. They can be seen only by means of modern electronic microscopes, but even so they are something of a mystery. Undoubtedly, plants suffering from virus disease have some form of infectious agent in their sap, but in many cases its exact nature has not been identified. It is, however, known to be very small and to multiply within the plants' cells, so that it is usually distributed throughout all the tissues, with the exception of the seed.

Results of Virus Infection
Plants, unlike animals, do not seem to produce antibodies to fight viruses, although, in some cases, they are able to resist to a certain extent. Thus, more than one virus can exist in a plant at the same time. For some plants, though not many, virus attack means sudden death, but usually infected plants become more crippled and degenerate with the passing of each season.
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Seeds of infected plants are usually free from virus, so, by saving seed, clean stock can be obtained again. This method is, however, suitable only in the case of fairly short-lived plants.

Special care has to be taken, for example, to exclude the risk of virus infection from good stocks of fruit trees, which are all propagated vegetatively as increase by seed is not feasible.

Symptoms of Virus Infection
The symptoms of virus infection are very varied. Common signs are stunted growth and mottled patterns on the leaves (often referred to under the general term "mosaic"). Other signs are ring-like markings on the leaves (ring-spots); curling or distortion of leaves and shoots; "breaking" of flowers (white streaking in the colour of the petals); abnormal production of shoots (proliferation), and many other abnormalities. Infection usually results in all the cells of the plants being invaded by the virus, although shoots already developed are not usually much altered. New shoots and leaves, however, begin to show abnormal symptoms as they grow.

The symptoms of the same virus may vary in different plants—or even in different varieties of the same species. For example, some varieties of strawberry affected by the so-called yellow edge virus may be quickly and severely crippled, while other varieties, similarly affected, show no outward signs of the disease. The latter varieties are referred to as "carriers" and, therefore, should not be planted near a very susceptible variety.

Plant viruses injected into the blood stream of animals, such as rabbits, may produce antibodies, with the result that animal antisera can be prepared and used in the detection of a specific virus. If the animal antisera is mixed with a dilute suspension of the virus from the sap of a plant, a cloudiness (precipitate) will appear.

Serological reactions such as this are used extensively in the identification of some plant viruses, and can be of great value in the work of virus classification. No generally accepted method of classification has, however, been adopted. Scientists usually use the name of the host plant first and follow this with the most obvious symptoms caused by the virus (for example, cabbage black ringspot virus and banana bunchy top virus).

The Spreading of Virus Diseases
Aphids are mostly responsible for the spread of virus diseases, although a few are spread by leaf-hoppers, thrips and whiteflies. These insects are referred to as insect "vectors". When feeding they may take up the virus from the sap of virus-infected plants and transmit it to healthy plants.

Viruses can also be transmitted by the propagation techniques of budding and grafting. This is a very common method of increase and spread of diseases, so that the use of clean stocks is essential for propagation.

Only rarely does a virus travel with the seed, and then only in a minute percentage: examples are lettuce mosaic, cucumber mosaic and bean mosaic. It is considered that there are many different strains of virus and that these, like other parasitic organisms, may vary greatly in their virulence towards different hosts.

Some viruses remain in and contain the soil in which virus-infected plants have been grown.

Raspberries are a case in point, and although it is not understood exactly how the soil is contaminated, it is certain that there are some fields where raspberries cannot be grown with profit because the young shoots become infected with virus from the soil.
**DISEASES OF FRUIT**

**APPLE BITTER PIT**
- **Damage:** Dark spots and brown areas in flesh
- **Control:** No remedy known—do not pick too early

**APPLE BROWN ROT**
- **Damage:** Fruit turns brown and develops white pustules
- **Control:** Prune away dead spurs and shoots. Bury deeply all rotten fruits. Store with care. Control codling moth

**APPLE CANKER**
- **Damage:** Wood decays. Bark peels
- **Control:** Scrape and cut out cankers. Paint cuts with a paint containing mercury

**APPLE FROST DAMAGE TO FRUIT**
- **Damage:** Young fruits malformed or skin russeted

**APPLE MILDEW**
- **Damage:** White coating on shoot tips
- **Control:** Prune. Spray with Karathane

**APPLE SCAB ON FRUIT**
- **Damage:** Dark spots
- **Control:** Spray with captan in spring
**DISEASES OF FRUIT**

**APPLE SCAB ON LEAVES**
- **Damage:** Dark spots
- **Control:** Spray with captan in spring

**APPLE SCAB ON SHOOTS**
- **Damage:** Blisters on young wood
- **Control:** Prune out scabby wood

**CHERRY BLOSSOM WILT**
- **Damage:** Browning of flower trusses and leaves on spurs
- **Control:** Remove affected spurs. Spray with Bordeaux mixture

**GRAPE MILDEW**
- **Damage:** Powdery white deposit on leaves and berries
- **Control:** Spray with Karathane and ventilate to avoid excess humidity

**GRAPE SCALD**
- **Damage:** Sunken brown spots on shoulders of berries
- **Control:** Ventilate to avoid excess humidity during sunny weather

**GRAPE SHANKING**
- **Damage:** Berries wither on part (or all) of the bunch
- **Control:** Do not overcrop—be sure root action is healthy

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PLANT DISEASES

PREVENTION OF DISEASE

CONTROL MEASURES

The methods used to control plant diseases are many and varied, but the best protection against such troubles is to be conversant with the needs of the crop being grown, and to practise good cultivation so that the plants make healthy, vigorous growth. Robust plants have some resistance to disease, but those weakened by adverse conditions are more likely to be attacked by parasitic fungi.

Many factors favour the spread of disease: buying cheap seed of poor quality from which weak seedlings are raised; growing plants too close together; acid soil; poor light in greenhouses; overfeeding with artificial manures; high temperatures. So far as fungus diseases are concerned, there is no substitute for good cultivation. Spraying, dusting, fumigating and seed treatments, important though they are, are only secondary.

Virus diseases present a rather different problem, for even well-grown plants can be severely affected.

GOOD CULTIVATION

The following are some of the factors of good cultivation, so important in the maintenance of clean, disease-free crops: Good soil drainage and correct soil preparation—if necessary, such humus-forming materials as peat and leaf mould can be added to improve the drainage; the supply of fertilizers, when necessary, so that plant foods are available whenever needed; the correct ventilation of frames and greenhouses so that the excessively warm and humid conditions which encourage plant parasites are never experienced; careful pruning to provide more air circulation in the open garden, for stagnant air encourages such destructive diseases as apple scab and American gooseberry mildew.

CROP ROTATION

Crop rotation is important in keeping down disease. If the same kind of crop is grown in the same ground for several years in succession, two undesirable things happen. First, the same plant foods are being taken continually from the soil, and second, if the particular crop being grown has a disease, then the disease will be encouraged to build up in the soil.

Plant parasites live on small pieces of crop debris (for example, on fragments of stem, roots and so on) and most, to ensure their survival in winter, produce some special fruit body of a hard, resistant nature. Routine cultivation, therefore, spreads infected material and the ground becomes heavily infected.

But most diseases are confined to a particular crop and can be “starved out” of the soil if different crops are grown in rotation. Under glass, where crop rotation may not be practicable, soil sterilization is essential.

WEEDS

Weeds act as alternate host plants to many fungus diseases which persist on them and then move on to cultivated plants. For instance, shepherd’s purse may carry the club root disease of cabbages, wallflowers and other cruciferous plants; and wild celery the serious leaf spot disease of cultivated celery. Greater plantain may carry the virus of spotted wilt, and white bryony may harbour the cucumber and marrow mosaic virus.

HYGIENE

Destroy all weeds and infected material. Remove and burn all dead and decaying
plant material, especially from frames and greenhouses. Remove and burn dead and dying branches from trees and shrubs and paint the wounds with a recognized protective preparation. Make sure that disease-carrying packing material and infected vegetable debris is not added to the compost heap.

**Pruning Cuts**

Paint with protective material, such as white lead paint, all large pruning cuts of 1 in. diameter or over. This is especially important if the cut is low down on the tree or shrub, for if a fungus does gain entry all the growth above this point may be killed. Young Morello cherries, apples and many ornamental shrubs can be lost in this way.

If a large branch tears away, trim the wound by cutting and chiselling to obtain a smooth surface. Should a large cavity be left, it may be necessary to paint its surface with preservative fluid. Fill the wound with a strong ordinary cement mixture and later cover the whole area with a good bituminous paint.

**Spacing**

Spacing the plants so that each has sufficient room may seem a small point, but hygienically it is important. Thickly sown seedlings are always subject to the familiar “damping off” disease. If they are pricked out too closely together into seed boxes they may still be crippled by various mildews and moulds. Very close planting of older plants or “massing” in beds may encourage such a disease as smut to attack small bedding dahlias and grey mould to attack godetias, petunias and zinnias.

**New Stock**

Examine any new plants which have been purchased. Disease is more obvious on active plants than on dormant ones, but with the latter there may be signs that all is not quite normal. Young cabbages may have slightly swollen roots due to attack by club root; young apple trees may already show symptoms of apple canker; young roses may have galls on their roots or canker in their stems; and many bulbs or corms such as tulips, freesias and gladioli may have discolourations on their flesh—inside the outer rough scales—caused by the presence of disease parasites. With a valuable or valued stock of plants, isolate any new arrivals until new growth shows that disease is unlikely to be present. This is especially worth-while with pot and greenhouse plants.

**Disinfection and Fumigation**

A more direct approach to plant health is the disinfection of greenhouses, frames, boxes, pots and even garden tools. Do this as routine without waiting for a disease to be present or suspected.

If a greenhouse crop has suffered from a severe disease, disinfection is essential before a new crop is planted. For example, old tomato plants at the end of the season are heavily infected with leaf mould (*Cladosporium fulvum*) and some such process as burning flowers of sulphur in the otherwise vacant house is used to kill off the old foliage, the disease fungus and its spores. A clean house is thus obtained and the old stems are removed for burning without spreading live spores.

In other cases empty the house of its plants, then spray with a good disinfectant or with cresylic acid. Use this at a strength of 1 pint in 5 gal. of water plus a wetting agent, such as Agral, and spray it over the interior of the house with the ventilators open. Then shut the ventilators and doors, keep the house closed for three or four days and afterwards leave it open and aired for about two weeks, after which plants can safely be brought back. Always wear goggles and gloves when carrying out this work.
DISEASES OF FRUIT

PEACH CHLOROSIS

Damage: Leaves yellow to almost white
Control: Correct drainage and use Sequestrene

PEACH LEAF CURL

Damage: Leaves distorted, yellow and dark red
Control: Spray in January with Bordeaux mixture. Remove infected leaves

PEACH MILDEW

Damage: White powdery deposit on shoot tips or young fruits
Control: Spray early in season with Karathane

PEAR SCAB ON SHOOTS

Damage: Blisters on young wood
Control: Prune out scabby wood

PEAR STONY PIT

Damage: Fruit pitted and hard brown areas in flesh
Control: Destroy infected trees

PEAR SCAB ON FRUIT

Damage: Dark spots
Control: Spray with captan in spring
**DISEASES OF FRUIT**

**PLUM BACTERIAL CANKER**

*Damage:* Spots on leaves, sickly appearance, yellowing, and die-back of whole branches
*Control:* Spray 3 times during season with Bordeaux mixture (especially just before leaf-fall). Feed generously

**PLUM BROWN ROT**

*Damage:* Fruits have whitish concentric rings, and mummify
*Control:* Cut out dead wood. Remove any "mummified" fruits. Control insects

**PLUM RUST**

*Damage:* Small yellow spots on undersurface of leaves
*Control:* Not usually serious except on weakened foliage. Alternate host anenomes

**PLUM SILVERED LEAVES**

*Damage:* Leaves silver. Affected branches have brown stain in wood when cut
*Control:* Cut out affected portions; paint wounds with a protective paint; feed tree generously

**PLUM SILVER LEAF FUNGUS**

*Damage:* Silvery film on leaves and cankering of wood
*Control:* Cut out all dead wood. Encourage good cultivation. Paint all large cuts with a protective paint

**WALNUT LEAF BLOTCH**

*Damage:* Irregular brown spots on leaves
*Control:* Spray with Bordeaux mixture
Garden frames can be disinfected with cresylic acid as recommended above, with 2 per cent formalin solution (1 pint of 38 per cent commercial formalin in 6 gal. of water) or with some other disinfectant. Water the fluid on the inside of the frames, treating the soil surface as well as the walls and lights. Close the frames for two days, then air for two weeks. The frames should be safe to use when the smell of the chemical has disappeared, but to be quite sure place a small plant in the frame overnight to see if it survives.

Stack pots and boxes and water them with 2 per cent formalin solution or a similar preparation. Then cover them with wet sacks for a day or two. Stakes should be dipped in one of the copper-containing preservative fluids now available, such as Cuprinol; the larger stakes are best stripped of bark before treatment. Taking such precautions keeps away disease and prolongs the life of the stakes.

Care must be exercised when using a chemical to clean a fruit store, for the smell of the chemical may be picked up by the fruit. It is safer to wash the shelving and boxes in the store with a strong solution of household soda in hot water during the summer.

Fungicides are now also available as “smokes”. One such is TCNB (tetra-chloronitrobenzene), which claims to check the activities of the grey mould fungus (Botrytis cinerea) on many greenhouse plants such as tomatoes, primulas, cyclamen and carnations. The simplicity of operation of smokes is an advantage: just place a small container of the required size in the greenhouse, close the ventilators and ignite the container with a match, then leave and close the door. The fungicide heats and is quickly dispersed as a gas. It condenses in a matter of hours on all parts of the plants (even on the undersurface of the leaves), on the soil and the interior of the greenhouse, so that any fungus parasite present to which the chemical is toxic is either killed or its growth inhibited. In the latter case, repeat the treatment, if necessary.

**SOIL STERILIZATION**

The soil in greenhouses and even in some beds outdoors can be treated to destroy disease-producing organisms. This process is known as soil sterilization but, in reality, it is only partial sterilization. Soils can be improved in this way, and those which are sick, that is, soils which contain disease organisms, can be rejuvenated. In particular, the continued good health of tomatoes grown in greenhouses depends on this kind of disease control.

Soil can be sterilized by means of chemicals or steam, and full information on this is given in Bulletin No. 22 of the Ministry of Agriculture, Fisheries and Food, London.

Chemical fluids are used to sterilize the soil in small garden greenhouses, usually cresylic acid at 24 per cent or formalin at 2 per cent. Fork the soil over and water the solutions on at 3 or 4 gal. per sq. yd. so as to saturate it. Cover the soil with wet sacks for two days and plant not less than one month later when the vapours have dispersed.

Treat small heaps of soil or compost on a clean floor by watering on one or other of these fluids. Treat each 6-in. layer, cover with wet sacks and leave for two days. Then spread the soil or compost with a clean spade to disperse the vapours, so that it will be ready for use fairly quickly.

Small quantities of sterilized soil can be bought. This is used as a growing medium for plants in small pots and others in the early stages of growth, so that they then have a better chance of escaping disease infection.

In the open air, soil sterilization has a
PLANT DISEASES

limited application. Where tulips, for example, are planted in the same beds each year there is a danger that there will be a build-up of tulip fire and grey bulb rot diseases. Such beds may sometimes need to be restored by some form of sterilization. If the area is small it is possible to use a chemical such as 2 per cent formalin, but there are now some good soil chemicals available which can be raked into the soil as a powder to give very good results against soil-borne diseases.

SEED TREATMENTS

Always buy seed—and the term in this sense includes bulbs, corms, tubers, etc. which can carry disease in the dormant state—from reliable firms which do their utmost to supply clean, disease-free material. Despite all precautions, though, some diseases which travel on seeds are easily missed, and once infected seeds are sown, the diseases have the opportunity of spreading. With some crops, therefore, precautions are taken by treating the seed before sowing with a proprietary seed dressing. This protective treatment results in the diseases being killed and the seed, bulb, corm or tuber being left uninjured with its capacity for growth unimpaired.

A disease may infect a seed in one of two ways: it may live on the surface of the seed, quite superficially, so that it can be killed easily; or it may penetrate deeply and live in a dormant state inside the tissues (cells) of the embryo plant.

In the first case, the seeds can be disinfected by steeping them in a solution of weak formalin (2 teaspoonfuls to 1 gal. water) or other suitable chemical, or, alternatively, by dusting them all over with an organic mercury compound, with tetrachloronitrobenzene (TCNB) or with tetramethylthiuramdisulphide (TMTD or thiram). These dusts are described by such names as “seed saver” or “seed dressing”.

In the second case treatment is more difficult. But good results are obtained against several important diseases by steeping the seed (bulb, corm, etc.) in hot water. The temperature and time of immersion varies with different diseases. This is called the hot water method.

With many diseases, even some of the internal type, good results are obtained by coating the diseased mother corm, bulb, etc. with a fungicidal dust, so that when the corm is planted the parasite is unable to grow out through the chemical into the surrounding soil. Thus it cannot infect the young growth or the young, developing corm. This method is of great value in keeping stocks of gladioli etc. free from disease. It is often possible to sow treated seeds or to plant treated corms in heavily disease-contaminated soil and get good seasonal results, although the disease still remains in the soil.

CHEMICALS USED AS SPRAYS

Chemicals used to protect plants from disease parasites are called fungicides. They must, without harming the plant, kill the fungus parasite or stop its spores from germinating. For many years the principal substances used as fungicides have been copper and sulphur, and occasionally mercury. They are still important, but there are now many modern organic sprays. These are very good but they are more specific in their action and so do not have such a widespread application as the older chemicals. Hundreds of new synthetic organic compounds are being examined and tested each year and there is still much to learn in this field of study. Even the substances known as “antibiotics” in human therapeutic practice, penicillin, streptomycin,
<table>
<thead>
<tr>
<th>Disease</th>
<th>Description</th>
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| **Blackberry Dwarf Virus**    | Damage: Numerous small stunted shoots  
Control: Destroy affected plants immediately |
| **Currant Leaf Spot**         | Damage: Small black spots on the leaves which fall in severe attacks  
Control: Spray with colloidal copper |
| **Currant Reversion Virus**   | Damage: "Nettle leaf" appearance of leaves in June. Rare in red currants  
Control: Burn affected bushes |
| **American Gooseberry Mildew**| Damage: White coating at shoot tips and on fruits  
Control: Spray with Karathane in the spring. Prune shoot tips in September |
| **Gooseberry Leaf Spot**      | Damage: Small black spots on leaves which fall in severe attacks  
Control: Spray with colloidal copper |
| **Gooseberry Rust**           | Damage: Orange-coloured blisters on leaves, fruits, etc.  
Control: Spray with colloidal copper just before flowering starts. Do not use mulches containing sedges, as these are alternate hosts of the fungus |
### DISEASES OF FRUIT

**RASPBERRY MOSAIC**
- **Damage:** Leaves mottled pale green or yellow
- **Control:** When serious get new clean stock

**STRAWBERRY GREY MOULD**
- **Damage:** Grey mould on fruit
- **Control:** Prevent by spraying or dusting with captan (when flowers first open) early in season

**STRAWBERRY MILDEW**
- **Damage:** Whitish mould on leaves and on fruits when ripening
- **Control:** Spray with Karathane

**STRAWBERRY RED LEAF SPOT**
- **Damage:** Red spots with grey centres
- **Control:** Spray early in season with Bordeaux mixture

**STRAWBERRY CRINKLE**
- **Damage:** Dwarfing of leaves
- **Control:** Destroy affected plants. Control aphids. Select runners from healthy plants only

**STRAWBERRY YELLOW EDGE**
- **Damage:** Yellow edging and stunting of leaves
- **Control:** Destroy affected plants. Control aphids. Select runners from healthy plants only

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griseofulvin, etc. have been and are being tested against various plant diseases. In special cases they have proved successful.

The plant—including the undersurface of the leaves—is covered by spraying with a protective film of the fungicide. Attacked plants cannot always be cured but those not yet affected can be protected. Hence the importance of early detection.

With most fungicidal sprays it is best to include a “wetter” or “spreader”. This has the effect of causing the fluid to spread and stick more closely to the leaves. Soft soap can be used in this capacity with some sprays, but it cannot be used if lime is present.

Many modern insecticides can be mixed with these fungicides so that both can be applied at the same time.

**SYSTEMIC FUNGICIDES**
The “systemic” type of fungicide enters the plant tissues and by its presence in the cells prevents, or at the very least minimizes, any attack.

**PROPRIETARY NAMES**
Many different names are in use for the same or similar fungicides. Some of these names are proprietary, others are based on the name of the chemical composing the fungicide. This is sometimes confusing, but reference can, if desired, be made to the list of approved products which is issued by the Ministry of Agriculture, Fisheries and Food with the express purpose of helping the purchaser to select the best and most efficient products. This booklet is frequently revised and kept up to date, and it contains lists of approved fungicides, insecticides and weedkillers and the names of their manufacturers (see Bibliography).

**METHOD OF APPLICATION**
There is a wide choice of machines suitable for applying the sprays and dusts used as fungicides. The difficulty is to select the best type for the work required to be done. The nozzle should deliver the spray as a fine mist in the shape of a cone so that the fungicide falls on the plant as a fog and a film of fluid covers the foliage. Spray on a fine day but not in bright sunshine.

The importance of keeping sprayers clean cannot be over-emphasized. Wash them well after use, clean the nozzle or nozzles, and place the empty machine upside down to drain. Sprayers are not cheap, and if put away with fluid still in them they can be ruined during the winter by rust or corrosion.

"Dusters" for small gardens are available in plastic containers which, when squeezed, produce a fine cloud of dust.

**RESISTANT PLANTS**
Some plants are slightly resistant to disease, while others are completely immune. A plant may be immune to one disease but very susceptible to another. For example, potatoes that are immune to wart disease (Synchytrium endobioticum) can be easily attacked by blight (Phytophthora infestans). Despite this, the production of resistant varieties marks an important step forward in checking disease and is probably the simplest method of doing so.

The work of producing resistant varieties is not easy, because they must stand comparison with susceptible varieties for quality of flower, or for flavour in fruits and vegetables. Breeding for quality and flavour, combined with a high degree of resistance, goes on continuously but there is always the chance that resistant plants will suddenly succumb to a new strain of the disease parasite. Then the search for new resistant plants starts all over again. This is why the study of crop protective measures such as spraying must always continue.
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CONTROL OF VIRUS DISEASES
The only spray treatment likely to be needed for the control of virus diseases is that designed to keep down insects, for these are the virus carriers. Burn plants with suspected virus symptoms to eliminate sources of infective material. Infected plants will not recover, and it is useless trying to save them. Support this destruction—especially in greenhouses—by regular spraying or fumigation to keep down insects. Annuals, which are, of course, propagated by seed, in general keep free of virus infection.

Take cuttings from healthy plants only, and wipe or dip the knife used to prepare them in disinfectant. When propagating plants such as strawberries select runners from healthy and vigorous plants.

CORRECTION OF NON-PARASITIC DISORDERS
Non-parasitic troubles, such as hail damage, can hardly be avoided, but the provision of some kind of protective cover can save serious frost damage being done to some crops. Imperfections in the soil, such as acidity, excessive alkalinity or faulty drainage can usually be corrected in the long run and so, too, can food deficiencies if these are correctly diagnosed.

It is important to see that some plants get all the necessary food elements. If fruit trees, for example, are allowed to suffer from malnutrition during the growing period, the resulting fruit, when stored, may show signs of internal breakdown (browning) long before it is ripe.

NOTIFIABLE DISEASES
There are certain diseases, known as "notifiable diseases", which must be reported to the Ministry of Agriculture, Fisheries and Food's Plant Pathology Laboratory at Harpenden, Hertfordshire, as soon as they arise. (A list can be obtained either from the Ministry or from the local County Agricultural Advisory Service.) An example is potato wart. There are various regulations about the selling of diseased plants and restrictions are imposed on the importation of plants from abroad. The intention, of course, is to protect stocks of plants in this country from infection by dangerous diseases.

The movement of plants between nurseries and gardens in this country cannot be regulated easily, but voluntary schemes are available for growers and nurserymen to encourage them to raise and sell clean stocks. The best known is probably the Scottish seed potato certification scheme. The grower has his stocks rigorously inspected during the growing season and, if all is well, he is granted a certificate which indicates that the stock is true to type and free from virus infection. Encouragement is thus given to the purchase of certified fresh Scottish potato seed, and the crippling effect of virus and the lower crop yield which is often obtained from home-saved seed is avoided.

There are similar voluntary schemes for plants such as strawberries, raspberries and even shallots. Varieties of those plants covered by such schemes and certified free from virus infection are available.
### DISEASES OF TREES AND FLOWERS

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<tr>
<th>Disease Type</th>
<th>Description</th>
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</table>
| **ANTIRRHINUM RUST**         | Damage: Brown pustules on leaves and stems  
Control: Grow resistant varieties                                      |
| **CARNATION RING SPOT**      | Damage: Pale spots with dark pustules in rings  
Control: Avoid humidity and spray with Bordeaux mixture                  |
| **CARNATION RUST**           | Damage: Brown pustules on stems and leaves  
Control: Spray with thiram                                                  |
| **CHRYSANTHEMUM LEAFY GALL** | Damage: Cauliflower-like mass of stunted shoots at stem base  
Control: Destroy affected plants                                            |
| **CHRYSANTHEMUM MILDEW**     | Damage: Powdery-white deposit on leaves  
Control: Spray with thiram                                                  |
| **CHRYSANTHEMUM RUST**       | Damage: Chocolate-coloured spots on undersurface of leaves  
Control: Spray with thiram and destroy affected leaves early                |
### DISEASES OF TREES AND FLOWERS

<table>
<thead>
<tr>
<th>Condition</th>
<th>Damage Description</th>
<th>Control</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>DAMPING-OFF IN STOCK SEEDLINGS</strong></td>
<td>Seedlings collapse at soil level, wither and die</td>
<td>Sow thinly and maintain good growing conditions. Water compost with Cheshunt compound or use a seed dressing.</td>
</tr>
<tr>
<td><strong>DELPHINIUM BLACK BLOTCH</strong></td>
<td>Dull black spots on leaves</td>
<td>Spray with copper fungicide regularly</td>
</tr>
<tr>
<td><strong>GLADIOLUS CORE ROT</strong></td>
<td>Centre of corm rots</td>
<td>Dust corms in store with TCNB and examine carefully before planting</td>
</tr>
<tr>
<td><strong>GLADIOLUS SCAB</strong></td>
<td>Sunken brown spots on corm base</td>
<td>Reject badly scabbed corms—change site each season</td>
</tr>
<tr>
<td><strong>CYCLAMEN GREY MOULD</strong></td>
<td>Rotting of flower and leaf stalks</td>
<td>Improve ventilation and dust with pentachloronitrobenzene dust (PCNB)</td>
</tr>
<tr>
<td><strong>HELLEBORE LEAF SPOT</strong></td>
<td>Dark brown or black spots</td>
<td>Spray with copper fungicide</td>
</tr>
</tbody>
</table>
PLANT DISEASES

A GUIDE TO PLANT DISEASES

1. DISEASES WHICH AFFECT MANY KINDS OF PLANTS

DAMPING-OFF AND FOOT ROT
(Pythium and Phytophthora species)
Damping-off is a common trouble which attacks very young seedlings, causing them to collapse at soil level, wither and die. It can also occur among young plants at a later stage when they are pricked-off into boxes or small pots. It is then usually known as foot rot. This trouble is caused by a fungus at the base of the stems or in the roots, and is encouraged by thick sowing and too wet soil conditions, the latter probably due to unsuitable compost being used, or over-watering and poor ventilation.

It helps to water the compost with Cheshunt compound or to dust with one of the “seed saver” preparations, but it is essential to use good compost and provide suitable growing conditions both for seeds and young plants in their early stages.

THE GREY MOULD FUNGUS
(Botrytis cinerea)
Grey mould causes a great deal of trouble in greenhouses because it likes humid conditions, can live on dead and decaying matter (facultative saprophyte) and can survive almost anywhere. It is thus able to get a hold on crop plants, especially if a dead or dying shoot—such as a snag left when trimming tomatoes, cucumbers, etc.—gives it an opportunity. It flourishes on such yellowing stubs and from there grows on into the main stem or sends spores out to alight on fruits, leaves and so on. Given the right conditions it can do enormous damage to cuttings of such plants as salvias, pelargoniums (geraniums), dahlias and chrysanthemums in greenhouses and among the flowers of zinnias, carnations, etc. Pot plants such as cyclamen, calceolarias and pelargoniums often suffer and tomatoes can be attacked not only in the stem but in the ripening fruits, which quickly rot.

Even on outdoor plants botrytis can quickly enter a wound or dead bud in soft stems of roses and other shrubs, killing the branch. In wet summers, and particularly if they are close-planted, petunias, Clarkias, godetias, zinnias and similar bedding plants may be killed. It is the stems of these plants which are attacked.

Tomato, strawberry and raspberry fruits are destroyed as they ripen, and the same fate can overtake apples and pears in store. Grapes and other imported fruits are likely to suffer seriously if the conditions in transit are not correct.

Moist air seems to be the factor of utmost importance to this disease. If the humidity is high the grey mould fungus will flourish through an extraordinarily wide range of temperatures.

Control
Keep down the humidity as far as possible by prudent ventilation and watering, in the latter case paying attention not only to the quantity given but also to the method of application.

The substances known as TCNB (tetrachloronitrobenzene) and PCNB (pentachloronitrobenzene) seem to be very effective against Botrytis cinerea. They are now used very extensively as smokes and dusts in greenhouses, as well as in powder form raked into the soil outdoors against other species of botrytis which are
closely related to the grey mould fungus. (See tulip fire and tulip grey bulb rot.)

POWDERY MILDEWS
The powdery mildews are a group of fungi which include many genera, but all are closely related and all resemble one another in the way they grow on the host plants they attack. They are the type of disease most often seen in ordinary gardens.

Their habit of growth is fairly conspicuous. They produce a white powdery coating on the leaves, shoots and sometimes fruits of their hosts. This white covering consists of a network of threads of the mildew fungus sending down its suckers to feed in the epidermal (outer) cells, and producing on many of the threads long chains of spores. These are cut off in regular succession and released in enormous numbers to spread disease. Such mildews are commonly seen on roses, delphiniums, Michaelmas daisies, clematis, cyclamen, hawthorn, peas, cucumbers, swedes, strawberries, gooseberries, grapes, apples, young oaks and many other plants.

Before the arrival of winter the white coating develops small dot-like bodies (perithecia), which survive the winter and produce another kind of spore to begin the disease again in spring.

Control
Moist conditions often encourage these mildews to attack plants, especially in greenhouses and frames, but dryness at the roots also encourages them to attack. This appears to lower their resistance to mildew, and should be guarded against by watering and mulching. The best spray to use against this kind of mildew is Karathane.

DOWNY MILDEWS
These mildews are very different from the ones just described. The downy mildews grow deeply into the plant but they also produce a velvety, mould-like growth on the surface to release their spores. They include many serious troubles of flowers and vegetables.

Among vegetables they attack onion, spinach, pea, parsnip and lettuce, and among flowers there are similar mildews which attack antirrhinum, veronica, meconopsis, stock and other plants.

Control
It is the young plants that are seriously affected by these mildews, and a timely spray with zineb (dithane) is often required.

At no time allow the plants to suffer dryness at the roots.

CROWN GALL AND LEAFY GALL
Crown gall is the result of infection by Bacterium tumefaciens, leafy gall by Corynebacterium fascians.

Crown gall takes the form of a sphere varying in size from a pea to a cricket ball. It is hard with a smooth or rough surface and it usually occurs on the roots. Sometimes, however, it may show on aerial shoots of blackberry and other plants.

Leafy gall resembles a cauliflower-like mass of shortened shoots, growing usually at the base of the stem of the plant. It is usually rather soft. On sweet peas the shoots are very flattened, stunted and not so numerous.

Although crown gall may be seen on many herbaceous plants—gladioli, dahlias, etc.—it mostly attacks the roots of trees and shrubs—roses, apple and other fruit trees and even some conifers.

Any plants showing signs of leafy gall should be burnt and no cuttings should be taken from them except possibly in the case of pelargoniums, where the cutting material comes from upper shoots well away from the infected base of the stem.
### Diseases of Trees and Flowers

<table>
<thead>
<tr>
<th>Disease</th>
<th>Damage</th>
<th>Control</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hollyhock Rust</td>
<td>Underside of leaves take on bright tan colour. Often severe on weak old plants.</td>
<td>Feed to keep plants vigorous and replace every 2 years.</td>
</tr>
<tr>
<td>Iris Leaf Spot</td>
<td>Pale circular spots on leaves. Not usually serious</td>
<td>Keep beds well cleared of old leaves in spring.</td>
</tr>
<tr>
<td>Lilac Blight</td>
<td>Shoots and flowers blacken and wither</td>
<td>Cut out affected parts.</td>
</tr>
<tr>
<td>Aster (Michaelmas Daisy) Mildew</td>
<td>Plant looks as if covered in flour</td>
<td>Spray with Karathane and avoid dryness at the roots.</td>
</tr>
<tr>
<td>Narcissus Bulb Rot</td>
<td>Bulbs become brown, soft and shiny. Encouraged by wet soil</td>
<td>Choose well-drained site</td>
</tr>
<tr>
<td>Narcissus Stripe</td>
<td>Yellowish or light green stripes on the young leaf. Not as severe on some varieties</td>
<td>Discard affected plants in spring. Inspect when leaves are about 8 in. high.</td>
</tr>
</tbody>
</table>

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**DISEASES OF TREES AND FLOWERS**

**PAEONY STEM WILT**
- Damage: Mould appears at base of young stem
- Control: Water the crowns in early spring with Bordeaux mixture

**PHLOX LEAF SPOT**
- Damage: Small purple spots
- Control: Spray with copper fungicide

**POLYANTHUS LEAF SPOT**
- Damage: Pale yellow spots
- Control: Spray with copper fungicide

**RHODODENDRON BUD BLAST**
- Damage: Buds wither and often turn greyish
- Control: Spray third week in July with D.D.T. wash and repeat in 3 weeks

**ROSE BLACK SPOT**
- Damage: Black spots on leaves
- Control: Spray with captan

**ROSE MILDEW**
- Damage: Whitish powder on leaves and stems
- Control: Spray with Karathane
PLANT DISEASES

RUST DISEASES
Rust diseases are easily recognized as they commonly show on leaves and stems as yellow-brown- or orange-coloured pustules. These have a rusty appearance, hence the common name.

They are highly specialized and produce spore stages of different kinds in a definite order. The rusts are interesting, because although some produce all their spore stages on the same plant (autococious rusts) many produce them on different plants (heterococious rusts). In the latter the parasitic rust fungus is said to use alternate hosts, a factor of great importance when considering control measures.

It is of extreme importance to know the alternate host and the method by which the fungus lives and persists on its different host plants.

Some common examples of rust diseases are mint rust (Puccinia menthae), which produces all its spore stages on mint plants during the season, and currant rust (Cronartium ribicola), which has some spore stages on the black currant leaves in summer but also lives and produces other spores on the Weymouth pine and similar five-needled pines.

Control
Rust diseases are checked by a good spraying with Bordeaux mixture or colloidal copper.

In autococious rusts, where the parasite lives on the one kind of plant, control is fairly simple by destroying diseased plants and spraying.

With heterococious rusts it may also be necessary to seek out the alternate host and either destroy it or treat it by spraying.

THE HONEY FUNGUS (Armillaria mellea)
The honey fungus is an underground parasite which attacks the roots of trees and shrubs. It rarely shows above ground, except when it produces its honey-coloured clusters of toadstools on old stumps or at the base of trees which it has killed.

When it has killed a tree or shrub it sends out long, black, cord-like strands (rhizomorphs) which may be many feet in length. These grow through the soil to attack other trees.

Some people claim that it can only attack roots which have been injured or which are weakened by some other cause; many others believe it to be a more serious parasite. It is widespread, causes many losses and no tree or shrub is known to be immune. Where soil conditions are known to be adverse—excessively wet, for instance—the honey fungus seems to flourish, rather than in good, well-drained soils.

It is risky to clear woodland of old scrub and use the land immediately for young fruit trees. Honey fungus on old tree stumps and pieces of root may try to attack the young trees.

Control
Where trees are killed by this parasite, remove the stumps and all possible roots for burning. If this cannot be done, make a trench in a circle round each dead stump and throw the soil inward. Then fork over the soil inside the trench and saturate it with 2 per cent formalin solution in the usual manner. If the stumps are left treat them with creosote, pouring this into holes bored near the outer edge. This will discourage further fungal infection.

SILVER LEAF (Stereum purpureum)
This disease is well known but not well understood. The main symptom is the silvering of the leaves, but this is not entirely reliable because other agencies such as cold and aphid attack can sometimes cause foliage to become silvered. In trees or branches affected by the true
PLANT DISEASES

silver leaf fungus a brown irregular stain can usually be seen in the wood when the infected branch is cut across.

The real proof is the appearance of the typical purple-coloured fungus outgrowths, but these appear only on the dead wood.

The plum varieties Victoria and Czar are said to be very susceptible to this disease, but it also attacks peach, morello cherry, laburnum and Portugal laurel.

It is less commonly seen on currants, gooseberries and roses.

Control
Infection can occur only through a wound, and the way to prevent this disease from gaining entry is to treat all wounds with a good protective paint and to burn all dead wood before 15th July each year as required by the Silver Leaf Order of 1923. The intention is to prevent the fungus flourishing in dead wood.

2. DISEASES WHICH NORMALLY ATTACK ONE OR TWO KINDS OF PLANTS ONLY

As many diseases as possible are mentioned briefly under this heading or shown in the illustrations.

They are listed under their respective hosts

FRUIT DISEASES

BLACK CURRANT

RUST
Brown powdery appearance on leaf undersurface. Spray with colloidal copper after picking (or before on young stocks). Alternate host is five-needled pines.

GOOSEBERRY

DIEBACK
Branches die back and wither when near fruit harvest due to botrytis infection through wound or dead side shoot. Cut off behind point of infection and paint over cuts with a protective paint.

PEACH

LEAF CURL
Spray in January with Bordeaux mixture, or 3 per cent lime sulphur.

PEAR

MILDEW
White coating on shoot tips. Cut these off and spray with Karathane.

BROWN ROT
Fruit turns brown and develops white pustules. Cut out dead spurs and shoots when pruning. Bury deeply all rotten fruits. Keep the store clean and do not store bruised fruit. Pick and store when dry and wrap better-class fruits in special wrappers. Try to prevent injuries from wasps and birds. Control codling moth.

CANKERS
Scrape and cut out cankers, and paint cuts with a good paint.

RASPBERRY

GREY MOULD
On fruits should be checked by spraying with captan early in season.

VIRUS
Mosaic shows as yellow blotches or spots and crinkling of leaves. Some varieties are only slightly affected and may still bear fruit. If crippled they must be discarded.
**Diseases of Trees and Flowers**

**Sempervivum Rust**
- **Damage:** Leaves show bright tan-coloured spots
- **Control:** Destroy affected plants and spray the others with colloidal copper

**Tulip Breaking**
- **Damage:** White streaks or stripes in petal colour
- **Control:** If desired to keep stock pure, destroy all affected plants

**Sweet Pea Mosaic**
- **Damage:** Leaves mottled light and dark green
- **Control:** Keep down aphids—destroy affected plants

**Sweet William Rust**
- **Damage:** Characteristic rusting of leaves
- **Control:** Spray with colloidal copper in autumn

**Tulip Fire**
- **Damage:** Scorching of leaves and spotting on petals. Soil is contaminated
- **Control:** Treat soil with TCNB at planting time. Choose good bulbs and spray with zineb or captan very early in spring on young foliage

**Violet Leaf Spot**
- **Damage:** Pale or white spots
- **Control:** Spray with copper fungicide
PLANT DISEASES

3. TREE AND FLOWER DISEASES

**ALMOND**

**LEAF CURL**
Swollen and malformed reddish blisters on leaves. Spray before buds burst in January or February with lime sulphur. Half pint in 2 gal. water.

**ANTIRRHINUM**

**DOWNY MILDEW**
Furry grey mould on leaf undersurface. Destroy crippled plants, feed and spray with zineb.

**ASTER (Michaelmas daisy)**

**WILT**
Browning and withering of leaves from bottom of plant up. Take short cuttings in early spring and plant out on fresh site in April.

**ASTER (China)**

**FOOT ROT**
Often encouraged by wet conditions. Provide good drainage and water in with Cheshunt compound.

**WILT**
Very serious, attacks stem half-way up and prevents flowering. Also contaminates soil. Grow resistant varieties.

**BEGONIA**

**BACTERIAL WILT**
Brown spots on leaves and on stalks so that branches wilt and die. Cut off affected parts and spray with colloidal copper.

**CAMELLIA**

**LEAF BLOTCH**
Greyish blotches—in young rooted cuttings. Cut off affected parts and spray with captan.

**VIRUS**
Yellow spots and streaks but the disease is not important.

**CARNATION**

**STEM ROT**
Leaves turn yellow and wither. Destroy affected plants and use sterilized soil for the cuttings.

**LEAF SPOTS**
Spray with colloidal copper.

**DAHLIA**

**LEAFY GALL**
Cauliflower-like growth of leaves. Destroy affected plants.

**DELPHINIUM**

**MILDEW**
Spray with Karathane.

**BLACK ROOT ROT**
Due to wet soil and lack of humus for aeration of the roots.

**VIRUS**
Leaf mottling and stunted flowers. Destroy plants.

**ELM**

**DUTCH ELM DISEASE**
In July or August leaves on a branch turn yellow, wilt and turn brown but remain on the tree. The tree in time shows dead branches in its crown (stag-headed). Encourage vigorous growth.

**EUONYMUS**

**MILDEW**
Often serious in southern districts. Spray with Karathane.

**FREESIA**

**VIRUS**
Leaves show pronounced striping. Best to destroy heavily infected stock and plant new stock.

**GARDENIA**

**CANKER**
Cut off any affected branches and spray with colloidal copper.
PLANT DISEASES

GLADIOLUS
Dry Rot
Black lesions on corms. Dip in organo-mercurial dust before planting. Plant on a fresh site each season.

GLORINIA
Virus

GODETIA
Grey Mould
Dust with TCNB dust.

HYDRANGEA
Mildew
Spray with Karathane.

IRIS
Ink
On bulbous irises, black inky patches on bulbs, which should be burnt.

SOFT ROT
On bearded iris soft rotting of rhizomes. Remove dead parts. Use fungicidal dust.

Virus
Chiefly on bulbous iris—leaves show mottling and flowers show “breaking”. Burn affected plants.

LEAF SPOT
Not usually serious if beds are well cleared of old leaves etc., in spring.

JUNIPER
Rust
Swollen branches producing white horn-like fruiting bodies containing brown spores. Cut off and burn.

LABURNUM
Silver Leaf
Cut out and burn affected parts.

LARCH
Canker
Orange fungus bodies on the cankered areas. Cut out and burn affected parts.

LILAC
Blight
Blackens young shoots and flowers causing them to wither and droop. Cut out affected shoots.

LILIES
Botrytis
Spots and brown patches on leaves. Spray early with Bordeaux mixture.

Virus
Mosaic is common. Destroy infected plants and keep down aphids.

MAPLE
TAR SPOT
Black spots on leaves—not usually serious. Burn old leaves.

MECONOPSIS
Downy Mildew
Serious in seedlings. Spray with zineb. Provide good cultivation.

MICHAEILMAS DAISY (see Aster)

OAK
Mildew
Can be serious on young oaks. Spray with Karathane.

PRIMULA
Virus
Mottling on leaves. Very common on all kinds of primulas. Destroy affected plants.

RANUNCULUS
Rust
Cluster cups on leaves. Other host is cocksfoot grass. Destroy affected foliage and spray the plant with colloidal copper.

RHODODENDRON
Rust
Orange spots on underside of leaf—not very common. Alternate host is spruce. Spray with thiram.
ROSE
CHLOROSIS
Leaves become pale due to iron deficiency. Apply Sequestrene.

LEAF BLACK SPOT
Spray with captan. Pick off infected leaves.

CANKER
Remove brown cankered shoots by pruning.

SPRUCE
RUST
On needles. The alternate host is rhododendron. Do not, therefore, grow rhododendrons on a site that is near spruce plantations.

STOCK
FOOT ROT
Plant collapses. Too much water round roots. Destroy plants.

VIRUS
Flower “breaking” and mottled leaves. Often spread from infected brassicas. Destroy infected plants.

SWEET WILLIAM
RUST
Sometimes serious enough to need spraying of young plants with colloidal copper in autumn.

TATGETES
FOOT ROT
Due to wet soil conditions.

TULIP
FIRE
Scorching of leaves and spotting on petals. Soil is contaminated. Treat soil with TCNB at planting. Choose good bulbs and spray with zineb or captan early in spring on young foliage.

VIRUS
“Breaking” in flowers—plants are not much affected.

VIOLA
STEM ROT
Pansy Sickness—do not plant deeply—have good, well-drained soil—sprinkle 4 per cent Calomel Dust in planting holes, and change the site each season.

VIRUS
Causes “breaking” in flower petals. Affected plants should be destroyed.

VIOLET
SMUT
Swollen blisters on shoots, and leaves contain black powdery spores. Spray Bordeaux mixture after destroying affected plants.

WALLFLOWER
DOWNY MILDEW
Occasionally serious. Spray with zineb.

WINTER KILLING
Frost injury common on soft-grown plants.

VIRUS
Flower “breaking” and leaf mottling. The alternate host is cabbage. Be careful not to raise wallflowers near old cabbage beds.

WILLOW
CANKER
Brown spots on leaves. Small cankers on shoots. Cut away cankered wood and burn it. Paint over the cuts with tar.

RUST
Yellow spots on leaves, stems cankered. Spray early with Bordeaux mixture.

ZINNIA
SEEDLING BLIGHT
Seedlings die as result of infected seed. Destroy.

GREY MOULD
Serious in greenhouses and in wet seasons. Dust well with TCNB.
DISEASES OF VEGETABLES

BROAD BEAN CHOCOLATE SPOT
Damage: Brown streaks and spots encouraged by shortage of potash or lime
Control: Spray severe attacks with colloidal copper at end of April

BEAN RUST
Damage: Brown powdery pustules on underside of leaves
Control: Burn the old tops after crop is finished

BEETROOT LEAF SPOT
Damage: Pale spots on leaves. Not usually serious
Control: Burn old infected leaves

BROCCOLI RING SPOT
Damage: Brown spots surrounded by concentric rings
Control: Burn the old infected leaves

CELERY LEAF SPOT
Damage: Brownish-black spots on leaves. Seed-borne
Control: Buy clean seed. Spray with Bordeaux mixture early, even on young plants still in boxes

CABBAGE CLUB ROOT
Damage: Roots swell and smell unpleasant. Plants do not thrive, and wilt in hot sun
Control: Dress soil with lime and use 4 per cent Calomel Dust when planting out
DISEASES OF VEGETABLES

LETTUCE GREY MOULD

Damage: Grey moulded decay of plants, usually at ground level
Control: Spray TCNB or pull up and burn affected plants

MALLOW MOSAIC

Damage: Yellow mottling on young leaves
Control: Destroy affected plants

MINT RUST

Damage: Thickened shoots with orange-coloured cups
Control: Burn off old stems in autumn

ONION MILDEW

Damage: Plants soften and collapse. Mildewed areas are powdery white
Control: Spray with zineb

ONION NECK ROT

Damage: Neck of plant becomes soft and brown
Control: Harvest carefully. Dry under cover

ONION WHITE ROT

Damage: White fungus on roots
Control: Use 4 per cent Calomel Dust or TCNB dust in the seed drills
PLANT DISEASES

4. VEGETABLE DISEASES

**ASPARAGUS**

**FROST**
Causes pinching and shrinking of stem just below the bud.

**BEAN, DWARF AND RUNNER**

**ANTHRACNOSE**
Brown spotting on stems and pods often due to infected seed. Change site.

**FOOT ROT**
Frequently due to planting too often on same site.

**VIRUS**
Mosaic can be carried on the seed. Destroy infected plants.

**CABBAGE FAMILY**

**CLUB ROOT**
Thickened, swollen roots preventing good growth. Apply lime for brassicas.

**RING SPOT**
Brown spots with concentric rings. Not usually a serious disease.

**DOWNY MILDEW**
Common but rarely serious. Yellow patches on leaves. Spray young plants with zineb and do not allow them to suffer dryness of soil.

**VIRUS**
Several kinds, some infecting flower crops such as wallflower, stocks and candytuft. Destroy first affected plants. Keep down aphids.

**CUCUMBER**

**MILDEW**
Spray colloidal copper at half strength.

**VIRUS**
Mosaic green mottling in leaves. Destroy affected plants when young. Keep down insects.

**WITHERING**
Young fruits wither through weakness due to faulty cultivation.

**LEEK**

**SMUT**
Blisters full of black powder on leaves and bulbs. Water drills when sowing with formalin, \( \frac{1}{4} \) pint in 4 gal. water.

**LETTUCE**

**MILDEW**
Give good ventilation and use resistant varieties.

**GREY MOULD**
Rotting at soil level. Dust with TCNB and do not allow to wilt at any time.

**MOSS**
Prevent aphid infestations, especially from previous crops.

**MOSAIC**

**MARROW**
Young plants showing yellow mottling should be destroyed.

**ONION**

**MILDEW**
Serious—spray with zineb.

**WHITE ROT**
White fungus destroys roots—treat drills when sowing with 4 per cent Calomel Dust, 1 oz. to 10-ft. drill, or TCNB dust.

**SMUT**
Blisters full of black powder on leaves and bulbs. Water drills when sowing with formalin \( \frac{1}{4} \) pint in 4 gal. water.

**VIRUS**
Stripe. Serious in shallots. Get a new stock. Not so serious in onions except in bulbs kept for a seed crop.

**PEA**

**FOOT ROT**
Change the site each season.

**POTATO**

**DRY ROT**
Shrivelling of seed tubers—do not plant infected stock.
PLANT DISEASES

BLACKLEG
In June base of stem blackens and leaves yellow. Not a serious disease.

VIRUS
Several serious ones. Avoid by planting fresh Scotch seed at least every 2 years.

Rhubarb
Crown Rot
Black rotten areas below crown. Change site and get fresh sets.

Shallot (see Onion)

Swede
Virus
Young leaves are yellow, thickened and stunted (see Cabbage).

Mildew
Can be serious. Spray with Karathane for small areas.

Sweet Corn
Smut
Some grains swollen and full of black powdery spores. Cut out and burn infected parts while young.

Tomato
Stem Rot
Remove affected plants and spray with captan.

Grey Mould
Reduce the humidity and dust the plants with TCNB.

Wilt
Mound up soil round stem base and shade plants.

Blight
Symptoms the same as potato blight. Appears on outdoor plants only. Spray with colloidal copper when the plants are "stopped".

Virus
Several viruses known causing severe mosaic, streak and malformations. Destroy plants.

Flower drop
Dry soil conditions.

Small Fruits
Poor pollination due to dry air conditions.

Blossom End Rot
In fruits; short of water when young.

Cracking
Alternate wet and dry conditions.

Turnip
Club Root (see Cabbage)

Virus
Yellowish-green mottling on leaves. Destroy plants.
PARSNIP CANKER

Damage: Brown rotten patch on root. Cause unknown
Control: Do not sow too early

PEA MILDEW

Damage: Haulms look powdery white
Control: Good cultivation. Get rid of old rows as soon as clean-picked

PEA POD SPOT

Damage: Brown sunken spots with darker margins
Control: After picking, burn tops and buy clean seed

POTATO BLIGHT ON LEAVES

Damage: Brown marks
Control: Spray with Bordeaux mixture before the tops touch in the rows. Earth up well

POTATO BLIGHT ON TUBERS

Damage: Browning of skin and outer flesh
Control: Spray with Bordeaux mixture before the tops touch in the rows. Earth up well

POTATO COMMON SCAB

Damage: Scabby growths on tuber
Control: Include plenty of humus in the soil. Feed with sulphate of ammonia when plants are young

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DISEASES OF VEGETABLES

POTATO WART

Damage: Wart-like growths on tuber
Control: Grow immune varieties

SPINACH DOWNY MILDEW

Damage: Often serious. Grows deeply into plant
Control: Thin young plants out well and spray with zineb. Change the site each year

TOMATO BUCK-EYE ROT

Damage: Brown concentric zones on fruit
Control: Mulch the soil surface to prevent water splashing

TOMATO FOOT ROT

Damage: Brown decay at stem base
Control: Earth up bases and water with Cheshunt compound

TOMATO LEAF MOULD

Damage: Leaves have velvety brown spots
Control: Spray with zineb. Choose resistant varieties

TOMATO MAGNESIUM DEFICIENCY

Damage: Orange-yellow patches on leaves
Control: Several sprayings with Epsom salts, 3 oz. in 1 gal. water at 2- to 3-week intervals
GARDEN PESTS

Plants are a source of food for many types of insects and other small creatures, and there are few plants which are not attacked by them. In some cases the attacks may be sporadic and unpredictable, but most of the more serious pest attacks can be expected to cause damage to certain plants year after year. The severity of the attacks usually depends on the weather conditions of the current and previous seasons. A mild, wet autumn is often followed by a severe infestation of leatherjackets in the spring, and hot weather is ideal for the multiplication of greenfly and other aphids.

The variation in the range of pests found in different localities is probably due to the climate, but is also influenced by the amount of shelter from the weather, the type of soil and the kind of vegetation growing near the garden.

No single garden is therefore likely to harbour all the pests mentioned in this chapter, and preventive measures should only be taken if pests are known to be present and they are causing appreciable damage to plants.

It is wise to learn to recognize the more common types of pest feeding on the plants, and, during a few years of experience, to build up a general idea of the degree of damage caused by those which occur regularly.

Pests can usually be divided roughly into three categories:
(a) those which cause so little damage that control is unnecessary;
(b) those which normally cause little damage but are liable to increase under certain conditions, such as hot weather, rain, etc. Keep these pests under observation and deal with them if they show signs of increasing;
(c) those which cause severe damage every year. If possible take preventive measures before they appear, or destroy them as soon as they are seen.

If these points are kept in mind pesticides need not be used unnecessarily and the beneficial insects, of which there are large numbers, will have a chance to exert a natural control over the pests.

BUYING PESTICIDES

There are a great many pesticides available and each one may be sold under a variety of trade names. Make sure that any pesticide bought bears on the label the mark of the Agricultural Chemicals Approval Scheme which is operated by the Ministry of Agriculture, Fisheries and Food. The labels of approved products will also indicate which pests are controlled by the pesticide and which plants are adversely affected by the chemical.

USING A PESTICIDE

1. Before using a pesticide read the instructions carefully.
2. Do not use more pesticide than is recommended or the plants may be damaged.
3. Spray during dull weather or in the evening as damage can be caused by spraying in bright sunshine.
5. Do not spray in windy weather when the spray might drift to open blooms.
GARDEN PESTS

or to fruit and vegetables ready for picking.
6. Most pesticides are poisonous to human beings and it is unwise therefore to smoke or eat while applying them. They are also poisonous to domestic animals.
7. After spraying, store all pesticides out of reach of children, wash out the utensils used and wash the hands thoroughly.

LATEST APPLICATION
Allow three weeks to elapse between the spraying and harvesting of edible plants sprayed with aldrin and dieldrin. For plants sprayed with D.D.T., B.H.C. and lindane allow two weeks, for those sprayed with malathion one week, and for those sprayed with nicotine two days. Derris is non-poisonous to human beings but, as with the other materials recommended, do not use it near ponds containing fish.

The information in the following pages will enable the gardener to recognize and deal with the more important and troublesome garden pests.

It is impossible to include all the pests which may be found; should any of the less common pests suddenly appear in larger numbers than usual, help can be obtained from the advisory services of the gardening press or insecticide manufacturers.

GENERAL GARDEN PESTS

ANTS
Ants of various species, especially the Black Ant, are responsible for many types of damage in the garden. In borders and rock gardens, their underground nests loosen the soil round the roots of plants, causing them to wilt and die. On lawns, the small piles of loose soil round the entrances to their nests are unsightly and may impede mowing. Ants may also swarm over plants infested with aphids and feed on the honeydew excreted by these pests, but they rarely damage the plants directly, although they may sometimes injure the blossoms when hunting for nectar. They also feed on ripe fruit, particularly when it has already been damaged by earwigs or wasps.

Control
Soak the nest thoroughly by pouring aldrin into the entrances, or apply aldrin dust to the entrances and runs.

CHAFFER GRUBS
These are the larvae of the Cockchafer and related beetles. The largest of them grow to 1½ in. long, and all species have whitish, C-shaped bodies with brown heads. They feed on the underground parts of many plants including shrubs and trees.

Control
Dress infested land with aldrin dust or, if no root vegetables are to be grown for 18 months, with lindane, forking the dust thoroughly into the top 4 in. of soil. If the pests are attacking the roots of established plants, water the soil well with liquid aldrin or lindane, but lift the plants as soon as possible and replant them, after the grubs have been removed, in soil previously treated with insecticide.

CUTWORMS
Cutworms are fat, brown or greenish caterpillars which feed on the surface of the soil at night, gnawing the stems and leaves of plants at ground level, and hiding just under the surface or among long vegetation during the day. If the stems are damaged, the plants wilt and collapse.

Cutworms attack many types of
**CHAFER GRUB**

*Damage:* Attacks roots of herbaceous plants, shrubs and trees.
*Control:* Treat land with lindane or aldrin dust. Water established plants with liquid aldrin or lindane.

**ANT**

*Damage:* Loosens soil round roots; plants wilt; associated with aphids.
*Control:* Aldrin.

**CUTWORM**

*Damage:* Gnaws collar of plant; plants collapse; eats roots and tubers.
*Control:* Dust surface of soil with D.D.T. or aldrin.

**SWIFT MOTH CATERPILLAR**

*Damage:* Tunnels into tubers, bulbs and corms.
*Control:* Dust surface of soil with aldrin.

**LEATHERJACKET**

*Damage:* Feeds on roots of grass, causing dead patches on lawns; eats underground parts, causing failure of plants.
*Control:* Apply D.D.T. or aldrin to soil.

**MILLIPEDE**

*Damage:* Feeds on roots and seeds; attacks newly sown seeds of pulse crops.
*Control:* Use lindane or aldrin dust on soil or to dress seeds.
Vegetables as well as ornamental plants, such as marigolds, chrysanthemums and rock plants. They also damage roots and gnaw into potato tubers and root vegetables.

**Control**
Dust the ground under attacked plants with D.D.T. or aldrin.

**Leatherjackets**
The larvae of the harmless Cranefly or Daddy-long-legs are the notorious and destructive Leatherjackets. These legless, grey-brown or grey-black grubs grow up to 1½ in. long and have tough, wrinkled skins. They feed underground on many types of plant roots as well as bulbs and tubers, and are also common pests on lawns, where they cause patches of grass to die.

These pests are inevitably more troublesome after a wet autumn as they must have moist conditions to survive. They are seldom serious pests in dry, sandy areas.

**Control**
In mild weather during late autumn or spring, when the grubs are near the surface, spray infested soil with D.D.T. or dress with aldrin or D.D.T. dust. Lawns should be thoroughly watered with a dilute D.D.T. solution.

**Millipedes**
Snake Millipedes are often mistaken for wireworms (see page 384) because they also have shiny, cylindrical bodies, but they can be distinguished by their numerous short, bristle-like legs, and by their peculiar habit of coiling up like a watch-spring when disturbed. They grow to about 1 in. in length, and vary in width from about 2 mm.
in colour from cream to black. Less common are the Flat Millipedes which have flatter bodies than the Snake Millipedes.

These pests feed on the roots of many plants, will destroy the sown seeds of peas and beans, and may also extend the damage caused by slugs and wireworms.

Control
Dress the soil with aldrin or lindane dust. To protect pea and bean seed, dust the drill with aldrin before covering.

SLUGS AND SNAILS
Slugs and sometimes snails can be very destructive creatures in the garden. They attack many types of plant, particularly the low-growing ones whose foliage touches the soil, by eating holes out of the stems, leaves and petals. The damage is often confused with that done by caterpillars and other insects, but slugs and snails usually leave trails of slime on the plant. These pests are abundant in wet, cool conditions, especially on soils containing plenty of humus. They feed at night, and during the day hide under vegetation or under the soil surface.

Strawberries are the only fruits which are likely to be seriously damaged by slugs, although raspberries and gooseberries may sometimes suffer. The pests eat large cavities out of the flesh of the fruits, and the young foliage is also attacked. In the vegetable garden they often eat holes in lettuce, spinach and cabbage. Celery is also a favourite food and the stalks are often badly damaged after earthing up. The small blackish Keeled Slugs are particularly troublesome, as they usually live underground and feed on roots and tunnel into potatoes, carrots and turnips.

Control
To make poison bait, mix 1 oz. powdered metaldehyde with 3 lb. bran or (for Keeled Slugs) bone meal. Spread the bait thinly on the ground or place it in small heaps, and protect it from rain by raised tiles or by placing it in a small flower-pot laid on its side. Proprietary slug baits can be bought ready-made and there are also metaldehyde sprays which can be applied to the plants.

SWIFT MOTH CATERPILLARS
Swift Moth caterpillars are large, whitish creatures with brown heads, which wriggle quickly backward when disturbed. They live in the soil feeding on roots and tunnelling into bulbs, tubers and corms.

Control
Dress the soil with aldrin dust and work it into the top few inches. Established plants should be watered copiously with liquid aldrin.

WIREWORMS
Wireworms, the cylindrical, golden-yellow larvae of Click Beetles, grow up to 1 in. long and, unlike the millipedes with which they are often confused, have only three pairs of legs at the front of the body. They are present in the soil of most gardens, but not always in sufficient numbers to be troublesome. They feed on the roots of a wide range of plants and tunnel into potatoes and other tubers. They may attack bulbs and corms.

Control
If the damage is serious, dress the soil with aldrin dust and fork it into the top 4 in.

Lindane dust may also be used on ground where no root vegetables are to be grown within 18 months.

WOODLICE
Woodlice are the grey or brownish creatures with oval, armour-plated bodies which are found in the dark, damp places of every garden, hiding under stones, under loose bark and in
tangled vegetation. They cause serious damage only in sheltered, humid conditions, such as frames and greenhouses, or if they are present in large numbers. At night they feed on the roots, stems and leaves of most plants.

**Control**
Eliminate the dark, damp hiding places frequented by the pests during the day or, if this is impossible, dust or spray the hiding places and infested areas with D.D.T. or B.H.C.

**PESTS OF THE VEGETABLE GARDEN**

**APHIDS** (Greenfly, Blackfly, etc.)
These are the most abundant pests in the garden, and most plants, including vegetables, are liable to attack by one or more species of aphids. A close watch should be kept for them and, even if only a few are seen, they should be destroyed immediately as they can multiply very quickly, especially when the weather is warm. Aphids feed by sucking the sap from a plant and, by congregating on the tender young growth, can quickly cripple it and cause general stunting. Many species also transmit virus diseases which can reduce or wipe out a crop. The following are the most important species which attack vegetables:

The Black Bean Aphid, greenish-black in colour, is found on beans, beetroot and spinach. The Carrot Aphid is very difficult to see since its colour is almost exactly the same as the leaves of the carrot. The Cabbage Aphid has a mealy, greyish-white appearance and is found in tightly packed colonies on the leaves of cabbage, Brussels sprouts and cauliflower. It must be controlled in the early stages of infestation because, once it has invaded the inner leaves of cabbage hearts and sprouts, it is difficult to reach with insecticides and it makes the plants practically inedible. The Lettuce Aphid is green and transmits a virus which severely stunts lettuces.

**Control**
Spray or dust with malathion, lindane or nicotine, repeating the application as necessary.

**CATERPILLARS**
Caterpillars of the Large White Cabbage Butterfly, which have green, black and yellow markings, and the velvety green caterpillars of the Small White Cabbage Butterfly are common pests of cabbages, cauliflowers and related plants. They eat holes in the leaves, starting on the outer ones, and leaving nothing but the skeleton of main veins. The caterpillars of the less common Cabbage Moth, yellowish-green on the underside and dark, brownish-green on the back, are less common but more difficult to control, because they tunnel into the interior of cabbages and destroy the hearts. They also attack onions, lettuces and peas.

**Control**
If possible crush the yellow eggs which are laid singly or in clusters on the underside of the leaves. The best control is obtained when the caterpillars are young. As soon as damage is seen, spray or dust with D.D.T. Apply derris if the crops are within two weeks of harvesting.

**CELERY FLY**
The pale green maggot of the Celery Fly feeds inside the tissues of the leaves of celery and parsnip, forming large blisters which turn brown, and eventually cause the death of the leaves.

**Control**
As soon as the first signs of attack are seen, spray with lindane or malathion, and give a further two to three applications at weekly intervals. Early treatment will prevent more serious trouble later.
PESTS OF THE VEGETABLE GARDEN

BLACK BEAN APHID

Damage: Smothers young growth, particularly broad beans
Control: Spray with malathion, lindane or nicotine

CABBAGE MOTH

Damage: Tunnels in cabbages and allied plants
Control: Crush eggs and spray early with D.D.T. or, if crops are near maturity, with derris

CABBAGE ROOT FLY

Damage: Maggots feed in the roots causing wilting of the plant. In severe attacks plants killed
Control: Use aldrin as seed-dressing or root drench

LARGE WHITE CABBAGE BUTTERFLY

Damage: Eats leaves, sometimes leaving only skeleton of leaf
Control: Spray with D.D.T. or derris when caterpillars are still young

CARROT FLY

Damage: Maggots tunnel into roots of carrots, parsley and celery. Carrot leaves turn reddish
Control: Dust seed drill with aldrin. Dress seedlings with lindane

CELERY FLY

Damage: Attacks celery and parsnip, forming brownish blisters on the leaves
Control: Spray with lindane or malathion. Pick off and burn damaged leaves

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## Pests of the Vegetable Garden

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<tr>
<th>Pest</th>
<th>Damage</th>
<th>Control</th>
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</thead>
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<tr>
<td><strong>Flea Beetle</strong></td>
<td>Attacks cabbage and allied plants. Peppers the leaves with tiny, round holes. Beetles jump when disturbed.</td>
<td>Spray or dust with D.D.T. or lindane.</td>
</tr>
<tr>
<td><strong>Onion Fly</strong></td>
<td>Maggots burrow into bulbs of developing plants. Bulbs rot. Leaves turn yellow and collapse.</td>
<td>Dress seeds or rows of seedlings with aldrin.</td>
</tr>
<tr>
<td><strong>Pea Moth</strong></td>
<td>Caterpillar feeds inside the pods, eating into the peas.</td>
<td>Spray main-crop peas with D.D.T., or sow early and late varieties.</td>
</tr>
<tr>
<td><strong>Pea Thrips</strong></td>
<td>Attacks flowers, preventing formation of pod; outside of developing pod mottled silver. Similar marking on leaves.</td>
<td>Spray with nicotine, D.D.T. or malathion.</td>
</tr>
<tr>
<td><strong>Potato Root Eelworm</strong></td>
<td>Infests potato roots causing them to rot. Lower leaves wither and drop. Poor yield.</td>
<td>Buy certified &quot;seed&quot;. Do not plant on infested land for 5 to 8 years.</td>
</tr>
</tbody>
</table>
| **Turnip Gall Weevil** | Globular swellings on roots of brassicas. Causes stunting of young plants. | Dust rows of seedlings with lindane. Burn stumps of affected plants. }
GARDEN PESTS

CUTWORMS
Cutworms attack many types of vegetable, especially lettuce and brassicas. (See General Garden Pests, page 381.)

EELWORMS
Eelworms are so small that they are not normally visible to the naked eye, but they can, nevertheless, cause serious damage to certain plants and are difficult to eradicate. As chemical control is difficult and very expensive at present, the most practical control is to starve out the eelworms by not planting their food plants on infested soil for a number of years.

Potato Root Eelworms attack potatoes, feeding on the roots and causing them to rot. The growth of such potatoes is poor, the lower leaves wither and drop off, and on infested land the yield of tubers dwindles progressively each year.

Control
To prevent infestation buy only certified “seed”. Do not plant potatoes on heavily infested land for five to eight years. On medium or heavy soils, grow maincrop potatoes once in four years, and on light soils once in six to seven years. Grow early potatoes every three years or twice in succession every five years.

Stem and Bulb Eelworms sometimes attack onions, causing them to become swollen and puffy at the base with distorted, twisted leaves (“onion bulb”). The plants later start to rot. This pest also feeds on chives, leeks, shallots, beans, parsnips, rhubarb and strawberries.

Control
Do not grow any of the food plants on infested soil for three years, and thereafter practise a three-yearly rotation.

FLEA BEETLES
There are a number of species of Flea Beetle which attack garden plants, particularly cabbages, radishes, turnips and swedes. They are black, or black and yellow, insects, one-tenth in. long, which leap off the plants on to the soil when disturbed. The beetles eat small holes in the leaves, which eventually look as though they have been peppered by small shot. The worst damage occurs on seedlings, which are often killed off by these pests.

Control
Spray or dust the seedlings at weekly intervals with D.D.T. or lindane until the rough leaves are well developed, when the plants should be able to withstand later attacks.

FEA MOTH
Pea Moth caterpillars are pale yellow with black heads, and can cause serious damage in some localities. They are found inside the pods, feeding on the peas, and produce what are known as “maggoty peas”. Peas which are in flower between mid-June and mid-August are most susceptible to damage.

Control
In areas where this pest is prevalent, sow early varieties of peas to escape the worst of the damage, or sow in late June or July. Peas which come into flower between June and August should be sprayed with D.D.T. seven to ten days after flowering has begun and again ten days later.

PEA THRIPS
Thrips are minute insects, seldom noticeable, which are particularly abundant in warm, dry weather. The Pea Thrips, the only important species which attacks vegetables, is black and only one-fifteenth in. long. It attacks peas and broad beans, injuring the flowers so badly that the pods may fail to develop or, if they do develop, they are often small and distorted or have a distinctive, silvery, mottled appearance. The leaves are also speckled silvery-white where the insects have sucked the sap from the cells.
GARDEN PEDEST

Control
As soon as the first signs of damage are seen, spray or dust with D.D.T., nicotine or malathion, and repeat applications at ten-day intervals as necessary. Regular syringing with water in dry weather also helps to reduce damage.

ROOT MAGGOTS
The larvae of certain flies are common and destructive pests of vegetables in many areas. The maggots are small, whitish, peg-shaped creatures without legs or visible heads, which feed on the roots of vegetables.

The maggots of the Cabbage Root Fly eat away the lateral roots of cabbages and related plants, and then tunnel in the main root. Attacked plants are retarded in growth and may wilt and die. This pest also tunnels in the roots of turnips, swedes and radishes.

Control
To prevent damage to root crops and to the seedlings of the cabbage family, dust the seed drills with aldrin before covering. When transplanting, dip the roots of brassicas in a liquid solution of aldrin or dieldrin, or apply either of these chemicals as a root drench within four days of planting.

Carrot Fly maggots tunnel in the roots of carrots, parsley and celery, so that the roots are deformed and the plants stunted. The foliage of carrots may become reddish in colour. Attacked seedlings are often killed in dry weather.

Control
Dust the seed drills with aldrin before covering, or apply a 4-in. band of lindane dust along the rows of seedlings when they are 2 to 4 in. high. Carrots sown in late May or early June or in exposed, windy positions, are less likely to be attacked. Garden twine, soaked in creosote and strung on pegs between the rows, will help ward off egg-laying flies.

The maggots of the Onion Fly burrow into the bulbs of onions and shallots. The leaves turn yellow and collapse and the bulbs may be reduced to a soft, rotting mass. Dig up such plants immediately and also the soil round them because the maggots will often move on to feed on healthy plants.

Control
Onion and shallot sets which have been dipped in liquid aldrin or dusted with aldrin powder before being planted will not be attacked. Protect growth from seed by dusting the drills with aldrin before covering, or by applying a 4-in. band of dust along the rows of seedlings when they appear.

SLUGS
Slugs attack lettuce, spinach, cabbage and celery. (See General Garden Pests, page 381.)

TURNIP GALL WEEVIL
Round swellings on the roots of turnips, swedes, cabbages and related plants may be caused either by the disease Club-root, in which case the swellings will be solid, or by the larvae of the Turnip Gall Weevil, in which case the cut-open gall will reveal a cavity, often containing a small, white, curved grub. These pests cause stunting of young plants and make them less able to withstand dry weather.

Control
Apply a 2-in. band of lindane dust along the rows of seedlings when they have two rough leaves. Wherever possible, discard galled plants when transplanting but, if they must be used, cut off the galls first and feed the plants well. Burn galled cabbage stumps.

WIREWORMS
Wireworms attack potatoes, carrots and turnips. (See General Garden Pests, page 381.)
PESTS OF THE FRUIT GARDEN

'BIG BUD' MITE

Damage: Invades buds of black currants. Buds swell and wither.
Control: Burn badly affected plants. Spray new plants annually with lime sulphur.

BROWN SCALE

Damage: Sucks sap of plums, peaches and soft fruits.
Control: Spray with tar oil winter wash.

COMMON GREEN CAPSID

Damage: Causes brown patches on pears and plums, also distortion and raggedness on leaves of currants and gooseberries.

CURRANT BLISTER APHID

Damage: Causes raised, reddish-brown or yellow blisters on leaves of currants.
Control: Use D.D.T. emulsion, malathion or nicotine before flowers open.

CURRANT-LETTUCE APHID

Damage: Terminal leaves mottled yellow and tightly curled.
Control: Spray with D.D.T. emulsion, malathion or nicotine before flowers open.

GOOSEBERRY RED SPIDER MITE

Damage: Infests leaves of gooseberries which pale, wither and drop.
Control: Use malathion or derris after flowering. Repeat at 14-day intervals.
PESTS OF THE FRUIT GARDEN

GOOSEBERRY SAWFLY

Damage: Attacks leaves, only mid-ribs being left
Control: Spray or dust with D.D.T. or derris

RASPBERRY APHID

Damage: Feeds at tips of canes, young leaves curl
Control: Tar oil wash in winter

RASPBERRY BEETLE

Damage: Grubs feed first on outside of developing fruit, then inside fruit
Control: Use derris or D.D.T. 10 days after full bloom, Repeat after 10 days

PESTS OF THE FRUIT GARDEN

APHIDS

By sucking the sap, aphids can cause devitalization and reduction of crop on all types of fruit. The eggs are laid on the bark in the autumn and infestation starts when they hatch in the early spring. The young insects are usually hidden deep in the folds of the developing leaves, but their presence is often betrayed on sunny days by ants, which run up and down the trunk feeding on the sugary honeydew excreted by the pests. If aphids are not dealt with in the early stages they will quickly multiply and cluster on the young shoots and on the underside of young leaves, often causing them to become severely distorted and, in some cases, discoloured.

It is possible to deal here with only a few of the more common species of aphids which infest fruit, but, with few exceptions, notably the easily recognized Woolly Aphid on apple, the control measures recommended are adequate for all species.

Apples are attacked by the Green Apple Aphid and the Rosy Apple Aphid which cause curling of the young leaves at the tips of new shoots. The latter species also attacks young fruits, causing them to become stunted and misshapen. The purplish-brown Woolly Aphid is distinguished by the masses of white "wool" which cover the colonies. This species feeds on bark and causes the formation of swollen tumours, which later tend to split as the wood grows and thus allow disease organisms to enter.

Currants are attacked by the whitish Currant Blister Aphid, which causes the
formation of raised blisters on the leaves. These blisters are usually a reddish-brown, but on black currants may be yellow. The green Currant-Lettuce Aphid causes the terminal leaves to curl tightly and become mottled with yellow.

Gooseberries are most likely to be infested by the Lettuce Aphid, and the symptoms of attack are the formation of small curled leaves at the tips of the shoots.

Pears are not so likely to be damaged by aphids as other fruits, but the Pear-Bedstraw Aphid may occasionally be troublesome, curling the young leaves.

Plums are often severely crippled in the spring by the Plum Leaf-curling Aphid, which causes the leaves to become tightly curled and coated with sticky honeydew. Later, in the summer, the foliage may be attacked by the Mealy Plum Aphid which covers the underside of the leaves. It is a pale green species with a white powdery covering. It does not cause leaf-curling but may cause the leaves to fall prematurely.

Raspberries may be damaged by the greyish-green Raspberry Aphids, which congregate at the tips of the canes causing curling of the young leaves.

Strawberries are very prone to aphid attack, especially by the greenish-brown Shallot Aphid, which causes the leaves to become twisted and the flower trusses stunted, and by the Strawberry Aphid, a pale creamy-coloured insect which is an important carrier of virus diseases.

Control of Woolly Aphid
Spray with lindane or malathion at the pink-bud stage of apple blossoms. Colonies seen after blossom should be sprayed only with malathion or else painted with 10 per cent tar oil.

Control of other aphids
Kill the over-wintering eggs on tree fruits, currants and gooseberries by spraying every fourth year with 5 per cent tar oil in December or early January when the plants are completely dormant. During the intervening years apply sprays in spring as follows:

Tree fruits—D.D.T. emulsion, lindane, malathion or nicotine between bud-burst and the appearance of the green blossom buds.

Currants—D.D.T. emulsion, malathion or nicotine just before the flowers open (late "grape" stage).

Gooseberries—D.D.T. emulsion, malathion or nicotine immediately after blossoming.

Raspberries—Tar oil each winter.

Strawberries—Malathion or nicotine just before flowering and again after picking.

Outbreaks of aphids during the summer should be dealt with by spraying or dusting with malathion or nicotine.

APPLE BLOSSOM WEEVIL
The Apple Blossom Weevil, formerly an important pest, is now easily controlled by D.D.T., but may still be found in great numbers in neglected orchards, particularly near woods. The adult weevil lays its eggs on the unopened flower buds of apple and sometimes of pear. The whitish grubs which hatch out feed inside the buds, prevent them from opening and cause them to wither, so that these brown "capped" blossoms are noticeable after the other blossoms have shed their petals. The grubs, or yellowish pupae, are usually found inside the blossoms if they are opened.

Control
Apply D.D.T. at the bud-break stage. One application should give adequate control for a number of years.

"BIG BUD" MITE
The "Big Bud" Mite, or Black Currant Gall Mite, microscopic in size and invisible to the naked eye, invades the buds
of black currants in vast numbers, and
the buds become globular and swollen
to about twice their normal size. Infested
buds usually wither and die without
producing leaves, and the general effect
is a progressive reduction in the yield of
fruit.

The mite is also responsible for the
spread of the virus disease known as
“Reversion”, which also causes gradual
deterioration of yield.

Control
The complete eradication of this mite is
extremely difficult. The bushes which
are badly affected either by “Big Bud” or
“Reversion” should be dug out and
burnt. On newly planted or lightly
infested bushes, keep the pest in check by
spraying with 2 per cent lime sulphur
just before the blossoms open, and again
with 1 per cent lime sulphur three weeks
later.

Capsid Bugs
Capsid bugs are fast-moving, active
insects which resemble aphids when
young but grow to about ½ in. long. They
feed by piercing the leaves or fruit and
sucking the sap.

The Apple Capsid feeds on the leaves
of apple and causes some distortion.
Damage to the fruit is, however, more
serious, and where the insects have fed,
rough brown patches appear on the sur-
face of the skin which may also be raised
like a wart. Although attacked fruit may
be unsightly, the flesh is usually perfectly
sound and the apples can safely be stored.

The Common Green Capsid attacks a
wide variety of soft fruits and tree fruits.
As with the Apple Capsid, rough brown
patches appear on the skin of pears and
plums which may also be distorted and
split. On bush fruits such as currant or
gooseberry small brown spots develop
on the young leaves which become dis-
torted and torn as they grow.

Control
Spray tree fruits with D.D.T. or B.H.C.
when the blossom buds are still green.
Currants and gooseberries should be
sprayed with D.D.T. only; the currants
just before flowering (“grape” stage) and
the gooseberries just after flowering.

Caterpillars
Caterpillars of one type or another are
common pests on fruit, particularly tree
fruits, and those which feed on the
foliage can reduce the leaf area so much
that crops suffer a severe check. Some,
such as the Codling Moth caterpillar,
damage the fruit itself.

Codling Moth caterpillars are among
the most common and destructive of
apple pests and, together with the larvae
of the Apple Sawfly, are responsible for
the condition known as “maggoty
apples”. The Codling caterpillar is pink-
coloured and enters either near the “eye”
of the fruit or by a hole in the side which
is often surrounded by a red ring. It
burrows into the apple and feeds round
the core. If attacked apples do not fall
prematurely, the mature caterpillars
descend the trunk from late August
onward and hibernate in cracks and
crevices in the bark. The control mea-
ures are quite different from those used
against the Apple Sawfly, and it is there-
fore important to be able to distinguish
these two pests (see page 397).

Control
Provide the caterpillars with hibernating
quarters by tying corrugated paper or
loose sacking round the tops of the
trunks in mid-July, removing and burn-
ing them during the winter. Pick up and
destroy all prematurely fallen fruit.
Spray the trees with D.D.T. in mid-June
and again three weeks later, adding mal-
thion or derris to keep red spider in check.

Fruit Tree Tortrix Moth caterpillars
are small, greyish-green creatures. In the
**APPLE BLOSSOM WEEVIL**

*Damage:* Grubs hatch on opening buds and burrow inside them. Buds dry and go brown
*Control:* Use D.D.T. at bud-break stage

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**APPLE CAPSID**

*Damage:* Feeds on leaves causing distortion, and on developing fruit causing wart-like growths
*Control:* Use D.D.T. or B.H.C. at green-bud stage

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**APPLE SAWFLY**

*Damage:* Maggots tunnel in the fruitlets and make ribbon scars on surface. Attacked fruit smells
*Control:* Use lindane at petal-fall

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**CODLING MOTH**

*Damage:* Caterpillars burrow into fruit, feeding at the core
*Control:* Tie corrugated paper or sacking round tops of trunks in July. Burn in winter. Spray twice with D.D.T. in midsummer

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**FRUIT TREE RED SPIDER MITE**

*Damage:* Leaves speckled with yellow, later silvering and even later bronzing
*Control:* Destroy over-wintering eggs with D.N.C.-petroleum in late winter or malathion or derris in early June

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**GREEN APPLE APHID**

*Damage:* Curling of young leaves and distortion of new growth
*Control:* Use D.D.T. emulsion, lindane, malathion after bud-burst. Spray with tar oil in winter
PESTS OF THE FRUIT GARDEN

MEALY PLUM APHID

Damage: Attacks underside of leaves in summer, causing them to fall prematurely
Control: Apply malathion or nicotine

MUSSEL SCALE

Damage: Sucks sap. Found on most trees and bush fruits, but mainly attacks apple
Control: Spray with tar oil winter wash

PEAR MIDGE

Damage: Maggots feed inside young fruitlets, causing abnormal swelling
Control: Use D.D.T. at white-bud stage. Hand pick and burn infested fruitlets

PLUM LEAF-CURLING APHID

Damage: Attacks young leaves, curling them tightly and coating with sticky honey-dew
Control: Apply malathion or lindane after bud-burst

PLUM SAWFLY

Damage: Larvae enter young fruitlets leaving small hole which oozes a sticky black fluid
Control: Use lindane a week after petal-fall

ROSY APPLE APHID

Damage: Curling of young leaves and distortion of fruit
Control: Use D.D.T. emulsion, lindane, malathion after bud-burst. Spray with tar oil in winter
spring or early summer they feed on the leaves of apple and other tree fruits after rolling them up or tying them together with silk webbing. Later they may attach a leaf to a developing fruit and feed underneath on the skin, making small holes which appear unimportant but which allow the entry of disease organisms. Fruit damaged in this way cannot be stored.

Control
Apply D.D.T. when the green flower buds appear.

Caterpillars of the Winter Moth and its relatives feed on the foliage of apple, pear and plum from April to June, and also on the flower trusses and the developing fruitlets. They are green with pale lines along their bodies. A curious feature of this species is that the female moths are wingless and must climb the tree trunk to lay their eggs.

Control
Spray with D.D.T. when the green flower buds appear. If spraying is not possible, apply tree-banding grease in a 3-in. band round the trunk before the end of September, to prevent the wingless female moths from climbing into the branches to lay eggs.

PEAR MIDGE
The Pear Midge is a small fly which lays its eggs in the flowers of pear. The legless white maggots which hatch out bore into the young fruitlet and feed inside. The fruitlet then becomes abnormally swollen and rounded, and when cut open a blackened cavity containing the maggots is revealed. The fruit later falls to the ground where it cracks and decays, allowing the mature maggots to escape.

Control
Spray with D.D.T. at the white-bud stage. Infested fruitlets should be picked off and destroyed before they fall.

RASPBERRY BEETLE
The Raspberry Beetle is the pest responsible for "maggoty" raspberries and loganberries. The brown adult beetle damages the flowers, but more serious damage is done by the grub which, in its early stages, feeds first on the outside of the developing fruit, causing it to become hard and brown, and later tunnels into the plug of the fruit and feeds on the flesh from the inside.

Control
Spray with derris or D.D.T. 10 days after full bloom, and again 10 days later.

RED SPIDER MITE
Red spider mites are very small creatures which suck the sap on the undersurfaces of leaves. They are distantly related to insects or spiders and, in spite of their name, their colour is more usually orange-green than red. Although the fully grown adults are smaller than a pin-head, they can, when present in large numbers, cause considerable damage which results in a general weakening of the plant.

The Fruit Tree Red Spider Mite is particularly harmful on apple, plum and damson. In the early stages of the attack the leaves become dull and speckled finely with yellow. Later the foliage may take on a silvery appearance due to air entering the damaged cells, followed by bronzing and premature leaf-fall.

Control
To kill the over-wintering eggs, spray with D.N.C.-petroleum between the end of February and the bud-break stage. During the summer spray in early June with malathion or derris and repeat twice at 14-day intervals. Apply the spray to the underside of the leaves.

The Gooseberry Red Spider Mite infests the leaves of gooseberry which then become pale and sickly-looking, and may later wither and drop off.
GARDEN PESTS

Control
Spray the underside of the leaves with malathion or derris when flowering has finished. Repeat twice at 14-day intervals and pay particular attention to the centre of the bush.

SAWFLIES
Sawfly larvae resemble the caterpillars of moths and the damage done by the two types of pest is very similar.

The Apple Sawfly is a common pest of apple, and its larva is often confused with that of the Codling Moth.

Attacks by sawfly larvae are usually seen first in May, and they eat more of the flesh than does the Codling caterpillar which attacks in July and feeds mainly on the core.

Other differences between the attacks are that apples infested by sawfly larvae have an obnoxious smell when cut open, and fruits attacked by these larvae often display long “ribbon” scars on the surface, the result of the young larvae burrowing under the skin.

Control
Spray with lindane at petal-fall.

The Plum Sawfly attacks plums and damsons. The small white larva enters the young fruitlets, leaving a small hole which oozes a sticky, black fluid. It attacks more than one fruit, tunnelling in the flesh and causing premature dropping.

Control
Spray with lindane eight days after petal-fall.

The Gooseberry Sawfly has green, caterpillar-like larvae with black spots, which feed rapidly on the foliage of gooseberries, eating all but the mid-ribs. Eliminate this pest as soon as it is seen since it can do serious damage in a very short time.

Control
Spray or dust with malathion, D.D.T. or derris after the fruit sets or as soon as an attack is seen. Pay particular attention to the centre of the bushes where the infestation is often severe.

SCALE INSECTS
Scale insects, which are usually found only on neglected fruit trees and bushes, are described in detail on page 401. The Brown Scale, which is chestnut-brown, about ½ in. long and very convex, may be found on the bark of plums, peaches and soft fruits. The Mussel Scale, much flatter, is grey and shaped like a miniature mussel shell. It is found mainly on apple trees but can occur on almost any tree or bush fruit.

Control
Apply a tar oil wash in December or in early January.

SLUGS
Slugs attack strawberries, raspberries and gooseberries. (See page 384.)

PESTS IN THE GREENHOUSE

Many of the outdoor pests mentioned in this chapter, such as slugs, woodlice, millipedes, earwigs, thrips, capsid bugs, leaf-hoppers, aphids, caterpillars and leaf-miners, are also found under glass. Different species of these pests may be found but the control measures are the same, with the added advantage that in some cases insecticides can be applied as a smoke, thus saving much time and labour. This section will, therefore, be confined to those pests which are generally found only under glass.

EELWORMS
Potato Root Eelworms attack tomatoes grown under glass. Infested plants make poor growth because of the damaged roots, and the foliage droops and is purple.
**PESTS OF THE FRUIT GARDEN**

**FRUIT TREE TORTRIX MOTH**

*Damage:* Feeds on leaves, rolling them and fastening them together with silk webbing. Makes holes in the skin of fruit.

*Control:* Use D.D.T. at greenbud stage.

**WINTER MOTH**

*Damage:* Caterpillars attack leaves, flowers and developing fruitlets of apple, pear and plum.


**WOOLLY APHID**

*Damage:* Forms white, woolly patches on twigs. Feeds on bark and causes swollen growths.

*Control:* Use lindane or malathion at pink-bud stage.

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**PESTS IN THE GREENHOUSE**

**CUSHION SCALE**

*Damage:* Plants do not flourish and become sticky and covered with black mould.

*Control:* Wash with soapy water. Spray with nicotine-white-oil emulsion or with malathion.

**GLASSHOUSE LEAF-HOPPER**

*Damage:* Causes mottling on upper surface of leaf. Spreads until whole leaf turns yellow and falls.

*Control:* Spray with D.D.T. or lindane.

**GLASSHOUSE RED SPIDER MITE**

*Damage:* Yellow speckling spreading until whole leaf turns yellow and dies.

*Control:* Use malathion or derris spray at 7- to 10-day intervals or fumigate with azobenzene smoke.
PESTS IN THE GREENHOUSE

GLASSHOUSE WHITEFLY: Damage: Plants wilt and show diminished vigour. May become black and sticky. Control: Spray or fumigate with D.D.T., lindane or malathion.

MEALY BUG: Damage: Leaves become sticky and black. Control: Wash with soapy water. Spray with nicotine-white-oil emulsion or with malathion.


ROOT KNOT EELWORM: Damage: Conspicuous swellings on roots. Control: Sterilize soil or discard infested soil.


on the underside. Such symptoms can, however, be the result of bad root action due to other causes, and expert advice should be sought if eelworm is suspected.

Root Knot Eelworms produce similar symptoms on tomatoes, but they are comparatively easy to identify by the hard, elongated swellings which appear on the roots. Many other greenhouse plants may be attacked by this eelworm, especially cucumber, begonia, coleus and carnation.

General symptoms are the retarding of growth and pale yellow foliage which tends to wilt in warm weather. The shape and consistency of the root swellings vary on different plants.

Control
If the infestation is found after planting, feed heavily and mulch with a thick layer of moist peat to encourage the growth of new roots. Under glass it is possible, though expensive, to sterilize soil and compost with metham-sodium ("Vapam" or "Sistan") before planting, but this may have to be done yearly to keep the eelworm in check. Alternatively, discard infested soil and replace it after staging, pots, etc., have been thoroughly washed with cresylic acid. Follow the manufacturer's instructions for rates of application.

Glasshouse Red Spider Mite
The Glasshouse Red Spider Mite, one of the most serious greenhouse pests, is extremely small, and a strong magnifying glass is required to see it clearly, but it breeds quickly and can cause a lot of damage in a short time.

It attacks most plants, feeding on the underside of the leaves where it lays its round, reddish eggs, and the leaves become finely speckled with yellow marks which spread until the whole leaf turns yellow and withers. When plants are heavily infested, the mites spin fine webbing over the leaves. These pests will also infest outdoor plants, particularly those growing in sheltered places or against walls.

Control
Spray with malathion or derris two or three times at seven- to ten-day intervals, or fumigate with azobenzene smoke, repeating the treatment seven days later. The mites dislike humid conditions and frequent sprays of water will help to prevent serious infestations.

Glasshouse Whitefly
Although some species of whitefly are found out-of-doors, on brassicas and rhododendrons principally, the most common and troublesome is the Glasshouse Whitefly. The adults, which resemble miniature moths, are pure white and about one-twentieth in. long, and can be found clustering on the underside of leaves of a wide variety of plants. They flutter about when disturbed. The young, which are flat, scale-like creatures, difficult to see because of their small size and transparent greenish colour, are also found on the underside of leaves. The pests suck the sap, causing lack of vigour, wilting and, on some plants, yellow mottling of the leaves. The foliage also becomes sticky with honeydew excreted by the insects and sooty moulds may then grow on this material.

Control
Spray or fumigate with D.D.T., lindane or malathion. Only the adults are killed, so that two to three applications are necessary at ten- to fourteen-day intervals before good control is achieved.

Mealy Bugs
Mealy bugs are pale pink or yellow insects covered with a white mealy substance, which congregate in sheltered corners of the plants, such as leaf-axils, and suck the sap. Like many sucking insects they excrete large quantities of honeydew,
and the leaves may become covered by sooty moulds. They are normally found only under glass where they can infest a wide variety of plants.

Control
On deciduous glasshouse plants, such as vines and peaches, a winter wash of tar oil will give good control. On other plants spray with malathion or nicotine-white-oil emulsion (1 teaspoon 9% to 98 per cent nicotine, and 2 tablespoons summer white oil in 1 gal. water). Repeat two to three times at 14-day intervals.

SCALE INSECTS
Scale insects resemble small, discoloured blisters on the stem or leaf and are often not recognized as insects. Their bodies are protected by a tough scale which varies in shape and colour according to the species, and they remain motionless for most of their lives sucking the sap through elongated mouth-parts thrust into the plant tissues. Infested plants lose their vigour due to loss of sap and, as honeydew is excreted, the plant is liable to be disfigured by sooty moulds. In severe cases, leaves may turn yellow and drop off, and the plant may die.

Some important outdoor species, already discussed, are also common under glass where conditions are ideal for this type of insect.

The Cushion Scale, about one-sixth in. long, is oval and easily recognized by the white woolly mass which is pushed out behind it. This scale attacks orchid, camellia and magnolia but it is less common than the following species.

The Oleander Scale is a round, flat, whitish scale about one-twelfth in. in diameter, which attacks the foliage of cyclamen, acacia, oleander and ferns.

The Soft Scale, the most frequently found greenhouse species, is very flat, oval, about one-sixth in. long and yellowish-brown in colour. It attacks citrus, fig, vine, ivy and many other tender plants, and is found on the underside of the leaves, usually near the mid-rib.

Control
On deciduous glasshouse plants, such as vines and peaches, a winter wash of tar oil will give good control. On other plants wipe or brush off as much of the scale as possible with soapy water, then spray with malathion or nicotine-white-oil emulsion (1 teaspoon 9% to 98 per cent nicotine, and 2 tablespoons summer white oil in 1 gal. water). Repeat two to three times at 14-day intervals.

VINE WEEVIL
The Vine Weevil, also found on outdoor plants, has a curved, white grub, which is an important pest of pot plants. It attacks many plants and tunnels into the corms and tubers of cyclamen and begonia, causing the death of the plants.

Control
Mix aldrin dust with the potting soil. Some control can be obtained on established plants by drenching with liquid aldrin, but this is only a temporary measure.

PESTS OF DECORATIVE PLANTS

APHIDS
A great variety of aphids attack decorative plants, but the damage done is usually less spectacular than on fruit, because leaf distortion is not so common. The stems of young growth are twisted, but the aphids cause most damage by robbing the plants of large quantities of sap, causing poor growth, wilting and the formation of dwarfed, misshapen flowers. The leaves of infested plants are often made sticky by the honeydew excreted by the insects, and this sweet liquid is a medium for the
PESTS OF DECORATIVE PLANTS

ANGLE SHADES MOTH

Damage: Caterpillars eat large holes in leaves of annual and perennial plants
Control: Spray or dust with D.D.T.

BISHOP BUG

Damage: Brown-rimmed pinholes on young leaves, causing subsequent tearing and distortion. Blooms misshapen
Control: Spray with D.D.T. or lindane. Repeat at 14-day intervals

CHrysanthemum Aphid

Damage: Growing tips are distorted
Control: Use malathion, lindane or nicotine

CHrysanthemum Leaf-Miner

Damage: Leaves marked by twisting tunnels made by grubs
Control: Hand pick grubs from damaged leaves. Spray lindane or malathion

CLAY-COLOURED WEEVIL

Damage: Night-feeding. Eats leaves and bark of stem
Control: Provide day-time hiding places as traps, collect and destroy

EARWIG

Damage: Eats both leaves and flowers at night
Control: Shake earwigs out of plants, then spray soil with D.D.T., dieldrin or lindane
PESTS OF DECORATIVE PLANTS

**COCKCHAFER BEETLE**

*Damage*: Eats unopened buds of roses  
*Control*: Spray or dust damaged plants with D.D.T.

**GLADIOLUS THRIPS**

*Damage*: White or yellowish mottled areas on leaves and petals  
*Control*: Spray D.D.T., lindane or malathion

**HOLLY LEAF-MINER**

*Damage*: Yellow-brown blisters form on leaves  
*Control*: Hand pick. Spray with lindane or malathion

**LACKEY MOTH**

*Damage*: Caterpillars spin silk webbing over young shoots of trees and shrubs and feed inside webbing  
*Control*: Cut webbed shoots and bark, then spray or dust with D.D.T.

**LILAC LEAF-MINER**

*Damage*: Blister-like cavities eaten out of the leaf  
*Control*: Remove damaged leaves. Spray with lindane or malathion

**ONION THRIPS**

*Damage*: Flecking of carnation blooms  
*Control*: Spray with D.D.T., lindane or malathion or apply the first two as smoke. Repeat the treatment 10 to 14 days later
GARDEN PESTS

growth of harmless, though disfiguring, black moulds.

Many of the fruit-infesting aphids mentioned earlier also attack flowering cherries, crab apples, currants, etc., causing similar symptoms. These can be dealt with by the methods recommended for control on fruit trees.

The more important and widespread species which attack decorative plants include the following:

The Black Bean Aphid infests dahlias, nasturtiums, poppies and spindle-trees as well as feeding on vegetables.

The Chrysanthemum Aphid, a reddish-black species, attacks chrysanthemums.

The Peach-Potato Aphid, which is green, yellow or pink in colour, attacks antirrhinums, China asters, phlox, sweet peas, chrysanthemums and many other plants.

The Rose Aphid, a large green or red aphid, infests the shoots and flower buds of roses and scabious.

Control
As soon as aphids are seen on the plants, spray or dust with malathion, lindane or nicotine, repeating the application as necessary.

BEETLES AND WEEVILS

The grubs of some beetles, such as Wireworms and Chafer Grubs, are described in General Garden Pests (page 381). Beetle and weevil damage is usually less common on ornamental plants than on fruit and vegetables. The following may, however, be met with.

The adult Cockchafer, a large brown beetle, about 1 in. long, which often flies into lighted windows on summer nights, and the smaller Garden Chafer, about ¼ in. long, with bluish-green thorax and reddish-brown wing-cases, eat the unopened buds of roses.

Leaf Weevils, green or brown insects with a metallic sheen, ¼ to ½ in. long, eat holes in the leaves of trees and shrubs.

The dark brown Water-lily Beetle and its blackish larvae are common pests on water-lilies. They eat elongated holes in the leaves and they also attack the flowers, disfiguring them and causing early decay.

Control
Spray or dust damaged plants with D.D.T. But D.D.T. cannot be used on Water-lily Beetles if fish are present in the water; therefore sink the plants for a few days with pieces of iron, or wash the insects into the water with a strong jet of water, to allow the fish to feed on them.

The brown, ½-in. long Clay-coloured Weevil and the black Vine Weevil are wingless and feed on the foliage of trees and shrubs at night, the latter species confining itself to notching the edges of the leaves. They also eat away the bark of the stems, and often kill the young shoots in this way. During the day the weevils hide in the debris at the base of their food-plants. The grubs, which are whitish, legless creatures with curved bodies, are also pests and feed on the roots of many plants, especially on rockeries and in pots.

Control
These weevils are very resistant to insecticides, and, in gardens, the best control is obtained by persistent trapping. Provide day-time hiding places for the weevils by laying down sacking or corrugated paper at the base of attacked plants, examine these each day and destroy the weevils. To control the grubs, dress the soil with aldrin dust, forking it well into the top 4 in.

CAPSID BUGS

The Common Green Capsid (see page 393) and the Tarnished Plant Bug are common pests of chrysanthemums, dahlias, hydrangeas, salvias and other
plants. They attack the young leaves, which become torn and distorted as they grow larger, and they also feed on the flower buds so that they produce distorted, misshapen blooms.

Control
Spray with lindane or D.D.T. and repeat 14 days later. To prevent serious damage keep a close watch for small brown spots on the young leaves, which are signs of feeding by capsids, and, when they are seen, spray immediately.

CATERPILLARS
Caterpillars of the Angle Shades Moth, brownish-green with pale markings on the sides of the body, are common pests of such plants as chrysanthemum, dahlia, hollyhock, primula, wallflower, iris and gladiolus. Vapourer Moth caterpillars, hairy and brightly coloured, attack ornamental cherry and crab apple, hawthorn and rose, and the Winter Moth caterpillars, as well as attacking fruit trees, feed on the leaves of many ornamental trees and shrubs, eating out large holes and sometimes causing severe defoliation.

Control
Spray or dust with D.D.T.

Some caterpillars spin copious silk webbing over the leaves and young shoots of trees and shrubs, and these webs give protection to the caterpillars as they feed on the foliage and also help to protect them from sprays.

Caterpillars of the Small Ermine Moth, which are grey, attack the spindle in this way, and also attack many of the plants damaged by the caterpillars of the Lackey Moth. Lackey Moth caterpillars are blue-grey with red and white stripes, and feed on flowering cherry, crab apple, hawthorn, roses and other shrubs.

Control
Cut out the webbed shoots and burn them, then spray or dust with D.D.T.

Tortrix Moth caterpillars vary in colour between grey-green and dark green according to the species, but can be easily identified by their habit, when disturbed, of wriggling violently backward and dropping from the plant suspended by a thread of silk. They are often found on ornamental trees and shrubs such as hawthorn, flowering cherry and crab apple, holly, rhododendron and rose. They roll the leaves and tie them with silk, or tie young leaves together, feeding between them. The tips of herbaceous plants, such as helinium, phlox, rudbeckia and solidago are often tied in this way.

Control
If possible, crush the caterpillars inside the tied-up leaves, and then spray or dust the plants with D.D.T.

EARWIGS
Earwigs are often found hiding under flat stones, in long vegetation and other damp, dark places. They feed by night on the leaves and flowers of garden plants, such as chrysanthemums, cinerarias and dahlias.

Control
Keep the garden clear of piles of rubbish and long tangled vegetation which provide shelter. Shake the blooms to dislodge any sheltering earwigs, then spray the ground and lower parts of attacked plants with D.D.T., lindane or dieldrin, avoiding any open blooms.

eelworms
The Chrysanthemum Eelworm is a common pest of chrysanthemum, perennial aster, pyrethrum and related plants. The lower leaves are the first to show symptoms. Brown patches appear between the main veins of the leaf, and these darken and spread until the whole leaf shrivels and falls. The infestation proceeds upward and the buds may be attacked and “blinded”, and the flowers are often
PESTS OF DECORATIVE PLANTS

**RHODODENDRON BUG**

*Damage*: Leaves mottled, underside stained rusty brown
*Control*: Spray underside of leaves with D.D.T., lindane or nicotine in mid-June

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**ROSE LEAF-HOPPER**

*Damage*: Mottling of leaves, yellowing and leaf-fall in dry weather
*Control*: D.D.T. or lindane repeated at 14-day intervals

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**ROSE LEAF ROLLING SAWFLY**

*Damage*: Leaves roll inward towards mid-rib
*Control*: Hand pick and burn distorted leaves. In hot weather spray or dust with nicotine

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**ROSE SLUG SAWFLY**

*Damage*: Appearance of brown withered blotches on foliage
*Control*: Spray D.D.T. or derris on both surfaces of leaves

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**ROSE SCURFY SCALE**

*Damage*: Whitish “scales” encrust stems
*Control*: Spray malathion at 14-day intervals. Tar oil in winter

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**SMALL ERMINE MOTH**

*Damage*: Caterpillars spin silk webbing over young shoots of trees and shrubs and feed inside webbing
*Control*: Cut webbed shoots and bark, then spray or dust with D.D.T.
PESTS OF DECORATIVE PLANTS

SPIRAEA SAWFLY
Damage: Leaves eaten away leaving only main veins
Control: Spray with D.D.T. or derris

STEM AND BULB EELWORM
Damage: Gradual deterioration of bulbous plants. If cut across, bulb shows signs of decay
Control: Carry out hot water treatment of infested bulbs when dormant. See page 408

TORTRIX MOTH
Damage: Caterpillars feed on leaves of decorative plants, rolling them and fastening them together with silk
Control: Crush caterpillars inside leaves, then spray or dust with D.D.T.

VAPOURER MOTH
Damage: Caterpillars eat the foliage of flowering shrubs
Control: Spray or dust with D.D.T.

WATER-LILY BEETLE
Damage: Grubs disfigure leaves and flowers with elongated holes
Control: Wash grubs into water as fish food. If no fish, spray with D.D.T.

YEW SCALE
Damage: Stems encrusted with brown scales
Control: Spray malathion at 14-day intervals. Tar oil in winter
dwarfed and misshapen. The worst attacks take place when conditions are wet or humid.

**Control**
Immerse infested dormant stools for five minutes in water kept at a constant temperature of 110° F. (43° C.) or destroy the stock. Burn all fallen or withered leaves, as they contain eelworms and may be blown to other parts of the garden. Keep infested ground clear of all plants and weeds throughout the winter to destroy any eelworms in the soil.

The Stem and Bulb Eelworm is a common pest of daffodil, iris, hyacinth, bluebell and snowdrop, and also attacks begonia, gladiolus, onion, parsnip, strawberry and many weeds. The stems and leaves of infested plants are distorted, dwarfed and discoloured by yellow streaks. Daffodils and snowdrops may also have small yellowish swellings on the leaves. When the bulbs of attacked plants are cut across, dark rings are seen where some of the scales have begun to decay.

The final result of eelworm attack is the gradual deterioration and death of the plant.

**Control**
The eelworms in lightly infested bulbs can be killed by immersing the dormant bulbs for three hours in water kept at a constant temperature of 110° F. (43° C.) but, as special apparatus is required to do this successfully, it is easier to destroy the stock of bulbs and plant fresh ones in clean ground. Avoid growing possible host plants on contaminated ground for at least three years.

A different race of Stem and Bulb Eelworm infests phlox. The leaves of attacked plants become narrow and crinkled and the stems may be twisted and split.

**Control**
If possible treat dormant stools by immersing for one hour in water at a temperature of 110° F. (43° C.), or destroy the stock and keep infested ground clear of aubrieta, gilia, gladiolus, gypsophila, oenothera, primula, peas, potatoes and weeds for at least three years.

**LEAF-HOPPERS**
Many plants are attacked by leaf-hoppers, but usually most damage occurs on roses. The Rose Leaf-hopper is a small, pale yellow insect which resembles an aphid, but is able to jump quickly when disturbed. It sucks the sap on the underside of the leaf, causing a distinctive, coarse mottling near the mid-rib, which spreads until the yellowing is extensive and may cause premature leaf-fall in dry weather.

**Control**
Spray with D.D.T. or lindane as soon as damage is seen, and repeat at 14-day intervals as necessary.

**LEAF-MINERS**
Leaf-miners are the larvae of flies and small moths, which feed on the internal tissues of leaves between the upper and lower surfaces. There are two main types of mines: the linear type, which are winding tunnels growing wider as the larva grows, and the blotch type, which are blister-like cavities eaten out by one or more larvae. The damage is whitish at first and later turns brown as the injured leaf tissue withers. A large number of garden plants may be attacked by leaf-miners, but only in a few cases are the plants severely checked and disfigured.

Chrysanthemums, cinerarias and other related plants are often attacked by the Chrysanthemum Leaf-miner, particularly when they are raised under glass. The linear mines of this pest usually start on the edge of the leaf where they may not be noticed at first, and then
quickly invade the rest of the leaf, so that the whole leaf is destroyed in severe cases.

The Holly Leaf-miner forms yellowish-brown blisters on the leaves of holly.

Mines of the blotch type are made on lilac and privet by the Lilac Leaf-miner and, if the attack is severe, the shrubs look very unsightly when the damaged leaves shrivel.

A similar type of mine to that made by the chrysanthemum leaf-miner is made on rose leaves by the Rose Leaf-miner.

Control
If possible, remove the mined leaves by hand and burn them. Otherwise, spray with lindane or malathion two to three times at 14-day intervals, starting as soon as the damage is seen.

Rhododendron Bug
The Rhododendron Bug which feeds on rhododendron leaves, is cream-coloured when young, while the adults are shiny black with broad, lace-like wings. The leaves become finely mottled with yellow and sickly in appearance, and the undersides, where the small, flat bugs can be seen, are stained with rusty-brown marks.

Control
Spray the underside of the leaves with D.D.T., lindane or nicotine in mid-June, or when the damage is first seen. Give two or three applications at three-weekly intervals.

Sawflies
Sawfly larvae resemble moth caterpillars but have more legs. Like caterpillars, many species eat pieces out of the foliage of the plant and in severe cases may strip it completely.

The green larvae of the Banded Rose Sawfly and the Large Rose Sawfly feed on the rose leaves, and the former species also burrow in the stems.

The Rose Slug Sawfly also attacks roses, but the damage caused is distinct from that of other species. The yellowish, semi-transparent larvae of this species feeds only on one surface of the leaf, leaving the other to turn brown and wither, which results in the appearance of brown blotches on the foliage.

In the south of England spiraea is commonly attacked by the yellowish-green larvae of the Spiraea Sawfly which eat away the soft tissues of the leaves, leaving only the main veins intact.

Control
Spray the infested plants with D.D.T. or derris. In the case of the Rose Slug Sawfly treat both surfaces of the leaves.

Another sawfly which attacks roses is the Rose Leaf-rolling Sawfly. The female lays its eggs on the edges of the young leaves, which then roll inward towards the mid-rib, so that when the greenish-grey larvae hatch out they are protected within the rolled-up leaves.

Control
Hand pick and burn the distorted leaves when they appear. Chemical control is difficult, but nicotine dust can be applied when the temperature is 65° F. (18° C.) or over, and the vapour from the chemical will penetrate the rolled leaves.

Scale Insects
These insects are described more fully on page 401. Out-of-doors they are usually found on woody plants, and those species found on fruit trees are also common on some ornamental shrubs. The stems of ceanothus, cotoneaster, hawthorn, flowering currants, mountain ash and other trees and shrubs may become infested by the Brown Scale or Mussel Scale.

The Rose Scurfy Scale is a flat, white scale found encrusting the stems of roses, especially in sheltered places.

The Yew Scale is similar to the Brown Scale, but is found only on yew on which it is a common pest.
GARDEN PESTS

Control
On deciduous trees and bushes and on yew, spray with tar oil in December or January. On other plants and during the growing season, apply malathion two or three times at 14-day intervals.

THRIPS
Three species of thrips damage outdoor ornamental plants. The Gladiolus Thrips is found on gladiolus, and sometimes on iris, lily and freesia. The Rose Thrips is found on roses, morning glory, larkspur, lupin and other plants. These minute insects suck the sap of the leaves and flower petals, leaving white or yellow spots on the feeding areas and, if the attack is severe, the flowers may be misshapen or may wither before opening.

The Privet Thrips attacks the foliage of privet and lilac, causing a silvery mottling on the surface.

Control
Spray with D.D.T., lindane or malathion. Repeat at ten-day intervals as necessary.
Garden Weeds and their Control

The suppression of weeds in a garden is of the utmost importance. If they are not kept under control a garden will soon become a wilderness.

Most garden weeds are native species which prefer to grow in disturbed ground or in an open situation where there is little competition from other plants, and their capacity for producing and distributing seed is such that, no matter how thoroughly and regularly the ground is hoed, there will always be new crops of weeds to replace those that are removed.

Fortunately, chemical weedkillers have been greatly developed in recent years so that weeds associated with a wide range of vegetable, fruit and flower crops can now be controlled by chemical means.

These chemicals have been produced primarily for the commercial grower, and they are most useful when large areas of a single crop are grown. In the normal garden many different crops are grown in a small area, and the weedkiller suitable for one crop may have disastrous effects on another growing near by if it is accidentally contaminated. Nevertheless, there are times when chemicals can be used safely in the garden for weed control and this saves a great deal of hand labour. The recommended dosage should not be exceeded, or the plants may be damaged.

LAWNS

GROWTH-REGULATOR WEEDEKILLERS
The discovery of the selective action of the growth-regulator weedkillers 2,4-D and MCPA in 1942 first demonstrated the great economic potentialities of chemicals for weed control. It was found that these compounds would kill many broad-leaved weeds growing among crops of the grass family, and that they were as effective on cereals as on lawns. A single application will kill such weeds as plantains, creeping buttercup and sorrel; others, such as dandelions and ragwort, need to be treated again four to six weeks later; and a few, such as white clover, are more susceptible to the related compound mecoprop. If pearlwort is the principal weed in the lawn, treatment with lawn sand will also be necessary.

METHODS OF APPLICATION
MCPA, 2,4-D and mecoprop are obtainable under many different trade names, some of which are included in the chart which follows. Apply these carefully at the rate suggested by the manufacturers, either with a sprayer or a watering can fitted with a rose. The advantage of using a watering can is that there is less danger of the spray drifting on to sensitive plants. It does, however, distribute the chemical less evenly than a sprayer, and the rates recommended for application by means of a watering can are usually higher than those for spraying. For spot treatment of lawn weeds, some growth regulators are now available in aerosol containers.

BEST CONDITIONS FOR APPLICATION
Growth regulators are most effective if applied when conditions favour rapid growth. The application of a dressing of nitrogenous fertilizer about a fortnight
ANNUAL MEADOW GRASS—Poa annua

CHICKWEED—Stellaria media

GROUNDSEL—Senecio vulgaris

IVY-LEAFED SPEEDWELL
Veronica hederifolia
COMMON FUMITORY — *Fumaria officinalis*

FAT HEN — *Chenopodium album*

SCENTLESS MAYWEED — *Tripleurospermum maritimum*

SHEPHERD’S PURSE — *Capsella bursapastoris*
before treatment will help to give good results. It encourages the weeds to grow faster and the grass to grow over any gaps left when the weeds die.

PRECAUTIONS
2,4-D and related compounds can be used safely on well-established lawns but can injure young grass seedlings and newly laid turves. Do not apply for six months after sowing.

Most flowers, fruit and vegetables are extremely sensitive to growth-regulator weedkillers. Take great care that they do not come in contact with these plants, either through drift of spray droplets or through failure to clean a watering can or sprayer thoroughly after it has been used for weed control purposes. If possible, use the equipment with which weed killers are applied for this purpose only. If this is not possible, wash the equipment thoroughly after use, preferably with hot water. Wash several times and leave the container full of water overnight; then empty it and wash once more.

Do not use clippings from the first mowing after treatment as a mulch until the grass has decayed, when the chemicals will have broken down.

WEEDER BARS
One possible way of avoiding problems of drift and contamination is to use one of the weeder bars on the market. A weeder bar has a waxy base impregnated with weedkiller, so that when it is dragged over a lawn the chemical rubs off on the foliage. Coverage of weed foliage is less complete than with liquid application, however, so that results are more variable and, even though no drift is possible, contamination can still occur through waxy material adhering to the soles of shoes, tools and hands.

MOSS
Mosses need different treatment and are unaffected by the chemicals used for broad-leaved weeds. Lawn sand is, however, an effective method of control. It can be made by mixing 3 parts sulphate of ammonia, 1 part calcined sulphate of iron and 10 parts silver sand and should be applied at 1 to 2 oz. per sq. yd. Lawn sands containing calomel give more lasting control of moss, but badly infested lawns will often benefit as much from improved drainage, aeration and encouragement of the grass with fertilizer as from chemical treatment.

PATHS AND WASTE GROUND
RESIDUAL CHEMICALS
Prevent the establishment of weeds on paths by applying a residual, soil-acting herbicide such as simazine or monuron (see chart for trade names). These chemicals are insoluble and tend to stay near the surface of the soil where they kill the weeds as they germinate. At medium rates of application, their action persists for 6 to 12 months. But they must penetrate some distance into the soil to exert their full effect, and they act best when the soil is moist or when rain follows shortly after application. At the higher rates of application recommended for the destruction of perennial weeds they may persist for two years, but care must be taken to ensure that no roots of susceptible trees or shrubs are below the treated area. Plums and other stone fruits are particularly likely to be damaged in this way.

SODIUM CHLORATE
Weeds in paths and on waste ground can be killed with sodium chlorate, used alone or mixed with one of the residual herbicides to increase the persistence. Apply as a spray or as a fine powder on the leaves of the weeds.

Sodium chlorate will kill many annual and perennial species. If applied in spring it acts rapidly and can persist for about six
months. Its principal disadvantages are that the chemical and any organic material soaked in it are highly inflam-
 mable when dry, sometimes igniting spontaneously. The fire risk can be re-
duced by using one of the formulations containing a fire-retarding agent. When
there is lateral movement in the soil—
for example, on sloping ground in wet
weather—plants growing alongside the
 treated path can suffer damage from the
chemical draining down the slope.

GRASS-KILLERS
Where couch or other grasses are the
principal weeds of uncropped ground,
they are best controlled with dalapon.
This chemical is applied as a solution in
water and enters the plant mainly
through the leaves. It is most effective
if applied in spring, when growth is
rapid, or in autumn.

With couch a certain amount of re-
growth often follows the application if
the ground is left undisturbed; there is
less re-growth when the ground is dug
over or cultivated deeply two to six
weeks after spraying. Except under very
dry conditions susceptible crops may be
safely sown six weeks after dalapon
treatment, as long as the ground has been
depthly cultivated.

Many garden plants are susceptible to
injury by dalapon, but it has relatively
little effect on broad-leaved weeds; such
weeds as buttercups, docks and dande-
lions often take over when couch has
been killed.

Amitrole is another possible grass-
killer. It has more effect on these other
weeds than dalapon and, although as yet
it has been less widely used, it promises
to be a very useful chemical.

PERENNIAL WEEDS
For waste ground and fence lines where
docks, thistles, bindweed and other
perennials have gained a hold, and where
there is no danger of damaging near-by
susceptible plants, use MCPA or 2,4-D.
Either will kill the weeds down to ground
level, but a single application will rarely
give a complete kill of the roots. If
nettles or brambles predominate, the
brush-killer 2,4,5-T is more effective.

Painting a solution of the chemical on
the leaves of weeds is laborious, but it may
make possible the treatment of small
areas, too closely surrounded by sensitive
plants to allow other methods of applica-
tion to be used.

FRUIT PLANTINGS
Perennial weeds in apple orchards can be
controlled with growth regulators, but
take care to keep the chemical off the
tree foliage. Do not carry out this treat-
ment during the blossoming period.
Dalapon can also be used to kill couch
under well-established apple and pear
trees, but is not safe under plums and
cherries.

Control annual weeds among estab-
lished plantings of bush and cane fruits
through the summer by applying low
rates of simazine (1 to 2 lb. per acre of
active material) to clean ground in the
spring. Simazine is fully effective only if
the soil is moist, and it should, of course,
be kept off the fruit plants as much as
possible. Take care also not to exceed
the dosage recommended. Higher rates
applied for several years may lead to a
build up of chemical in the soil, and so
cause trouble with subsequent crops.

If couch has infested fruit plantings,
dalapon may be used as a control, but only
during the dormant season: even then
there is a risk of damage with some crops.

Established black currant bushes can
be safely treated with doses of up to 8 lb.
per acre; but gooseberries and raspberries
are rather more susceptible, the latter
being liable to injury if dalapon is ap-
plied at rates of more than 4 lb. per acre.
COMMON SPEEDWELL — Veronica officinalis

COUCH GRASS — Agropyron repens

SILVERWEED — Potentilla anserina

SMALL BINDWEED — Convolvulus arvensis
PERENNIAL WEEDS

CREEPING BUTTERCUP—Ranunculus repens

DOCK—Rumex obtusifolius

WHITE CLOVER—Trifolium repens

YARROW—Achillea millefolium
BLADDER CAMPION — *Silene vulgaris*

CHICORY — *Cichorium intybus*

TOADFLAX — *Linaria vulgaris*

WHITE MUSTARD — *Sinapis alba*
COMMON HORSE TAIL (in wet places)  
Equisetum arvense

DANDELION—Taraxacum officinale

HOARY PLANTAIN—Plantago media

PRIMROSE—Primula vulgaris
DECORATIVE PLANTS
Few safe herbicidal treatments have yet been developed for use among flowers. But with bulbs, an autumn or winter application of chlorpropham (CIPC) or a mixture of chlorpropham and diuron made before the shoots appear will prevent the emergence of weeds until well into the spring. Chlorpropham is especially effective against chickweed and annual grass.

Roses have shown a high degree of resistance to simazine and this material may be used between rose bushes as described for bush fruits under Fruit Plantings.

VEGETABLES
A number of chemical methods of weed control have been developed for use with vegetable crops. In the average garden, however, any one vegetable is rarely grown in a large enough area for advantage to be taken of these methods, and the herbicides in question are not usually marketed in small enough quantities.

The following crops can be sprayed successfully, and the appropriate chemicals are given in the chart: asparagus, broad beans, runner beans, cabbage, carrots, onions and peas. Further information may be obtained from the Weed Control Handbook (see Bibliography).

METHODS OF APPLICATION
The technique used to apply a herbicide is relatively unimportant as long as the correct amount of chemical is distributed evenly over the area being treated. Many types of small sprayer are suitable; those with plastic containers are usually cheaper than those made of metal, and some are designed especially for small-scale garden use. In many cases, a watering can fitted with a fine rose is adequate.

It is most important to follow as closely as possible the instructions supplied with the herbicide. With some chemicals the margin between the dose which will kill the weeds and that which will injure the crop is small, so measure out the required amounts carefully.

The amount of water used to apply the weedkiller is not so important, provided distribution is even. But with those chemicals which are taken up through the foliage, the amount of water used must not be so high that there will be excessive run-off.

SAFETY PRECAUTIONS
The chemicals mentioned are all of low toxicity to man and animals, but it is a sensible precaution to keep the concentrated materials well out of the reach of children and away from foodstuffs. They should also, of course, be kept well away from seeds and fertilizers.

Dispose of used containers in such a way that any remaining chemical will not find its way on to growing plants. Sodium chlorate is highly inflammable and needs to be treated with special care.

As many garden plants are highly susceptible to chemical weedkillers, take every precaution to ensure that the weedkillers make contact only with the weedy area being treated. Avoid spraying in windy weather at all costs.

Charts indicating the treatment for most types of weed appear on pages 421 and 424
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<th>Situation</th>
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<th>Appropriate Chemicals</th>
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<th>TREATMENT FOR WEEDS</th>
<th>Notes and Precautions</th>
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<tr>
<td>LAWNS</td>
<td>Broad-leaved weeds</td>
<td>MCPA, 2,4-D</td>
<td>Most fruit and flowers drift</td>
<td>Grass regulators, cause distorted growth</td>
<td>2,4-D, Clovetto, Lornox, Lornox Plus</td>
</tr>
<tr>
<td>PATHS, WASTE, GROUND, FENCE, ETC.</td>
<td>General weed growth</td>
<td>Mecrop (CMF), Lawn sand</td>
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<td>Scorching action</td>
<td>Affects leaves and roots</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Clotrol, Abol Double, Epothox</td>
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<td>Premmer, Sprex, Woezal, Brador, Shell Total</td>
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</tr>
<tr>
<td></td>
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<td></td>
<td>Telvar, CMU</td>
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</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Dowpon</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Dalapon</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Amtrile</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* Lornox Plus is a mixture of triclopyr and 2,4-D. + S.B.K. is a mixture of 2,4-D and 2,4-T.

Inclusion of a trade name in this list does not imply that the product is superior to others which are not listed.
COMMON RED POPPY or FIELD POPPY
Papaver rhoeas

KNOTGRASS—Polygonum aviculare

DAMP SOIL

RAGGED ROBIN—Lychnis flos-cuculi

RUSH—Juncus effusus
SOUR OR ACID SOIL

CORN MARIGOLD—*Chrysanthemum segetum*

FOXGLOVE—*Digitalis purpurea*

SOIL IN NEED OF LIME

BRACKEN—*Pteridium aquilinum*

CORN SPURREY—*Spergula arvensis*
<table>
<thead>
<tr>
<th>Crop</th>
<th>Type of Weed</th>
<th>Appropriate Chemicals</th>
<th>Some Trade Names</th>
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<tr>
<td>BUSH FRUIT</td>
<td>Couch</td>
<td>Dalapon</td>
<td>Dowpon</td>
<td>Affects leaves and roots</td>
<td>In dormant season only, not safe on raspberries</td>
</tr>
<tr>
<td></td>
<td>Annual</td>
<td>Simazine</td>
<td>Guesatop, Bladex</td>
<td>Residual, soil acting</td>
<td>Apply to clean ground before seeds emerge, prevents growth of seedlings</td>
</tr>
<tr>
<td>BULBS</td>
<td>Annual</td>
<td>Chlorpropham</td>
<td>CIPC, Zide No. 2, Residuren*</td>
<td>Soil acting</td>
<td>Apply to clean ground before shoots appear</td>
</tr>
<tr>
<td>ROSES</td>
<td>Annual</td>
<td>Simazine</td>
<td>Guesatop, Bladex</td>
<td>Residual, soil acting</td>
<td>Apply to clean ground before shoots appear, prevents growth of seedlings</td>
</tr>
<tr>
<td>ASPARAGUS</td>
<td>Annual</td>
<td>Monuron, Simazine</td>
<td>Telvar, CMU, Guesatop, Bladex</td>
<td>Residual, soil acting</td>
<td>Apply in spring before new growth emerges</td>
</tr>
<tr>
<td>BROAD BEANS</td>
<td>Annual</td>
<td>Simazine</td>
<td>Guesatop, Bladex</td>
<td>Residual, soil acting</td>
<td>Apply immediately after sowing, not safe on very light soils</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Chlorpropham</td>
<td>CIPC, Zide No. 2, Residuren*</td>
<td>Soil acting</td>
<td></td>
</tr>
<tr>
<td>CABBAGES</td>
<td>Small annuals</td>
<td>SMA</td>
<td>Monoxone</td>
<td>Scorching</td>
<td>After planting out, kills small weeds</td>
</tr>
<tr>
<td>CARROTS</td>
<td>Annual</td>
<td>Mineral oils</td>
<td>T.V.O., Shell W</td>
<td>Scorching</td>
<td>Kills small weeds, apply after seedlings have true leaves</td>
</tr>
<tr>
<td>ONIONS</td>
<td>Annual</td>
<td>SMA</td>
<td>Monoxone</td>
<td>Scorching</td>
<td>Kills small weeds, apply after &quot;crook&quot; stage</td>
</tr>
<tr>
<td>PEAS</td>
<td>Annual</td>
<td>Chlorpropham</td>
<td>CIPC, Zide No. 2, Residuren*</td>
<td>Soil acting</td>
<td>Apply immediately after sowing</td>
</tr>
</tbody>
</table>

* Residuren is a mixture of chlorpropham and diuron. Inclusion of a trade name in this list does not imply that the product is superior to others which are not listed.
Calendar of Work

These are reminders, based on experience of conditions in the middle of England during an average year, of the appropriate moments for the more important gardening tasks.

The dates given for these tasks should be amended by gardeners in different parts of the country. There is a three-week difference in the seasons between the cooler and warmer parts of Britain, while spring comes two days later and autumn two days earlier for every additional 100 ft. of altitude. Account should also be taken of climatic variations from year to year. Seasons may differ by up to three weeks in successive years, and in years of unusual weather spring can be as much as a month early or late.

JANUARY

January is the chief month for planning and for ordering seeds and plants.

Now is the time to decide whether the varieties of flowers and vegetables that were grown last year were sufficiently successful and suitable to the garden to be reordered. Make this ordering the first task of the New Year.

The advisability of buying seeds from a reputable firm cannot be over-stressed.

Start a gardening diary this month. It can be a great help in future years.

DECORATIVE GARDEN

Make root cuttings of such plants as anchusa, oriental poppy, phlox, gaillardia and perennial verbascum to provide plants to put out in spring. Cut up the roots into pieces about 2 in. long and put them into sand or fine soil according to the details given in Propagation.

The planting of trees and shrubs can continue if the weather is favourable, but be sure that the soil has been carefully prepared beforehand and that the young plants are staked firmly when planted.

If heavy snow falls, clear it from the branches of trees, particularly evergreens, where the weight can cause the boughs to break.

If frost lifts newly planted shrubs or perennials, push them back with the heel, firming the soil down all round the plants.

Inspect tubers and corms in store to see that mice are not attacking them.
Remove and burn any that are decaying. Order new begonias, gloxinias, dahlias and gladioli.

If turves were not laid in the autumn, lay them now—but only, of course, when conditions are suitable.

**VEGETABLE GARDEN**

If the vegetable garden was not dug in October or November, get as much digging done as possible, working in manure or compost where needed, and leave the ground in ridges.

Towards the end of the month cover with cloches ground ear-marked for February sowings so that it will have a chance to warm up.

Sow lettuce seed in a cold frame or under cloches. If a heated frame is not available, make up a hot-bed and sow carrots of the shorthorn type.

Prepare celery trenches, getting the compost well down below the top spit.

Force rhubarb by covering one or two crowns with a box or barrel and cover the outside with hay, bracken or long strawy manure. (For an alternative method, see under "Greenhouse".)

Lift artichokes, celery, leeks and parsnips if the ground is not frozen.

For an early crop of broad beans, start sowing seed to grow under cloches until March.

Towards the end of the month, put seed potatoes into trays for sprouting and set them in a light, frost-proof greenhouse, shed or spare room.

**FRUIT GARDEN**

Complete any winter pruning of top fruit, making sure to remove all dead wood and all suckers from the base of the trees; spray with a tar oil winter wash against hibernating insects.

Look over apples and pears in store and remove any showing signs of disease.

**GREENHOUSE**

Be especially careful with watering now as the atmosphere dries very slowly.

Pot-grown shrubs may be brought inside for forcing at a temperature of 50° F. (10° C.) or a few degrees more.

Sow tuberous- and fibrous-rooted begonias in a temperature of 60° F. (16° C.).

Continue to take cuttings from stools of chrysanthemums, and put them into a propagating frame where an average temperature of 45 to 50° F. (7 to 10° C.) can be maintained.

From the garden lift crowns of rhubarb for forcing, and if they are frozen, so much the better. Pack them in soil in boxes and put them under the staging. Arrange sacking or boxes over them to keep them in complete darkness. In a temperature of between 55 and 65° F. (13 and 18° C.) sticks will be produced for pulling in about four weeks.

Sow seeds of tomatoes, onions and leeks in boxes, and exclude the light until they have germinated.

Start to sow seeds of antirrhinums, scarlet salvias and verbena in boxes or pans and cover with glass and brown paper until they have germinated.

Sow sweet pea seeds, two or three to a 3-in. pot—first chipping the hard coats of the seeds (opposite the mark where the seed was attached to the pod) to help germination.

Tie in and prune peach trees growing under glass.

Carefully scrape the bark of vines under glass and paint with tar oil wash.

Sow seeds of cauliflower in boxes, giving them as much light as possible once they have germinated.

To grow large onions for exhibition, sow seed in boxes of John Innes seed compost early in the month. Keep them under the staging until germinated.
Although the weather can be very bleak, this is a month for great activity in the garden. Get on with as many seasonal jobs as possible so that there is no surfeit of urgent work to be done during the next two or three months.

DECORATIVE GARDEN
If the opportunity to prepare sweet pea trenches in the autumn was missed, the job can be done now—if the ground is in a suitable condition. Incorporate well-rotted manure or compost. Make open-ground sowings at the end of the month.

If the ground is friable, deciduous shrubs and trees can still be planted, otherwise store them in a frost-proof place for a few days. If the work of planting cannot proceed, heel them in out of the wind. The ground should be well prepared before planting. Treat stakes with a wood preservative such as Cuprinol before using them.

Fork over herbaceous borders and incorporate manure.

Cut back old plants of St. John’s wort (Hypericum calycinum) to the base.

Towards the end of the month prune varieties of Buddleia davidii; cut back the vigorous growths of Hydrangea paniculata if large flower heads are wanted—otherwise prune this shrub very little.

Divide snowdrops when the leaves have turned yellow.

Plant lilies such as Lilium regale.
Ornamental plants will benefit from a dressing of bone meal forked in at the rate of about 2 to 4 oz. to the sq. yd.

VEGETABLE GARDEN
Make a sowing of turnips towards the end of the month, if the weather is suitable. Sow early varieties of peas.

Sow radishes in a sunny, sheltered spot, then cover the ground with straw.

Lift the last of the parsnips and store. Protect broccoli curds from hard weather by folding large outer leaves over them.

Increase herbs like thyme and chives by dividing the roots now.

Sow leeks in frames and under cloches for an early crop.

FRUIT GARDEN
Cut back raspberry canes planted in the autumn or winter to about 6 in. Black currants planted during the last four or five months should be pruned back to within 2 in. of the soil.

Feed apples and pears with the appropriate fertilizers.

GREENHOUSE
Start begonia and gloxinia tubers, planting them close to one another in shallow pots or boxes.

Prick off 2 in. apart into boxes, seedlings of vegetables sown in January and during
the first half of February. Put the boxes on the shelving close to the light.
Sow cucumber seeds in 3-in. pots, and exclude light until they have germinated. Gentle bottom heat helps germination.
Sow seeds of such bedding plants as lobelias in the second half of the month—temperature 60° F. (16° C.).
Sow seeds of violas and pansies.
Start fuchsias into growth—temperature 50° F. (10° C.).
Take cuttings of winter-flowering begonias, and root them in a propagating frame with gentle bottom heat.
Pot young tomatoes from the January sowing, singly into 3- or 3½-in. pots, with a very little tomato fertilizer added to the compost. Maintain a temperature of 50° F. (10° C.).
At the end of the month sow celery and brassica seed in boxes and later prick out and keep the seedlings in a temperature of 60 to 65° F. (16 to 18° C.). These can be gradually hardened off afterwards in preparation for planting out into trenches.
Zonal and ivy-leaved pelargoniums that have been overwintered in the cold greenhouse or indoors should be pruned, repotted and watered to start them into growth again. Pot on rooted cuttings of these plants made in August. Water them more frequently from now on.
Sow seed of maincrop tomatoes.

MARCH

The momentum of work increases as the month advances. Weather conditions are important, because if the soil remains saturated the tilth required for sowing seeds cannot be obtained and the soil will remain too cold for successful germination.

DECORATIVE GARDEN
Complete the planting of deciduous shrubs and climbers.
Fork over flower beds to freshen them for the spring, but be careful not to damage the roots of shrubs and other permanent plants.

Hardy perennials are best lifted, divided and replanted in March, especially on newly cultivated ground, although many of them are just as successful when this work is carried out in the autumn. Heleniums, monardas and phlox are usually the most forward, and need attention first. Do not disturb plants like oriental poppies and peonies.

In the southern half of the British Isles plant ranunculus and anemone corms in a sheltered spot. Gladioli can also be put out in favourable positions.
Prune established bush and climbing roses. Cut away any dead or diseased
wood first, then continue the work in accordance with the instructions contained in *Reses*. Renew ties on climbing kinds and fork over the soil of the beds afterwards to remove footmarks.

Roll the lawn and trim the edges. Where moss has grown, rake well a few days after rolling, once the soil is dry enough, and treat with a proprietary mercury dressing if necessary. Where a new lawn is to be grown from seed, give the soil a final raking so that it is ready for sowing. In mild springs the first lawn mowing can be done if the grass has grown. The blades of the machine must be set high.

Replace pansies, wallflowers, forget-me-nots or Siberian wallflowers if they have failed during the winter and gaps have therefore appeared in the spring bedding schemes.

Prune *Jasminum nudiflorum*, chimonanthus and hamamelis after they have finished flowering.

Feed hedges with farmyard manure or fertilizer.

Inspect the shoots of shrubs and, if hard weather has damaged them, prune them back to sound wood.

In warmer parts of the country, and only if conditions are suitable, start to sow seeds of hardy annuals about the middle of the month in well-prepared soil worked to a fine tilth.

**VEGETABLE GARDEN**

Sow the early varieties of most vegetables. By a careful selection of varieties and restraint in the quantity of seed sown, a good succession of vegetables can be arranged and a glut avoided. Continue fortnightly sowings of early varieties of peas. Regular sowings of lettuces, carrots and radishes can begin in all but the very coldest districts.

Lightly fork and rake the soil to prepare good seed beds. Top dress, a few days before sowing, where required.

Collect pea sticks from the hedgerows now, before the leaves grow and the job gets too difficult. Erect supports for runner beans.

Plant Jerusalem artichoke tubers 1 ft. apart in rows and allow 3 ft. between the rows.

Sow parsnips as soon as the ground is ready, as they like a long season. Sow radish or lettuce at the same time in the drill as a catch crop. Parsnip seed is slow to germinate and the catch crop will mark the rows for hoeing.

Sow broad beans and onions out-of-doors. If these are sown thinly the seedlings can be left until the stems begin to swell. The thinnings can then be used for salads.

If conditions are favourable, plant the first early potatoes 4 in. deep and 1 ft. apart, leaving 1½ ft. between the rows.

Prepare an asparagus bed by deep digging and by making generous additions of really old manure or compost. Buy one-year-old crowns and cover them with 6 in. of good soil after planting according to the instructions in *Vegetables*.

Old asparagus beds should be overhauled before the shoots begin to show. Fork over the soil to a depth of 3 or 4 in. and add a fish fertilizer.

Prepare new beds for herbs.

Hoe between rows of all crops regularly to keep down weeds and conserve moisture.

Cut savoys, Brussels sprout tops and turnip tops.

Give a top dressing of nitrate of soda, sulphate of ammonia or dried blood to spring cabbage and winter lettuce.

Plant out the seedlings of broad beans sown in boxes in December or January.

Thin out autumn-sown onions.

Make a sowing of *Crimson Globe* beetroot under cloches.
FRUIT GARDEN
Give black currants a lime sulphur or thiram spray. Use Karathane on gooseberries to prevent American gooseberry mildew.
A captan spray will prevent the spread of cane spot on raspberries, loganberries and blackberries.
This is the last opportunity to plant soft fruit or young fruit trees. Stake the latter well, and check over old stakes and ties. Where necessary, renew them before the top growth increases in weight.
At the very end of the month, remove and burn grease bands that have been on fruit trees all winter.
If the season is mild, plant out young strawberry plants that were not put into permanent beds the previous autumn. Where the action of frost has lifted existing plants, firm them in with the heel. Put cloches over a few selected strawberry plants to encourage early flowering and fruiting. Start hoeing between the rows.
Start grafting apples and pears.
Protect the blossoms of wall-grown peaches and nectarines, when threatened by frost damage, by covering them with hessian or other suitable material.
Lightly prune cob-nuts and filberts.

GREENHOUSE
Start dahlia tubers by putting them in boxes of moist soil or peat in a warm greenhouse to encourage them to sprout and form shoots from which cuttings can be made. Spray them with water as needed in order to keep the soil moist.
Repot decorative plants in fresh compost similar to that in which they have been growing; sometimes they will need to be put into a pot a size larger. Plants that benefit particularly from this attention are *Asparagus sprengeri*, codiaeums, palms, smilax, begonias and all ferns.
For summer display sow more seeds of half-hardy annuals, such as ageratum, nicotiana, nemesis, zinnias and ten-week stocks. These can be pricked off, hardened off and planted out later.
Sow melon seeds singly about 1/4 in. deep in thumb pots. Keep them in a close atmosphere in a temperature up to 65 to 70° F. (18 to 20° C.). Encourage the seedlings into growth by plunging the pots up to their rims in peat or moss in a propagating frame. Keep the peat or moss moist.
Pot on the January- and February-sown tomatoes into pots, or into rings if ring culture is being undertaken. Keep the plants growing steadily but not too quickly, otherwise soft and easily breakable growth is produced, which is prone to disease and insect attack.
Harden off seedlings of outdoor varieties of tomato for planting out in June.
In the fern house, the growing period will be beginning, so give more air whenever the temperature allows.
Harden off the seedlings of cauliflowers, onions and leeks sown under glass in January for planting out in early April.
Air layering of greenhouse plants suitable for this type of propagation can begin now.
Sow seeds of Coltness Hybrid dahlias—temperature 60 to 65° F. (16 to 18° C.)—for bedding out in the summer.
Pay particular attention to pest control now that growth is starting.
Watch the water requirements of plants carefully now that the heat of the sun is increasing.
Provide seedlings with shade if necessary, and damp down and ventilate as experience dictates.
Ventilate plants in frames as necessary and make sure they do not lack water.
APRIL

Whatever work is due to be done in April, seed sowing must go on, because a late start can spoil a display in the flower garden or cause vegetables to be woody and poor.

DECORATIVE GARDEN
Finish off the planting of herbaceous perennials and fork over the border lightly, incorporating a little rotted compost. Do not mulch herbaceous plants yet, as it is too early in the season.

This is the last chance, until October, to plant evergreen or coniferous hedges. Evergreen shrubs and trees can also be planted on well-prepared ground and staked to help the young plants to establish themselves. If cold winds persist, protect the newly planted shrubs with a shelter made of dry sacking or polythene sheeting.

Cut back any evergreen shrubs that have become straggly to encourage new growth from the base.

Prune established conifers when necessary, using secateurs and not shears.

Prune early-flowering shrubs such as forsythias as soon as they have finished flowering.

With cloche protection, in very sheltered districts, some half-hardy annuals such as antirrhinums and callistephus can be sown out-of-doors.

Sow the seeds of hardy annuals if this was not done last month. Annual borders need careful marking out after preparing the seed bed. Draw irregular shapes on the soil surface with a stick, and label each area with the name of the plants destined to be grown there. Prepare small twiggy pea sticks for staking once the seedlings have germinated.

If daffodils have finished flowering, nip off the old flower heads so that the plants will not be exhausted in producing seed. Leave the stems and leaves, which can be knotted together to keep the garden tidy.

Sow grass seed for new lawns or to renovate bare patches on old lawns, provided the soil is not still cold and wet. If established lawns are weedy give a dressing of lawn sand or selective weedkiller used according to the manufacturer’s directions. Roll and mow the lawn, keeping the blades of the machine set high.

Plant new water-lilies and other aquatics or reorganize the existing planting of the pool.

Start dahlia tubers in the greenhouse or cold frame and plant them out later in the month. They will then produce good extra blooms for cutting.

Plant alpines, pansies and violas.

To start a herb garden, sow seeds of herbs, or push in stolons of mint or rooted cuttings of sage.
VEGETABLE GARDEN
Continue to sow vegetable seeds, making a succession of small sowings of each type rather than one big one. Thin the seedlings as soon as they are large enough to be dealt with and hoe regularly to suppress weeds. Sprinkle with a 4 per cent calomel dust along the rows of onion seedlings when they are being thinned to prevent attack from onion fly. After thinning, press back the soil with the feet.

Plant out autumn-sown cabbages and cauliflowers that have been overwintered under cloches or in frames.

Plant tubers of potatoes and seedlings of broad beans and lettuces.

Prepare marrow beds and incorporate plenty of manure.

Inspect established asparagus beds for early spears to cut, and plant crowns in new beds if this was not done in March.

Provide support for peas by pushing in along the rows of seedlings pea sticks gathered earlier in the year. Use sticks about 6 in. taller than the ultimate height of the peas.

Remove gradually the covering from rhubarb which has been forced under boxes for early supplies.

On well-prepared seed beds sow parsley, salsify and colewort, as well as spinach beet and kohlrabi.

FRUIT GARDEN
Spray apples and pears against aphids, apple blossom weevil and capsid bug, according to the progress of the blossoms (see Garden Pests).

Thin out, in stages, the fruits of outdoor peaches and nectarines growing against a wall, bearing in mind that there will be a natural drop of fruitlets during the next few weeks which will act as a further thinning.

Graft fruit trees as early in the month as the weather will allow.

Bark ring over-vigorous apple and pear trees by cutting out a ring of bark ½ in. wide all round the trunk, or a half ring on one side and another about 6 in. lower on the opposite side of the trunk. The result will be a better formation of fruit buds and the cropping capacity of the tree will be increased.

GREENHOUSE
Ventilate when strong sunshine sends the temperature soaring.

Either put the January-sown tomatoes into their final pots (9 or 10 in.) or plant them out directly into the border. Alternatively, put them into bottomless pots if ring culture is being carried out. Support them with stakes and tie them carefully.

Sow seeds of sweet corn in boxes and prick off into other boxes as soon as the seedlings are large enough to plant. The atmosphere should be kept buoyant once the seedlings have reached the prickling-off stage.

Continue to prick off all seedlings as they get big enough to handle and keep the atmosphere buoyant for them. Harden off seedlings that are to be planted out at the end of the month or in May, taking particular care that they are protected at night, as cold nights are a common, though sometimes unexpected, occurrence at this time of the year.

Plant out February- or March-sown cucumbers into made-up beds in the greenhouse or frame, and tie each to a small stake.

When nerines cease growing, reduce the amount of water given to them. Rest the bulbs completely when the foliage withers.

Take leaf cuttings of Begonia rex.

Sow seeds of herbaceous plants in a cool greenhouse or frame.

Sow ridge cucumbers.
CALENDAR OF WORK

Late-flowering chrysanthemums and perpetual flowering carnations raised from cuttings will be ready for repotting. Keep them growing slowly but evenly and shade them from sudden bright sunshine.

Take cuttings of dahlias as they are ready, and insert them round the edges of small pots filled with sandy compost Leave the tubers in moist peat to produce more growths from which cuttings can be made.

To produce flowers during the winter, sow early batches of primula seed (Primula sinensis, P. obconica and P. kewensis) in pans and maintain a temperature of 60° F. (16° C.), keeping the pans covered until after germination.

MAY

May is the first really rewarding month of the year when early salad crops, asparagus, early peas and flowers for the house can be expected. The general routine work of April—hoeing, sowing, thinning and planting—must still be continued.

DECORATIVE GARDEN

As herbaceous perennials will be growing quickly, stake them before the foliage grows too heavy or too difficult to handle without breaking. Use strong, twiggy stakes and push them down firmly in a ring round each plant, sloping them slightly outward. The plants will grow through the twigs and soon hide them.

Lift spring bulbs and heel them in in some corner of the garden. Clear the beds and prepare them for the summer bedding display.

Keep the border lightly forked, and mulch peonies and delphiniums with well-rotted compost.

Half-hardy annuals such as nasturtiums can be sown in the open.

The seedlings of annuals sown in April will require thinning. Stake them with rather thin twiggy stakes so that the plants can grow through them and hide their supports.

The old forget-me-nots, double daisies (Bellis perennis) and polyanthus can be divided now and set apart in a nursery border for use in the following year's spring display.

Continue to prune early-flowering shrubs after they finish flowering. Cut back, if necessary, branches of evergreen shrubs to make them shapely.

Feed roses and lilies with liquid fertilizer.

This is an especially good month to apply selective weedkillers.
Seeds of wallflowers, forget-me-nots, Siberian wallflowers, and biennials such as honesty and Canterbury bells can be sown in rows for flowering next year.

Pelargoniums (geraniums) may be planted in tubs or boxes outside during the last week of the month. Window-boxes can be prepared for the summer display. They will need careful and regular watering from now on.

Watch out for aphids on roses and spray against them with malathion as soon as they are noticed. They increase quickly in dry periods.

Start a new compost heap now that more fresh material is becoming available (see Composting and Green Manuring).

Continue to mow the lawn at regular intervals, taking the cutting blades a little closer to the sward.

Remove dead flower heads from the rock garden plants that have faded.

**VEGETABLE GARDEN**

Continue with seasonal sowings to meet individual requirements. Keep hoeing between rows of seedlings, and thin out when necessary. In some years a period of drought may occur towards the end of the month, and the vegetable garden will therefore benefit from some extensive overhead watering. Peas, especially, should be kept growing and not be allowed to suffer the effects of drought.

Plant out Brussels sprouts, summer cabbage and cauliflower seedlings that have been raised under glass and hardened off. Puddle them in, especially in dry weather, and keep a sharp look-out for cabbage root fly and the turnip flea beetle.

Sow runner beans and dwarf French beans when the danger of frost is over. As a precaution against frost damage, give cloche protection at night.

Sow seeds of maincrop beet and the last batch of summer spinach.

In mild districts sweet corn can be sown out-of-doors at the end of the month.

About the middle of the month pinch out the tops of broad beans.

If not already done, prepare celery trenches, ready for putting out the plants in June.

At the end of the month, plant out ridge cucumbers from a sowing made under glass last month.

Sow seeds of late winter cauliflower and New Zealand spinach outdoors by about the middle of the month.

If not already done, prepare the ground for planting out tomatoes as soon as they have been hardened off.

**FRUIT GARDEN**

Spread strips of black polythene or clean straw along the rows of strawberries to act as a mulch, suppress weeds, and keep the berries clean and free from slugs. Spray the plants with Karathane against mildew, then cover the bed with netting to protect the fruit from birds.

Thin out shoots of raspberries, leaving six or seven canes to each plant. Mulch both raspberries and black currants with clean straw.

Suckers formed on fruit trees and bushes should be removed from the base as soon as they appear.

Erect cages or netting over soft fruit to protect it from birds. Pick strawberries and gooseberries as they are ready.

Keep weeds under control.

In the latter half of the month, thin out the fruits on peaches and nectarines.

**GREENHOUSE**

The early tomatoes in pots, rings or borders will need pinching and tying up. February-sown tomatoes may now be put into final pots or rings. Give full ventilation during the day and spray the outside of the greenhouse glass with
whitewash. Keep the house dampened down during the day to prevent dry heat.

All seedlings and rooted cuttings may be cleared from the house to make room for melons or cucumbers.

Prick off seedlings of primulas sown last month and pot them into 3-in. pots.

Harden off rooted cuttings of chrysanthemums and dahlias for planting out later in the month.

Take cuttings of alpine plants and insert them in a sandy compost round the edge of small pots. Cover each pot with a polythene bag, first putting a couple of wooden labels or sticks in the pot to prevent the bag from touching the leaves of the cuttings. Slip on a rubber band to exclude air until the roots have formed. Turn the bag inside out each day.

As bunches of grapes develop, the berries need thinning to give good shape to the bunches and to ensure even development of the fruits. If necessary hold each bunch with a short, forked stick and nip out the berries with long-bladed scissors, starting at the bottom of the bunch and finishing at the shoulder.

Harden off sweet corn for planting out later in the month.

Move tuberous begonias into 6-in. pots. Mulch peach trees with well-rotted manure and train in young shoots.

Move late-flowering chrysanthemums at the end of the month into the pots in which they are to flower.

Top dress lilies in pots.

By the middle of the month move tomato plants destined for outdoors to a cold frame to harden off.

JUNE

Once June is in, the fear of frost is over, even in the colder parts of the country, and everything should be growing well. The object of good cultivation is to keep both decorative plants and vegetables growing at an even rate. Feeding with fertilizers or liquid feeds as advised in other chapters of this book is important during the summer months, as is constant vigilance against insect pests, diseases and weeds.

DECORATIVE GARDEN

The seedlings of wallflowers, Siberian wallflowers, forget-me-nots, honesty and Canterbury bells sown in May can be thinned to about 6 in. apart, preferably in two operations. The seedlings from the second thinning, if planted out in a freshly-prepared bed, will provide extra plants.

Remove dead flowers from lilacs, rhododendrons and azaleas.
Sow seeds of perennials in rows about 9 in. apart and thin the seedlings later. Choose a good nursery bed so that the plants get a really good start in life.

The seedlings of half-hardy annuals will have been hardened off in preparation for planting now, or they can be purchased in boxes from the local nurseryman. If a dry period follows the planting, take great care of the young plants until they become established.

Mulch border plants, especially phlox and Michaelmas daisies, and continue hoeing among all the plants in the border.

Lift late-flowering tulips and heel them in until the foliage has turned a creamy-yellow and then lift and store.

Prepare hanging baskets for putting out-of-doors, even in cool positions. Line each basket with polythene in which a few holes have been punctured, then line thoroughly with sphagnum moss before planting up with such plants as pelargoniums, lobelia, nepeta, fuchsias and marguerites. Use John Innes potting compost No. 2. Hanging baskets need careful watering as they dry out quickly, though with a polythene lining they will hold the moisture better.

Continue to keep a vigilant watch for aphids, black spot and mildew on roses, and mulch all types early in the month with old manure or well-rotted compost. Avoid using lawn clippings alone.

If plants are watered, water them really well. Light watering encourages feeding roots to form near the surface, which is not desirable.

Remove suckers from roses as low down as possible.

Lift and divide pyrethrums during the latter part of the month.

VEGETABLE GARDEN
Continue to sow seeds and work with the hoe among the rows of vegetables. Lettuces, peas, beet, radishes and spinach sown in May will be ready for thinning in two stages.

In all districts, ridge cucumbers, marrows, cauliflowers, savoys, broccoli, french beans and runner beans can be planted out-of-doors.

Plant out leek seedlings towards the end of the month in holes 6 in. deep in rows 1½ ft. apart with 6 in. between the plants in the rows. Make each hole with a dibber, sufficiently deep to take both plant and roots without any cramping. Drop the young leek plant into the hole and water in. Do not fill the holes with soil or firm round the plants with the foot.

Tomatoes can also be planted out-of-doors in all districts. Prepare the ground well and choose a sheltered spot. Drive in a stake before each plant is turned out from its pot. Keep the ball of soil round the root intact. Plant at the base of the stake then firm well and tie gently with garden string.

Plant out celery, keeping a good ball of soil at the root of each plant, and water the plant in very well. Celery is a gross feeder and also likes plenty of moisture. Spray the rows with malathion to combat the celery fly. Once the plants are established give a liquid feed.

Earth up potatoes and spray with Bordeaux mixture against blight. At the end of the month the first early varieties should be ready for lifting.

Finish cutting asparagus at the end of the month, or two weeks earlier in early districts, to give the plants a chance to build up their crowns for next year.

Remove any flower heads that appear on autumn-sown onions.

FRUIT GARDEN
Spray raspberries with a proprietary spray containing derris against the maggot of raspberry beetle which eats into the developing fruits.
Mulch wall-trained fruit trees.
Watch for signs of reversion in black currants (spread by big bud mite). Remove and burn affected plants.
If necessary, carry out a final thinning of apples and pears at the end of the month.
Thin plums when they are the size of acorns. If there is still a heavy crop later in the month, support the branches with poles or posts.

GREENHOUSE
Leave the ventilators fully open now, but early in the month guard against sudden falls in temperature at night.
Damping down is important as outside temperatures rise, and direct shade may be necessary for some of the young rooted cuttings taken in May, and for the primula seedlings that are now in separate pots.
Water all pot plants daily, preferably in the morning, except those which are resting, such as nerines and lachenalias.
Make further sowings of primulas.
Fumigate the house with smoke pellets to control white fly where it appears.
Pot on into larger pots rooted cuttings of perpetual-flowering carnations and chrysanthemums.
Move zonal pelargoniums into their final 6-in. pots before placing them outside for the summer months.
Move winter-flowering begonias into larger pots, as necessary.

JULY
A rewarding month for those who made an early start in spring. Continue to pick soft fruit and preserve it and make regular harvests of vegetables so as to use them in a young condition.

DECORATIVE GARDEN
Take soft-wood cuttings of shrubs and alpines, using the new growth, and dibble them into sandy compost in a frame or round the rims of pots.
Take pipings of garden pinks and insert them into pots of sandy compost. Keep them just moist until rooted.
Bud roses according to the details given in Propagation and Roses.
Layer border carnations by cutting the stems of non-flowering shoots at a joint and pegging them down in the soil.
If any clumps of June-flowering irises have spread too far, reduce their size by dividing them. Cut off the rhizomes, trim the leaves to a 5-in. fan and replant so that the rhizomes rest on the soil.
Feed and top dress plants in window-boxes, tubs and hanging baskets and
remove dead flower heads to maintain a good display.
Water wall plants well if there has been no rain, and renew mulches of well-rotted leaves or old compost.
Plant colchicums in the latter part of the month.

VEGETABLE GARDEN
Lift shallots and autumn-sown onions and lay them on the surface of the soil for a few days to dry, before storing them. Let the roots get plenty of light and air.
Pick broad beans as ready and put the haulms on the compost heap. Fork over the ground where they have been.
Continue to pick peas and, as soon as they are harvested, clear the haulms away and add them to the compost heap.
Gather herbs for drying. Do this on a dry day and towards the middle of the day when there is no moisture on the plants. Place them in a shallow box to carry them into the house to prepare them for drying.
Sow seeds of winter radish. These store well and can make a welcome change as a vegetable during the shortest days.
Lift early varieties of potato.
In the north, sow seeds of spring cabbage about the middle of the month.
The last sowings of summer lettuce should be made by the middle of the month.
In a good summer last sowings of peas can be made for a late crop.
In colder parts of the country, winter turnips should be sown by the middle of the month.
Give plenty of water to cucumbers in frames and marrows out-of-doors.
The yield from beans will be improved if the plants are watered well with weak liquid feed.
Remove side shoots from tomato plants and stake well.
Spray outdoor tomato plants and potatoes with Bordeaux mixture as a preventive against blight.
Plant out April-sown coleworts.

FRUIT GARDEN
To reduce damage to plums and other stone fruit at the end of the month and during August, destroy any wasps’ nests that are being built, by placing a handful of derris dust on each hole. If silver leaf disease appears on plum trees remove and burn infected parts. Paint over the scars with a white lead paint to prevent re-entry of the fungus spores.
Prune cherries and apricots grown as wall plants; summer prune apples and pears grown as cordons.
Remove straw from strawberry beds. Begin to propagate from good runners, pegging down the little plants as they appear, either directly into the soil or in 3-in. pots sunk into the soil for later forcing. Cut off unwanted runners.
Pick currants, raspberries and gooseberries as they are ready, and preserve them. Recipes are given in Preserving.

GREENHOUSE
Chrysanthemums and tomatoes in pots and in borders will need stopping and feeding regularly. It may be necessary to provide them with additional shade during the day. Paper or butter muslin sheets are suitable.
Put cuttings of pelargoniums round the edges of pots filled with silver sand and keep them in a cool or cold house or frame to strike.
Pot on primulas sown during the last two or three months and sow cinerarias for display next spring, prickling them off as soon as they have germinated.
Watch out for signs of red spider on peaches and nectarines. Ventilate the house more freely once the trees have finished cropping.
Take cuttings of fuchsias.
AUGUST

This is the month for horticultural shows or the preparation for them. Guard against birds and wasps, which are the chief enemies in August.

DECORATIVE GARDEN

Make a note now of any improvements that could be made to the herbaceous border by replanting in the autumn.

Inspect roses that have been budded in previous months and loosen any ties that are cutting into the bark.

Cuttings of shrubs can still be taken. This is a good month particularly for hydrangeas; cuttings are best inserted into 2½-in. pots and kept moist in a shaded frame without ventilation.

Check the stakes of Michaelmas daisies before the plants come into flower. If the foliage shows signs of mildew, spray it over with Karathane or flowers of sulphur.

From border plants remove dead flower heads or flowering spikes that have finished. Keep the border weeded and watered if necessary, because phlox, Michaelmas daisies, heleniums, chrysanthemums and other late border plants all seem to like plenty of moisture.

Disbud dahlias and tie in the growth as required and keep a careful look-out for greenfly attack.

Tie and disbud chrysanthemums according to variety and feed with chrysanthemum fertilizer. During dry weather these plants will be among the first to show signs of wilting and they should therefore be watered every evening if necessary.

Plant narcissi bulbs out-of-doors and in window-boxes.

Prepare the sites for new lawns that are to be autumn sown. Rake and roll thoroughly to prepare a good seed bed and sow the seed fairly thickly at the end of the month. If, however, the season has been dry and the soil is sugary and dry, delay the sowing until after rain. Occasionally mow established lawns without the box or hood on the machine, thus allowing the clippings to fall back as a mulch. This is especially useful in periods of drought.

Cut flowers such as limonium (statice), helichrysum and helipterum for drying and for future use as winter indoor decoration.

Take cuttings of lavender and rambler roses.

Plant bulbs of Lilium candidum.

VEGETABLE GARDEN

Feed celery, runner beans, marrows and ridge cucumbers with liquid feeds. Earth up celery, fastening the stems together with wide raffia before the soil is thrown
up, so as to keep the hearts firm and white.

Prepare a suitable site for a clamp for potatoes and other root crops to be kept through the winter. Obtain dry, clean straw for this job and keep it under cover until the clamp is made.

The seeds of the onion variety White Lisbon can be sown for salad onions in the spring. Choose a dry border, as losses will then be fewer during the winter than they would be in a badly-drained place.

In warmer districts, sow seeds of spring cabbage early in the month.

Continue to harvest beans, onions, peas, lettuce, beet, radishes and carrots as they are ready or required.

By the end of the month start blanching endive from the first sowing. Do only a few plants at a time, and never put pots over plants that are wet.

Harvest young vegetable marrows.

**FRUIT GARDEN**

Continue to protect developing fruits from wasps. Cover choice fruits with muslin bags.

Pick early varieties of apple such as George Cave for immediate use—not to store.

Strawberry runners pegged down during the previous months will be ready to be severed from the parent plants and put into new strawberry beds. The beds should be carefully and thoroughly prepared before planting. Alternatively, the best of the young plants can be potted up into 6-in. pots and taken into frames and later moved into the greenhouse after it has been cleared of the tomatoes. Put them on the shelving near the light for gentle forcing. This will provide early fruits next spring.

Once all the fruit has been picked from the raspberry canes, prune the plants. Cut out to ground level the canes that have just finished fruiting, leaving half a dozen of the strongest-growing canes to each plant.

Pick plums and greengages and preserve according to some of the recipes given in *Preserving*.

Summer-prune apples early this month and burn the prunings.

**GREENHOUSE**

Be ready with extra shading to put up at the first signs of scorched foliage. If the weather is very dry, watch out for thrips and red spider and damp down walls, paths and staging if necessary.

Reduce water supply to gloxinias and begonias that have finished flowering.

Picking will be in full swing from house-grown tomato plants. As the bottom trusses ripen and are picked, feed the plants with a liquid tomato fertilizer for subsequent fruits from the higher trusses.

Rooted cuttings taken and inserted during the summer will be ready for potting up singly or planting out in a frame. If they are left in their small pots at this stage they will grow away too quickly instead of making good firm plants.

Begin to water round cyclamen corms to start them growing. Scratch away the existing surface soil from the pots and replace it with John Innes potting compost No. 1.

Cut cucumbers and melons as they are ready, and top dress the beds with compost.

Continue to take cuttings of fuchsias.

Make an early start with indoor bulbs by potting some *Narcissus Paper White* and Roman hyacinths. Plunge these under a layer of ashes outdoors.
SEPTEMBER is the month for garnering and preparing for the winter. It is also the time for looking ahead to spring requirements.

DELECTABLY GARDEN
Sever rooted layers of border carnations pegged down in July and plant them out in their new permanent quarters. As they tend to get leggy and rise from the soil, top dress old plants with fine compost or loam.

Plant out sweet William, Canterbury bells and honesty.

Take cuttings of evergreens such as privet, laurel, rosemary and sage, making them 6 or 9 in. long with a heel of the old wood attached. Insert them in a frame or under a cloche for rooting in readiness for planting out next spring.

Towards the end of the month clear the ground of summer bedding plants, fork it over and level off. Sprinkle bone meal at the rate of 2 oz. per sq. yd. before putting in bulbs or spring display plants. Plant out polyanthus, primroses, double daisies and forget-me-nots.

Plant bulbs in window-boxes and out-of-doors, particularly snowdrops, narcissi and muscari. To give the best results, the narcissus bulbs need to be planted as soon as they are purchased, as they do not like to be out of the ground too long.

Bulbs that were saved from indoor bowls and dried during the summer can be planted in odd corners of the garden to add spring colour.

Seeds of hardy annuals, such as calendula, nigella, gypsophila and eschscholzia, can be sown in the open in warmer districts early in the month.

Pick ornamental gourds as they ripen, and leave them in a light, airy place for some days to dry before varnishing them.

Watch out for mildew on roses, delphiniums, chrysanthemums and Michaelmas daisies, and spray with Bordeaux mixture if necessary.

Paonies can be planted between now and November. Choose a position in full sun and plant in rich deep soil.

Now is the last opportunity to plant rhizomatous irises.

Lift the corms of gladioli as the foliage dies down.

Plant lilies.

Plant daffodils for naturalizing.

Prune rambler roses.

VEGETABLE GARDEN
Put out spring cabbage plants 1 ft. apart with 1 1/2 ft. between the rows.

Harvest marrows and clear the beds, putting the waste material on to the compost heap.
Lift potatoes and keep them dry until they can be put into a clamp made with the straw previously acquired. Make a good straw foundation in a sheltered position, and pack the tubers closely in a mound, on top of the straw. Cover the mound with a thick layer of straw and finish off with soil well packed down. Leave a small chimney of straw at the top running right through the soil layer to provide ventilation. Diseased or damaged tubers should not be included. The clamp can remain intact until mid-winter if necessary.

Sow seeds of winter lettuce, winter spinach and turnips for turnip tops.

Pull up tomato plants at the end of the month and leave in a sheltered place while the green fruit ripens, or cut the fruit off and ripen indoors.

Cut off the largest leaves of parsley sown in March in order to get a good crop of young leaves during the winter.

Towards the end of the month, lift maincrop carrots for storing.

**FRUIT GARDEN**

Gather apples, pears, black currants, blackberries, loganberries and stone fruit. Store the keeping varieties of apples and pears.

Prune loganberries as soon as the crop has been taken off.

Greasé band the trunks of fruit trees. The bands can be obtained from horticultural sundriesmen. Put them about head height on the trunk of the tree or, if the tree is small or broken in the trunk, band each bough. These bands trap wingless insects that crawl up the bark.

Prepare the planting positions for fruit trees that are to be planted in November.

Dig over the ground deeply.

**GREENHOUSE**

Now that the nights are getting colder, reduce ventilation and keep a check on the temperature. Remove shading, except for the most shade-loving plants. Stop damping down.

Clear the tomato crop. Clean out and disinfect the greenhouse before any chrysanthemums that have been standing out in pots during the summer are brought in. Towards the end of the month all such chrysanthemums should certainly be under cover, as nights can turn sharply chilly.

Start planting lilies in 6- or 7-in. pots to flower the following summer. Keep in an unheated greenhouse.

Sow seeds of annuals such as schizanthus, nemesia, cornflowers, godetia, marigolds and clarkia for flowering under glass or indoors during April and May of next year. Provided these plants are grown on slowly during the winter, and at no time given heat, they can be relied upon to provide a good display.

Continue to water and start to feed for Christmas flowering any cyclamen that were repotted in August. Pot on primulas, calceolarias and other plants that are being prepared for flowering at the same time.

Plant bulbs of hyacinths and daffodils, narcissi and crocus in soil or bulb fibre. Use the latter only if the bowls or pots are destined for an unheated greenhouse or the living-room. In any warm greenhouse the fibre will dry out far too quickly and it will be impossible to keep it watered sufficiently often. Put the pots in a dark, cool place or plunge them in a bed of fine clinker or ashes and leave them for a couple of months.

Cut out old and unwanted growths from greenhouse climbers.
OCTOBER

This is the month for autumn colour, when the last of the flowers are picked from the border and only a few chrysanthemums and dahlias remain where the frost does not strike. Start to tidy up all unwanted growth and put it on the compost heap or bonfire.

This is a good time to use slow-acting fertilizers such as basic slag and bone meal. Whatever fertilizers are used, scatter them on the surface, leaving them to be washed in by the rain or turned in later by digging.

DECORATIVE GARDEN

This is the time for collecting much plant material for winter decoration, before it rots or softens, especially fruits and seed pods for Christmas. Preserve beech branches with leaves by pruning them off the tree before the leaves start to fall. Stand them in a mixture of half a pint of glycerine and half a pint of water and leave them in it until they have taken up all the liquid. Later lay them flat between sheets of newspaper and either leave them under the carpet for a week or so, or press them with a very cool iron for a minute or two.

Herbaceous plants can be lifted and divided and the borders replanned and replanted. If they are being replanned, take the opportunity of digging them over deeply and incorporating good rotted compost or well-rotted manure. Get it well down.

Dig sweet pea trenches, incorporating well-rotted manure or compost.

Prepare the ground for new plantings of trees and shrubs which will be received at any time from now on from the nurseryman.

Plant tulip bulbs in late October, either in the general spring bedding scheme, or in bold groups of individual varieties in the border. It is better to keep tulips of one type in a group together, otherwise the effect is very ragged.

Plant lily-of-the-valley crowns. Put them in 3 to 6 in. apart and just cover the crown. They like to grow in a semi-shaded position.

If there has been a frost the dahlias should be lifted and the tubers dried and stored as described in Dahlias. Remember to label each plant as it is lifted before any confusion can arise.

Sow seed of sweet peas in pots in the first half of the month and keep in a cold frame. The seedlings should be ready for planting out in the following March.

Fill in hollows in lawns and carry out deep spiking, using a suitable fork or aerating machine. Renew worn patches with new turf.
Plant out biennials raised from sowings made in the early summer. Plant English and Dutch irises. Trim lavender and prune chaenomeles (cydonia) and wisteria. At regular intervals inspect bulbs plunged outdoors and bring them into a warm room as soon as they start to make growth.

**VEGETABLE GARDEN**

Finish lifting potatoes, carrots, and beetroot, as they do not stand frost. Store those that are to be kept. Other root and stem crops, such as parsnips, turnips, celery and leeks, benefit from some frost, and need more time in the ground.

Clear vacant land and start digging it over. Add old manure or rotted compost at the rate of a bucketful to the sq. yd. On heavy ground, leave the surface of the soil as rough as possible to expose it to the action of frost during the winter.

Protect the forming heads of cauliflowers by bending the outer leaves over them.

Sow thickly the seeds of winter-growing peas in a sheltered spot, such as a sunny border at the foot of a fence, and protect with straw or bracken.

Complete the earthing up of celery.

Take rhubarb crowns into the greenhouse or shed for forcing.

**FRUIT GARDEN**

Take cuttings of red and black currants and gooseberries and insert them in a shallow trench out-of-doors to overwinter. From the current year's growth, make the cuttings from 8 to 10 in. long. Take off the buds from the lower two-thirds of gooseberry cuttings to prevent the resulting young plants from producing suckers. These hardwood cuttings root slowly through the winter and never get away quickly the following spring, so leave them until October next year before planting them out into their permanent beds.

Black currant bushes three years old or more should be pruned back by a third immediately after the leaves have fallen.

Prune blackberries as soon as the crop has been taken off.

**GREENHOUSE**

Cyclamens and primulas for Christmas flowering should be growing well and will need feeding with liquid feed about every other week, although soft growth must be guarded against.

Chrysanthemums will be coming into bloom and may need feeding and tying. Give adequate ventilation to keep the atmosphere buoyant. Make watering a daily routine.

Put cuttings of pansies, penstemons and marguerites round the edges of pots filled with silver sand, and keep them in a cool or cold house or even a frame to root. They can be hardened off and planted out next spring.

Box up mint roots for forcing; lift a few roots, put them in a shallow wooden box and cover with fine soil. Keep the soil just moist and at a night temperature of not more than 50° F. (10° C.); fresh young shoots will soon appear and will provide mint for the kitchen throughout the winter months.

Plant rose trees in 10-in. pots to flower in the greenhouse (see The Use of Glass in the Garden). For the time being, however, the plants must be kept out-of-doors in a sheltered corner until December. Tuberous-rooted begonias and gloxinias should be finally dried off and kept in a cool, dry place until required the following spring.

To conserve heat in the greenhouse, line it with polythene film.
NOVEMBER

This is the month for bonfires and for collecting leaf mould. Beech, oak and lime leaves make the most valuable leaf mould and it is worth a trip to the woods to collect a few sackfuls.

DECORATIVE GARDEN
Plant roses of all types, spreading out the roots and filtering in loose soil among them before firming the soil round the stems. The existing soil mark on the stems is a good indication of the depth at which they should be planted. Standards need firm staking, and climbers and ramblers need to have their growth securely tied in to posts or walls to prevent the wind from tearing at the new roots before they are established.

Continue to plant young trees and shrubs as long as the weather is favourable. Always consider their proportions on maturity and arrange them far enough apart to prevent overcrowding later.

To help them to come on in time for picking at Christmas, protect Christmas roses (helleborus) from dampness and rain splashing by means of a cloche or a piece of glass.

Put polythene sheeting, dry straw or bracken on tender plants to protect them from frost damage. Cover wall plants with polythene sheeting to act as a curtain during snow or frost.

Put in deciduous hedge plants after thorough preparation of the ground. Plant very firmly.

VEGETABLE GARDEN
Progress with as much digging as possible so as to have the ground worked before frosts or excessive rains come. If new ground is being broken up, turn in the turf or other surface growth, putting it upside down at the bottom of the top spit. Chop it roughly with the spade and sprinkle with a fish fertilizer, then replace the top-soil.

Heel over broccoli heads to the north for protection.

Look over potatoes in store and remove any diseased tubers.

FRUIT GARDEN
Any fruit, except strawberries, can be planted in November. Prepare the ground thoroughly, stake the plants if necessary and always be sure to plant very firmly.

Root-prune vigorous or unfruitful top fruit by making a trench round the tree about 3 or 4 ft. away from the trunk and severing any roots that cross the trench. One side of the tree can be root-pruned now and the other side next year. If trees are growing against a wall, root-prune in a large semicircle.
GREENHOUSE
Maintain a dry atmosphere, especially now that the chrysanthemums are flowering, but close the ventilators during fog and always at dusk. Try to keep a temperature of 45°F. (7°C.), even at night.

Bring in crowns of seakale and rhubarb for forcing. Put them into boxes of dampened loam and place the boxes under the staging. Arrange sacking or boards over them to exclude the light and so encourage pale, tender growth.

Early Roman hyacinths and Narcissus Paper White should now be ready for bringing into the greenhouse. They should, however, first be acclimatized by spending a few days in a cold frame. Roman hyacinths need special care so that they do not grow too grassy. To avoid this keep them fairly near to the light and do not over-water.

Start to bring into the house in batches other bulbs planted in bowls and pots during September and October, so as to provide a succession of blooms later on.

Pot up lily bulbs as soon as they arrive. They do not like to be kept out of soil too long. Many are imported and therefore may not be available until December or even early in the New Year, but the sooner they are potted the better. If the bulb scales are soft on arrival, plump the bulbs up a little by first plunging them in moist peat in a seed box and then syringing them daily with soft water. Once they are firm pot them immediately. Plant out in the spring.

Watch for white fly. Control with D.D.T.

Water plants with particular care at this time of year as they react unfavourably to excess supplies.

DECEMBER

December is the month for stock-taking and replanning. New beds and paths can be made and carpentry and constructional work can be done. If the weather and conditions are suitable, digging and trenching can continue.

DECORATIVE GARDEN
Protect any tender plants from hard frosts. Delicate wall shrubs or climbers can be covered with sacking.

Buds of Jasminum nudiflorum can be brought indoors as soon as they appear and put into water to help them to open before Christmas.

Give the lawn a final rake and spike it to give aeration. Add a dressing of worm-killing powder.

Cover tender rock garden plants with glass to protect them from damage by excessive wet. Woolly-leaved plants especially need protection.
Reconstruction of the rock garden can begin. The building of paths, steps and walls can be carried out now, but do not lay concrete during frost, or if frost is forecast.

Prepare window-boxes with fresh soil and plant wallflowers or winter-flowering pansies.

Improve soil by digging in humus-forming materials.

VEGETABLE GARDEN
If the weather is favourable, prepare celery trenches for next spring.

If frost or snow threatens, lift enough parsnips to supply the kitchen during a spell of bad weather.

Continue with winter digging whenever the ground is free from frost.

Order seed potatoes.

Make sure that covering material for frames is available and dry ready for use when it is needed.

FRUIT GARDEN
Look over apples and pears in store and discard any that are too soft or are showing signs of disease.

Grease band any trees that were not done last month. Renew any bands that have trapped many insects.

Start winter pruning of top fruit after leaf fall.

Protect undeveloped fruits on fig trees by covering them with straw or by hanging sacking over the branches.

Root-prune over-vigorous fruit trees, especially figs, which require a very restricted root system if they are to bear fruit at all.

Complete planting of fruit trees as soon as possible.

Spray top fruit with tar oil wash against insect eggs and hibernating grubs. Follow the manufacturer’s instructions given on the container.

GREENHOUSE
Cut back the stems of the chrysanthemums when they have finished flowering but continue to keep them moist. Syringe them occasionally to encourage the shoots to produce new growth to provide material for cuttings. Insert the cuttings as they become available about 3 in. apart in a propagating box. Keep the atmosphere in the box close and moist until roots have been formed.

Start to take cuttings of perpetual-flowering carnations as they are available and insert them round the edges of small pots in very sandy compost.

Cover cold frames with mats at night or during prolonged frost, or insulate them in the same way as a cold greenhouse with polythene sheeting.

Christmas-flowering plants in the greenhouse cannot be hardened off in the ordinary way and should be treated as tender plants. Cover them and protect them from cold air by carrying them into the house in a deep-sided box. Small stakes will prevent the stems from breaking if the plants have to be transported very far.

For an early crop of broad beans, sow long-pods in boxes of John Innes seed compost. Keep them in the greenhouse or a frame until the middle of March.

Bring in the roses planted in pots in October. Leave bone dry until all the leaves have dropped off and then prune drastically to only two buds from the base of each main stem.
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