The American HORTICULTURAL Magazine

fall 1970 / *volume 49* / *number 4*

Journal of the American Horticultural Society, Inc.

2401 CALVERT STREET, N.W. / WASHINGTON, D. C. 20008

For United Horticulture . . .

The particular objects and business of the American Horticultural Society are to promote and encourage national interest in scientific research and education in horticulture in all of its branches.

THE AMERICAN HORTICULTURAL MAGAZINE is the official publication of The American Horticultural Society and is issued during the Winter, Spring, Summer, and Fall quarters. The magazine is included as a benefit of membership in The American Horticultural Society, individual membership dues being $15.00 a year.

THE AMERICAN HORTICULTURAL MAGAZINE is devoted to the dissemination of knowledge in the science and art of growing ornamental plants, fruits, vegetables, and related subjects. Original papers which increase knowledge of plant materials of economic and aesthetic importance are invited. For manuscript specifications, please address the chairman of the Editorial Committee.

Second class postage paid at Baltimore, Maryland and at additional mailing offices.

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Fall 1970

HANDBOOK OF HOLLIES

A Special Issue on *Ilex*

DOROTHY EBEL HANSELL, Editor

THEODORE R. DUDLEY, Technical Editor

GENE K. EISENBEISS, Technical Editor

The American Horticultural Society, Inc.

The Holly Society of America, Inc.

FRONT COVER: A fine specimen of English holly. Photo by Gottlieb Hampfler.

BACK COVER: *Ilex aquifolium* 'Ferox.' Hedge-hog holly. The oldest identifiable cultivar of *Ilex* still in cultivation. Wood block print from the herbal of Jacques Philippe Cornuti, *Canadensium Planatarum Historia, Enchiridion Botanicum.* Paris, 1635.

IN APPRECIATION

He who undertakes the writing of a book sets himself upon a difficult and lonely road, companioned and counselled only, as a rule, by his editor and publisher through the long journey.

His plight, however, is a joyous one compared with that of the editor who undertakes the compilation of a jointly published book.

This can be attested by Dorothy Ebel Hansell, editor of the new 1970 edition of *The Handbook of Hollies,* the result of a joint publishing endeavor by the Holly Society of America, Inc., and the American Horticultural Society, Inc. on behalf of their members and the general public.

In twenty-four months of steady work on this project, Mrs. Hansell has been involved with the Boards of the two Societies, two technical collaborators, a Revision Committee of seven persons, the twelve-member Editorial Committee of AHS, some thirty authors of the articles which appear herein, another dozen or so suppliers of various illustrations, the staff of AHS, and a steady procession of postmen bearing the pounds upon pounds of paper which is the prologue to production of any such volume as this.

By early rising and diligent effort, Mrs. Hansell has managed this large undertaking with all the skill to be expected from one who came early to the editorial field. She was in her mid-twenties when she assumed her father's position as editor and publisher of *Gardener's Chronicle of America* at his death. She also fell heir to his position as executive secretary of the National Association of Gardeners. A dedicated lifelong gardener herself, she spent many happy years as editor of *The Garden Journal* of the New York Botanical Garden and now, as editor of *The Bulletin* of the American Association of Botanic Gardens and Arboreta.

The American Horticultural Society, its Board of Directors and Editorial Committee express deep appreciation to The Holly Society of America, and especially to Mrs. Hansell, the technical collaborators, and the Revision Committee for the devoted effort which has produced this handsome volume. We believe that *The Handbook of Hollies,* 1970 Edition, is a major contribution to horticultural literature.

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PREFACE TO 1957 EDITION

The newly organized and incorporated Holly Society of America published its first bulletin in 1947—it was Gustaf E. Malmborg's *Comments On The Holly Species.* This was a cooperative venture with the Wildflower Preservation Society and was issued as a reprint from that organization's *Wildflower Magazine.* To a young and struggling association, with little funds and less experience, this modest twelve-page booklet was a noteworthy and prideful achievement.

Before this time, there was extremely little interest in hollies except that shown by the English holly orchardists in the Pacific Northwest, by small numbers of conservationists, foresters, and garden club members concerned with the destructive practices of gathering Christmas greenery from native trees in the eastern and southern United States and by an even smaller group of nurserymen, ornamental horticulturists, and directors of arboreta who early foresaw the commercial and ornamental possibilities inherent in hollies.

Since then, the intervening years have seen a phenomenal, an almost unbelievable and an ever-increasing interest in these plants. Aside from their values as Christmas decoratives—whether from orchards, native trees, or from ornamental plants—the rich and wide variety of hollies available and their uses for hedges, barriers, screens, specimen and accent plants, ground covers, foundation and background plantings, shade and boulevard trees, flower arrangements, wildlife and songbird food and cover plants, for topiary work and even bonsai—all these make the attention now given hollies quite understandable.

The large number of native and introduced hollies, and those of foreign countries yet to be admitted to the United States, with their correct names, varieties, cultivars, descriptions, culture, uses and potentialities, create a puzzling and a bewildering situation to those who wish to grow or to know more about them. Ths is especially irritating to home owners, landscape architects, horticulturists, students, nurserymen, and prospective orchardists where reference facilities are lacking or not readily available. Now, ten years after its first cooperative publication, the Holly Society of America, Incorporated, is happy and most grateful to avail itself of the facilities of the American Horticultural Society in preparing this *Handbook of Hollies,* which may be useful to those interested in this fascinating group of plants and which, in some small way, may make another contribution to both organizations' interest in the advancement of horticulture.

The publication of this Handbook would have been most difficult to complete without the splendid cooperation of a large number of helpful individuals. A listing of these would make impressive reading but limitations of space make this impossible. The appreciation of the guest editor is therefore expressed to all those who, in one way or another, assisted in the preparation of this work. Sincere apologies are, likewise, hereby expressed to all those who were inconvenienced by letters or by personal conversations in the search for facts and the constant need for checking on the correctness of details—no matter how trivial they might now appear in print. The enormity of this and the complexities involved in the preparation of this Handbook are ones which shall neither soon nor easily be forgotten.

There are those, however, to whom special attention must be called. Firstly, to all the contributing writers, very sincere and most heartfelt thanks. With no thought of any renumeration, they have freely given of their time,

their talents, their knowledge, and their experience to make this Handbook possible. May the satisfaction these writers receive from their contributions to horticulture be ample compensation for their labors. Deep appreciation is also extended to W. Dallimore, late keeper of the Museum, Royal Botanic Gardens, Kew, England, for the inspiration provided by his *Holly, Yew and Box* and personal correspondence over the past six years; to Henry Cork, dealer in second-hand books, London, England, for his help in locating needed references on the folklore and history of the hollies; to Dr. John C. Wister, Director, Arthur Hoyt Scott Horticultural Foundation, Swarthmore, Pennsylvania, and his committee of Professor Robert B. Clark and Dr. Charles H. Connors, Rutgers University, New Brunswick, New Jersey, for their *Preliminary Holly Check List,* Bulletin No. 6 of the Holly Society of America, Inc., which immeasurably helped in locating sources of descriptions of many of the English and American hollies and without which the preparation of this Handbook would not have been undertaken; to Henry T. Skinner, Gabriel Edwin, contributors Francis de Vos and William F. Kosar, all of the United States National Arboretum, Washington, D. C., for their valued suggestions and facilities in providing the majority of the excellent photographs of holly specimens; to M. M. Fulton, trustee and former historian, Holly Society of America, Inc., Harrisburg, Pennsylvania, for the use of his reproductions of the article on the English hollies by Tom Moore which appeared originally in the *Gardeners' Chronicle,* London, England, 1874, 1875, and 1876; to contributor Shiu-ying Hu, Flora of China Project, The Arnold Arboretum of Harvard University, Jamaica Plain, Massachusetts, for her line drawings of the American and Oriental hollies from herbarium and fresh specimens and of the English hollies from the pictures included in Tom Moore's articles mentioned above; to S. B. Detwiler, former chief, the old Hillculture Section, Soil Conservation Service, Washington, D. C., assistant chief G. B. Posey and their fellow co-workers F. L. O'Rourke, C. S. Britt, Wilmer W. Steiner, contributor Jackson M. Batchelor, and others, for their foresight in the late 1930's as to the commercial potentialities of the hollies, their compilation of a valued bibliography of holly references, and for their complete collection of useful field data and literary materials; to C. R. Wolf, Millville, New Jersey, President, Holly Society of America, Inc., the trustees and members of the Society, for their encouragement in the undertaking of this work and, likewise, that of Alfred Teufel, Portland, Oregon, President, Oregon Holly Growers Association; to the officers and directors of the American Horticultural Society, Washington, D. C., for their confidence in entrusting this work to the guest editor and the contributing writers and in making the publication of this handbook possible; to Mrs. Jayne Silva for her splendid and cheerful secretarial abilities; to Miss May M. Blaine, formerly secretary to David Fairchild, for her technical knowledge of botanical terms and for her painstaking correction of errors in grammar, spelling, and punctuation; to B. Y. Morrison, editor, *The National Horticultural Magazine,* for reading the Handbook throughout its many stages and for his valued suggestions gleaned through his many years of experience in the field of horticulture; and, lastly and especially, my deepest appreciation to James R. Harlow, managing editor, *The National Horticultural Magazine,* whose contributions can best be summed up by saying that without his special and inclusive talents this *Handbook of Hollies* could not have been completed.

HARRY WILLIAM DENGLER,
Holly Hollow, Hyattsville, Maryland

PREFACE TO 1970 EDITION

In November, 1968, Fred C. Galle, President of the American Horticultural Society, sought the cooperation of the Holly Society of America in publishing a revised edition of the *Handbook of Hollies* (1957). Since the Holly Society of America had been aware for some time of the need for a new edition of the Handbook, it welcomed the opportunity to cooperate with the American Horticultural Society in this venture.

In April, 1969, Larry F. Livingston, then President of the Holly Society of America, appointed the Holly Handbook Revision Committee: Daniel G. Fenton, consultant; Charles Young, adviser—finance; Fred C. Galle, adviser—southern area; Archie Erickson, adviser—Northwest Pacific area; Dr. Oliver D. Diller, adviser—central area; John Riker, adviser—eastern area; Gene K. Bisenbeiss, adviser—arboreta; Dr. Elwin R. Orton, Jr., adviser—experiment stations; and Dorothy Ebel Hansell, chairman. Mrs. Hansell was also appointed editor.

An expression of appreciation is extended to all the writers who reviewed and revised their contributions to the 1957 edition of the Handbook to update them for this edition; to Donald H. Parker of Colonial Williamsburg, who reviewed "Topiary Hollies" by the late Alden Hopkins and furnished new illustrations; to Dr. Elwin R. Orton, Dr. J. L. Peterson, Dr. Herbert T. Streu, Dr. L. M. Vasvary, all of Rutgers—The State University of New Jersey, to Ambrose Brownell, J. Bon Hartline, Dr. Oliver D. Diller, and I. C. MacSwain for their contributions to the 1970 edition; to Elizabeth C. Hall, a long-time staff member of The New York Botanical Garden and now senior librarian of the Horticultural Society of New York, for furnishing old clippings useful in writing descriptions of English hollies; and to Dr. Theodore R. Dudley and Gene K. Eisenbeiss, both of the United States National Arboretum, for their valuable technical assistance which assures that the nomenclature in the Handbook conforms to the International Code for Cultivated Plants (1969) and agrees with the Holly Checklist to be published by the United States Department of Agriculture with the cooperation of the Holly Society of America.

DOROTHY EBEL HANSELL, *Chairman*
Holly Handbook Revision Committee

Morristown, New Jersey
June 30, 1970

Holly Folklore and Legends

HARRY WILLIAM DENGLER

There are few groups of trees and shrubs which possess such a fascinating and diverse background as do those plants which belong to the genus *Ilex* or, as they are more commonly called, hollies. Since the days of the Romans, the Greeks, the Druids, and the Indians of the Americas, holly has played an exciting part in medicine and magic, science and superstition, and legend and lore.

Much of our present-day folklore of medicines, superstitions, and Christmas customs comes from the practices and beliefs of the early Britons. These can be traced further to the Druids, an order of priests, teachers, philosophers, and astronomers of ancient Britain and Gaul, who lived some two thousand years ago. They believed the sun never deserted the holly tree (*I. aquifolium*) and to them it was a sacred plant. It was their custom to decorate the interiors of their dwelling-places with evergreens in which the woodland spirits might take refuge from the rigors of winter.

Holly has long been symbolic of Christmas. The name is believed to be a corruption of the word "holy," although many historians differ on the point. William Turner, the earliest English writer on plants, in his herbal of 1568, calls the tree "Holy" and "Holytree." In parts of Italy, sprigs of holly were used in decorating the mangers in commemoration of the Infant Saviour. In Germany, holly is called *Christdorn*—the thorn woven into the crown of crucifixion. Legend has it that the berries of holly were once yellow, but, being stained from the wounds of Christ, have ever since remained red. Among the old Pennsylvania Dutch, the holly berries represented the blood of Christ issuing from His wounds, and the white flowers of the holly tree were symbolic of the purity in which He was conceived.

Stowe, in his *Survey of London,* published in 1598, wrote that in his time every man's house, the parish churches, the corners fo the streets, and the market places were decorated with holly at Christmas. Henry Mayhew estimated that the amount of holly sold in London, in 1851, was 250,000 bunches.

All the peoples of the great nations of antiquity—the Assyrians, Egyptians, Persians, Greeks, and Romans—were accustomed to decorating their altars, their homes, and themselves with flowers, and to combining leaves and blossoms into wreaths and garlands. The compositions of these floral decorations possessed deep significance and the plants involved had symbolic meaning, being varied according to the social standing of the wearer and the seasons of the year. Wreaths of holly were sent the Roman newlyweds as tokens of good wishes and congratulations.

The symbolism or language of flowers is almost as aged as that of speech itself. The ancient Chinese, the Assyrian, and the Egyptian races seemed to possess a simple but complete way of transmitting ideas and sentiments by means of floral arrangements. Each blossom and plant had its meaning, and these were ingeniously selected and composed to convey the message at hand—a practice much favored, needless to add, by suitors in pressing their romances with their ladies fair. Floral symbolism reached its zenith with the classic Greeks. In the old floral vocabularies, mistletoe implied the ability to overcome difficulties while holly stood for foresight—a bouquet of the two carried this message: "By foresight you will surmount your difficulties."

Most peoples of antiquity were accustomed to celebrating an annual observance when the usual curbs on propriety and sobriety were considerably relaxed. During such occasions, the populace ex-

hibited much merriment and indulged in passions that never would be tolerated at other periods of the year. These eruptions of human energy, often plunging into mad orgies of excesses, took place most commonly towards the end of the year, and were usually associated with the beginning or ending of a sowing or harvesting season.

Of all such festivals, none is perhaps more widely known than that of the Saturnalia. This event took place in December, the last month of the Roman year, which occurred about the time of our present Christmas and commemorated the good King Saturn, the god of sowing and husbandry. It was during Saturn's reign that no war was rife, the fields and flocks produced abundantly, no men were bound in slavery, and the world was a most pleasurable place in which to live.

During the great festival of the Saturnalia, it was customary among the Romans to send holly boughs along with gifts to their friends as tokens of their good wishes and emblems of the esteem in which they held them. It is from this custom that historians consider holly to be symbolic of goodwill and for this reason that we decorate our homes and churches with this colorful greenery during the Christmas holidays.

The holly, like other thorny plants, was believed in early Europe to repel all evil spirits. In its name, the witches perceived the word "holy" and its spiny foliage and blood-red berries were suggestive of Christian associations. Pliny, the Elder, wrote that a holly tree planted about the house served as a counter-charm and kept away all evil spirits or enchantments and defended the house from lightning. Branches of holly were hung about the homes and stables, and cattle were said to thrive if a piece of holly was hung where it could be seen on Christmas Day.

Canes of holly were formerly highly prized in early England. Fast-growing, young shoots of holly made excellent walking sticks and were carried by maidens and matrons alike as protection against mad dogs, vicious beasts, and other perils of that day. A staff of holly was considered so effective that when thrown at any animal, even if it did not find its mark, would so affect the beast as to cause him to lie down beside it.

Henry Phillips, in 1823, however, deemed quite credulous the old customs of his forefathers, who trusted to branches of holly for their defense against witchcraft. "But this precaution," he wrote, "has become unnecessary, since old ladies have lost their charming powers, and the spells of the youthful fair are too agreeable to be driven from us by a rod of holly."

Many superstitions existed about bringing in the holly for Christmas. In Wales, if it was brought in before Christmas Eve, it was sure to cause family quarrels throughout the year. In parts of Germany and England, the prickly varieties were known as he-hollies, while the smooth-leaved kinds were called she-hollies. The type of holly brought into the household determined who was to dominate the home during the year. If the holly was smooth, the wife was in command; if the holly was prickly, the husband governed for the year. This latter custom was brought into America and was known until the turn of the century among the Ulster Scots of Pennsylvania. Here, the belief existed, too, that if the holly was brought into the house during good weather, the wife would master the household for the ensuing year; if during rough weather, the husband would be the ruler.

Superstitions, too, existed regarding the removal of the holly after Christmas. In some parts of England, it was decidedly unlucky to leave holly up after New Year's Eve, or Twelfth Night, lest the maidens of the household be visited by a ghost for each leaf in the decorations. Others said that a misfortune for each leaf would befall those unheeding this rule. The holly could not merely be thrown away but had to be burnt, else the ill-luck would continue as though the holly had not been removed. Elsewhere in England, holly had to be taken down before Shrove Tuesday and burnt on the same fire on which the pancakes were to

of painters for a deep greene, which they do call Sap greene.

C The berries which be as yet vnripe, being dried and infused or steeped in water, do make a faire yellow colour; but if they be ripe they make a greene.

CHAP. 31. *Of the Holme, Holly, or Huluer tree:*

Agrifolium.
The Holly tree.

¶ *The Description.*

THe Holly is a shrubbie plant, notwithstanding it oftentimes growes to a tree of a reasonable bigneſſe: the boughes whereof are rough and flexible, couered with a smooth and green bark. The substance of the wood is hard and sound, and blackish or yellowish within, which doth also sinke in the water, as doth the Indian wood which is called *Guaiacum*: the leaues are of a beautifull green colour, smooth and glib, like almost the bay leaues, but lesser, and cornered in the edges with sharp prickles, which notwithstanding they want or haue few when the tree is old: the floures be white, and sweet of smell: the berries are round, of the bigneſſe of a little Peaſe, or not much greater, of colour red, of taſt vnpleasant, with a white stone in the midst, which do not easily fall away, but hang on the boughes a long time: the root is wooddie.

There is made of the smooth barke of this tree or shrub, Birdlime, which the birders and country men do vse to take birds with: they put off the barke, and make a ditch in the ground, specially in moist, boggy, or soggy earth, wherinto they put this bark, couering the ditch with boughes of trees, letting it remaine there till it be rotten and puttrified, which will be done in the

Quercus vulgaris cum gl
The Oke Tree with his

Gerarde, J. The Herball or general historie of plantes. Gathered by John Gerarde of London, Master in chirurgerie. Very much enlarged and awarded by Thomas Johnson, Citizen and Apothecarye of London, with engraved title page and nearly 3000 (2766) wood cuts. London. Printed by Adam Jslip Joice Norton, and Richard Whitakers, Anno 1633.

the space of twelue daies or thereabout: which done, they take it forth, and beat in morters vntill it be come to the thickneſſe and clammineſſe of Lime: lastly, that they may cleare it from pieces of barke and other filthineſſe, they do wash it very often: after which they adde vnto it a little oyle of nuts, and after that do put it vp in earthen veſſells.

¶ *The Place.*

The Holly tree groweth plentifully in all countries. It groweth green both winter and sommer; the berries are ripe in September, and they do hang vpon the tree a long time after.

¶ *The Names.*

This tree or shrub is called in Latine *Agrifolium*: in Italian, *Agrifoglio*, and *Aguifoglio*: in Spanish, *Azebo*: in high Dutch, **Healddiſtell**, and of diuers **Steepalmen**: in low Dutch, **Hulſt**: in French, *Hous* and *Houſſon*: in English, Holly, Huluer, and Holme.

¶ *The Temperature.*

The berries of Holly are hot and drie, and of thin parts, and waſte away winde.

¶ *The Vertues.*

They are good against the collicke: ſor ten or twelue being inwardly taken bring away by the A stoole thicke flegmaticke humors, as we haue learned of them who oftentimes made triall thereof.

The Birdlime which is made of the barke hereof is no leſſe hurtfull than that of Miſſeltoe, for it B is maruellous clammie, it glueth vp all the intrails, it shutteth and draweth together the guts and paſſages of the excrements, and by this meanes it bringeth deſtruction to man, not by any qualitie, but by his glewing substance.

Holly beaten to pouder and drunke, is an experimented medicine against all the fluxes of the C belly, as the dyſenterie and ſuch like.

be baked; misfortune was certain to befall anyone so unwise as not to heed this belief.

In some parts of England, the holly could not be burnt, but had to be saved until the following year to protect the house from lightning. In cottages with leaded-pane windows, it was essential that one pane of each window include a sprig of variegated holly in the holiday decorations. If the Christmas decorations were thrown away, a death in the family would occur before next Christmas. However, a sprig of holly from church decorations was considered quite valuable and insured its owner a year of good luck.

Among the early Anglicans of America, holly was kept in their churches until Good Friday to prevent the Christmas festivals from being forgotten. Berries from the Christmas holly were kept for good luck during the year in Louisiana.

Among the Chinese, the Oriental holly, *Ilex chinensis,* was much used for decorating temple-courts and large halls during their New Year festivals in February.

Legend has it in Brittany that when Christ was bearing His cross, a small bird attempted to relieve His sufferings by plucking thorns from His brow. The bird's breast became stained with blood and became known forever afterwards as Robin Redbreast. To this very day, in England and Germany, it is considered unlucky to step on a holly berry, a favorite food of the robin, in recognition of the bird's charitable act.

Of all old English traditions, however, one of the most enchanting is that even the bees must be wished a Merry Christmas and a sprig of shiny green and bright red holly must adorn each hive.

Quite apart from the holly superstitions associated with Christmas are those related to divination—the pretended art of foreseeing future events by supernatural or magical means. Perhaps, to paraphrase Folkard, the most interested in this form of sorcery were those vain and silly maidens no longer able to endure the suspense of not knowing the names of their future husbands. Off to the house of the old witch they would go—there had to be three of them for the magic to work. The witch would show the three of them how to construct a witch's chain of holly, juniper, and mistletoe berries with an acorn at the end of each link, and how to wind these beads around a slender wand of wood. This was to be placed on the fire with magical sayings and, as the last acorn was burnt, each would see her future husband walk across the room.

A less expensive but more painful method of foreseeing a future husband in early England was for the maiden to place three pails of water on her bedroom floor. Upon retiring, she pinned three leaves of holly on her nightdress, opposite her heart. During her sleep, she would be awakened by three loud yells, followed by three coarse laughs; after this, the form of her future husband would be seen. The intensity of his love for the maiden was determined by whether or not the pails were disturbed. Unfortunately, this charm was only potent if carried out on Halloween, Midsummer Eve, New Year's Eve, and Christmas Eve.

Another traditional form of foreseeing the future in parts of England consisted of collecting nine smooth-leaved, or she-holly leaves, and placing them in a three-cornered handkerchief which had to be tied with nine knots. The knotted handkerchief was placed under the pillow and, during sleep, pleasant dreams of the future were certain to ensue. The holly leaves had to be picked late on a Friday and the utmost care taken to maintain complete silence until the following morning for this spell to be fully effective.

A quaint fortune-telling superstition of England consisted of fixing little lighted candles on holly leaves and placing them in a pan of water. If the leafy vessels floated, it was a sure sign that the project the person had in mind at the time would prosper. If, however, they sank, the person would do well to abandon the idea as soon as possible.

The Indians of early Pennsylvania regarded the holly as their "Red Badge of

Courage" and the token of success in battle. They had a method of preserving and hardening the berries without shrinkage or loss of their brilliant colors. These were used as decorative buttons on vests, sleeves, trousers, and in their hair. Brisk trading in the berries occurred with tribes where holly did not grow naturally.

These Indians often painted or embroidered sprays of holly, like coats-of-arms, on their shields and jackets. Many legends were told about the holly's connection with happier days and great victories. The spines of the leaves symbolized the fierceness of the warriors and their refusal to take insults from anyone; the toughness of wood indicated that the Indians would never submit to their enemies. Since the leaves of holly do not readily fall off, the tree was an emblem of courage and everlasting life. When Indians went on the warpath, sprigs of holly were often pinned on their clothing with great ceremony to speed their triumphant return in safety.

In the floral vocabulary of the ancients, holly symbolized "defense" and, strangely enough, eastern North American Indians planted holly about their cabins as "protectors," feeling that the trees kept away the evil spirits.

Among the many old and curious beliefs associated with healing was the idea that diseases could be transferred to trees and plants, especially by passing the patient through an arch or hoop of the branches, or through a cleft in the trunk of a tree. In almost every country of the world, this superstition could be found. In England, ruptured children, or those with rickets, were passed through fissures of tree trunks, often of holly. To insure succcess, the tree should never before have been used for this purpose. The trunk was split from east to west; the youngster was passed through by a maiden and received by a boy on the other side. Sometimes this was repeated three times; sometimes, too, the child had to be thrust through head first for the charm to work; at other times, the feet must be the foremost part of the body.

When the passing-through ceremony was completed, the split, which had been held open with wedges, was allowed to spring together, and the wound bound and plastered up with clay. As the gash gradually healed, so did the youngster's rupture in a like manner. It is recalled that the largest-known American holly tree was similarly used to cure the rupture of a boy some forty years ago in North Carolina. The Russians used holly trees in a somewhat similar manner for curing tuberculosis.

Culpeper, in his pithy herbal of 1653, relates that holly is governed by the planet Saturn, and, as such, influences the *Melancholy*, a sediment of the blood whose receptacle was the spleen. Thus the holly, like other Saturnine plants, is considered "cold and dry in quality, fortifying the retentive faculty, and memory; makes men sober, solid, and staid, fit for study; stays the unbridled joys of lustful blood, stays the wandering thoughts; and reduces them home to the centre."

Writing specifically about the virtues of the holly tree, Culpeper states that the berries expel wind and are, therefore, good for the colic. If a dozen ripe but undried berries are eaten in the morning, and then fasting follows, they purge the body of wastes. If the berries are dried, however, and beaten into a powder, they bind the body, stop bleeding and fluxes. The bark of the tree and also the leaves are exceptionally good, being used in fomentations for broken bones and such members as are out of joint. Gerard, in his herbal of 1597, some fifty years earlier had published Culpeper's remedies in language more picturesque than printable.

In more modern times, infusions, decoctions, and fomentations of holly were used for a wide assortment of human disorders. In England, a tea of holly bark was a cure for the cough. In France, a decoction of leaves and bark was considered equal to and sometimes better than quinine in the treatment of the intermittent fever. A tea of holly leaves was a cure for measles by tribes of North American Indians; while an

elixir of the leaves, bark, and wood was regarded by them as a specific against disease. A beverage of the berries pacified the squaws of the Cherokee Indians and curbed their urge for wandering. The juice of holly leaves was recommended in the cure of jaundice. A tea of holly leaves was also good for pain in the side.

American Indians wore sprigs of holly during childbirth, believing them to ease the pain and to insure the delivery of healthy offspring.

John Evelyn, in 1662, related that a posset, made of milk and beer in which is boiled some of the most pointed of holly leaves, is certain to abate the torments of colic when all else has failed. Leaves of holly, he reported, dried to a fine powder and drunk in white wine is prevalent against the gall stone.

In England, an old cure for chilblains was to thrash them soundly with branches of holly; a rustic specific for whooping cough was to drink new milk out of a cup made from the wood of variegated holly. Followers of Zoroaster in Persia and India used an infusion of water and holly bark to sprinkle the faces of newly-born children.

An old and quaint English cure for toothache concerns the belief that the pain was caused by the gnawing of little worms inside the tooth. The remedy for this was to hold a smoldering holly coal in the mouth so that the smoke could enter the cavity of the afflicted part. This promptly dispatched the tiny offenders and caused them to drop out of the tooth.

While all these remedies have been attributed to our familiar American and English Christmas hollies, other members of this same family have likewise contributed to the well-being of the world. In the Far East, decoctions of the bark and leafy shoots of the familiar Chinese holly are commonly used as tonics, especially for the kidneys; the crushed seeds of *Ilex chinensis* are frequently used in medicines. Among the natives of the Saint Helena Islands of South Carolina, a mixture of lard and mockingbird bush, *I. cassine*, is used as an ointment for smallpox. Farther northward, the berries and bark of winterberry (*I. verticillata*), the deciduous holly, have often been substituted for Peruvian bark in cases of intermittent fevers. The bark (*Cinchona*) and fruit are tonic; the latter also emetic. The bark has also been used as a wash for gangrene and eruptions of the skin. The dahoon holly was used by the early settlers of North Carolina to purify the coastal swamp water and render it fit to drink.

Despite these varied and valued healing properties of holly and its contributions to the medicinal lore of the world, it is of interest to note two old Welsh superstitions: to pluck a sprig of holly in flower was a sure cause of death in the family of the picker, and holly must never be brought into a sick room for the patient was almost surely to suffer a relapse or die as a consequence.

Young branches of holly were cut by the Morbihan peasants in Europe and cured for hay. The stems were dried, bruised, and fed to cattle three times a day. Milk and butter from these holly-fed cows were said to be both wholesome and good.

The young shoots of *Ilex chinensis* are sometimes blanched in China, and eaten in salads. Here, too, the limber twigs of the familiar Chinese holly, *I. cornuta*, are used as nose rings for cattle.

Palatable and stimulating is a tealike beverage called maté, yerba maté, or Paraguay-tea. Brewed from the leaves of *I. paraguariensis*, one of several South American hollies, maté is an all-purpose drink used by more than thirty million South Americans daily, principally in Paraguay and Argentina.

An early South American Indian custom, still practiced today, is to serve each visitor to camp with a gourd of maté. The chief sips some of the tea through a *bombilla* and passes the receptacle to the visitor, who drinks from the same tube. Everyone in camp partakes of the beverage until it is consumed. It is an act of unpardonable rudeness to refuse to drink any of the maté.

Maté is recoginzed by the chemists as a stimulant for the nerves and muscles as well as for the brain. The British, French, and German armies used it during the first World War, finding it a valuable stimulant in times of stress.

High in the mountains on the eastern side of the equatorial Andes in Ecuador, the Zapara and Jibaro Indians have used *guayusa* since pre-Columbian times. It is a tea brewed from another South American holly, *I. guayusa* Loes., related to but distinct from *I. paraguariensis*. In appearance *I. guayusa* is not unlike the old holly trees of England. While quite acceptable as a substitute for coffee or tea, the infusion, as brewed by these Indians, is so strong that it acts as an emetic. The *guayusa* pot is kept carefully covered and the brew simmered over a slow fire throughout the night. On arising in the morning, the Indians would drink enough to make them vomit, believing that the beverage conferred strength and swiftness to the hunter. Groves of this holly were planted about the villages of the Indians.

Since ancient times, southern tribes of the North American Indians held in greatest esteem the celebrated "black drink" or "cassena," brewed from the toasted leaves of *Ilex vomitoria*, the yaupon of southeastern United States. To the Indians, this holly tea restored lost appetites, confirmed their health, and gave them courage and agility in war.

Accounts of the black drink ceremony among the American Indians were recorded as long ago as 1536. In the spring of the year, the Indians gathered in areas along the sea coast where the yaupon grew in abundance, some traveling several hundred miles to attend the rituals. The leaves of the holly were parched in earthenware vessels over fires and then boiled for a considerable period. While brewing, the pot was kept carefully covered, but if by chance, any women came into the vicinity while the pot was uncovered, the Indians threw the drink away, believing that some evil would be imparted to the beverage. No woman was allowed to move or walk about during the cooling and serving process and should, perchance, this occur, the Indians would throw the drink away, disgorge what they had already swallowed, and severely punish the transgressing female. At the same time, the Indians continually called out, "Who will drink? Who will drink?" Any squaw within hearing distance of the shouts was obliged to remain motionless, even if standing on tiptoes, until the men had consumed their fill.

On other occasions, the cassine was used in ceremonies concerned with the well-being of the tribe. Sitting at the head of a semicircular bench, the chief, with his councillors and elders, accepted the blessings of those who were to partake of the drink. Having accepted salutations from each of the braves, one at a time, the eldest first, the chief ordered the women to brew up the drink.

Matters of importance to the tribe were discussed and debated by the priests, elders, and nobles among the Indians. No decisions were made until a number of councils had carefully deliberated the opinions and recommendations of the speakers. During the discussions, the chief was served the hot drink in a capacious shell. The chief, in turn, directed the rest to drink from the same vessel.

So esteemed did the Indians hold this holly tea that no one was allowed to drink it during the council except those proved to be brave and courageous warriors. So strong was this beverage that it immediately threw the drinker into a deep sweat. Those whose stomachs rejected the beverage were not to be trusted to any difficult or warlike mission. The drink, the Indians believed, nourished and strengthened the body.

Some sixty species of hollies yield leaves for beverage purposes. It is of more than passing interest to note that the leaves of one holly frequently used for tea by the natives of the Chinese-Tibetan border is the same holly, *I. yunnanensis* var. *eciliata*, belongs to the same section of plants, and has been used in a similar way, as the hollies used by the Indians of both North and South America since ancient times.

In the old traditional English Shrovetide dances—the last merrymaking period before the observance of Lent—there often appeared a holly-boy and an ivy-girl. The holly was supposed to be male and to personify the steadfast and the holy, while the ivy, because of its clinging and embracing nature, was symbolical of a maiden's love and friendship. In some areas of England it was traditional, according to Dallimore, for the girls to make chains of holly to burn on Shrove Tuesday, the boys retaliating with ropes of ivy.

The observance of May Day, with its poles and dances, has long been a traditional custom of the spring festivals of the European peasants. This is a remnant of the ancient worship of the benevolent tree spirits and of the necessity each spring of paying homage to them to insure the fertility of the fields and flocks in the coming year. Often, the spirit was represented by a pole, a freshly cut tree, a branch, flower, a vegetable, a person, or a combination, like a bough-bedecked mummer.

Jack-in-the-Green, so Sir James Frazer informs us, is the best-known example of the latter. Encased in a wickerwork covered with holly, ivy, and surmounted by a crown of flowers and ribbons, he dances on May Day at the head of a troop of fellow chimney-sweeps, all collecting gifts of pennies. Here should be mentioned the preference of the chimney-sweeps for branches of holly in cleaning the chimneys of London, and the tradition that all flues must be cleaned by New Year's Eve to permit an easy exit for all household evils.

Of all the unusual customs concerning English hollies, perhaps none is more curious than the use of the bark in making birdlime. This mucilaginous substance was spread on branches and other places where birds were accustomed to roost. In the days before firearms, there was no easier way of trapping the ingredients for a tasty sparrow or starling pot pie. Birdlime was also used for keeping snails, insects, and other vermin from climbing fruit trees and invading gardens. In some provinces of China, bark of the beautiful *Ilex latifolia* is used for the same purposes.

The bark of the holly was gathered in midsummer and boiled in spring water for twelve hours. On cooling, the inner green bark was separated from the rest and laid aside in a cool cellar for a fortnight, whence it became a perfect mucilage. It was then pounded fine in a mortar, washed in a stream of running water, boiled with a third part of capon or goose grease. Oil of walnuts was substituted for the grease to prevent the birdlime from freezing in winter weather.

The folklore recorded here relates only to a very few of the five hundred hollies believed to occur in various parts of the world. As these species gradually become introduced to America, and as their folklore successively becomes known, a most exciting story is surely to be unfolded.

Mr. Dengler retired July 31, 1970, as extension forester, Maryland Extension Service, University of Maryland, College Park, Maryland, having served in that capacity for twenty-seven years. He is one of the founders of the Holly Society of America, Inc., its first vice-president, and a former trustee. In 1957 Mr. Dengler was the recipient of the Holly Society "Certificate of Honor" and in 1967 a walnut plaque and life membership in recognition of twenty years of meritorious service to the Society.

The History of English Holly in the Pacific Northwest

AMBROSE BROWNELL

There is a bit of interesting history surrounding the introduction of *Ilex aquifolium*, better known as English holly, to western Oregon. Although the genus *Ilex* is widely dispersed on the five major continents and appears in hundreds of species, varieties, and cultivars throughout the world, it remained a stranger to the western states of America until imported from England to the newly colonized country of the Pacific Northwest between 1850-75. These transplanted hollies found such salubrious climate and ideal soil for their growth that today, one hundred years later, many of Oregon's inhabitants consider them native to their State.

Soon after the arrival of Oregon's pioneers, who first followed the Lewis and Clark Trail to the West, multimasted ships sailing around the Horn from England began to load, in addition to furs, outbound cargoes of wheat, salmon, and the forest products of an adventurous and enterprising people. In return, the diverse imports from abroad included stocks of fruit trees, shrubs, and the beloved hollies direct from their English homeland. And in packets of mail came seeds of all descriptions including, of course, those of the English holly tree.

For the record, a mated pair of little hollies transported from England was presented by the ship's skipper to the owners of a salmon cannery at Clifton, Oregon, in 1875. They were planted on the banks of the Columbia River where today their huge branches cover almost a quarter of an acre. Another holly of great historical interest is growing at Fifth and Yamhill streets in downtown Portland, where it was planted in 1874 on the grounds of the Pioneer Post Office. Today, this magnificent specimen is undoubtedly the largest and most spectacular English holly in America.

Nearly a half century elapsed after recognition of Oregon's statehood before the first steam trains linked the West with the East by rail. The next quarter century brought a vast increase of population and of commerce to the Far West, good reason to celebrate in 1905 with a World Fair and Exposition dedicated to Lewis and Clark, who together had blazed the first Oregon Trail across the North American continent. Since most of the pioneer Oregonians had migrated from the eastern states, it became a popular custom to remember the folks back home at Christmastime with a package of Oregon-grown English holly. So welcome were these generous and colorful presents of holly that local florists soon offered to forward for a nominal charge, bounteous branches of the red-berried holly and gaily ribboned wreaths.

Thus encouraged by a growing demand for Christmas holly for out-of-state shipment, Oregon nurserymen began to select and propagate their choicest berried hollies to be planted in groves for commercial production. The first commercial holly plantings were set out about 1900.

Before many years of holly marketing had passed, it became apparent to the growers that much improvement could be made toward producing hollies more suitable for profitable production. Years of patient search and evaluation preceded the selections of outstanding parent stock for testing and eventual reproduction.

Fortunately for today's holly enthusiasts, England's nineteenth-century gardeners possessed not only "green thumbs" but an understanding of and an intense love for their native hollies. To further stimulate interest in hollies, annual shows were held and England's foremost

horticulturists competed for prizes which were awarded for introductions of exceptional distinction and beauty.

Cooperating with the enthusiastic nurserymen in their search for new and exotic kinds were the willing hollies themselves, ever prone to mutate in bud and seed. Almost chameleon-like, the English hollies proved to be the most versatile of all the species in changing their habits of coloration and growth. As long ago as 1875-76, the English *Gardeners' Chronicle*, in a monumental monograph by Thomas Moore, described and illustrated over one-hundred and fifty named garden varieties or cultivars of English holly.

Most of the colorful mutants appeared as bud sports and are classified as such when the margins of the leaves are edged with silver or gold, or when the leaves are centrally illuminated with gold or silver coloration. Also among bud sports were dwarfed hollies and those with diminutive leaves or spiraled or twisted leaves. Nor should I fail to mention the famous weeping hollies, the beautiful leaves of which are either green or variegated.

Living in a region conducive to growing English hollies, I sought to collect as a hobby the different green and variegated types which had been observed throughout the Pacific Northwest. It proved to be a delightful task since holly owners everywhere were most generous in furnishing cuttings, and I soon came to learn of the camaraderie that exists among garden enthusiasts. Even huge exotic specimens, discovered on some of Portland's older estates, were bought outright and moved to our arboretum.

Before long my quest led me to England, where I placed orders for species and named cultivars of *Ilex* from leading nurseries. Many of them proved to be duplicates of those collected locally. During the past decades many new cultivars have made their appearance, and I have assembled a creditable and worthwhile collection of English holly.

It is an exciting, rewarding experience to discover a "beauty queen" among thousands of seedlings or a spontaneous mutant twig, one of nature's unheralded whims, appearing seemingly out of nowhere to display leaves of green transformed to silver or gold. And lest I forget, some of our most colorful hollies are those whose soft new leaves are brightly margined in gold gradually fading to silver in their second year.

Only recently, while walking among our hollies, I spotted a fasciated bud sport low down on one of the sixty-year-old trees from our original grove, which had lately been transplanted. This, hopefully, will add a new cultivar to the English hollies in America.

Hollies from Europe are released from time to time by the United States Department of Agriculture, Plant Introduction Service, Crops Research Division. One of the most interesting cultivars, which will soon be available, is *Ilex aquifolium* 'Crassifolia' or saw-leaved holly, described in Hanbury's *Complete Book of Gardening* (1770) as having leaves as long as any, very narrow, and of thick substance. Dallimore in *Holly, Box & Yew* finds it difficult to associate this holly with *I. aquifolium*. On the other hand, he finds it difficult to associate *I. aquifolium* 'Crassifolia' with any other species, stating it is probable that it may be a species whose history is lost.

I should not overlook the role which the English hollies play in this new era—the hybridization of species. Perhaps the most popular inter-specific hybrid is 'Nellie R. Stevens', whose probable parentage is *Ilex cornuta* × *I. aquifolium*.

Mr. Brownell, the owner of Brownell Holly Arboretum and Nursery at Milwaukie, Oregon, has been collecting, propagating, and growing English as well as American and Oriental hollies for many years. He followed in the footsteps of his father, the late Senator George C. Brownell, who planted one of the first commercial groves of English holly in the Pacific Northwest sixty years ago.

U.S. National Arboretum

Right, *Ilex aquifolium* 'Early Cluster'. Left, *I. aquifolium* 'Big Bull'.

Pacific Northwest Pioneers With English Holly

In his *History of English Holly in Oregon and the Northwest,* John S. Wieman tells of the men whose interest in English holly, in the late 1800's, led to its development as an industry in the State of Oregon.

Mr. Wieman knew many of these men, having worked with them on holly problems during the more than 30 years he was superintendent of the Bureau of Nursery Services of the Oregon State Department of Agriculture. He first recognized the possibilities in English holly in 1927, and in the next four or five years observed and studied the variations in English holly trees. Then he started to raise seedlings and to select for hardiness and early and late berry production.

Among the holly pioneers were John F. Broetje, George C. Brownell, Herman F. Bleeg, and Gustav Teufel.

Mr. Broetje, who arrived in Oregon about 1883, carried on a nursery and florist business in southeast Portland. His two sons continued the business and one of them, John H., sold hollies of the FRENCH-ENGLISH GROUP to George C. Brownell who had moved from Kansas to Oregon in 1890. The trees were planted in 1910 and did well until 1919, when a severe frost killed them to within a few feet of the ground. For the next few years it was difficult to get enough cut holly to meet the Christmas season demand. Mr. Brownell's son Ambrose began seeking hollies other than the French-English, and it was through his efforts and those of Herman F. Bleeg and others that newer and more desirable cultivars became available.

Mr. Bleeg, who was born in Leipzig, Germany, went to Portland, Oregon, via New York and Wisconsin. He was the gardener, then the manager of the Beth Israel Cemetery in Portland from May, 1889, until his death almost forty-five years later. Some of his first holly cuttings came from a tree at the grave of Henrietta White, which had been transplanted from her husband's (Levi White) estate in Portland by Gustav Teufel.

(Continued on page 178)

English Hollies

HARRY WILLIAM DENGLER
THEODORE R. DUDLEY
GENE K. EISENBEISS

UNIV. WASH. AUDIO-VISUAL PROD. CENTER

Upper, *Ilex perado* var. *platyphylla*.

Lower, *Ilex aquifolium* 'Angustifolia'.

The hollies in this group more specifically relate to the varieties, selections, clones, cultivars, and hybrids of *Ilex aquifolium* L., the English or common holly of Europe. This holly, however, is a member of a poorly understood complex comprising, in part at least, *Ilex perado* Aiton and *Ilex platyphylla* Webb and Berthelot, which itself may be but a variety of *I. perado*.

Ilex aquifolium is rather widely distributed throughout parts of southern and central Europe, occurs in Africa and China, and is a common plant in the British Isles, especially Scotland and England; *I. perado* is native to the Azores and the Canary Islands and *I. platyphylla* native to the Canary Islands. The relationships of these three hollies to one another and their possible hybrids and varieties have caused considerable confusion among holly authorities.

The hybird, *Ilex* × *altaclarensis* (Dallim.) Rehd., *I. aquifolium* × *I. perado*, contains a number of cultivars, perhaps as many as forty. All these cultivars were formerly included under *I. aquifolium*. In the accompanying list of English hollies, the designation of × *altaclarensis* in parentheses at the end of the description of a cultivar indicates its relationship. The spelling of the hybrid name, × *altaclarensis*, with an "a" is not to be confused with the male cultivar 'Altaclerensis' that is spelled with an "e."

In its native habitat, *Ilex aquifolium* varies in form from a moderate-sized shrub to a tree anywhere from twenty to eighty feet tall. It is an evergreen species with leaves more or less oval in outline, 1-1/2 to five inches long, 3/4 to two inches wide, and coriaceous in texture. The margins are wavy and spiny, and the spines are often complete-

BOTH PHOTOS U.S. NATIONAL ARBORETUM

Left, *Ilex aquifolium* ARGENTEO-MARGINATA GROUP. Right, *I. aquifolium* ARGENTEO MEDIO-PICTA GROUP.

ly absent on the leaves of older trees. The latter characteristic resulted in their being called "he," "she," or "free" hollies, irrespective of their proper sex.

The English hollies are undoubtedly the oldest, best-known, and, up to the present time at least, the most useful of all members of this genus. As far as is currently known, they are also the most variable of all hollies. One of the earliest references to cultivars of this species is that of the "hedgehog holly," said to have been introduced to England from France in the late sixteen hundreds. Many cultivars of the English hollies are so old that their origins would be most difficult to determine.

One of the most assiduous collectors of holly cultivars on record was Wrench of Fulham, who lived during the latter part of the reign of Charles II, 1630-85. In Hunters' edition of *Evelyn's Silva,* 1776, thirty-six cultivars of variegated-leaved hollies are named. Loudon, 1838, noting the large number of variegated hollies available in London nurseries, grouped these as: *albo-marginatum,* white-edged-leaved; *aurea marginata,* gold-edged-leaved; *albo-pictum,* white-spotted-leaved; *aureo-pictum,* gold-spotted-leaved. He also included the "silver-blotched" and the "gold-blotched hedgehog" hollies.

In a series of fourteen articles appearing in the *Gardeners' Chronicle,* London, 1874-76, Tom Moore described 153 cultivars of the "common holly." This is the most important work on the hollies to date and because of its completeness has become known as *Moore's Monograph.*

In 1908, W. Dallimore of the Arboretum, Royal Gardens, Kew, in his book *Holly, Yew and Box,* treated the "common holly" as fully as was possible and directed attention to other *Ilex* species, many of which were not then known. Dallimore brought up to date and clarified the descriptions and names of previous authors. Many of his descriptions of the English cultivars were those of Moore, as were the leaf illustrations included in the *Monograph.* Dallimore, however, felt it advisable to place some of these

hollies under *I. platyphylla,* while others he referred to as hybrids. Like Moore's, Dallimore's work was an important contribution; his limited edition book is a sought after item among holly fanciers.

The descriptions of the hollies in this group which follow alphabetically, fall in two readily discernible classes. The first includes those which were selected and named from plants growing in the United States. These might have originated as seedlings, branch sports, or mutations, from seedlings or imported cultivars, accidental or planned hybridization. Where known, the name of the originator and the State of its origin follows the description in parentheses. The second group includes those importations from Europe, largely the British Isles, known or believed to be currently growing in North America. These will be recognized by their more complete description, the absence of their originator and place of origin and, most often, a Latinized title somewhat descriptive of the cultivar. Names in parentheses with this group indicate former names or names by which they might still be known. In all the latter cases, the descriptions are freely copied and condensed, where necessary, from those originally appearing in *Moore's Monograph* and Dallimore's *Holly, Yew and Box.*

Grateful appreciation is here expressed to both the late W. Dallimore and to Roy Hay, editor, [1957] *Gardeners' Chronicle,* for their kind permission in allowing this. Their courtesy has been most helpful to many confused nurserymen and collectors in determining whether their hollies are correctly labeled.

Both photos Univ. Washington Audio-Visual Prod. Center

Above, *Ilex aquifolium* 'Aurea Regina'.

Right, *Ilex aquifolium* 'Ferox Aurea'. Left, *I. aquifolium* 'Myrtifolia'.

The remarks concerning the completeness of the list of American hollies applies equally to this group.

Readers are also advised to study the comments of A. N. Roberts and R. L. Ticknor on the English hollies under the article "Commercial Production of English Holly in the Pacific Northwest."

Descriptions of English Hollies

Except as otherwise noted, the following are cultivars of *I. aquifolium*.

1. 'Alcicornis'

Noted for its very spiny, bright green leaves, 3-1/2 inches long, 1-3/4 inches wide, oblong-obovatel., entire wedge-shaped base, the rest of the margin furnished with numerous narrow, stiff, sharply pointed spines. Greenish young bark. Free-growing.

2. 'Altaclerensis'

Male holly with purplish bark, vigorous and dense habit, forming a noble specimen. Leaves deep green, roundish ovate or oval, 3-4 inches long, 2-1/2 to 3 inches wide. On some leaves, spines numerous and regularly developed; on others, few or lacking; where present, they are stronger and more divaricate than on *platyphylla*. Resembles 'Hodginsii' in appearance and has been called the High Clere holly (× *altaclarensis*).

3. 'Amber'

Cultivar with large, bronze-yellow fruit. (Hillier and Son, Winchester, England.)

4. 'Angustifolia'

Narrow, pyramidal habit. Bark green or purplish. Leaves shining green, lanceolate or lanceolate-ovate, about 1-1/2 inches long, 1/2 inch wide, with a longish, entire point. Weak, narrow, regular spines on each side of leaf, lying in the same plant. Resembles 'Myrtifolia' but has narrower spines and the elongated entire apex well defined. Sex designation very confused.

5. Argenteo-marginata group

The most common of silver variegated-leaved hollies, varying somewhat in appearance. Bark of young wood green. Leaves broadly ovate, 2 to 2-1/2 inches long; dark green with slightly mottled disk; irregular, narrow, silvery margin. Spines usually somewhat numerous but irregularly divaricate; sometimes few or almost lacking. Names in the trade include 'Silver Queen', 'Silver Princess', "Silvary', and 'Teufel's Silver Variegated'.

6. 'Argenteo-marginata Elegantissima'

Bark of young shoots green. Leaves elliptic-oblong, 2 inches long, 1 inch wide, dark green, mottled with gray and with a broad, rather even, creamy white edging. Spines bold, regularly developed, becoming divaricate from the wavy surface of the leaf.

7. 'Argenteo-marginata Erecta'

This female, known in England as 'Upright Silver-striped', has leaves about 2 inches long, flat, with a very regular marginal series of strongly developed spines, somewhat resembling those of 'Handsworth New Silver'. Leaves have mottled green center and a broad creamy white margin.

8. 'Argenteo-marginata Pendula'

Well-known fruiting cultivar of weeping habit, vigorous growth. Bark purple. Leaves 2-1/2 to 3 inches long, ovate or ovate-oblong; surface green, freely blotched with grayish green, margin irregularly but often boldly marked with creamy white. Spines large, conspicuous; somewhat less crowded and regular than in 'Handsworth New Silver'. Frequently known in England as 'Perry's Weeping'; the American commercial synonym is 'Silver-Weeping'.

9. Argenteo medio-picta group

Green-barked, variegated hollies. (Some green foliage may have to be pruned out). Leaves ovate or cuneatly ovate, 1-1/2 to 2 inches long, about 1 inch wide; dark green at the edge with a large, central blotch of creamy white, irregular in shape, size, position, frequently confined to basal half of the leaf. Spines very strong, much divaricated. Male and female trees available. 'Silver Milkmaid' in England; a female in the American trade bears the commercial synonym of 'Silver Milkmaid', and a male is known as 'Silver Milkboy'.

10. 'Argentea Regina'

Bark of young wood purplish or reddish brown. Leaves broadly ovate, 2-3/4 inches long, 1-3/4 inches wide; spines strongly developed, much-divaricated, fairly evenly spaced. Disk dark green with patches of grayish green; broad, irregular, but well-defined, creamy white edging, most strongly developed at apex. A male holly, 'Silver King' is the commercial synonym in the American trade for 'Silver Queen' in England.

11. 'Atrovirens Variegata'

Conspicuous male with reddish purple bark. Leaves ovate or obovate, 2-1/2 to 3 inches long, 1-1/2 to 2-1/4 inches wide. Spines evenly placed, usually arranged in the same plane, although occasionally slight waviness noticeable. Margin dark green with a feathered, golden blotch mixed with pale green in the center; colors bright and effective (× *altaclarensis*).

12. Aurea marginata group

In its widest sense this name includes a large proportion of the variegated-leaved female hollies with golden margins. Some showing slight variations have been selected and named, so there is considerable latitude in this group. Typically, bark usually green; leaves large, about 2-1/2 to 3 inches long, 1-1/2 inches wide; disk

dark green with gray-green mottlings; golden edge moderately narrow, unequal but rather strongly developed about the tip. Leaves sometimes entirely golden. Spines stout, divaracate, unequally distributed.

13. 'Aurea Marginata Ovata'

Young wood reddish brown. Leaves ovate, mottled green and gray with broad, pale yellow edges. Spines strongly developed, fairly regular.

14. AUREA MEDIO-PICTA GROUP

An attractive group, frequently occurring as sports on solid green-leaved English hollies with variations in leaf size, coloration, and spines. It is recognized by leaves irregularly marked by a large, deep golden blotch often occupying more than half the surface, while the irregular margin is glossy, dark green. Male and female trees; some known in American trade under the names of 'Golden Butterfly' and 'Harlequin', both female, and 'Golden Milkboy', male.

15. 'Aurea Medio-picta Latifolia'

In England, this was considered the best type in the AUREA MEDIO-PICTA GROUP, distinguished from others by the large, flattened leaves. Spines variable in number and position; stout, well-developed, divaricate, generally wanting at the rounded base of the leaf, sometimes confined to a few near the apex. Broad disk irregularly marked with a large, branching, deep yellow blotch, frequently covering more than half the leaf and narrow, irregular, green margin.

16. 'Aurea Regina'

One of the best of the golden-variegated cultivars. Free-growing, male. Bark of young wood green; leaves broadly ovate, 2-1/2 to 3-1/2 inches long, 1-1/2 to 2 inches wide, with very strong, spreading, and variously directed spines. Disk usually much mottled with dark green, pale green, gray, often in nearly equal proportions, with broad, well-defined, continuous margin of deep golden-yellow. The tendency to variegation is so strongly marked that it is not uncommon to find leaves which, either on one side of the midrib or both, are entirely gold-colored. ('Golden Queen' of England = Golden King', commercial synonym of American trade.)

17. 'Aurifodina'

The smudge holly of England. Upright or pyramidal habit, thickly covered with medium-sized or rather small leaves. Bark usually reddish, occasionally green. Leaves ovate-acuminate, about 1-3/4 inches long; disk dark green, flushed or marbled with dull yellow-green, edge unequally marked with tawny orange-yellow, sometimes extending over half the leaf. Spines continuous but distant, placed along the edge or, rarely, few, scattered, moderately divaricate. A distinct cultivar because of the tawny hue which the variegation assumes during winter. Male.

18. 'Bacciflava'

Very old, yellow-fruited cultivar said to have been cultivated in 1688 in Leiden, The Netherlands, probably under another name. The name 'Bacciflava' was first erected by Weston (England Fl. P. 17) in 1775.

19. 'Balearica'

Female, usually of pyramidal habit, from the Balearic Islands. Leaves ovate or ovate-oblong, 3 to 3-1/2 inches long, about 2 inches wide, thick in texture, bright green. Most leaves entire or bare, but a few erratically placed spines; occasionally, short spines fairly well represented along the margins. (Whether this is a cultivar under *I. aquifolium*, or under *I. perado* or × *altaclarensis* is still undetermined.)

20. 'Balkans'

A female clone grown at the Missouri Botanical Garden from seed collected by Anderson in Yugoslavia in 1934.

21. 'Barnes'

A male sport of *Ilex aquifolium* 'Angustifolia'. Globular in shape. Leaves small, quadrangular-shaped, with 5-7 sharp, divaricate spines. An excellent pollinater. (Mattoon.)

22. 'Beacon'

A green-stemmed type, selected in 1945 as a heavy, consistent bearer of extra large, distinctly bright orange-red berries in large quantities. (Wieman, Oregon.)

23. 'Beautyspra'

A hardy seedling, selected about 1930, with cherry-red berries and pronounced spiny, crinkled leaves, somewhat smaller than average. Early-bearing, early-ripening. Recommended for landscaping and orcharding. (Wieman, Oregon.)

24. 'Belgica'

A fine female tree of vigorous habit. Young bark green. Leaves sap-green, 3-1/2 inches long, ovate or oblong-ovate, with a formidable array of strong, rather thickly placed spines at the edges. (× *altaclarensis*)

25. 'Berigold'

A pale yellow-fruited English holly with gently spined leaves. Fruits freely. Originated in the Pacific Northwest. (Brownell, Oregon.)

26. 'Big Bull'

A green-stemmed male, selected in 1935. Vigorous, upright growth habit; leaves green and lustrous. Good pollenizer. Very hardy. (Teufel, Oregon.)

27. 'Boulder Creek'

Leaves very large, glossy, black-green; fruit brilliant red. Received from Leonard Coats Nursery, San Jose, California, in 1957. (Monrovia Nursery, Azusa, California.)

28. 'Bonanza'

Leaves closely grouped, rich green, well-spined and wavy, deeply channeled along midrib, trian-

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Top left, 'Beautyspra'. Top right, 'Shortspra'.

Lower left, 'Beacon'.

gular in shape. Abundant fruit borne in clusters. (Brownell, Oregon.)

29. 'Camelliaefolia'

Female, considered one of the most ornamental of the English hollies. Large, dark-colored fruit. Vigorous habit, growing naturally into a shapely pyramid, retaining dense foliage at all seasons. Bark of young wood purple. Leaves oblong or elliptic, acuminate, dark olive-green, very glossy; 3 1/2 to 5 inches long, 1-1/2 to 2 inches wide; margins either smooth, spineless throughout, or with an erratic spine or two; or with lower part entire, upper with some 4 or 5 well-developed, undulating spines on each side; or rarely armed on both margins throughout entire length. (× *altaclarensis*)

30. 'Ciliata'

An attractive, purple-barked female of neat pyramidal growth habit. Leaves ovate or lanceolate, shining green, 1-1/2 inches long, rarely 2 inches, 1/2 to 3/4 inch broad; margined with weak, long, regularly placed spines, forming a kind of fringe to the edge. While Dallimore cited 'Ciliata 'and 'Ciliata Major' as females, later comments have referred to male and female forms. Further study is needed in the clonal and sex identification of these two and other cultivars, including 'Recurva', 'Tortuosa', etc.

31. 'Ciliata Major'

A free-growing, vigorous female. Bark of young shoots purple. Leaves ovate or ovate-oblong, flat, ciliate-margined with crowded, long, broad-based, plane spines; basal leaf portion usually entire, apex more or less prolonged. Color of Leaves, glossy, dark green, sometimes olive-tinged.

32. 'Colburn'

Fruiting cultivar, similar to 'Camelliaefolia', but leaves more spinose and divaricate. (× *altaclarensis*) (Beadle, North Carolina.)

33. 'Coleman'

A hardy English holly. On November 10, 1955, after a very late, warm fall, the Washington area was hit with zero temperatures almost overnight. Many hollies were killed and all English hollies, with the exception of 'Coleman', were severely damaged. Of all the cultivars growing in the State of Washington at the time, 'Coleman' was the only one that suffered no damage either to the leaves or to the berries. (Callison, Washington.)

34. 'Covergirl'

Female, very compact grower; dense, broad, mound-shaped plant. Leaves unusually small, 1-1/2 inches long, 3/4 inch wide. Collected from source plant growing in Portland, Oregon. (The John Wieman Holly, Oregon.)

35. 'Crispa'

The screw or screw-leaved holly of England. Bark of young shoots purple. Leaves blunt-ended, spirally twisted, more variable than in other cultivars (from one tree many different types may be gathered); margins entire or, in some cases, rudimentary spines produced, or one or more erratic spines abnormally developed. Chief characterstics of this male cultivar are glossy, deep green leaves with thickened margins, spiral twisting, and rugosity of upper leaf surface.

36. 'Crispa Aureo-picta'

The gold-blotched screw holly of England. Young bark purple. Leaves twisted, coriaceous, with a thickened margin as in 'Crispa'. Glossy, puckered on the surface, almost shapeless from the twisting and irregular development of the spines, sometimes wholly wanting, the thickened edge being undulated, sometimes sparingly produced in an altogether erratic manner. Marginal portions deep green; disk marbled with yellow and pale green, yellow predominating near the base.

37. 'Deluxe'

Rank-growing, hardy, green-stemmed female with exceptionally large leaves and berries considerably larger than average. An early-ripening cultivar, selected in 1935; considered excellent for commercial orchards and landscape work. (Teufel, Oregon.)

38. 'Donningtonensis'

A male cultivar of free, pyramidal growth. Bark very dark purple. Leaves variable in size and form, stout in texture; dull purplish green, with a purple streak along the midrib on the back; contrasting with bright green cultivars. Leaves lanceolate in general outline, but not infrequently turned to one side so as to become sickle-like; frequently a small lateral and often falcate lobe at the base; average about 2 inches long, 3/4 inch wide, sometimes slightly exceeding these dimensions. Margins frequently entire or with 1-5 erratic spines; occasionally spines more numerous, sometimes margins furnished throughout with them. Spines, when present, strong, much divaricate. (× *altaclarensis*).

39. 'Dr. Huckleberry'

A female selected from a mixed planting of seedlings on the Wilmarth place at Brighton, Oregon, in 1946, and tested at the Oregon Experiment Station as O.S.C. No. 25. An early ripening form of the green-stemmed Bleeg group. Exceptionally bright red, oval-shaped berries. Leaves on mature plants medium to large, wavy, spiny, and holding their shiny green color well under adverse conditions. Not subject to leaf drop. Rapid-growing, early cropping tree. Greens not excessively coarse, well-balanced in growth and leaf arrangement. One of the best. (Oregon.)

40. 'Dude'

Sport, discovered in Gresham, Oregon, about

1935, which has gold-margined leaves. Normally produces abundant pollen. (Wieman, Oregon).

41. DUTCH TYPE GROUP

Applied to English hollies in the Pacific Northwest differing from the cultivars so commonly associated with the Christmas season. In general, leaves quite flat, glossy, dark green, most often spineless. Berries usually larger, more uniformly round in shape, produced abundantly, early-ripening, and firm to handle.

42. 'Early Cluster'

Winter-hardy, early-bearing female, selected in 1932. Berries in extremely heavy clusters. An outstanding producer of good-quality holly. (Wieman, Oregon.)

43. 'Earlygold'

Leaves, similar in color to those of "Lilygold', retained on tree three years. Early ripening, firm, bright scarlet fruit. Height of 15-year-old tree in 1959, 12 feet; spread, 5 feet; trunk diameter 6 inches; shape pyramidal. (Teufel, Oregon.)

44. 'Echo'

Small, wavy-leaved fruiting mutation of 'Angustifolia.' (Brownell, Oregon.)

45. 'Eldridge'

Female cultivar introduced on Long Island, New York, about 1900. Berries large, red, borne in profusion. Leaves, large, flat, ovate. (× *altaclarensis*) (Batchelor, New York.)

46. 'Escort'

Sturdy, free-growing, green-leaved male selected as dependable and profuse producer of pollen for orchard pollenizing. (Brownell, Oregon.)

47. 'Evangeline'

Compact, conical tree, producing an abundance of red fruit amid dense, spiny foliage. Growing on the Whitney estate, Woods Hole, Massachusetts. (J. K. Lilly, III. Massachusetts.)

48. 'Favorite'

Female holly, selected about 1935. Berries medium to large, bright red, extremely early ripening, early bearing. Leaves medium spiny, flat, with slight crinkles. Produces short, long, and branched sprays of unusual quality, excellent for arrangements. (Wieman, Oregon.)

49. 'Ferox'

Male, commonly called hedgehog holly, or, in America, "Green Porcupine" or "Porcupine," because of the prickly leaf surface. Bark of young shoots purple. Leaves ovate-oblong, or narrowly ovate, 2 to 2-1/2 inches long, much acuminate, with strongly developed divaricate, marginal spines; surface more or less convex, being echinate, or furnished with stiff, erect spines.

50. 'Ferox Argentea'

Originally called the silver-striped hedgehog holly, also silver-variegated hedgehog. Leaves same size, shape, and spininess of 'Ferox', but majority of spines silver-colored; broad and irregular margin of the same color, disk deep green. A male, or non-fruiting, cultivar.

51. 'Ferox Aurea'

The gold-blotched hedgehog, a well-marked and handsome male holly. Young bark purple. Leaves varying considerably in size and form, oblong or ovate-oblong, very strongly spined at margin and upper surface; also strongly waved, more or less recurved longitudinally; surface a deep rich green. Green spines, which bristle from surface, have pale tips. On the plain central portion, near base of leaf blade, is a conspicuous blotch of golden-yellow.

52. 'Firecracker'

Low-growing, bushy, cultivar with spiny leaves. An early and abundant producer of crimson berries in clusters. (Brownell, Oregon.)

53. 'Fisheri'

Bold, free-growing, handsome male. Young bark unusually green, sometimes purple. Leaves variable in character, about 2-1/2 inches long, 1-1/4 inches wide, very dark green, coriaceous in texture; ovate, with a somewhat acuminate apex. Leaf margins thickened, somewhat spiny throughout, with strong, much-divaricated spines; more commonly with 1-2 to 5-6 spines along the edges, occasionally entire, and an entire acuminate point.

54. 'Flavescens'

This golden-variegated female has no distinctly defined variegation, but a yellowish flush spreads more or less over the leaf surface, variable in extent and position. Dull bronzy yellow sometimes covers the upper half of the leaf, sometimes an irregular portion near the center, other portions remaining green. Coloring most strongly marked on young and year-old shoots; the older, more persistent leaves becoming gradually greener. Leaves oblong-ovate, sometimes as much as 3-1/2 inches long, thick in texture, strongly waved, with prominent marginal spines.

55. 'Foxii'

Male. Bark of young shoots purple. Leaves very glossy, bright, green, ovate, stoutish in texture, 2-1/2 inches long. Spines rather far apart, regular, plane, fully developed, appearing somewhat like those of 'Ovata', but as if longer spines had been added to its margin.

56. FRENCH-ENGLISH GROUP

Type of holly rather than a true clonal or horticultural variety, which contains a certain amount of mixture, depending on the source of the propagating stock. Originally selected and propagated by P. H. Peyran of Hollycroft Gar-

dens, Gig Harbor, Washington, from *I. aquifolium* stocks obtained in France and shipped by boat to the Pacific Northwest. Type has dark blue or purplish wood and durable, thick, leathery leaves. Trees fairly rapid-growing but late in bearing. Berries round-oblate, very firm when red-ripe; late ripening unsuitable for commercial production in some areas. Type tends to produce a high percentage of parthenocarpic berries.

57. 'Fructu-aurantiaca'

This is apparently a selection of the yellow-berried holly; its deep orange-colored fruits are sometimes flushed with scarlet. 'Orange Gem' is a commercial synonym in the American trade.

58. 'Fructu-lutea'

Leaves from 2-1/2 to 3 inches long, ovate, bright green; margins generally armed with a moderate number of spines, slightly divaricate. In general appearance it closely resembles the ordinary English hollies. Yellow-berried seedlings apparently are not uncommon.

59. 'Golden Beau'

Bright golden-variegated male cultivar. (Teufel, Oregon.)

60. 'Green Knight'

Dark-leaved, ornamental male of stately habit. (Brownell, Oregon.)

61. 'Green Maid'

Hardy, vigorous-growing, graceful, dense and large-leaved, green-stemmed female. Berries well disposed, large, and early-ripening. (Brownell, Oregon.)

62. 'Green Plane'

Vigorous tree, robust fruit-bearer. Leaves long, bold, sharply pointed; margin varying from entire to fully spiny. (Brownell, Oregon.)

63. 'Handsworth New Silver'

A handsome "silver holly," purple-barked; a female of free and vigorous growth habits. Leaves elliptic-oblong, 2-1/2 to 3-1/2 inches long, margined with very prominent spines which lie in the plane of the leaf with little tendency to divarication. Disk mottled with green and grayish green, a distinct and tolerably even creamy white margin. Strong, conspicuous, marginal spines also white. Commercial synonyms in the American trade include 'Silverboy' and 'Silver Plane'.

64. 'Hastata'

Distinct male of dwarf habit. Bark purple. Leaves dark green, small, peculiarly shaped, varying from 3/4 to 1-3/4 inches long, 1/2 inch wide, irrespective of the spines, which are large and very prominent for so small a leaf. Usually 1 or 2 pairs of spines on each side at the base, occasionally more on upper half of the leaf forming a large, entire, oblong, bluntish lobe, not infrequently emarginate. Thus the whole leaf, in the case of those few-spined below, and the apex entire, has a strongly marked hastate figure.

65. 'Hendersonii'

Green-barked cultivar. Leaves opaque, dark green, 2-1/2 to 3-1/2 inches long, 1-3/4 to 2 inches wide, oblong-elliptic, with sunken veins, the apices usually acute, the margins entire, or with a few scattered spines. A female producing large fruits, not abundantly. (× *altaclarensis*)

66. 'Hodginsii'

Female of hardy, vigorous growth. Young bark purplish. Leaves dark green, roundish ovate, 2-3/4 to 3-3/4 inches long, about 2-1/2 inches wide. Marginal spines bold, somewhat far apart, fairly evenly placed, or occasionally only a few scattered ones. 'Hodginsii' resembles 'Altaclerensis' and 'Shepherdii'; leaves, however, darker in color than those of the latter. (× *altaclarensis*)

67. 'Ingramii'

A very distinct, small-leaved male holly. Bark purple. Leaves elliptic-ovate, 1-1/4 inches long, about 1/2 inch wide, evenly bordered with plane spines. Disk dark olive-green, somewhat mottled and rugose. Teeth and margins grayish white, markings being freckled with no distinct outline. Also known as 'Ingram'.

68. 'Integrifolia'

A purple-barked cultivar. Leaves ovate, entire, thick in texture, somewhat thickened margin, dark green, 2 inches long, 1 inch wide. Leaf has slight twist, point being sometimes acute, sometimes bluntly rounded. Somewhat of the character of 'Scotia', but leaves not so decidedly rounded or twisted.

69. 'James G. Esson'

Selected and named in 1949 from seedlings of × *altaclarensis* raised by James G. Esson, superintendent of the Mrs. Roswell Eldridge estate, Great Neck, Long Island, and grown on for several years at The New York Botanical Garden. A tree of vigorous habit and rapid growth, it produces an abundance of large, shiny red berries in clusters along the branches. The leaves, more glossy and a richer green than those of 'Eldridge', have 4 to 5 well-developed spines (sometimes more, rarely less) along each side. (Everett, Bronx, New York.)

70. 'J. C. van Tol'

An early-bearing holly with early coloring of its large, shiny, dark red fruits. Leaves smooth, glossy, somewhat convex. (van Tol, Holland.)

71. 'Latispina'

Free-growing male of fine pyramidal habit. Bark of young shoots dark purple. Leaves 2 to 2-1/2 inches long, acuminate spiny point generally decurved; 2-3 broad, elongated spines, commonly deflexed, sometimes erect, occasionally hooked backwards with a rounded shoulder.

Lower right, Univ. Washington Audio-Visual Prod. Center
Others, U.S. Nat onal Arboretum

Top left, 'Teufel's Deluxe'. Top right, 'Pinto'.

Lower left, 'Teufel's Hybrid'. Lower right, 'James G. Esson'.

Leaves glossy, very deep green, texture leathery, margins thickened; entire leaf, in some instances, slightly twisted. Sometimes margin merely wavy without spines except for the long terminal one.

72. 'Latispina Major'

Male; leaves large than 'Latispina'.

73. 'Laurifolia'

Well-known male, called the smooth-leaved holly. Erect, tall habit; somewhat open, irregular growth. Bark dark purple. Leaves dark green, very glossy; varying from 2-3 inches long, and in form from ovate to oblong-lanceolate or elliptic; usually quite entire, rarely with from 1-6 marginal spines, very rarely spiny throughout; surface either flat or slightly undulated. (× *altaclarensis*)

74. 'Lawsoniana'

Young bark reddish brown. Leaves ovate or bluntly elliptical, 2-1/2 to 3-1/2 inches long; margins distantly but rather evenly spined, nearly or quite plane; opaque green, central portions marked with broad bands or blotches of yellow, very variable in shape, often occupying greater part of the surface on one side of midrib, marginal portions of two shades of green. Occasionally as many as 10 spines on each side of the leaf, fewer when either basal part or portion of margin is spineless. A female, considered in England one of the handsomest of the golden hollies. (× *altaclarensis*.)

75. 'Lewis'

Female, of upright habit with attractive, divaricately spined, deep green leaves. Large, deep red berries borne abundantly along the twigs. (McLean, Maryland.)

76. 'Lichtenthalii'

Leaves oblong, 4 inches long, 1-1/2 inches wide, bright green. Spines regularly spaced, moderately strong, divaricate. Distinctive characteristics are narrowness of leaves in relation to length; distinct pale color of principal vein, spines, margins and under surface; and formation of two tiny spines, one on each side near the base of the leaf. This cultivar is also known as 'Lichtenthal'.

77. 'Lillibet'

Somewhat broader leaves and low, spreading growth in contrast to that of 'Angustifolia', of which it is a sport. Good fruit-bearer. (Brownell, Oregon.)

78. 'Lilliput'

Male, selected for its similarity to 'Lillibet'. (Brownell, Oregon.)

79. 'Little Bull'

A mutation of 'Angustifolia' with glossy, spiny leaves about three times as large as normal. A good pollenizer. Very ornamental and useful for landscaping where a hardy male tree is desired. (Teufel, Oregon).

80. 'Longspra'

Very hardy, rapid-growing, orchard-type tree. Female. Originated in Portland, Oregon, about 1925. (Wieman, Oregon.)

81. 'Louise'

Seedling of 'Teufel's Hybrid', selected in 1948. Vigorous cultivar producing large, scarlet fruit. Leaves very glossy, dark green, retained for three years; less than normal number of spines. Hardy to 0° F. (Teufel, Oregon.)

82. 'Madam Briot'

Leaves broad oblong-ovate, 2 1/2 to 3 inches long, 1-1/4 to 1-1/2 inches wide; spines strong, divaricate; margin narrow, golden; center mottled yellow and green, sometimes wholly golden. (Probably originated in France.)

83. 'Marnokii'

A fruiting cultivar with green bark on the under sides of branches, purplish above. Leaves almost as large as those of 'Camelliaefolia' but less dense and ornamental; from 4 to 4-1/2 inches long, 2 inches wide, oval, acute with a peculiar twist about the middle. Margins usually thick, spineless; occasionally a few erratically placed spines, more rarely the margins well- and regularly armed with strong, divaricate spines. (× *altaclarensis*)

84. 'Marshall Tito'

Hardy male clone, originating from seeds collected by Anderson of the Missouri Botanical Garden in Yugoslavia in 1934. (Brownell, Oregon.)

85. 'Misty Green'

Female, with leaves two tones of green; centers dark green, edged with a broad, marginal band of a paler shade. (Brownell, Oregon.)

86. 'Mundyi'

A green-barked male. Leaves dull in appearance, regular in shape, broadly ovate, usually 3-4 inches long, 1-1/2 to 2 inches wide; evenly spined along the whole margin, sometimes slightly undulated on one side; prominently and evenly veined as to give the upper side a somewhat ribbed appearance. (× *altaclarensis*)

87. 'Muricata'

A green-barked cultivar. Leaves ovate or oblong-ovate, acuminate varying from 1-3/4 to 2-1/2 inches in length, and 3/4 to 1 inch wide; moderately flat and spiny. Spines short and fairly evenly spaced along the margins, majority pointing in one direction. Disk dark green, heavily streaked or blotched with gray or greenish yellow; marginal band, yellow tinged with green, of irregular width, generally widening about the apex.

88. 'Myrtifolia'

A small-leaved, neat-growing English holly, female, with both green and purplish bark. Leaves usually from 1-1/4 to 1-1/2 inches long,

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Top left, 'Pilkington'. Top right, 'Dr. Huckleberry'.

Lower right, 'Oregon Select'.

1/2 to 5/8 inch wide, ovate-lanceolate, margin either entire or with one or two erratic spines or, more commonly in the largest leaves, moderately spiny throughout. Spines usually subdivaricate, someimes nearly flat, especially in the few-spined examples, bright green in color. This variety appears closest to 'Angustifolia'.

89. 'Nigrescens'

Distinctive male, vigorous, of ornamental value. Leaves ovate-oblong 3 to 3-1/2 inches long, and 2-1/4 to 2-1/2 inches wide. Apex acute, margin often entire, occasionally a few erratic spines, other times 4 or 5 pairs; in all instances, small. (× *altaclarensis*)

90. 'Nobilis'

Young bark purplish. Leaves dark green, roundish ovate, 2-3/4 to 3-3/4 inches long, having bold marginal spines somewhat distant, fairly evenly spaced. Male, closely resembles 'Altaclerensis' and 'Hodginsii'. (× *altaclarensis*)

91. 'Oregon Select'

A chance seedling selected and named in 1947. Trees mature and bear fruit early. A green-stemmed holly with shiny leaves and well-balanced sprays; a favorite for commercial cutting. Leaves generally spiny, some smooth leaves developing on older trees. Berries bright red, oval-shaped, early-ripening. (Sawyer, Oregon.)

92. 'Ovata'

A slow-growing, unusual male with purple young shoots. Leaves ovate, deep opaque green, moderate and fairly even in size, 2-1/2 inches long, very thick in texture; regular, angular, scarcely spiny teeth, sinuses between them unusually even, regular, and pronounced.

93. 'Pendula'

This is *I. aquifolium* var. *pendula* Loud. Branches pendent. Bark deep purple, purplish in some cases, green in others. Leaves deep green, ordinarily from 2-3 inches long, divaricately spiny. Spines somewhat broader and sometimes fewer than in the average English holly. A handsome specimen many yards in circumference, with an evenly balanced head. Since no leading shoot is formed, it is necessary to keep a shoot tied upright to get height.

94. *perado*

Ilex perado Ait. of Azores and Canary Islands, a moderate-sized tree. Leaves oval, often blunt at the apex, varing considerably in size, sometimes attaining a length of 6 inches and width of 3-4 inch or may be little more than half that size; dark green; often entire, sometimes margins armed with short, spiny teeth. Fruits large, deep red, sometimes almost black, borne in dense axillary clusters.

Var. *platyphylla*. *Ilex platyphylla* W. and B. of the Canary Islands, is now considered *I. perado* var. *platyphylla*, a handsome evergreen tree of small stature. Leaves large, dark green, broadly oval, often 4-5 inches long, 2-1/4 to 3 inches wide, occasionally, on wild plants, 8 inches long, 4-1/2 inches wide, with tiny, brown or black, triangular stipules. Margins usually unequally, irregularly armed with short spines; occasionally spines wholly suppressed; more frequently on lower halves a few to many spines, again margins sometimes evenly armed with spines. Apex usually acute, terminated with a spine, but not always so.

95. 'Pilkington'

A seedling selection of *I. aquifolium*, made about 1900. Planted widely as one of the best of green-stemmed "Bleeg types." Very similar in most respects to 'Dr. Huckleberry'. Early ripening berries large, bright Chinese red, oval-shaped. Leaves medium in size, thick, black-green, wavy, spiny, shiny, with some smooth in older trees. Rapid-growing, early cropping trees, not excessively coarse or woody. A commercial cutting holly. Tree is compact and conical; terminal growth averages about 12 inches long, making it ideal for Christmas gift boxing. (Bleeg, Oregon.)

96. 'Pinto'

Mutation of 'Early Cluster', discovered in 1935. Leaves very glossy, splashed with gold. Consistent bearer of round, red fruits which remain on branches for a month at room temperature. Winter hardy, recommended for landscaping and orcharding. (Wieman, Oregon.)

97. 'Rederly'

Tall, attractive female of erect growth. Stems slender, light in weight, brown in color. Leaves glossy dark green. Heavy clusters of bright red berries, reddening in early November. (Brownell, Oregon.)

98. 'Robinsoniana'

A very distinctive less-known male with very fierce spines. Leaves glossy, deep green, 3 inches long, barely 1 inch wide. Margins undulated, divided into numerous divaricate spines often 1/2 inch long, sometimes standing out straight from the margins, sometimes bent downwards at right angles with the leaf, at other times turned upwards at the same angle. Also known as 'Robinson'.

99. 'Royal Red'

One of the DUTCH TYPE GROUP. Large clusters of almost cherry-size berries. Leaves bold, rounded, heavy textured, deep dark green; generally tipped with a single, often blunted spine. (Brownell, Oregon.)

100. 'Scotia'

Well-marked female of tree, erect habit, densely clothed with glossy, very dark green leaves. Bark of young growth dark purple. Leaves oblong-obovate, bluntish, rounded at the apex, 1-1/2 to 2 inches long, 3/4 to 1 inch wide, leathery; margins entire, thickened, wavy; apex usually blunt, occasionally with a short spine or

with a cuplike thickening, and margin moreover bearing an occasional, but very rare erratic spine.

101. 'Serratifolia'

One of the smaller, neat-leaved hollies, resembling 'Myrtifolia', but differing in its more decidely divaricate spines and in its tendency to become recurved at the point. A male of pyramidal habit, well adapted for training into formal specimens. Bark green or purplish. Leaves lance-shaped in outline, less than 1-1/2 inches long, 1/2 inch wide; glossy dark green; stiff, midrib convexly curved so that the leaf edges are brought up and form a channel of the upper surface. Numerous regular and rather stout spines moderately divaricate.

102. 'Shepherdii'

In England considered one of the finest and hardiest of the large-leaved hollies. A vigorous male with green bark. Leaves stout in texture, 2-3 inches or more long, broadly ovate with a short acumen, rarely quite spineless, occasionally few-spined, more frequently spiny throughout, flat or plane. Spines rather strongly developed; in rare instances, somewhat wavy or divaricate. Leaf bright green, distinguishing it from 'Hodginsii" which is a much darker hue. (× *altaclarensis*)

103. 'Shortspra'

A green-stemmed female, selected around 1932. An extremely hardy cultivar with orange-red berries, and compact habit suitable for landscape purposes as well as for cut holly. (Wieman, Oregon.)

104. 'Smithii'

Male with narrow leaves, the green counterpart of 'Donningtonensis'. Bark green, sometimes tinged with reddish purple. Leaves lanceolate, 2 to 2-1/2 inches long, 3/4 to 1 inch wide; glossy, bright green, comparatively thin in texture. Spines distant, irregular, weakish, moderately divaricate.

105. 'Sparkler'

Robust, upright habit, branching readily. Fruit-bearer at young age. Introduced in 1964 or earlier. (Monrovia Nursery, California.)

106. 'Special'

A fast-growing, thrifty female with large, deep green, well-spined leaves. Large berries, an opalescent red, produced generously. (Brownell, Oregon.)

107. 'Squire'

Male, selected from shipment of seedling hollies from Pennsylvania in 1925, growing on the former G. G. Whitney estate in Woods Hole, Mass. Propagated by Wilfred Wheeler and others. (J. K. Lilly, III, Massachusetts.)

108. 'St. George'

A brother plant to 'Squire'. Leaves glossy green, oblong. (J. K. Lilly, III, Massachusetts.)

109. 'Teufel's Hybrid'

An exceptionally glossy, green-leaved, green-stemmed female with bright red berries. Hardy. Sets fruit consistently at an early age. A very fine commercial holly. (Teufel, Oregon.)

110. 'Thornton'

From a tree found in 1962 on a farm 7 miles north of Warwick, Md., and believed to be about 30 years old. A female with glossy leaves, dark green throughout the year. Hardy in the Cecilton, Maryland, area. (Livingston, Maryland.)

111. 'W. J. Bean'

A tall, compact, attractive cultivar of slow growth. Leaves spined and large, resembling 'Hodginsii, though smaller. Twigs purple. Berries large and bright red. Considered excellent at Kew. (Kew, England.)

112. 'Waterer'

Called 'Waterer's Gold' or 'Waterer's Gold-striped' holly in England, one of the most distinct, easily recognized of the numerous gold-variegated kinds. Bark of the young shoots green, striped with a greenish yellow. Leaves varying in shape and size, oblong, ovate, obovate, or often oblique, 1-1/2 to 2-1/2 inches long, 1 to 1-1/3 inches wide. Spines usually few in number, produced at irregular intervals, never strongly developed; occasionally absent except for small terminal one, more frequently represented by 2-6 on the upper half of the leaf. Disk dark green, mottled often in sectional streaks with yellowish green and grayish green; broad, but irregular marginal band of deep golden-yellow, which is not continuous. Not infrequently leaves wholly or half golden. It is a close, neat, slow-growing, male cultivar, naturally compact; rarely are vigorous leading shoots formed.

113. 'Whitesail'

A female seedling from Dallimore's 'Handsworth New Silver', of ARGENTEA-MARGINATA GROUP. Leaves unusually long, silver-variegated with wider white margin. (Wieman, Oregon.)

114. 'Whittingtonensis'

A small-leaved, elegant male. Bark purple. Leaves shining, dark green, lanceolate or elliptic-ovate, thinnish, 2-1/2 inches long, 5/8 inch wide, sometimes 3 inches long, and 1 inch wide, sometimes rather recurved. Spines numerous, stiff, divaricate, often unequally spaced. Quite distinct in character, but sometimes confused with 'Donningtonensis', a much darker-hued plant. Also known as 'Whittington'.

115. 'Wieman's Globe'

Compact, globe-shaped tree bearing carmine fruits. The original, a seven-foot seedling, was selected at Knappa-Svenson, Oregon, about 1930. Recommended for landscaping. (Wieman, Orgon.)

116. 'Wilsonii'

A vigorous-growing, green-barked female, one of the most ornamental of all the green-leaved cultivars. On healthy specimens leaves grow to a large size, sometimes being upwards of 5 inches long, 2-1/2 inches wide, oval, armed with numerous, evenly developed spines 1/4 inch or so long, usually in the same plane and pointing in an upward direction. In shade, leaves are dark, very distinct by reason of the well-defined veins. Berries intermediate in size and color between those of *I. perado* var. *platyphylla* and the average English holly. (× *altaclarensis*)

117. 'Yellow Beam'

A hardy, consistent-bearing female with clean, yellow fruits. Selected in 1937. Foliage tends towards a spineless leaf. (Wieman, Oregon.)

118. 'Zero', or 'Teufel's Weeping'

Female of upright habit; the branches long, thin, and graceful, tending to a weeping effect. Leaves dark green, slightly smaller than average. Berries bright red, early ripening and remaining firm long after Christmas. A vigorous grower; withstands cold temperatures without damage, hence the name 'Zero'. (Teufel, Oregon.)

Mr. Dengler is one of the founders of the Holly Society of America, Inc. In 1957 he was the recipient of the Holly Society's Certificate of Honor and in 1967 a walnut plaque and life membership in appreciation of his twenty years of meritorious service to the Society. He retired on July 31, 1970, as extension forester, Maryland Extension Service, University of Maryland, College Park.

Dr. Dudley is research botanist, United States National Arboretum, Washington, D.C.; he was previously horticultural taxonomist at Arnold Arboretum, Jamaica Plain, Massachusetts. Introduced to hollies by the late Wilfred Wheeler for whom he worked about six summers, Dr. Dudley has long been a member of the Holly Society of America, Inc., and is presently serving as a member of its Holly Checklist Committee and of the International Registration Committee.

Mr. Eisenbeiss is research technician at the United States National Arboretum, Washington, D.C., a trustee of the Holly Society of America, Inc., and chairman of its Holly Checklist Committee. He is also registrar for the Holly Society of America Inc., which is the International Registration Authority for cultivated *Ilex*.

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Typical of the FRENCH-ENGLISH GROUP of *Ilex aquifolium*.

Pacific Northwest Pioneers

(*Continued from page* 163)

Mr. Teufel, a gardener, took care of not only Mr. White's estate, but other estates, including that of C. L. Miller where there were hollies of the FRENCH-ENGLISH GROUP. It was from these trees and other hollies on the places where he worked that Gustav Teufel got his cuttings and successfully rooted them. In 1925 George Teufel, who shared his father's interest, added hollies with silver-variegated leaves to their nursery and found it a profitable investment. Their holly nursery reached into the third generation with Alfred, son of George. The nursery in Portland, which now bears the name of the late Alfred Teufel, has an extensive stock of other trees and shrubs in addition to holly of their own origination.

BIG AMERICAN HOLLIES

Here are four of The big specimens of *Ilex opaca* recorded by the Big Tree Committee of the Holly Society of America, Inc. Information about other big American hollies may be obtained from the Committee's chairman, John H. Gruver, 4322 12th Street, St. Simons Island, Georgia 31522.

Left. A fine American holly, *Ilex opaca*, in excellent condition and heavily fruited, is to be seen in Southmont, Davidson County, North Carolina. Its measurements are 81″ in circumference, 41′ feet in height, with a spread of 39′.

Center. This American holly, female, fully branched almost to the ground, stands 45′ tall at "Woodstock" in Prince George County, Maryland. Its average diameter spread is 32′; its circumference at three feet above ground is 108″. At 4½′ above ground the trunk divides into three trunks, 62″, 34″, and 69″.

Right. This nicely shaped American holly, male, was planted at Longwood Gardens, Kennett Equare, Pennsylvania, in 1928; it was then 35′ high. Today, this tree is 59′ high, 143″ in circumference at 15′ above ground, where it divides into three trunks, 82″, 38″, and 69″ in circumference at breast (4½′) height. It has a diameter spread of 32′.

At the Meadow Farm near Ashland, Virginia where race horses are bred, there is a very well-preserved, heavily fruited American holly with a height of 45′, a diameter spread of 38.5′. The tree has seven stems: 57″, 38″, 26″, 28″, 54″, 38″, and the seventh 75″ double, (a) 46″ and (b) 44″ at 6′. Since the seventh stem has grown almost together (a+b), it was necessary to measure b at 6′. The diameter of the stump is 15″.

Hollies Native to the United States

FRED C. GALLE

The number of evergreen and deciduous holly species native to the United States is less than twenty-five. While the number of species is not large as in other countries, it does represent some very important plants for landscaping. In the past, we have all too often looked for new plants from foreign lands without sufficient regard for the value of our native plant materials. With the increased interest in hollies, our native species have become popular, not replacing the introduced plants, but supplementing them in the landscape. The majority of American hollies is native to the southern states; therefore some may not be satisfactory in northern areas. Only after sufficient testing under varied conditions will their true hardiness be known.

The true landscape value of a plant cannot always be judged by observing the plant only in its native habitat. Many people, who are familiar with hollies in their native habitat, fail to recognize them when used in a landscape planting. *Ilex glabra,* inkberry, is a good example. Many hollies are lowland plants native to marshes or bogs, but, contrary to public belief, they will survive in other situations. Most of the native hollies will do well planted in well-drained garden soil.

Descriptions of the North American Species

1. *Ilex cumulicola* Small—dune holly.

This evergreen, fastigate, compact tree or large shrub usually reaches 25 feet in height. The leaves are similar to those of *Ilex opaca,* but more acuminate or narrowly elliptic with the spines pointing forward. The leaves vary from 3/4 inch to nearly two inches long. The bright red fruit is noted for its apple-like scent when crushed. The plant is native to the dunes of Florida; it is not known to occur elsewhere. The plant is hardy as far north as Georgia, but because of its close similarity to *Ilex opaca,* there is little reason to use it or to try to extend its range beyond the lower South.

2. *Ilex opaca* Ait.—American holly.

The most common and best-known species of the native hollies, *Ilex opaca,* becomes a tree 50' or more in height. It is rather compact, pyramidal or round-headed in form. The evergreen leaves vary in size from 2 inches to 4 inches in length and the margins vary from flat to wavy. Leaf margins are usually spiny toothed, but many of the southern hollies have leaves which are almost entire. These trees with almost entire margins are thought to be the result of natural hybrids between *Ilex opaca* and *Ilex cassine.* They are usually less hardy than the

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'Foster #2', a selection from *Ilex opaca* × *I. cassine* var. *angustifolia.*

Left, *Ilex longipes*. Right, *I. decidua*.

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spiny leaved trees. The foliage varies in color from dull to glossy green. A few trees with variegated foliage have been reported, but, as of the present time, none have been found to equal the variegations in the foliage of some of the English hollies. The fruit is usually borne one berry to a pedicel. The berry is typically rounded to elliptical and is 3/8 inch or more in diameter. The fruit, which is typically bright red, sometimes varies from orange to yellow.

Ilex opaca is native to a large part of the eastern United States from Massachusetts to Pennsylvania and West Virginia, south to Florida, and west to Texas, Missouri, Tennessee, and Indiana. The trees are normally found in rich, hardwood bottoms in association with oaks, and among pines in the Coastal Plain areas. Although capable of growing on poor soils of either sand or heavy clay, the best growth is in deep, rich, fertile, well-drained soils. American holly also occurs along the banks of streams.

The ultimate size of *Ilex opaca* restricts its use for home foundation plantings, except for two-story houses or for large buildings. It is best used as an individual specimen on a lawn, as a screen planting, or as background for a shrub border.

2a. *Ilex opaca* f. *subintegra* Weatherby
Leaves entire or nearly so.

2b. *Ilex opaca* f. *xanthocarpa* Rehd.
Yellow-fruited.

Several horticultural forms or cultivars have been named.

3. *Ilex myrtifolia* Walt.—myrtleleaf holly.

The myrtleleaf holly has long been regarded as a variety of *Ilex cassine,* but it is now generally listed as a separate species. It is a large shrub or small tree with gray bark and irregular branching. The evergreen leaves are narrowly elliptic or linear, usually one to two inches long. The fruit is typically red, but yellow fruit has been found as well as other color variations. The yellow-fruited form has been named f. *lowei* Blake. Little selection has been done on other colored forms. The myrtleleaf holly is found in swamps and bogs of the Coastal Plain from Florida to Louisiana, north to North Carolina. Myrtleleaf holly is certainly an ideal plant for the South and one which should be made more readily available by nurserymen.

4. *Ilex* × *attenuata* Ashe—Topel holly.

A natural hybrid between *Ilex opaca* and *I. cassine*, the Topel holly forms a large shrub or small tree, pyramidal in its growth habit The leaves are elliptic to oblong-obovate, 1-1/2 to four inches long, with one long spine at the apex and a few spines along the margin. The fruit is red and usually born in clusters. The plant is similar in many respects to various forms of *Ilex cassine* but, because of its pyramidal habit and heavy fruiting, is somewhat better for use in the lower South. The type specimen was found in Florida; other hybrid forms can be found throughout the South, where the two parent species occur.

An interspecific hybrid within *I.* × *attenuata* is 'East Palatka'.

5. *Ilex cassine* L.—dahoon holly.

This holly is an extremely variable shrub or small tree The evergreen leaves are lanceolate to elliptical, from 1-1/2 to four inches in length. Variations exist in glossiness, size, and amount of fruit. A narrow-leaved form of *Ilex cassine* is available in the trade. Yellow-fruited forms have been named, but are extremely rare. The plant is usually found in moist, acid soils along the Coastal Plain from Virginia to Florida and west to Louisiana.

There are interspecific hybrids known as Foster #1 through #5, selections by E. E. Foster of Bessemer, Alabama. The seeds were obtained

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Ilex curtissii

from a cross of *Ilex cassine* var. *angustifolia* × *I. opaca*. 'Foster # 2' and # 3, the most popular of this group in the South and the ones most often sold as Foster holly, are used in general landscape work as foundation plants, hedges, and specimen plants. Both selections are typically small-leaved, glossy green, with a spiny margin, and have a compact, pyramidal habit of growth. They are heavily fruited as is *Ilex cassine*. 'Foster # 4' is a male plant; 'Foster # 1' and # 5 are more like inferior forms of *Ilex opaca* and have been discarded.

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Right, *I. vomitoria*

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Below, *Ilex vomitoria* 'Tricolor'.

5a. *Ilex cassine* var. *angustifolia* Ait.

A narrow-leaved variety of *Ilex cassine*, listed and available in the trade.

6. *Ilex vomitoria* Ait.—yaupon holly.

Yaupon is a common red-fruited, evergreen plant in the southeastern United States. It is a shrub or small tree up to 25 feet tall, with stiff, grayish branches. The evergreen leaves, oval to elliptic, vary in size from 3/8 inch to nearly two inches long. The leaves are glossy green, with a crenate margin. The fruit is typically shiny red, borne in clusters, and varies in size from 1/8 to 1/4 inch in diameter. It is quity showy on specimen plants. There are a few yellow-fruited cultivars of *Ilex vomitoria*, one named 'Yawkeyi' and another 'Otis Miley'.

In recent years several dwarf forms of yaupon have been selected. While the original dwarf selection is not heavily fruited, other selections of dwarf yaupon from Texas are reported to fruit regularly. Plants with weeping habits of growth and other variations have been noted. Weeping yaupons are an oddity and form attractive specimen plants. The plant is usually tall and slender, with drooping limbs as long as ten feet.

Continual selection and evaluation of the numerous natural forms of yaupon and the presently named cultivars are necessary, if the best specimens are to be made available to the public.

Yaupon holly is native from Florida to Texas, north into southern Virginia and northern Arkansas. It is hardy in Tennessee and up to Washington, D.C. Throughout the South, it is used in foundation planting, in hedges, for

screens, and for other landscape purposes.

It is well to note that this plant has the highest caffine content (in the leaves) of any species native to the United States and has been used in the past to make tea (the "black drink" of the Indians) and other beverages. Stories and legends concerning the Indians' use of this plant are prevalent.

7. *Ilex krugiana* Loes.—Krug's holly.

An evergreen shrub or small tree to 30 feet, Krug's holly has glabrous, grayish white twigs. The dark green leaves are elliptic or ovate (occasionally subrotund), varying from two inches to nearly 3-1/2 inches long, usually with an entire margin or with a few spines at the upper half of the leaf. The black fruit is borne solitary or in small clusters, usually two to five on a peduncle. The plant grows in the West Indies and in the hammocks of the Everglade Keys in Dade County, Florida. It is not common in landscape work, and there is a question as to whether it is reliably hardy beyond the lower South. It is a link between the distinct United States and the Central American holly groups.

8. *Ilex glabra* (L.) Gray—inkberry or gallberry.

Of the evergreen, black-fruited hollies, *Ilex glabra* is undoubtedly the most common species within this group. It is a stoloniferous shrub, forming dense clumps with upright branches six to ten feet in height. Leaves are usually green, obovate to elliptic-oblanceolate, or oval, 3/4 inch to nearly two inches long. The leaf usually has a few obtuse teeth along the margin near the apex, or is entire. There is a great deal of variation in the color and glossiness of inkberry foliage. Typically, it is light green, but there are specimens with dark green leaves and some with glossy surfaces. The fruit is typically black, borne individually or in small clusters, and up to 3/8 inch in diameter. The plant is native from Nova Scotia south to Florida, west to Missouri.

Extreme variations exist within the plants through the entire area. There has been found, both in north Florida and in New Jersey, the white-fruited form, *Ilex glabra* f. *leucocarpa*. F. W. Woods. The cultivar 'Ivory Queen' from New Jersey is superior.

There has been very little selection with the forms of inkberry. *Ilex glabra* 'Compacta',* selected by Princeton Nurseries, Princeton, New Jersey, is a slow-growing, compact shrub with glossy, dark, green leaves. It bears black fruit abundantly. A red-fruited form of *Ilex glabra* is reported in Small's Manual, but it is not known to be available in the trade.

Inkberry, while extemely common in the South and in many areas along the Coastal Plain, should be used more often, for it can be shaped or pruned to low hedges and works very well for foundation or mass plantings.

Plants growing in heavy shade and left without care may become leggy and lose the compact habit of growth.

9. *Ilex coriacea* (Pursh.) Chapm.—large gallberry.

This plant is very similar in characteristics to *Ilex glabra*, being stoloniferous in habit and forming large, open clumps. Individual plants grow 10 to 12 feet high. Leaves are glossy, dark, green, obovate to oblanceolate, margins entire or with a few sharp-pointed serrations toward the apex. Fruit is commonly glossy black, but there is extreme variation from this, even to reddish brown. The plant is native in the Coastal Plain from Virginia to Florida, west to Louisiana. *Ilex coriacea* is not nearly so desirable a landscape plant as *Ilex glabra* and should be used in the South only as a mass planting in the shrub border. Both *Ilex glabra* and *Ilex coriacea*

*Not a valid cultivar name.

Left, *Ilex glabra* 'Ivory Queen'. Right, *I. verticillata*.

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Left, *Ilex opaca* 'Manig'. Right, *I. opaca* 'Osa'.

appear differently when the crown is destroyed and root shoots develop.

10. *Ilex verticillata* (L.) Gray—black alder or winterberry.

In some areas *Ilex verticillata* is also called coonberry or Michigan holly. This large deciduous shrub to small tree attains 20 feet or more in height. Winterberry forms a wide, spreading plant; individual specimens may be quite rounded in outline. The leaves are elliptic or obovate to oblanceolate, 1-1/2 to 3-1/2 inches in length, with acuminate or doubly serrate margins, usually very pubescent beneath, at least near the veins. The bright red fruit is borne abundantly in clusters close to the stem.

Ilex verticillata f. *chrysocarpa* Robins is a yellow-fruited form.

Ilex verticillata is native in swamps and low woodland areas from Nova Scotia to western Ontario and Wisconsin, south to Florida and west to Missouri. It is hardy in Zone 3 of the U.S.D.A. Plant Hardiness Map and is more commonly used than *Ilex decidua,* but it does not hold its fruit nearly so long in the landscape scene or under cut conditions. Another feature which may be disadvantageous is that after the first fall frost the leaves turn black or brown, giving it the name black alder.

There are several botanical varieties and forms of winterberry, in addition to the yellow-fruited form. These plants differ from the species in leaf shape and other minor details. The cultivar 'Polycarpa' has brownish twigs and red fruit larger than normal. A fine new cultivar., *I. verticillata* 'Xmas Cheer', is available in the trade.

Ilex verticillata is more common in wet areas but will do well in average home garden soils. It can be used in the shrub border and is a good

Left, *Ilex* × *attenuata* 'East Palatka'. Right, *I. opaca* 'Old Heavy Berry'.

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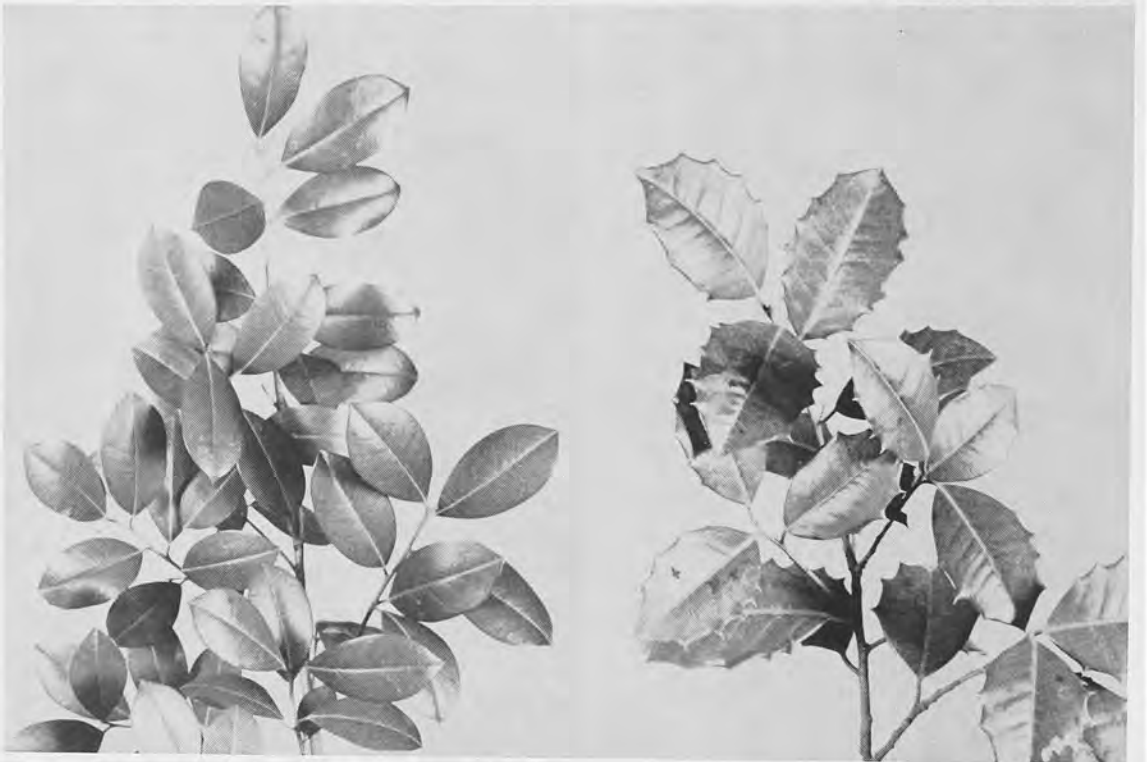

attraction for birds.

11. *Ilex laevigata* (Pursh) Gray—smooth winterberry.

A deciduous shrub, closely allied to the preceding, *I. laevigata* is about ten feet or more in height, usually with upright branches. The leaves are somewhat glossy, elliptic, oval, or sometimes lanceolate, one to 3-1/2 inches in length, the margins finely serrulate. The fruit is borne singly and is commonly orange-red, although there is one cultivar with yellow fruit called 'Hervey Robinson'. Smooth winterberry is native in swamps and low woods from Maine to New Hampshire, south to north Georgia.

In some areas, the plant is favored over *Ilex verticillata*, on account of its yellow fall foliage and retention of the less abundant fruit. The plants, however, are not so common in the trade as is ordinary black alder or winterberry.

12. *Ilex curtissii* (Fern.) Small—Curtis holly.

This species develops into a large shrub or small tree to 15 feet high, with spreading branches. The deciduous leaves are thin, lanceolate to elliptic spatulate, varying from 3/4 to 1-1/2 inches in length. The red fruit is borne singly or in small clusters and usually persists through the winter. Found in hammocks along the Suwannee River and other streams in Florida, it is also listed as *Ilex decidua* var. *curtissii* Fernald.

13. *Ilex longipes* Chapm. ex Trel.—Georgia holly.

This deciduous, large shrub or small tree grows to a height of 20 feet and forms wide-spreading branches. The leaves are elliptic to elliptic-obovate, 1/3 inch long, and remotely toothed. The red fruit is usually solitary on a stalk 1/2 to 3/4 inch long. A yellow-fruited form, *vantrompii* Brooks, has been reported, sometimes as *I. collina*. The plant is normally found on rocky banks in North Carolina, Tennessee, Georgia, Alabama, Florida, and Louisiana.

The status of *Ilex longipes* and *Ilex collina* causes considerable confusion. Some believe the two plants are identical, even including *Ilex longipes* as a form of *Ilex decidua*. Until further study can be presented, the plants are preferably listed as separate species.

14. *Ilex collina* Alex.

The latest addition to the native deciduous hollies, described in 1941, was found at high altitudes in Virginia and West Virginia. The leaves are broadly elliptic to obovate, yellowish green beneath, with a finely serrated margin; the shape of the calyx lobes shows close affinities to *Ilex verticillata*.

The bright red fruits are borne on long stalks or pedicels. In spite of the confusion, most authorities prefer listing the plant as a separate species.

15. *Ilex montana* Torr. and Gray—mountain holly.

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Ilex opaca 'Jersey Knight'.

Sometimes called the large-leaved or mountain winterberry, this deciduous, large shrub or small tree grows to 35 feet or more. The leaves are ovate or oblong-lanceolate, 2-1/2 to six inches long, and sharply serrate. The fruit is bright red and very noticeable in the fall in contrast to the green foliage. The plant is native to wooded mountain slopes from New York to south Georgia and Alabama. Its botanical history is checkered, having been called *Ilex dubia* and *Ilex monticola* Gray.

15a. *Ilex montana* var. *mollis* Britton or *I. mollis* Gray.

This plant, which may be only a variety, is not keyed here since its status is in doubt, but it does exist in north Florida and Georgia and this should be noted. In brief, it is a hairy-leaved plant, much like a small *Ilex montana*, but the leaves are darker, shorter, and less ovate.

16. *Ilex buswellii* Small—Buswell possumhaw holly.

The southernmost, native deciduous holly is found in hammocks along the Caloosahatchee River in Florida. The plant is a heavily branched shrub to ten feet, with dark purple twigs. The leaves are elliptic to ovate, 3/4 to 1-1/4 inches long, serrate beyond the middle of the leaf. The fruit is red.

17. *Ilex ambigua* (Michx.) Chapm.—ambiguous winterberry

This deciduous shrub or small tree grows to 20 feet in height. The leaves are thin, hairy above, plainly veined beneath, from 1-1/2 to 2-1/2 inches long. The fruit is red, matures

early, but does not normally hold throughout the winter. *Ilex ambigua* is found in hammocks and sand-hill areas with live oak, hawthorn, and hickory in the Coastal Plain areas from North Carolina to Florida, west into Texas and Arkansas. A form with small leaves, *Ilex ambigua* f. *channellii* Edwin has been described.

18. *Ilex decidua* Walt.—possumhaw holly.

Ilex decidua is generally considered the best of the native deciduous hollies. It forms a large shrub or small tree to about 25 feet, with gray twigs. The leaves are partly fascicled, obovate to obovate-oblong, 1-1/2 to 2-1/2 inches long, dark green, occasionally somewhat glossy. The fruit is borne singly or in small clusters on short spurs, and its color varies from bright orange to red. Yellow-fruited plants, while rare, have been found in at least two areas. The form found in Alabama has been named 'Byers Golden'.

Natural crosses of *Ilex decidua* × *Ilex opaca* have been observed by at least three individuals (Simpson, McDaniel, and Galle). I have not observed the other seedlings, but my plants are semievergreen with thin leaves, similar to those of *Ilex opaca* and take on a bronze fall color, similar to that of *Ilex decidua*. Simpson reported that older seedlings which have flowered appear to be sterile. Young plants do not fruit so readily as mature plants or some of the other species. *Ilex decidua*, native from Virginia to Florida and west to Texas, is usually found in low woodland and river bottoms. The plant is hardy in Zone 5 of the U.S.D.A. Plant Hardiness Map.

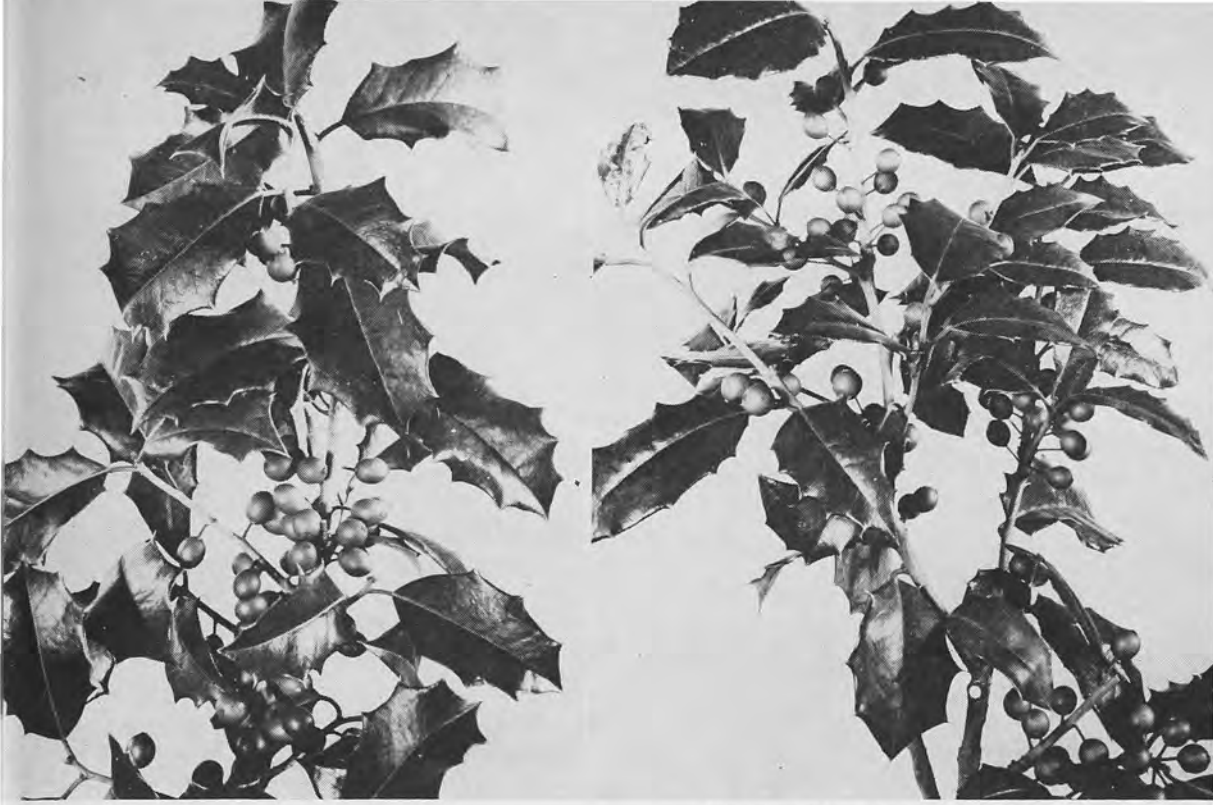
The principal characteristic of the possumhaw

U.S. National Arboretum

Above, *Ilex opaca* 'Miss Helen'.

Arnold Arboretum

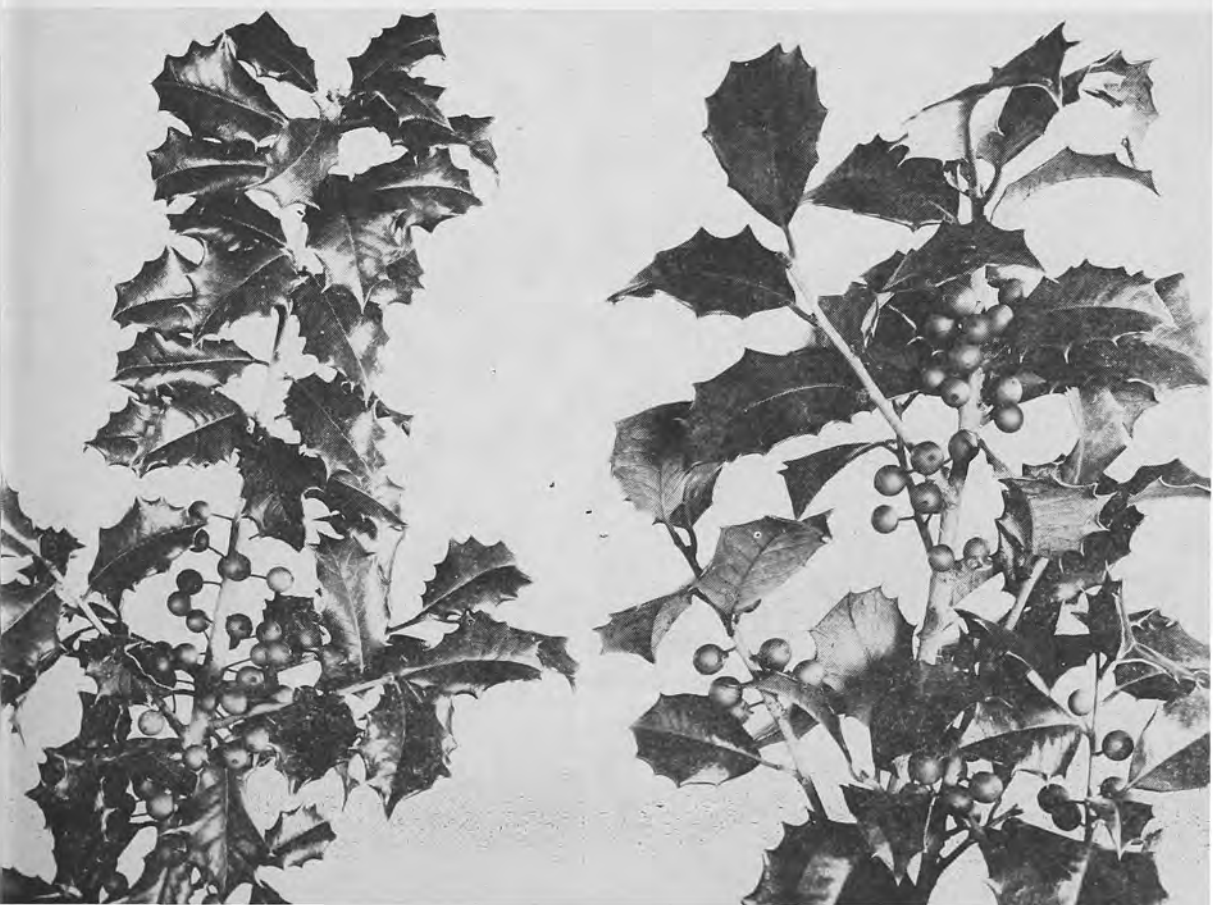
Lower left, *Ilex opaca* 'Emily'. Lower right, *I. opaca* 'Amy'.



ALL PHOTOS NEW JERSEY SILICA SAND CO.

Upper left. *Ilex opaca* 'Lady Alice'. Upper right, *I. opaca* 'Cumberland'.

Lower left, *Ilex opaca* 'Menantico'. Lower right, *I. opaca* 'Maurice River'.



over other deciduous hollies is that it retains its fruit well into winter and often until spring, provided birds and squirrels are not a problem. Many of the other deciduous hollies, while equally colorful, lose their fruit, often before Christmas.

19. *Ilex cuthbertii* Small

This large shrub or small tree usually has densely pubescent twigs. The deciduous leaves are thick, obovate to elliptic, inconspicuously toothed, and pubescent, mainly on the under side. The red fruit is borne singly or in pairs. The plants are found in wooded areas in the Coastal Plain of Florida and Georgia.

20. *Ilex beadlei* Ashe

Often referred to as a variety of *Ilex montana, Ilex montana* var. *beadlei* (Ashe) Fernald. This plant is very similar in its general characteristics and in geographical distribution to *I. montana*, but its leaves are typically more pubescent. Even the twigs are pubescent as contrasted to those of mountain holly. The plant is found in rocky woods of North Carolina, Tennessee, Georgia, and Alabama.

21. *Ilex amelanchier* M. A. Curtis

This deciduous shrub or small tree has somewhat persistent, elliptic to elliptic-lanceolate, pubescent leaves, 1-1/2 to 3 inches long. The dull or velvety red fruit is borne on long pedicels. The plant occurs in Coastal Plain areas in South Carolina and Georgia, often in difficult habitats.

Native United States Hollies Presently Available from the Nursery Industry

It contains certain cultivar names which are invalid according to the *International Code of Nomenclature of Cultivated Plants* (1969), since these names have been published without a description after January 1, 1959, or are in Latin form after January 1, 1959, or are synonyms of valid names, or have never been published. These invalid cultivar names do not appear on "List of Cultivars Currently Available in the Trade" by Gene Eisenbeiss elsewhere in this Handbook.

Note: The list was obtained through a letter survey, but does not imply endorsement or approval of these plants for all areas.

(M)—denotes male plants; otherwise female plants.

*—denotes invalid cultivar names at this time.

Right. This is the mother plant of *Ilex opaca* 'Hedgeholly', now in the garden of the Bosley Nursery, Mentor, Ohio.

Left. This specimen of *Ilex opaca* 'Santa Claus' is the main pollinator for many female hollies in the garden of Paul R. Bosley, Sr., Mentor, Ohio. Its dense form has resulted from taking cuttings annually for many years.

Both photos Bosley Nursery

Ilex × *attenuata* 'East Palatka'[1]
Ilex × *attenuata* 'Louise Holmes'
Ilex × *attenuata* 'Savannah'
Ilex cassine
Ilex cassine var. *angustifolia* × *I. opaca* 'Foster #2'
Ilex cassine var. *angustifolia* × *I. opaca* 'Foster #4' (M)
Ilex decidua
Ilex glabra 'Compacta'*
Ilex glabra 'Ivory Queen'
Ilex myrtifolia
Ilex myrtifolia 'Prostrata'*
Ilex opaca
Ilex opaca 'Albert Pride' (M)
'Amy'
'Angelica'
'Arden'
'Arlene Leach'
'Arthur Pride' (M)
'B. & O.'*
'Betty Pride'
'Big Ditch'
'Big Mack'*
'Big Red'
'Bittersweet'
'Bountiful'
'Brilliantissima'* = 'George E. Hart'
'Brooks'
'Brown #7'
'Brown #9' (M) * = 'Jersey Knight'
'Canary'
'Cape Cod Dwarf'
'Cardinal'
'Cardinal Hedge'
'Cardinal Improved'* = 'Cardinal Hedge'
'Carnival'*
'Carol'
'Cave Hill #1'*
'Cheerful'
'Chief Paduke'
'Christmas Carol'
'Clark'
'Croonenburg'
'Cumberland'
'Cup Leaf'
'Dauber'
'David'
'Delia Bradley'
'Diane'*
'Dr. Cribbs'* (M)
'Edith May'*
'Elizabeth'
'Emily'
'Fair Lady'
'Farage'
'George E. Hart'
'Goldie'
'Goliath'* (M)
'Gravatt'
'Greenleaf'*
'Hedgeholly'
'Helvetia'
'Homer'* (M)
'Howard'

[1] often listed under *I. opaca*

J. Bon Hartline

The original tree, from which *Ilex opaca* 'Chief Paduke' is a selection, is still growing in a cemetery in Paducah, Kentucky. (Photo, March 1970).

'Isaiah' (M)
'Jersey Knight' (M)
'Jingle Bells'
'Joanne'
'John Banks' (M)
'Johnson'
'Joyce'
'Judge Brown'
'Judy'*
'Judy Evans'*
'Kentucky Gentleman'* (M)
'Klein #1'
'Lady Alice'
'Lake City'
'Laura'
'Ling'*
'Ling-a-Ling'*
'Lucille'
'Mae'
'Manig'
'Marion'

'Marta'*
'Mary Holman'
'Maryland Dwarf'
'Mattoon'*
'Maureece'
'Maurice River'
'McDonald'*
'Menantico'
'Merry Christmas'
'Miss Helen'
'Morgan Gold'
'Mrs. F. J. Close'
'Mrs. Santa'
'Natale'
'October Glow'
'Old Heavy Berry'
'Old Leather Leaf'
'Osa'
'Parkton'* (M)
'Peace'*
'Pearle LeClair'
'Pride of Butler'*
'Pyramidalis'* = 'George E. Hart'
'Red Flush'*
'Red Spice'*
'Red Velvet'
'Robbinsville'* (M)
'Runyan Selection'*
'Sallie'
'Santa Claus' (M)
'Scott'*
'Sleigh Bells'*
'Slim Jane'
'St. Mary'
'Susan'
'Toner'
'Trisco'
'Valentine'*
'Warrior'* (M)
'Webber'*
'Westcroft'
'Wilfrid' (M)
'Wyetta'
'Yule'

Ilex verticillata
Ilex verticillata 'Xmas Cheer'
Ilex verticillata 'Polycarpa'
Ilex vomitoria
Ilex vomitoria 'DeWerth' (M)
Ilex vomitoria 'Folsom Weeping'
Ilex vomitoria 'Grey's Littleleaf'
Ilex vomitoria 'Grey's Weeping'* (Male and female available)
Ilex vomitoria 'Jewel'
Ilex vomitoria 'Nana'*
Ilex vomitoria 'Pride of Texas'* = 'Pride of Houston'
Ilex vomitoria 'Schillings Dwarf'
Ilex vomitoria 'Stokes' Dwarf' (M)
Ilex vomitoria 'Tricolor' (M)

Mr. Galle, director of horticulture of the Callaway Gardens, Pine Mountain, Georgia, is the author of numerous articles on ornamental plants for southern areas of the United States. He is especially interested in azaleas and hollies. Mr. Galle is currently president of the American Horticultural Society.

For Illustration on facing page

Evergreen-leaved hollies

1. *Ilex opaca*
2. *Ilex cassine*
3. *Ilex krugiana*
4. *Ilex myrtifolia*
5. *Ilex vomitoria*
6. *Ilex coriacea*
7. *Ilex glabra*

Deciduous-leaved hollies

8. *Ilex montana*
9. *Ilex ambigua*
10. *Ilex laevigata*
11. *Ilex decidua*
12. *Ilex longipes*
13. *Ilex amelanchier*
14. *Ilex verticillata*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Vegetative key to the species of *Ilex* in the United States

A. Leaves evergreen.
  B. Fruit red or occasionally yellow.
    C. Leaves usually spiny toothed.
      D. Spines pointing forward, fruit pulp apple scented ..... 1. *Ilex cumulicola*
      DD. Spines pointing outward (some varieties spineless), fruit pulp not apple scented ..... 2. *Ilex opaca*
    CC. Leaves serrate, crenate or sometimes entire, but not spiny toothed.
      D. Leaves entire or with a few oppressed teeth near apex.
        E. Leaves less than 2 in. long, linear or narrowly elliptic ..... 3. *Ilex myrtifolia*
        EE. Leaves 2-5 in. long.
          F. Leaves oval or elliptic-obovate; length less than 4 times the width ..... 2a. *Ilex opaca* f. *subintegra*
          FF. Leaves elliptic; length more than 4 times the width.
            G. Leaves with an acute or tapering apex, usually elliptic or lanceolate ..... 4. *Ilex* × *attenuata*
            GG. Leaves blunt or obtuse at apex, oblanceolate to oblong ..... 5. *Ilex cassine*
            GGG. Leaves linear to linear oblong ..... 5a. *Ilex cassine* var. *angustifolia*
      DD. Leaves with crenate or scalloped margin, elliptic or ovate-oblong, 3/8 to 1-1/4 in. long ..... 6. *Ilex vomitoria*
  BB. Fruit black or dark purple.
    C. Leaves ovate, petioles relatively long and slender, twigs white with age ..... 7. *Ilex krugiana*
    CC. Leaves obovate or spatulate, perioles short, twigs dark.
      D. Leaves entire or coarsely with 3-7 serrations near apex ..... 8. *Ilex glabra*
      DD. Leaves spinescent toothed above the middle and spiny tipped, somewhat leathery ..... 9. *Ilex coriacea*
AA. Leaves deciduous, fruit red or occasionally yellow.
  B. Fruit with smooth nutlets.
    C. Leaves pubescent (occasionally glabrous) at least on the veins beneath, usually dull above; fruit 1-3 in cluster; calyx pubescent .. 10. *Ilex verticillata*
    CC. Leaves glabrous or nearly so beneath, usually lustrous above; fruit solitary; calyx glabrous or merely ciliate ..... 11. *Ilex laevigata*
  BB. Fruit with nutlets ribbed or lined on the back.
    C. Leaves glabrous or only few hairs at veins.
      D. Leaves typically broadest above the middle.
        E. Leaves 3/8 to 3/4 in. long, obscurely crenate ..... 12. *Ilex curtissii*
        EE. Leaves 1-1/4 to 3-1/2 in. long.
          F. Leaves pale beneath, marginal teeth, slender pointed tips crenulate ..... 13. *Ilex longipes*
          FF. Leaves yellow green beneath, marginal teeth, finely serrate ..... 14. *Ilex collina*
      DD. Leaves broadest at the middle or below.
        E. Leaves conspicuously serrate, 2-3/8 to 6-3/8 in. long ..... 15. *Ilex montana*
          F. Leaves only 3/4 to 1-1/2 in. long, leathery ..... 16. *Ilex buswellii*
          FF. Leaves 1-5/8 to 2-3/4 in. long, thin membranous, pubescent above ..... 17. *Ilex ambigua*
    CC. Leaves pubescent beneath.
      D. Leaves typically broadest above the middle.
        E. Leaves crenate-serrate; fruit usually clustered ..... 18. *Ilex decidua*
        EE. Leaves usually inconspicuously toothed, fruit solitary ..... 19. *Ilex cuthbertii*
      DD. Leaves broadest at the middle or below.
        E. Leaves serrate, fruit one per stalk ..... 20. *Ilex beadlei*
        EE. Leaves inconspicuously serrate, fruit usually 3 per stalk ..... 21. *Ilex amelanchier*

American Holly For The Central States

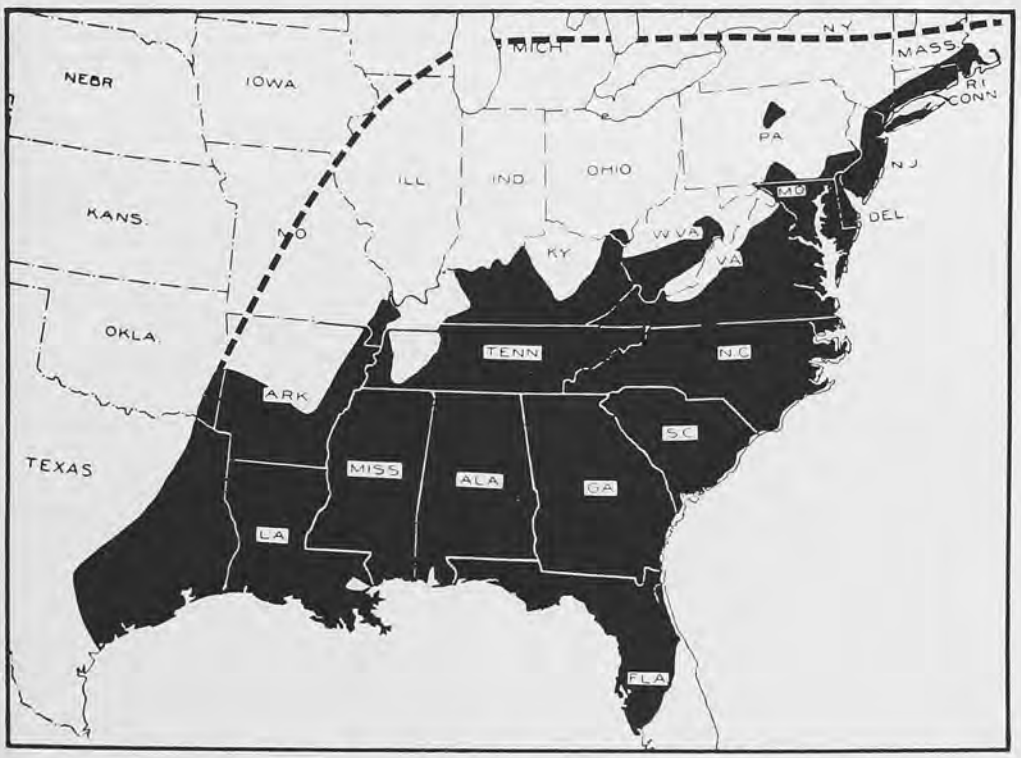
OLIVER D. DILLER

There is an ecological axiom that tree species exhibit their greatest indifference to site near their center of natural distribution and, conversely, they are restricted to special habitats near the edge of their range. For example, American holly (*Ilex opaca*) grows well on bottomlands in the southern states, while in the central states it requires good soil drainage and a certain amount of protection.

The natural range of American holly is shown in the accompaning map.[1] Living specimens growing at considerable distances to the north of its natural range are evidence that the geographic range of this species can be extended. However, it is necessary to select hardy cultivars, suitable planting sites, and use proper cultural practices to obtain satisfactory growth and survival.

The upper boundary indicated by the broken line in the map corresponds roughly with climatic zone VI in northern Arkansas, zone V in Missouri, Illinois, Indiana ,and Ohio, and the lower part of zone IV in northern Illinois, Indiana, lower Michigan and New York.[2]

HARDY CULTIVARS. There are many cultivars of *I. opaca* which have demonstrated their hardiness in the central states during the past 50 years. Since soil and climatic conditions vary widely in the broad sweep of territory from northern Arkansas through the central region, it would be meaningless to list the many cultivars which have been found suitable for planting in this extensive area. Members of The Holly Society of America who are located in these states are able to provide the



names of selections which are locally adapted.

SITE SELECTION AND CULTURAL PRACTICES. In a recent survey of a number of large specimens of American holly in Ohio, it was evident that the major site factor common to all the locations is good soil drainage. This appears to be more important than any other soil condition. It is true that most of the soils had a pH in the acid range from 4.5 to 6.0, but it has not been established that low pH is essential to satisfactory growth.

Other conditions which appear to be important for satisfactory performance of American holly in the central states are protection from exposure to drying winds, adequate soil organic matter, and shallow depth of soil freezing. Trees which have been planted in locations protected from drying westerly winds and those which have been mulched heavily each fall with leaves or other organic materials have shown much better growth performance than those in exposed locations or in soils which are frozen several feet deep for an extended period. Since American holly is an evergreen, it is especially susceptible to dessication during winter months if subjected to drying winds and frozen soils. Wind barriers and surface mulches ameliorate these conditions. Hence, it is apparent that site selection and certain cultural practices compensate for certain factors which are less critical in the southern and eastern states.

DISEASE. There is some evidence that disease may be a factor which might limit how far north of its natural range *I. opaca* can be grown successfully. Perhaps the most serious diseases reported in the central states are purple blotch and various tar spots which may cause entire leaves to become dark and sooty in appearance. These diseases have been successfully controlled in Indiana[3] by a series of spray applications containing zineb. This material gave complete control of three types of holly leaf spot when properly timed and applied. There is also a possibility that there was a stimulating effect from the zinc in zineb. The increased vigor from improved foliage may result in increased resistance to less than ideal weather and site conditions.

In summary, experience in the central states has shown that certain *I. opaca* cultivars can be grown successfully in many locations several hundred miles to the north of the natural range of the species. It is important that selections which have proven their hardiness to subzero temperatures be used and that well-drained sites with some degree of protection from wind and deep soil freezing be taken into consideration. Disease can be controlled by means of suitable sprays, properly timed and applied.

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1 Collingwood, G. H. and W. D. Brush, *Knowing Your Trees.* Rev. and ed. by Devereaux Butcher. American Forestry Ass'n. Wash. D.C. 1964.

2 Rehder, Alfred. Map of Climatic Zones I-VII. *Manual of Cultivated Trees and Shrubs.* The MacMillan Co. 1956.

3 Simpson, Robert C. "Control of Leaf Spot and Purple Blotch on American Holly." *American Nurseryman.* May 1, 1962.

Dr. Diller retired as professor of forestry and curator of the Secrest Arboretum at the Ohio Agricultural Research and Development Center, Wooster, in January, 1970. He served as chairman of the Department of Forestry at the O.A.R.D.C. from 1950-1965. Dr. Diller is a trustee of the Holly Society of America, Inc., and chairman of its Arboretum Committee.

Eastern Asian Hollies in Cultivation

SHIU-YING HU

The author is grateful to Dr. Richard A. Howard, Dr. Theodore R. Dudley, and Gene K. Eisenbeiss for a considerable amount of technical assistance in the final stages of this manuscript. Their aid permitted her to return to a year of field work in Hong Kong on schedule.

This chapter contains the hollies of China, Japan, and Korea, the eastern Asian region of phytogeographers, known to be in cultivation.[1] From this region, American gardens are blessed by two of its four most popular species of *Ilex*, i.e., *I. cornuta* Lindl. & Paxton (Chinese holly) and *I. crenata* Thunb. (Japanese holly). These two species, together with *I. opaca* Ait. (American holly) and *I. aquifolium* L. (English holly), constitute the important taxa of hollies of commerce in America.

The *Ilex* flora of the eastern Asian region is very complex. Approximately 120 species are recognized. Because of its large area and varied topography, China is especially rich in the species of *Ilex*. It shares many species in common with the neighboring countries of Korea and Japan. Some species are widespread and may occur in China, Japan, Korea, India, Burma, Vietnam, the Philippines, Borneo, Indonesia, and Malaysia. Others have very limited distributions and occur only in China or Japan.

Because of space limitations, the flower characters are not given in the descriptions. Moreover, species not known in cultivation and a few which are known only from very insufficient material are not included in the enumerations. The numbers in parentheses, following the names in the text, correspond to numbers indicating the sequence of species arrangement in the first edition of the *Handbook of Hollies* (1957). These numbers are retained for two reasons, namely, the convenience for cross references with the first edition of the *Hand-*

[1] A complete key to all Asiatic species of *Ilex* was published in the *Handbook of Hollies* (1957).

Left, *Ilex latifolia*. Right, *I. integra*.

U.S. National Arboretum

FRED C. GALLE

Ilex latifolia.

book and the indication of phylogenetic relationship of species. For example, the numbers associated with *I. yunnanensis* (23) and *I. sugerokii* (24) indicate a close relationship between them. So do the numbers attached to *I. viridis* Champ. ex Benth. (26) and *I. crenata* (27), *I. cornuta* (63), and *I. integra* Thunb. (64), etc. However, this principle applies only to species belonging to the same section.

ENUMERATION OF SPECIES IN CULTIVATION

Ilex asprella (Hook. & Arn.) Champ. (115)

A deciduous shrub up to 9 feet high. Leaves ovate or elliptic, attenuate at both ends, serrate, 1 to 2 inches long, 1/2 to 1-1/4 inches wide. Fruits pea-sized, 1/4 inch in diameter, pedicels 1 inch long, six times longer than the petiole. A native of southeastern China, occurring also in Taiwan and the Philippines; introduced into the United States in 1960. Morphologically very close to *I. longipes* Chapm., of southeastern United States; under cultivation it might share the same range, i.e., from West Virginia to Texas.

Ilex buergeri Miq. (98)

A large, evergreen tree up to 50 feet high. Leaves ovate-elliptic or oblong, 2 to 2-1/2 inches long, 1-1/2 to 2-1/2 inches wide, crenate. Fruits pea-sized, 4-7 fasciculate in the axil of leaves. A native of Japan and eastern China; it makes a beautiful specimen. Introduced into the United States in 1960.

Ilex centrochinensis S. Y. Hu (*syn. Ilex aquifolium* var. *chinensis* Loes.) (62)

An evergreen shrub up to 10 feet high. Leaves shiny, deep green, spinose, oblong-lanceolate, one-half to one inch long, each side with 6 to 8 strong spines. Fruits pea-sized, pedicels very short, 1/8 inch long; pyrenes 4, wrinkled and pitted, stony. A native of central China, occurring in the same region where *Metasequoia glyptostroboides* was discovered, apparently an element of a very old flora. Introduced as P. I. 62723. Often confused with *I. ciliospinosa* in cultivation.

Ilex 'Brooklyn Queen'

A previously un-named selection, described here for the first time, of *I. centrochinensis* with puberulent branchlets and flowering clusters; elliptic leaves 1-1/2 to 2 inches long, 1/2 to 3/4 inch wide, acute at both ends, with 3-5 weakly spinose, small teeth on each side; parthenocarpic fruit compressed globose, brilliant red; pyrenes 5, all empty.

Ilex chinensis Sims (13)

An evergreen tree up to 50 feet high. Leaves oblong-elliptic, serrate, 1-1/2 to 4 inches long, 3/4 to 1-1/2 inches wide, shiny, dark green above. Fruits in loose cymes of 3 to 7, ellipsoid, about 1/4 inch long, 1/4 inch in diameter, scarlet. A very beautiful

Ilex cornuta

FRED C. GALLE

species, extensively cultivated in China and used in New Year festivals (in February). Specimens in the University of Florida collections do not seem to express the full beauty of the species. Worth trying to raise in the more temperate climate of North and South Carolina and Tennessee.

Ilex ciliospinosa Loes. (71)

A shrub or small tree up to 20 feet high. Leaves evergreen, spiny, ovate to elliptic, 1 to 1-1/2 inches long, 1/2 to 3/4 inches wide, with 5 to 7 weak spines on each side. Fruits fasciculate, often only in pairs, ellipsoid, bright red, 1/4 inch long, pedicels very short. A native of western China, introduced in 1908. Its good qualities are compact habit, small evergreen leaves, and bright red berries. Often confused with *I. centrochinensis* in cultivation.

Ilex cinerea Champ. (97)

An evergreen shrub or small tree, 6 to 20 feet high. Leaves oblong, 4 to 5-1/2 inches long, 1 to 1-1/2 inches wide, serrate, petioles very short, slightly less than 1/4 inch long. Fruits pea-sized, in large axillary clusters. A native of Hong Kong, common on dry clay slopes.

Ilex corallina Franch. (102)

An evergreen tree up to 30 feet high. Leaves ovate-lanceolate, acuminate, normally 4 inches long, 1-1/2 inches wide, sharply serrate, the teeth of juvenile growth often ended with weak spines. Fruits quite small, bright red, less than 1/4 inch in diameter, 5 to 7 in close clusters in the axils of leaves. A native of western China. Cuttings were introduced from British gardens by F. G. Meyer in 1957.

Ilex cornuta Lindl. & Paxton (63)

A beautiful evergreen holly of tree form and compact growth. Leaves shiny green, oblong or quadrangular in outline, sinuate-spinose, normally 2 to 3 inches long, 1 to 1-1/4 inches wide, with 2 strong or sometimes 1 or 2 weak spines on each side and one at the apex. There is a great variation in the spines on the leaves. Fruits rather large, oblong, about 1/2 inch long, on elongate pedicels, 5 to 8 in an axillary fascicle. A native of eastern China, a very valuable holly, hardy as far north as Boston. The off-season flowers of a staminate plant, which brought about parthenocarpic development of the rudimentary ovaries into miniature and deformed fruits, have been observed in Maryland. Many new stocks were introduced by F. G. Meyer in 1957 from European gardens.

Leaves gathered in spring or winter, dried and used in Chinese medicine, officially called *"Folium Ilicis cornutae,"* prescribed to patients who suffer from fever with cough, pain in back and knees, dizziness and ringing in ears.

Ilex cornuta f. *cornuta*

The common form with quadrangular leaves and strong spines on the angles; fruits less than 1/2 inch long, 1/4 inch in diameter.

Ilex 'Avery Island' (also known as *I.* 'Chinese Yellow')

A pistillate clone of *I. cornuta* with large clusters of light yellow fruits; origin, Jungle Gardens, Avery Island, Louisiana.

Ilex 'Burfordii'

A cultivar with entire leaves and a terminal spine.

Ilex 'D'Or'

A pistillate clone of *I. cornuta* with both quadrangular, multispinose and entire, unispinose leaves and yellow fruits, 3/4 inches in diameter; origin, Mrs. Carl Singletary, Columbus, Georgia; propagated and distributed by Callaway Gardens, Pine Mountain, Georgia.

Ilex 'Dwarf Burford'

A dwarf selection of *I. cornuta*. A 6-year old plant may attain 18 inches in height and in spread; leaves 1-1/4 inches long to 3/4 inches wide; fruits 5 or 6 in each fascicle, on pedicels 1/4 inches long.

Ilex cornuta var. *fortunei* (Lindl.) S. Y. Hu

A variety with elongated fruit pedicels.

Ilex 'Hume'

A pistillate clone of *I. cornuta* with narrower leaves; origin, McLean Nurseries, Towson, Maryland.

Ilex 'Jungle Garden'

A staminate clone of *I. cornuta* with leaves varying from quadrangular and 7-spined to ovate and single-spined; origin, Jungle Gardens, Avery Island, Louisiana.

Ilex 'Lehigh Valley'

A hardy, new cultivar of *I. cornuta* described here for the first time; with subentire elliptic or sinuate-quadrangular, spinose leaves; developed by Luther K. Ziegler of Lehigh Valley Nurseries.

Ilex 'National'

A clone of *I. cornuta* with very abundant red fruits; origin, U. S. Botanical Garden, Washington, D.C.

Ilex 'Rotunda'

A dwarf clone of *I. cornuta* with spinose leaves; origin, Jungle Gardens, Avery Island, Louisiana.

Ilex 'Shangri-La'

A pistillate clone *I. cornuta* with an erect, treelike habit. Leaves glossy, dark green, quadrangular-oblong, spinose, 1 to 2-1/2 inches long. Fruits deep vermilion, short-pedicellate 1/2 to 3/4 inch in diameter. A fast-growing cultivar producing 5 feet of terminal growth in one season and flowering in March or early April. Fruits reach mature size in June, turn red in early November and persist on the plant until the following March. Jackson Batchelor, Gardens Beautiful, Willard, North Carolina.

Ilex 'Shiu-ying'

An attractive pistillate clone originating as a seedling selection of *I. cornuta* 'Burfordii' at the nursery of, and named by, Stewart McLean, Towson, Maryland. A slow-growing, small, and compact tree. Leaves glossy, dark green, quadrangular, slightly narrowed in the middle, up to 2-1/2 inches long; leaf margins with 3, or very rarely 4, strong spines on each side. Fruits brilliant scarlet-red, nearly 1/2 inch in diameter, borne in fascicles of 7-8, rarely less, on elongated pedicels. Its name is associated with Dr. Shiu-ying Hu, the author of this article. *Shiu* in Chinese means elegant, and *ying* means flower or plant.

Ilex crenata Thunb. (27)

A compact, evergreen shrub normally 2 to 5 feet high, may grow up to 20 feet high. Leaves shiny, dark green, obovate, faintly crenate, 1/2 to 1 inch long, 1/4 to 1/2 inch wide, rounded or obtuse at the apex, punctate beneath. Fruits black, solitary, or rarely 3 in a loose cyme, axillary. A native of Japan, a very useful species for landscaping, for hedges, for foundation planting, and as background for perennials. Many cultivars available.

Ilex crenata f. *crenata*

The normal form with globose habit, obovate-oblong leaves, plane on both surfaces, 3/4 to 1 inch long, 1/2 inch wide.

Ilex 'Compacta'

A clone of *I. crenata* with compactly packed, shiny, dark green, obovate leaves, 1/4 to 1 inch long, to 1/2 inch wide, apex obtuse or rounded, base acute, margin with 5-6 minute teeth. A Bennett hybrid.

Ilex 'Convexa' (*I.* 'Bullata')

A cultivar with leaves convex above, concave beneath. There is a very beautiful specimen in the Arnold Arboretum collection, with mound-shaped growth 15 feet in diameter.

Ilex 'Fastigiata'

A cultivar with upright habit, probably not yet introduced from Japan.

Ilex 'Glass'

A staminate clone of *I. crenata* f. *macrophylla*, with compact, upright habit. Leaves very small, shiny, dark green, 1/4 to 1/2 inch long, to 1/4 inch wide, obtuse at both ends; 3, rarely up to 5 teeth on each side.

Ilex 'Golden Variegated'

A clone of *I. crenata* with low growth.

Left, *Ilex cornuta* 'Hume'. Center, *I. cornuta* 'Shiu-ying'. Right, *I. cornuta* 'Burfordii'.

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Leaves shiny, thickly coriaceous, elliptic, acute at both ends, some blotted and spotted yellow, some entirely green, 1/4 to 3/4 inch long, to 1/4 inch wide, each side with 4 minute teeth at the apical end.

Ilex 'Green Island'

A dwarf clone of *I. crenata* with small, elliptic leaves, 1/2 inch long, 1/4 inch wide.

Ilex 'Helleri'

A dwarf cultivar of *I. crenata* with compact habit. Leaves small, elliptic, to 1/2 inch long, with 2-4 teeth on each side.

Ilex 'Hetzi'

Leaves rather large, shiny, dark green, convex-obovate or oblong-obovate, to 1 inch long, 1/4 to 1/2 inch wide, base obtuse, apex rounded or obtuse, 7-10 teeth on each side. (Present information indicates this is an *I. crenata* Rovex hybrid. Ed)

Ilex 'Howard'

A Bennett hybrid, with *I. crenata* 'Convexa' being a parent. Leaves obovate-oblong, slightly convex, to 1 inch long, to 1/2 inch wide, both ends obtuse, 8-14 teeth on each side.

Ilex 'Kingsville Dwarf'

A dwarf clone of *I. crenata* with lanceolate leaves about 1 inch long, 1/4 inch wide.

Ilex 'Kingsville Green Cushion'

A very dwarf cultivar of *I. crenata* with low, spreading habit; origin, Kingsville Nurseries, Kingsville, Maryland.

Ilex 'Latifolia'

A cultivar, much cultivated in Europe and United States. Leaves large, 3/4 to 1-1/2 inches long, obtuse at the apex.

Ilex 'Longfellow'

A clone of *I. crenata* with small, elliptic leaves, 1/2 to 1 inch long.

Ilex 'Longifolia.'

A cultivar of *I. crenata.* Leaves lanceolate or oblong-elliptic, up to 1-1/4 inches long to 1/2 inch wide, acute at both ends. Commonly cultivated in Germany, Great Britain, and the United States.

Ilex 'Luteo-Variegata'

A cultivar of *I. crenata.* Leaves elliptic or lanceolate, variegated or blotched with yellow. Introduced to the United States by F. G. Meyer from the Royal Botanic Gardens, Kew, in 1957.

Ilex 'Major'

A clone of *I. crenata* with shiny, dark green, obovate leaves, to 1 inch long, 1/4 to 1/2 inch wide, base acute, apex rounded, rarely obtuse, 7 to 13 teeth on each side.

Ilex 'Mariesii' (also known as *I. crenata* var. *nummularia* (Franch.) Yatabe, and *I. crenata* 'Nummularia')

The suborbicular leaves of this cultivar are crowded at the ends of the twigs. Often used for dwarfing by Japanese artists.

Ilex 'Maxwell'

An *I. crenata* Bennett hybrid. Leaves oblong or oblong-obovate, convex, to 1 inch long, to 1/2 inch wide, apex obtuse or rounded, base acute or obtuse, 5-6 teeth on each side. A very desirable selection.

Ilex crenata f. *microphylla* Rehder

Dwarf wild form, more abundant in Korea than in Japan. Leaves small, oblong to obovate, to 3/4 inch long, about 1/4 inch wide.

Ilex crenata f. *microphylla* 'Microphylla'

A cultivar of low and compact habit. Leaves small, shiny, elliptic, acute at both ends, 1/2 to 1 inch long, to 3/4 inches wide, 4 minute teeth on each side.

Ilex 'Morris Dwarf'

A clone of *I. crenata* f. *microphylla* of very dwarf habit. Leaves small, dark green, elliptic oblong, 1/4 to 3/4 inch long, 1/2 inches wide; 4 or 5 minute teeth on each side, apex variable, generally acute, sometimes rounded or obtuse.

Ilex 'Oleafera'

A Bennett hybrid. Leaves dark green, obovate or oblong-obovate, 1/2 to 1 inch long, 1/4 to 1/2 inch wide, size and shape very variable.

Ilex crenata var. *paludosa* (Nakai) Hara (also known as *I. crenata* var. *radicans* or *I. radicans*)

A wild variety growing in swampy places. Stems prostrate; leaves broad-elliptic, with rounded apex and obtuse base.

Ilex 'Repandens'

An *I. crenata* cultivar of spreading habit. Leaves narrow, obovate.

Ilex 'Rotundifolia'

A selection of *I. crenata* of upright habit. Leaves shiny, dark green, flat, oblong

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Ilex crenata 'Convexa'.

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Ilex crenata 'Helleri'.

or obovate-oblong, 3/4-to 1-1/4 inches long, 1/2 to 3/4 inch wide, obtuse at both ends, 11-16 teeth on each side. 'Rotundifolia' has the largest leaves of all the *I. crenata* cultivars in American gardens.

Ilex 'Stokes'

A cultivar of *I. crenata* of compact, sturdy habit. Plant Patent No. 887; origin, Warren E. Stokes, Butler, Pennsylvania.

Ilex 'Tennyson'

A selection of *Ilex crenata* 'Latifolia'. Leaves elliptic, about 1 inch long, 1/2 inch wide.

Ilex 'Tingle One'

A low-growing, small-leaved *I. crenata* cultivar. Leaves oblong elliptic, 1/4 to 3/4 inch long, to 1/4 inch wide, obtuse or acute at both ends, occasionally rounded at the apex, largely flat, some convex. Probably a hybrid between *I. crenata* f. *microphylla* and *I. crenata* 'Convexa'; origin, Tingle Nursery, Pittsville, Maryland. Originally published in a Tingle catalogue as 'T1' and later altered to 'T-One'.

Ilex 'Vaseyi'

A selection of *I. crenata* 'Latifolia.' Leaves rather loosely arranged, oblong-obovate, 1/2 to 1 inch long, 1/4 to 1/2 inch wide, more or less convex, apex rounded, base obtuse. A Bennett hybrid.

Ilex crenata f. *watanabeana* Makino

Leaves papery, oblong-elliptic, 1 to 1-1/2 inches long. (Fruits greenish yellow. Ed.) A

native of southern Japan and Okinawa; introduced into the United States in the late 1950's.

Ilex 'Willow leaf'

A selection of *I. crenata* 'Longifolia' of spreading habit. Leaves shiny, light green, oblanceolate, 1/2 to 1-1/4 inches long, 1/4 to 1/2 inch wide, some slightly convex. A Bennett hybrid, originated at Tingle Nursery.

Ilex cyrtura Merr. (106)

An evergreen tree up to 35 feet high. Leaves oblong-elliptic, serrate, 2-1/2 to 4 inches long, 1 to 1-1/2 inches wide, apex caudate, the tip 3/4 inch long. Fruits pea-sized, 3 or 4 fasiculate in the axils of leaves, pedicels short. A native of southern China and Burma.

Ilex delavayi Franch. (91)

A shrub or small, evergreen tree 10 to 25 feet high; branchlets with warty ridges. Leaves elliptic-lanceolate, serrate, 1-1/2 to 2-3/4 inches long, 1/2 to 3/4 inch wide, apex acute. Fruits pea-sized, red, 3-5 fasciculate, peduncles about 1/4 inch long. A very interesting species, a native of the high mountains in western Yunnan, China, occurring in mixed forests at altitudes of 10,600 feet.

Ilex dipyrena Wall. (67)

An evergreen shrub or small tree, 10 to 40 feet high. Leaves ovate-oblong, 1-1/2 to 3 inches long, 1 to 1-1/2 inches wide, entire or with 1 to 4 sharp spines on each side, apex acute or with a strong spine. Fruits globose, about 1/2 inch in diameter, subsessile. A native of the eastern Himalayan region, growing in mixed forests at altitudes of 7,000 feet; a very variable and interesting species, intermediate between *I. aquifolium* of Europe and *I. pernyi* of eastern Asia. Cuttings were introduced by F. G. Meyer in 1957 from European gardens.

Ilex excelsa (Wall.) Hook. f. (16)

An evergreen tree, 20 to 30 feet high. Leaves broad-elliptic, 2 to 4 inches long, 1 to 1-1/2 inches wide, entire, acuminate. Fruits globose, to 1/4 inch in diameter, 3 to 7 in a cyme or umbel. A native of the eastern Himalayan region, similar to *I. rotunda* in appearance.

Ilex fargesii Franch. (90)

A small, evergreen tree, 20 feet high. Leaves oblanceolate, 2-1/2 to 4-1/2 inches long, 1/2 to 3/4 inch wide, acuminate, upper 1/2 serrate, the lower margins entire. Fruits pea-sized, globose, fasciculate, pedicels very short. A native of central China, introduced by E. H. Wilson of the Arnold Arboretum in 1908; often used for hybridization. In 1957, a narrow-leaf form was introduced by F. G. Meyer (P. I. 269621).

Ilex ficoidea Hemsl. (105)

An evergreen tree about 25 feet high. Leaves shiny green, oblong-elliptic, acuminate, faintly crenate, 2 to 3-1/2 inches long, 1/2 to 1-1/2 inches wide. Fruits rather large, 1/4 inch in diameter, fasciculate, pedicels 1/4 inch long. A very interesting species, first known from Hong Kong, now known from warm-temperate region of China. Cuttings and seeds were introduced by F. G. Meyer in 1957.

Ilex forrestii Comber (55)

An evergreen shrub or small tree about 20 feet high. Leaves oblong to oblanceolate, acuminate, subentire or serrate at the apical end, 2 to 3-1/2 inches long, about 1 inch wide. Fruits fasciculate, small, less than 1/4 inch in diameter, berry-like, with 5 to 7 small, smooth seeds. A native of northwestern Yunnan, China, occurring in mixed forests at 7,000 to 7,500 feet altitude. A curious species, fruiting abundantly.

Ilex fragilis Hook. f. (111)

A deciduous tree about 30 feet high, branchlets with warty spurs 1/2 inch long. Leaves ovate, papery, serrate, acuminate, 2 to 5 inches long, 1 to 2-1/4 inches wide. Fruits 1 to 6, in axils of leaves terminating a spur or at the basal portion of a normal branch, compressed globose, less than 1/4 inch long and in diameter. Native of the eastern Himalayan region, a very curious species, unrelated to any other *Ilex*. Cuttings were brought back from British gardens by F. G. Meyer in 1957.

Ilex franchetiana Loes. (88)

An evergreen shrub or small tree, about 20 feet high. Leaves oblanceolate, 1 to 4-1/2 inches long, to 1-1/2 inches wide, acuminate, apical portion serrate. Fruits globose, 1/4 inch in diameter, fasciculate, pedicels 1/4 inch long. A native of western China; fruiting very abundantly. Introduced by E. H. Wilson. Not hardy in Boston.

Ilex franchetiana var. *franchetiana.*

Leaves oblanceolate or oblong-elliptic, 3-1/2 to 4-1/2 inches long, 1 to 1-1/4 inches wide. Cutting and seeds introduced by F. G.

Meyer from British gardens in 1957.

Ilex franchetiana var. *parvifolia* S. Y. Hu

A variety with smaller leaves, obovate to elliptic, 1 to 2 inches long, 1/4 to 1 inch wide. A good specimen of a pistillate plant is in the University of Washington Arboretum, Seattle, Washington.

Ilex geniculata Maxim. (114)

A deciduous shrub. Leaves ovate-oblong, 1-1/2 to 5 inches long, 3/4 to 2 inches wide, sharply serrate, acuminate. Fruits solitary, or rarely 3 together in a loose cyme, behind a bud in the axil of a leaf or terminating a short spur; when solitary, the stalk kneelike, 1 to 2 inches long, nodding. A very pretty species, first introduced into this country by the Arnold Arboretum in 1894 when its first director, C. S. Sargent, obtained plants from Japan.

Ilex georgei Comber (70)

A compact, spinose, evergreen shrub up to 18 feet in height. Leaves shiny, green, ovate-lanceolate, 3/4 to 1-1/2 inches long, to 1/2 inch wide, apex with a very short spine, margin with 4 to 7 spines on each side. Fruits abundant, fasciculate, subsessile, ellipsoid, about 1/4 inch long. Native of Yunnan in southwestern China; a very beautiful species, fruiting more abundantly than *I. pernyi*. Originally introduced by George Forrest to England. Cuttings of both staminate and pistillate plants were introduced by F. G. Meyer in 1957, and again in 1959, from England to the United States.

Ilex graciliflora Champ. (80)

An evergreen tree, 20 to 30 feet high. Leaves green, shiny, leathery, obovate-elliptic, 3/4 to 2-3/4 inches long, 1/2 to 1 inch wide, apex obtuse, margin faintly crenate. Fruits fasciculate, 1/4 inch in diameter, pedicel about 1/2 inch long. A beautiful species, fruiting abundantly; native to Hong Kong.

Ilex hanceana Maxim. (*syn. I. buxifolia* Hance). (60)

An compact evergreen, boxlike shrub. Leaves small, obovate, entire. Fruits small, paired, red. A native of Hong Kong, a very curious but poorly understood species. Well worth cultivating; in the warmer part of the United States, it might take the place of *I. crenata*. Its foliage is compact like that of *I. crenata*, but its red fruits offer a better color contrast than the black fruits of *I. crenata*.

Ilex hookeri King (87)

An evergreen tree, up to 50 feet high. Leaves and fruits like those of *I. franchetiana*. A native of the Himalayan region; introduced from England as cuttings by F. G. Meyer in 1957. (P. I. 243097)

Ilex integra Thunb. (64)

A shrub or small tree, 9 to 15 feet high. Leaves obovate or broad-elliptic, 1 to 3 inches long, 1 to 1-1/4 inches wide, apex abruptly acuminate, oblong, or the tip obtuse. Fruits fasciculate, subglobose, 1/2 inch long, pedicels almost 1/2 inch long; pyrenes 4, rugose, pitted, stony. A native of

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Ilex crenata 'Mariesii'.

Japan, and very ornamental because of its large fruits. Introduced by the Arnold Arboretum as seeds in 1881 and 1915.

Ilex integra f. *integra*.

Fruits subglobose-oblong. Leaves obovate.

Ilex integra 'Ellipsoidea'

A cultivar with ellipsoid fruits.

Ilex integra 'Oblanceolata'

A cultivar with narrower oblanceolate leaves, 1/2 to 3/4 inch wide.

Ilex integra 'Xanthocarpa'

A cultivar with yellow fruits.

Ilex intricata Hook. f. (94)

A compact, low, evergreen, shrub, often prostrate; branchlets warty. Leaves small, obovate, or roundish, crenate, shiny, up to 1/2 inch long, 1/4 inch wide. Fruits red, paired, rather large, subsessile, less than 1/4 inch in diameter. A native of the Himalayan region; in Yunnan, China, it grows at altitudes of 9,000 to 11,000 ft. One of the most beautiful and interesting species; it should be hardy because of its habitat in high altitudes.

Ilex latifolia Thunb. (77)

An evergreen tree up to 60 feet high, branchlets stout. Leaves thick-leathery, glossy, serrate, oblong, 3 to 6-1/2 inches long, 1-1/2 to 3 inches wide. Fruits in axillary racemes or fascicles, central axis 3/4 inch long, crowded with globose, red berries, 1/4 inch in diameter. An elegant species, native of eastern China and Japan; grows well in southeastern United States. Two magnificent specimens in the rear garden of the Williamsburgh Inn, Williamsburg, Virginia, are espaliered against the white walls for a height of 30 to 40 feet.

Ilex latifolia var. *latifolia*

The common variety with green leaves.

Ilex latifolia 'Variegata'

A cultivar with yellow-variegated leaves.

Ilex leucoclada Makino (65)

A shrub, the branchlets ash-colored. Leaves lanceolate, 3 to 4-1/2 inches long, 3/4 to 1-3/4 inches wide, attenuate at both ends. Fruits faciculate, globose, 1/4 inch in diameter, pedicels about 1/4 inch long. A native of Japan.

Ilex liukiuensis Loes. (82)

A small tree. Leaves obovate or elliptic, 1-3/4 to 2-1/4 inches long, 3/4 to 1 inch wide, base cuneate, apex obtuse, crenulate. Fruits apple-shaped, to 1/2 inch in diameter, pedicels 1/2 inch long. A native of the Liukiu Islands.

Ilex macrocarpa Oliver (116)

A deciduous tree up to 50 feet high, with greenish gray, smooth bark. Leaves ovate, 2 to 6 inches long, 1-1/4 to 2-3/4 inches wide, serrate, acuminate, base rounded or obtuse. Fruits black, large, solitary, in leaf axils on current year's growth, often fasciculate with leaves at the ends of spurs, globose, about 3/4 inch in diameter, with pointed stigma and short style. A native of warm-temperate China, curious for its large black fruit.

Ilex macropoda Miq. (119)

A deciduous tree, 40 feet high; branchlets provided with rough spurs up to 2 inches long. Leaves on elongated branchlets, fasciculate with flowers or fruits at the end of spurs, ovate or ovate-elliptic, 1-1/2 to 3 inches long, 1 to 2 inches wide, sharply serrate, base rounded, apex acuminate. Fruits solitary, in leaf axils, usually at the apex of spurs, rarely at the base of elongate branchlets, globose, 1/4 inch in diameter, red, pedicels about 1/4 inch long; pyrenes 5, striate and sulcate. A native of China and Japan, closely related to and resembling the American species *I. montana* Torr. & Gray. Attractive in October; fruits too juicy to hold the brilliant red color after frost.

Ilex melanotricha Merr. (89)

An evergreen tree, 30 feet high. Leaves oblanceolate or oblong-elliptic, 3 to 5-1/2 inches long, 1 to 1-1/2 inches wide. Fruits pea-sized, pedicels almost 1/2 inch long, pubescent; pyrenes 4, palmately striate and sulcate on the back, woody. A native of southwestern China and adjacent Burma, closely related to *I. franchetiana*. Introduced from England by F. G. Meyer in form of seeds in 1959. (P. I. 261216)

Ilex memecylifolia Champ. ex Benth. (38)

An evergreen shrub, 6 feet high; branchlets puberulent. Leaves thick-leathery, ovate-oblong or obovate, 1-1/2 to 3 inches long, 1/2 to 1-3/4 inches wide, base cuneate, apex abruptly short-acuminate. Fruits 4 or 5 fasciculate, globose to 1/4 inch in diameter, pedicels 1/4 to 1/2 inch long; pyrenes 4 or 5, rough, hairy. A native of Hong Kong. Known in cultivation in the United States since 1963.

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Ilex chinensis.

Ilex micrococca Maxim. (109)

A deciduous tree, 60 feet high; lenticels conspicuous on current year's growth. Leaves ovate or ovate-elliptic, 3 to 5 inches long, 1-1/2 to 2 inches wide, aristate-serrate or subentire, base rounded, apex acuminate. Fruits small, round, red, less than 1/4 inch in diameter, a great number of them forming a compact, spherical ball on a short peduncle in leaf axils on current year's growth; pyrenes 6 to 8, smooth, leathery. A very interesting species, native of southeastern China and Japan.

Ilex mutchagara Makino (29)

An evergreen shrub, 9 feet high, glabrous. Leaves oblanceolate, 1-1/2 to 2 inches long to 1/2 inch wide, glossy, coarsely crenate, punctate. Fruits solitary, in the axils of bracts at the base of current year's growth, globose, almost 1/2 inch in diameter; pyrenes 4, smooth. A native of Okinawa, closely related to *I. crenata.*

Ilex nipponica Makino (*syn. I. nemotoi* Makino) (113)

A small tree with puberulent branchlets. Leaves oblanceolate, 1-1/4 to 2-1/2 inches long, 1/3 to 3/4 inch wide, mucronate-crenate, slightly scabro-puberulent along the midribs on both sides. Fruits red, solitary, or 3 in a subsessile cyme, globose, less than 1/4 inch in diameter, pedicels very short, less than 1/4 inch long; pyrenes 5, smooth.

Ilex nothofagifolia King.-Ward (93)

An evergreen shrub, 8 to 20 feet high; branchlets very warty, densely covered with shiny, green leaves even on the third year's growth. Leaves small, oblong or roundish, 1/4 to 1/2 inch long, 1/4 to 1/2 inch wide, serrate, apex mucronate, pedicels half as long as the lamina. Fruits very small, usually solitary, depressed globose, red, pedicels very short; pyrenes 4, smooth. A very interesting species occurring in undergrowth of coniferous forests of the eastern Himalayan region. Introduced into the United States in 1965 from England.

Ilex pedunculosa Miq. (21)

An evergreen shrub or small tree, 15 feet high. Leaves ovate or oblong-elliptic, 1-1/2 to 3 inches long, 3/4 to 1-1/4 inches wide, entire, base rounded, apex acuminate. Fruits pea-sized, in 3's in a loose cyme or solitary, in leaf axils on current year's gowth; peduncle and pedicel together up to 2 inches long, pendulous; pyrenes usually 5, may be 4 or 6, smooth. A very attractive species, native of China and Japan; hardy in Boston, Massachusetts.

Ilex pedunculosa var. *pedunculosa*

A variety of upright habit. Leaves green, 1-1/2 to 3 inches long. Fruits red, hanging.

Ilex pedunculosa 'Aurantiaca'

A cultivar with yellow-variegated leaves.

Ilex pedunculosa 'Variegata'

A cultivar with white-variegated leaves.

Ilex pernyi Franch. (69)

A beautiful evergreen shrub or small tree, 25 feet high; branchlets pubescent. Leaves subsessile, ovate, 1/2 to 1-1/2 inches long, to 3/4 inch wide, with 1 or 2 strong spines on each side, apex spiny. Fruits paired, scarlet, globose, about 1/2 inch in diameter, subsessile, pyrenes 4. A native of central China; introduced to England in 1900, to the United States three times by the Arnold Arboretum, first by E. H. Wilson in 1908 and 1917, and then in cooperation with a university in Nanking, China. A very desirable species, hardy in Boston, Massachusetts.

Ilex pernyi var. *pernyi*

The typical *I. pernyi* has small, subsessile, ovate leaves, widest above middle, 1/2 to 1 inch long, to 1/2 inch wide, truncate at the base. Fruits subsessile, globose; pyrenes, 4.

Ilex pernyi 'Veitchii'

A cultivar with larger leaves, generally

1-1/2 inches long and fruits usually with 2 pyrenes. Concerning the number of seeds of this taxon, Dr. H. H. Hume wrote on November 24, 1953, "I found in 120 fruits taken at random, 29 fruits 2 seeds each; 80 fruits 3 seeds each; 11 fruits 4 seeds each." This observation proves that the number of seeds is variable in this cultivar.

Ilex 'Arnold Shine'*

A very hardy, previously unnamed clone of *Ilex pernyi* 'Veitchii' is described and named here for the first time. The type plant has been growing at the Arnold Arboretum, Jamaica Plain, Massachusetts, as an *I. aquifolium* of hybrid origin. Branchlets and flowering clusters puberulent; leaves shiny, deep green above, ovate, 1-1/4 to 2-3/4 inches long, 1/2 to 1 inch wide, with 2 to 3 strong spines on each side. Flowers white, blooming in April. Fruits parthenocarpic, bright red, long-lasting.

Ilex 'Dr. Hu'

A pistillate hybrid of *I. pernyi* with puberulent stems and flower clusters. Leaves ovate to ovate-lanceolate, 1 to 1-3/4 inches long, 1/2 to 1 inch wide, 3 to 5 spines on each side. Flower buds reddish purple; flowers white, the petals purplish on outside of the tips. Fruits parthenocarpic, subglobose, red, 1/4 inch in diameter; pyrenes 4. Origin, Brownell Farms, Milwaukie, Oregon.

Ilex pubescens Hook. & Arn. (34)

An evergreen shrub about 10 feet high; branchlets, leaves, and flower clusters covered with long, grayish hairs. Leaves elliptic or obovate-elliptic, 3/4 to 3 inches long, to 1 inch wide, base obtuse, apex acute or shortly acuminate, subentire or the apical half faintly serrate. Fruits globose, red, less than 1/4 inch in diameter, fasiculate in leaf axils of second year's growth, pedicels 1/4 inch long; pyrenes 6, sometimes 5 or 7, 3-striate on the back. A native of southern China, occurring also in Formosa. Introduced into the United States in 1935.

Ilex rotunda Thunb. (17)

A glabrous tree up to 60 feet high. Leaves ovate or broad-elliptic, 1-3/4 to 3-1/2 inches long, 3/4 to 1-1/2 inches wide, base acute or obtuse, apex acuminate, entire. Fruits 3 to 7 in a small umbel in leaf axils on current year's growth, ellipsoid, 1/4 inch long; pyrenes 5 to 7, 3-striate and 2-sulcate on the back. A native of eastern Asia from Korea and Japan southward to southeastern China. *I. rotunda* proved to be the most beautiful species in the living holly collection at the University of Florida, Gainesville, Florida. (Not to be confused with *I. cornuta* 'Rotunda')

Ilex rotunda var. *rotunda*

A glabrous variety.

Ilex rotunda var. *sinensis* Masamume (syn. *I. rotunda* var. *microcarpa* Hu)

A variety with pubescent peduncles and pedicels, smaller fruits, and less sulcate pyrenes.

Ilex 'Lord'

A cultivar of *I. rotunda*. Leaves entire and spineless. Fruits red, shining, and produced in great abundance. Origin, University of Florida, Gainesville, Florida

Ilex 'Romal'

A staminate cultivar of *I. rotunda*; origin, Glen Saint Mary Nursery, Glen Saint Mary, Florida.

Ilex rugosa F. Schmidt (92)

A small, prostrate shrub; the branchlets angular, ridged, under a lens tuberculate. Leaves oblong or lanceolate, 1 to 2 inches long, to 3/4 inch wide, the reticulation of nerves impressed, the surface appearing ru-

Ilex pedunculosa.

FRED C. GALLE

* The original plant appears more likely to be *I. ciliospinosa*. (Ed.)

gose. Fruits fasciculate, often only 1 or 2 growing to maturity, globose, less than 1/4 inch in diameter, pedicles 1/4 inch long; pyrenes 4, rarely 5, striate-sulcate, woody. A very variable species, native of Sakhalin and northern Japan; introduced into the United States twice by the Arnold Arboretum as seeds, in 1895 from the Forest Department of the University of Tokyo and in 1902 from the Botanic Garden of Tokyo.

Ilex serrata Thunb. (112)

A deciduous shrub, 4 to 8 feet high; branchlets with conspicuous lenticels. Leaves elliptic, 1 to 1-1/2 or 2 inches long, to 3/4 inch wide, sharply serrate or double-serrate, attenuate at both ends, glabrous or inconspicuously pilose along the midribs beneath. Fruits globose less than 1/4 inch in diameter, solitary, or in 3's in a simple cyme, behind a bud and in leaf axils on current year's growth; pyrenes 6, smooth, leathery. Used as a bonsai subject in Japan.

Ilex serrata var. *serrata*

A glabrescent wild variety with red fruits.

Ilex serrata 'Leucocarpa'

A cultivar with white fruits.

Ilex serrata var. *sieboldii* (Miq.) Loes.

A wild variety with pubescent branchlets and leaves.

Ilex serrata 'Xanthocarpa'

A cultivar with yellow fruits.

Ilex subrugosa Loes. (100)

An evergreen tree, 30 feet high, branchlets hairy. Leaves leathery, lanceolate, coarsely serrate, 1-1/2 to 4 inches long, 1/4 to 1 inch wide. Fruits globose, fasciculate, about 1/4 inch in diameter, pedicels 1/4 inch long; pyrenes 4, striate-sulcate, woody. A pretty species, native of western China.

Ilex sugerokii Maxim. (24)

An evergreen shrub, 15 feet high. Leaves ovate, the upper half serrate, the lower half entire, 3/4 to 1-1/2 inches long, 1/2 to 1 inch wide, base rounded, apex acute. Fruits solitary, in leaf axils on current year's growth, globose, 1/4 inch in diameter, red, pedicels 1/2 to 1-1/4 inches long; pyrenes 4 to 6, smooth. A native of Japan, introduced to the United States twice by the Arnold Arboretum, in 1914 by E. H. Wilson and in 1925 as seeds from the Botanic Garden of Sapporo, Japan. Rare in cultivation in the United States. In 1961, Dr. J. L. Creech, of the U. S. Department of Agriculture, sent 16 introductions, of wild origin, of *I. sugerokii* and its varieties to the United States as seeds and cuttings.

Ilex sugerokii var. *sugerokii* (*I. sugerokii* var. *longipedunculata* Maxim.)

A variety with ovate and rather opaque leaves, peduncles 3/4 to 1-1/4 inches long in fruit.

Ilex sugerokii var. *brevipedunculata* (Maxim.) S. Y. Hu

A variety with smaller, very glossy, elliptic leaves and shorter fruiting pedicels about 1/2 inch long. (P. I. 261745)

Ilex szechwanensis Loes. (28)

An evergreen shrub, 3 to 10 feet high. Leaves yellowish green, obovate-elliptic, 1-1/2 to 2-3/4 inches long, 3/4 to 1-1/2 inches wide, serrate, punctate beneath. Fruits black, solitary, in leaf axils on current year's growth, globose, 1/2 inch long; pyrenes 4, smooth. A native of western China.

Ilex triflora Blume (30)

An evergreen shrub with punctate leaves and black fruits, resembling *I. viridis* but the fruits usually fasciculate. A very wide spread species extending from the warm region of China southward to Java.

Ilex venulosa Hook. f. (32)

An evergreen shrub or small tree about 25 feet high. Leaves large, entire, leathery, oblong-elliptic, 4 to 8 inches long, 1-1/3 to 2-1/4 inches wide, apex long caudate, primary lateral nerves 15 to 22 pairs. Fruits very small, globose, less than 1/4 inch in diameter, 5 to 7 in a crowded cyme, several cymes fasciculate in the axil of leaves on second year's growth, central axis of fascicle evident, sometimes 1/4 inch long; pyrenes 5 to 7, 3-striate on the back. A native of the eastern Himalayan region, occurring in Yunnan, China, Burma, and northern India, an interesting species.

Ilex viridis Champ. ex Benth. (26)

An evergreen shrub, 15 feet high. Leaves shiny, yellowish green, punctate beneath, ovate-elliptic, 1 to 2-3/4 inches long, 1/2 to 1-1/4 inches wide, serrate, midrib impressed above. Fruits solitary, black. A native of southeastern China and Hong Kong.

Ilex wilsonii Loes. (53)

A beautiful evergreen tree, 30 feet high. Leaves glossy, entire, ovate or obovate-oblong, 1-3/4 to 2-1/2 inches long, 1/2 to

1-1/2 inches wide, apex acuminate. Fruits globose, less than 1/4 inch in diameter, pedicels about 1/4 inch long; pyrenes 4, 3-striate, esulcate. A native of the warm-temperate region of China; introduced into England in 1926 and into the United States before 1937. (Not to be confused with *Ilex* × *altaclarensis* 'Wilsonii'.)

Ilex yunnanensis Franch. (23)

An evergreen shrub, 5 to 12 feet high; branchlets densely pubescent. Leaves ovate to ovate-lanceolate, 3/4 to 1-1/2 inches long, to 3/4 inch wide, base rounded to subacute, apex acute, mucronate. Pistillate flowers white, solitary, in leaf axils on current year's growth. Fruits red, globose, 1/4 inch in diameter, pedicels about 1/2 inch long, nodding; pyrenes 4, smooth. A native of western China; introduced by the Arnold Arboretum in 1911, E. H. Wilson Seed No. 4458. A very attractive species, hardy as far north as Boston, Massachusetts. Introduced again by F. G. Meyer in 1957 from England. (P. I. 243103).

Ilex yunnanensis var. *yunnanensis*

A wild variety with leaves ovate-lanceolate, aristate, crenulate-serrate; peduncles to 3/4 inch long; calyx lobes ciliate.

Ilex yunnanensis var. *gentilis* (Franch.) Loes.

A wild variety with crenate, ovate leaves, obtuse at the apex.

Natural Hybrids of Asiatic Origin

Ilex × *kuisiana* Hatusima (*Ilex buergeri* × *I. integra*)

A shrub 12 feet high. Leaves oblong or oblong-obovate, 2-1/4 to 3-1/2 inches long, 1 to 1-1/4 inches wide, leathery, acuminate, tip obtuse, base cuneate, apical half remotely serrate. Pistillate flowers 5 to 6 in fascicles; pedicels 1/2 inch long. Recorded from Kyushu, Japan. Cultivated in the United States since 1961.

Ilex × *makinoi* Hara (*Ilex leucoclada* × *I. rugosa;* also known as *Ilex fauriei*)

A natural hybrid, evergreen. Leaves ovate-oblong, 1 to 2 inches long, 1/2 to 3/4 inch wide, obtuse at both ends. Flower solitary. Fruit not seen. Introduced into the United States in 1961.

Shiu-ying Hu, botanist, Arnold Arboretum, Harvard University, Cambridge, Massachusetts, was formerly professor of Botany, West China Union University, Chengtu. She is the author of the *Genus Ilex in China* and many botanical articles. Dr. Hu, who has traveled extensively in China and made several botanical expeditions there, is an authority on the flora of China.

Planting and Feeding Hollies

STEWART H. McLEAN

Hollies have a much undeserved reputation for being difficult to move successfully. The main reason for this apparently stems from inexperienced individuals attempting to move native American hollies from their natural environment to a setting completely opposite to that in which they had spent the early years of their lives. Often trees are yanked from the ground, are much too large for one person to handle, are exposed to drying winds in transit, or are moved at the wrong time of the year. Naturally, such trees formerly shaded from the hot summer sun, protected from the cold wintry winds, and moved without adequate roots, are unable to adjust to or support themselves in their new location. Hence, they do poorly, grow slowly, or just simply die.

Actually, there is nothing magical or mysterious about planting hollies. In fact, few plants are as easy to grow or as tolerant of different soils as the hollies. We find them growing successfully on mountain tops, at nearly sea level in almost pure sand, on hammocks in swamp lands, and under most types of soil conditions in between.

If hollies do have any preferences towards soils, they lean towards those neutral to slightly acid, well-drained, fairly light, and loamy to sandy in texture. Heavier soils should be lightened with leaf mold, decomposed pine needles, rotted cow manure, or a liberal amount of sand. The last is preferable since it is more permanent in its action as a soil conditioner. It is only necessary to use enough organic material or sand to make the soil friable and easy to work. This helps the newly planted holly on its way to becoming nicely established.

An overabundance of organic material has a tendency to take away any incentive the roots might have to grow deeper and farther out into the soil in search of food and moisture. And too, as the organic material is either decomposed or used up by the plant, cracks and air-pockets may form which allow the soil and roots to dry out.

In planting hollies, one should first be reasonably certain that the plant he has chosen would be hardly in his area and suitable for the purpose he has in mind. He should attempt to determine the finest cultivar of the species. Preferably, he would buy his plant locally from a reputable nurseryman. Naturally, the plant should be healthy, vigorous, and as freshly dug as possible.

In purchasing dug plants, the size of the burlapped root-ball in relation to the size of the tree is important. Generally, the ball should be a foot in diameter for each inch of trunk diameter, measured about a foot from the base of the plant. For example, a tree with a trunk caliper of two inches should have a root-ball two feet across. The ball should be firm, solid to the touch, and tightly laced to prevent breakage in handling.

The best time for planting dug hollies is early spring, after the frost is out of the ground and until new growth starts to appear. Hollies are also moved successfully in the fall when the plants become dormant, but before the ground freezes.

Careful consideration should be given to the location of hollies before they are actually planted. They should, of course, be placed so that they will harmonize with their surroundings and fit into the landscape plan. Large-growing hollies should be allowed ample space to develop to their proper size, particularly if they are to keep their lower branches sweeping the ground. All too often, both of these factors are overlooked.

The hole for the plant should be roughly twice as large and twice as deep as the size of the root-ball. Most of the

sod is skimmed off. Before removing any soil, the top layer of soil and sod roots is carefully and completely chopped up and thoroughly mixed into the topsoil in the hole. The topsoil is removed and placed in a pile beside the hole. The poorer soil below is dug out and replaced with good topsoil, if possible. Placing the soil on pieces of burlap will facilitate cleaning up.

Enough topsoil should now be shoveled back into the hole and firmed well so that when the plant is placed into the hole, the top of the root-ball will be just slightly below ground level. Bear in mind that if the soil is heavy, sand, leaf mold, rotted cow manure or decomposed pine needles should be added

After placing the tree in the hole, it should be checked from two sides to test for plumbness. Without removing the burlap, more soil should be added, filling the hole nearly two-thirds full and tamping the earth tightly about the ball. Here, the burlap may be loosened from the top of the ball, cut away, or merely opened out and covered over with soil.

If the soil is very dry, a good watering is then advisable. When all the moisture has soaked in, enough earth should be added to slightly, but completely, cover the ball. This, too, must be firmly tamped to prevent any air-pockets which would allow the roots to dry out. The surface of the ground should slope slightly from the sides of the hole to the base of the plant; this forms a catch basin to facilitate watering. Water again, spraying the top as well as the ground. This should be repeated often until the plant becomes well-established.

Small plants in pots or cans are best planted in the spring. These can, however, be planted at other times of the year when the ground is not frozen, provided a reasonable amount of protection from summer sun and wind is given them. The hollies should be removed from their containers without breaking the core of earth. Container-grown plants require slightly more after-care. Since the plants are not rooted so deeply, more attention must be given to their moisture needs.

Hollies are generally shallow-rooted plants and appreciate a light mulch to keep their roots cool and moist. Well-rotted cow manure, peat moss, pine needles, woods' soil, leafmold, or buckwheat hulls are satisfactory for this purpose. The mulch should be kept a foot away from the trunk to reduce mice and decay injuries. It should extend beyond the tips of the branches.

By nature, hollies are heavy feeders and are quick to respond to a generous application of fertilizer. This, applied around mid-March, quite often brings out the gorgeous fruit and foliage characters inherent in the plants, the true beauty of which would never otherwise be enjoyed by their owners. Summer and fall feedings of hollies are not recommended.

The kind and amount of fertilizer vary with the size of the plant and the type of soil in which the holly is growing. This is a good reason for buying hollies from a local nurseryman, who should know the local conditions and the needs of the hollies in his area.

In the Baltimore area, pulverized 10-6-4 commercial fertilizer has been used with exceptional success. A good rule to follow is: one pound of fertilizer for each inch of trunk diameter up to three inches. Above a diameter of three inches, the amount of fertilizer is tripled. The fertilizer is applied on the top of the ground. One third of the amount should be evenly distributed in a band slightly inside the branches; the remaining two-thirds should be spread in a band outside the dripline. This band should be twice as wide as the area covered inside the dripline.

While the planting and fertilizing of hollies may seem unduly complicated, such is actually not the case. All that is involved is common sense. No magical green thumb is necessary. A good holly, suitably selected, properly planted, and moderately cared for, will reward its owners with many pleasures each day of the year.

Mr. McLean, a trustee of the Holly Society of America, Inc., is a holly nurseryman and orchardist of Baltimore, Maryland.

Pruning Hollies

L. J. ENRIGHT

Both the shrub and tree types of hollies frequently require periodic pruning. Nature, unattended, often produces forms and shapes which are not the most desirable for ornamental plant specimens.

There is no substitute for good pruning and shearing. Judiciously done, the pruning and shearing of hedge hollies result in healthier and stronger plants, more vigorous growth, denser or more open forms, a greater abundance of fruits, and control of the size and shape of the plant.

As with other ornamental plants, we prune hollies to adjust them to the unnatural conditions in which they often have to grow. Hollies adapt themselves quite readily to various environments and usually need little pruning other than to train a true leader or to remove dead, diseased, or damaged branches.

It is always better to allow the plant to grow as naturally as possible, although there will be occasions where stiff, formal shearing will be required. In most cases, to cut for grotesque shapes and forms destroys the overall beauty and dignity of hollies. Good pruning consists simply of removing portions of the plant growing out from the typical form, reducing parts which are out of proportion to the rest of the plant, keeping the leaders clear, and removing dead wood and branches growing into the ground.

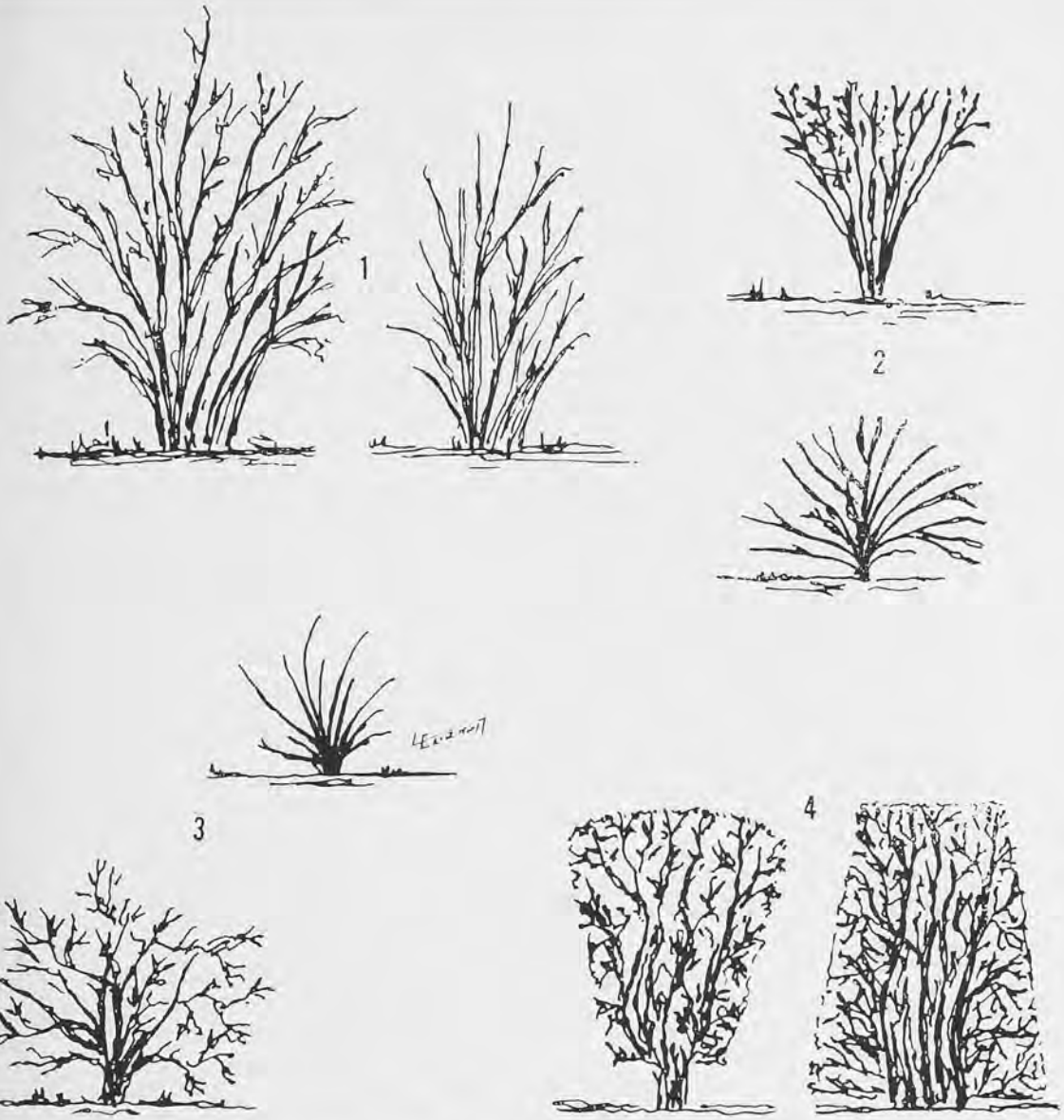
Vigorous-growing plants of Japanese hollies will often send forth long, leggy shoots of new growth. If these detract from the beauty of the plant, are growing too close to a building, or protrude over a garden path or walk, they are easily shortened back to the proper length. This is quickly done with a sharp hedge shears, or more slowly with a hand clipper. A denser, more compact plant results from this treatment.

Young plants of American hollies are often of a sprawling nature, with no recognizable leading shoot apparent. Here, the most flexible and most promising branch can be tied to a stake in an upright fashion. The stake should be well-sharpened and firmly driven. One or more ties are made as is necessary, with narrow strips of cloth rather than string.

Invariably, however, such sprawling hollies will, as the nurserymen say, "break"; and one or more erect-growing shoots will arise from either the trunk or a side-growing branch. Lightly cutting back the tips of some of the side branches may cause this to happen sooner than if the branches had not been pruned. If two or more upright shoots break, it is probably best to allow them to grow for one full season, and then cut those which seem less likely to make a good leader. Preferably the one selected should be as close as possible to the main axis of the tree. No concern need be given a noticeable crook which will result where the leader joins the trunk of the tree. This will lessen with age, and the lower branches will eventually hide this deformity.

These leading shoots often grow very rapidly and spoil the symmetry of the holly. Such leggy branches are pruned back to the desired length. This forces side shoots to break and allows the plant to fill out nicely.

There is, of course, no objection to tree types of hollies with two or more trunks. In fact, some growers prefer multiple-stemmed hollies. This is purely a question of personal taste or, where the lower branches are completely trimmed from the tree, the landscape effect desired. If single-stemmed hollies are desired, it is a simple matter to cut out the least promising of double- or multiple-leaders, whenever they appear. This can



PEN AND INK SKETCHES BY L. J. ENRIGHT

1. Thinning or pruning shrubby types of holly produces plants of more desirable form and attractive appearance. Left, before pruning; right, after pruning.

2. Cutting all shoots at the same height results in a flat-topped, unattractive shrub—upper sketch. Too severe pruning at any one time causes plant to appear dehorned—lower sketch.

3. Renewal pruning improves the appearance of older shrubby types of hollies and helps to maintain more vigorous growth in mature plants. Lower sketch—before renewal pruning; upper sketch—after renewal pruning.

4. The lower branches of holly hedges need adequate sunlight, so the base of hedges should not be cut narrower than the top. Left, incorrect; right, correct.

be safely done at any time of the year.

Sometimes, the leading shoots of hollies are injured by frost, wind, insects, diseases or heavy snow. These are trimmed back to live wood, just above a bud or leaf, and the surrounding side branches pruned back in proportion.

If the leader is completely killed, it

should be cut back to the nearest whorl of branches. In this case, a side branch may be bent into an upright position and fastened in place with a splint or brace for several seasons, until it naturally assumes its new duties. If this is difficult or awkward to do, all the uppermost whorl of branches but one are pruned back to the trunk or shortened about half their length. The branch selected to be the new leader should be one which appears most capable of growing upright in the shortest time. For several seasons, it will probably be necessary to trim the side branches near the top of the tree so that they will conform to the overall shape of the tree.

Some cultivars of American hollies often send up vertical shoots on the side branches of the tree. These may originate close to the trunk near the base, or may appear farther upward and outward on the branches. These should be clipped out when small; otherwise their upright growth might injure the branches above.

Older plants of Chinese hollies will also frequently send up vigorous-growing shoots which may grow four to five feet in length in one season. These shoots should be removed unless one is required to fill out a scraggly plant.

An occasional lateral tip may need to be shortened and, within the framework of the hollies themselves, some twigs may need to be thinned or pruned out when they start growing into nearby branches. This can be done anytime during the dormant season; a good time, of course, is just before the Christmas holly season when the pruner will be rewarded with a supply of holiday greens. It should always be remembered in pruning American hollies that if a branch is cut completely back to the trunk, or a twig back to a branch, no new growth will arise from this point. Therefore, if new growth is wanted, all cutting should be done back to a leaf or a bud.

It is good to remember, too, that the buds on hollies are arranged in a definite pattern as they appear on the leaders and branches of the plants. The direction in which these buds point indicates the direction in which the new shoots arising from them will grow. By pruning back to the proper bud, we can then control the direction of any branch. With proper pruning, we can thus force new twigs to fill in openings or unsightly gaps in hollies where they appear. Theoretically, at least, it is possible to fashion weeping forms of hollies by pruning with this purpose in mind.

The filling-in of an unsightly opening in larger hollies can be speeded up by pulling an overhanging branch into the gap. This branch is held in position by a weight or stake driven into the ground.

When it is necessary to remove large limbs, they should be trimmed so that all final cuts are flush with and parallel to the parent branch or the main leader. The first cut eliminates the hazard of a fallen limb tearing the bark from the portion of the tree below the working area. The second cut completely removes the heavy limb and allows freedom of movement for the worker. The third and final cut can then be made carefully at the base of the stub to be removed. Pruning wounds of less than two inches diameter are rarely treated with a wound compound, but larger wounds should be covered with an asphalt base-wound dressing. Those which contain turpentine or coal tar will injure the growing tissues. House paints will injure the tissue and also slow the healing process.

The rate of growth and the desired height for the planting will determine the amount of shearing and pruning necessary for hollies used as hedges. Shearing at frequent intervals throughout the growing season will make it possible to maintain a soft foliage outline from the ground up. If large twigs and branches are cut off well within the outlines of the hedge, no unsightly stubs will be visible to mar the attractiveness of the planting. Once a holly hedge becomes established, it should not be necessary to indulge in a great deal of actual pruning to maintain its form.

Mr. Enright was formerly on the staff of the Department of Horticulture, College of Agriculture, University of Maryland, College Park.

Holly Propagation

J. BON HARTLINE

Nature has provided that the genus *Ilex* be perpetuated by seeds. The plants are dioecious; each plant will be either male or female, and only the female plants produce fruit.

The female plants with their crop of berries are most attractive and are, therefore, the most wanted. There are many colors of fruit, including black and white and many shades of red, orange, and yellow. Each color has its own merit, but red is the most popular.

Nature has kept most species pure by isolating them geographically or by arranging that they bloom at different times so that they will not hybridize. However, when plants from different areas are brought together, as in an arboretum or garden, the chances are that the seed produced will, in many cases, be the result of hybridization because the blooming period of many hollies overlap.

Holly plants of the same species usually vary one from the other in one or more ways—sex, size and shape of the plant, luster and shape of the leaf, color of fruit, age at which fruiting begins, and hardiness. Because of these differences, the production of plants of some species from seed is not generally recommended.

There are methods of propagation other than seed by which the desirable and selected traits are passed on to the new plants. However, production of holly plants from seed, until rather recently, has been the only economical method to produce plants in quantity. Most named cultivars have been found in the wild state or have been selected from seedlings grown in nurseries or home gardens.

Raising plants from seeds is of utmost importance to plant breeders and hybridizers and to those persons who seek the pleasure of sowing seeds and growing plants.

Production From Seed

The berries are gathered in the fall after they are mature, and the pulp is crushed and washed away. A food sieve is an excellent tool for this purpose. Seeds which float should be discarded with the pulp, since they are usually not viable and would not germinate.

It is generally believed that holly seeds are "hard" seeds and require a year or eighteen months to germinate. This is only partly true, since seeds of *I. crenata, I. vomitoria, I. myrtifolia, I. amelanchier, I. glabra, I. cassine,* and of some *I. opaca* of southern origin will germinate in a very short time after being properly handled. *Ilex aquifolium, I. cornuta, I. verticillata, I. serrata, I. decidua,* and most *I. opaca* seeds will require a longer period—up to eighteen months before all seeds germinate.

An easy and practical way of handling small amounts of seed is to plant them in a peat-sand mixture (which has been heat- or steam-sterilized) in plastic or clay flower pots of a suitable size and enclosed in a plastic bag. The peat-sand mixture should be moist but not wet. The potted seeds, placed in a cool area (60° - 70° F) and with indirect light, need little attention until the seedlings appear.

When large amounts of "hard" seeds are to be germinated, they may be handled as described above or sown directly into flats; they will usually germinate in ten to fourteen months. It is the length of time or aging rather than the cold treatment itself which aids germination. Sterilizing the medium first is necessary to control weeds and fungi.

Seeds may also be stratified. To prepare the seeds for storage, they are mixed with moist sand in a one to three ratio and put in a porous container. The container is then stored in a cool place or may be buried on the north side of a

building and protected from rodents. After a year of storage, the seeds are then ready to be sown in flats or in outside beds. Not all the seeds will germinate at one time. Several months may elapse from the time the first appear before all have sprouted.

When planted outside, a prepared area of a good loamy soil with a generous addition of peat moss and sand provides an excellent growing bed. The bed should be fumigated with methylbromide to control weed seeds and soil insects. The seeds are scattered evenly, pressed into the soil, and then covered with a thin layer of soil. On top of this a 1/2-inch layer of peat is added to prevent crusting and drying.

Partial shade helps until the seeds have sprouted; and the seed bed should be protected from rodents.

The seedlings may be left in the seed bed for one year before they are transplanted, or they may be potted when approximately one inch high. These tiny plants must be treated with care for several weeks until they are reestablished.

Propagating Plants from Cuttings

The most widely used method of propagating cultivars, or any individual plant, to keep them "true," is by rooting cuttings. Active, live twigs (or cuttings) are removed from the parent plant and roots are induced to form on the base of the cuttings. Each cutting is then a separate and independent living plant with all the characteristics of the plant from which it was removed.

Cuttings of most evergreen hollies are best taken in mid- to late summer. However, good results have been achieved in taking cuttings as late as February, even later. Cuttings should not be removed from the plant until the latest growth cycle has ceased and the foliage has obtained its natural dark green color. By this time, the cuttings have stored the necessary reserve food supply to carry them during the period when they do not have roots of their own. The most desirable cuttings are, therefore, those without active growth but with well-matured, dark green leaves and stem wood of heavy caliper.

The length of cuttings depends on circumstances. If the supply of material to be propagated is scarce, then the grower would probably make cuttings one to three inches in length. If the supply is ample, the cuttings would be longer and the length governed by the equipment and method used in rooting them. By taking large, well-branched, two-year wood cuttings, ten to 14 inches long and with a good number of berries, and rooting them in late summer, a very attractive plant can be potted by October. There is demand at the Christmas season for small, live American and English hollies carrying their red berries.

A stronger and more vigorous root system will be obtained with large cuttings. A length of six to eight inches is better than the two- to three-inch length. Of course, cuttings of the smaller size will root with equal ease, but they are generally slower-growing and take longer to reach a salable size or a desirable size for planting in the landscape. This might mean as much as a year's difference. By necessity, species which make short annual growth have to be started from shorter cuttings.

Cuttings root most readily when taken from the current season's growth, and from the most vigorous and healthy specimens. If an old or weak specimen does not have desirable cutting wood, heavy pruning and fertilizing will induce good growth and wood for the next year.

The position on the parent plant from which cuttings are removed has a relation to the type of growth which can be expected. For example, cuttings of a flat, spreading *Ilex crenata* should be taken from spreading branches and not from a vigorous, upright sprout which is not characteristic of the plant's growth habit. On a pyramidal plant the most desirable cuttings are those showing the upright characteristic. This does not mean that cuttings cannot be taken from all parts of the parent plant; but the plants obtained from such positions will have a tendency to develop different patterns of growth for a few years.

Individual plants of the same species vary greatly in rooting ability. Some American holly trees root consistently well and very easily, while others are poor to unsuccessful in rooting. This is an inherent factor which does not change from year to year.

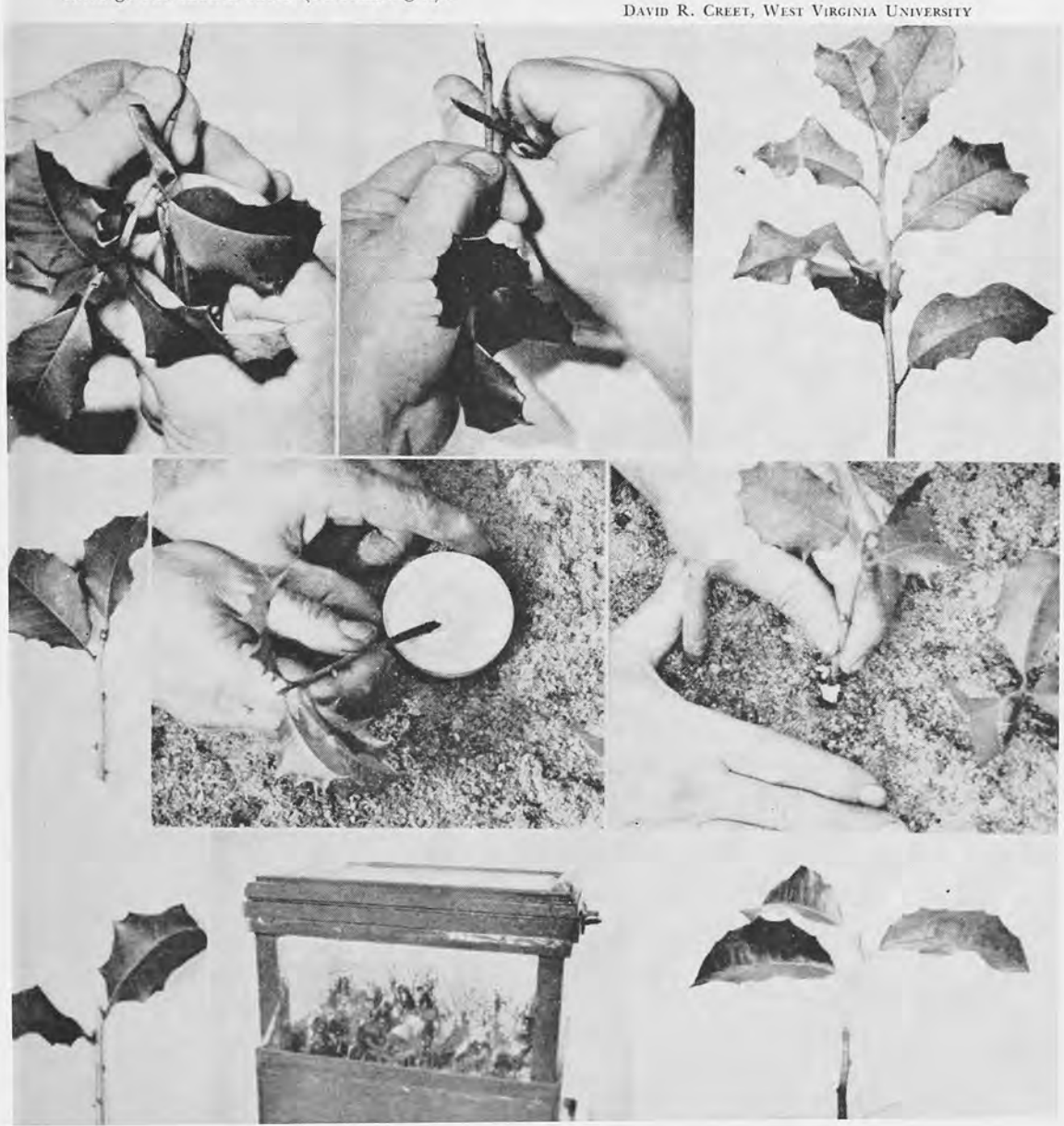
Preparation of Cuttings

Cuttings should be taken preferably in the early part of the day while they are turgid and full of water. Whether cut early or late, they should be kept out of bright sun and away from wind to prevent drying of the leaves. A covered box or large plastic bag containing some moisture is ideal protection for fresh cuttings. After being severed from the parent plant, the cuttings should be prepared quickly and put in the propagation bed immediately. However, if it is necessary, cuttings may be held several days in a cool place and kept moist.

The bottom one-third of the leaves are cut off close to the stem and a "wound" is made on opposite sides of

A desirable stem cutting, large enough for two cuttings (top, right); removing the unwanted leaves (top, left); making a clean-cut tip (top, center). The two resulting cuttings: the terminal cutting (center row, left); the basal cutting (bottom row, left); treating the cutting with a root-inducing substance (center row, center); placing the cutting in the rooting medium (center row, right). The cutting in a polyethylene sealed window box (bottom, center) and the rooted cuttings one month later (bottom, right).

David R. Creet, West Virginia University



the stem. This wound consists of a slice, approximately one to 1-1/2 inches long, through the outer bark and cambium layer just so the white of the inner wood is visible. Not all species require wounding (*I. crenata* does not), but a larger root system develops so it is generally recommended. Where the base cut is made in relation to buds is not important, since roots will form on any treated portion. The cut or wounded area heals and forms a callus, and from this callus new roots are initated. With some species, roots are also initiated under thin bark and appear all along the stem.

After the leaves are trimmed and the wounding cut made, the cuttings are dipped into a root-promoting hormone. Several chemicals aid rooting, and the preparations are available as liquid or powder. Most growers prefer powder, because it is easily applied and because it can be stored safely for six months or possibly longer. However, large holly producers (and some amateurs) sometimes like a liquid preparation because its strength can be varied. Hard-to-root cuttings and older wood can be forced to root more readily when stronger hormone solutions are used.

Before applying the hormone powder or solution, it is advisable to hose off all soil and dip the cuttings into a fungicidal solution; a five percent "Clorox" solution, an organic mercury solution, or other similar solutions can be used. The cuttings should be partially dried before the rooting powder is applied.

Placing the Cuttings

The propagation bed or area may vary in many ways. It may be outside in full sun with misting nozzles or in a basement under artificial light and a plastic film tent for covering. Between these two extremes are a number of alternatives. For the hobbyist who wishes to root a few cuttings, a small indoor propagation box is adequate. The size of the box is governed by the number of cuttings to be struck; a 12 inch x 18 inch or an 18 inch x 24 inch box is usually sufficient. There should be enough metal ribs (such as curved wire) to support a sheet of plastic over the top and down the sides of the box to form an airtight seal.

The rooting medium is 50 percent sharp sand or "Perlite" and 50 percent acid peat-moss thoroughly mixed and three to four inches deep. Although some propagators have good results with 100 percent clean, washed sand, it is advisable to incorporate acid peat moss when rooting holly. The 1/2 and 1/2 mixture gives better results than all sand or all peat. If sand is used in the mixture or alone, it is a good practice to sterilize it to prevent fungus infection. "Perlite" is sterile, and peat moss is generally considered to be.

Peat moss is difficult to wet thoroughly, so the medium must be sprinkled several times before the cuttings are struck. Twenty-four hours are sufficient for soaking the medium. Good bottom drainage is absolutely essential to prevent waterlogging and to allow air to permeate the mixture.

An electric heating cable with thermostat, set in the rooting medium, is very desirable. Heating cables with built-in thermostats are available for small beds. In greenhouses, the benches should be equipped with heating pipes or ducts beneath them. The optimum temperature is 72° to 75° F. At lower temperatures root formation will be slower. Higher temperatures will speed root formation but will also greatly increase the danger of root-rot fungi. Temperatures appreciably above 75° F will "steam" and kill the cuttings. The air temperature above the medium is not critical, but the optimum is 5° to 10° cooler than the medium.

The rooting medium is compressed to make a firm bed which will support the cuttings and keep them upright. The next step is to make holes in the medium with a pointed peg, such as a pencil, into which the cuttings (which have been dipped in a root-promoting hormone preparation) are inserted. Cuttings should not be crowded, but spacing depends, of course, on the size of the cuttings. Spacing two by two inches is usually adequate. After each row of cut-

tings has been struck, the medium is packed firmly; when all cuttings are placed, the entire area is carefully watered.

A plastic cover is then placed over the box to maintain a high humidity. Once a day the plastic cover may be removed for ventilation and the cuttings sprinkled. With good drainage, excess water is not a problem.

While the box should receive plenty of light, the cuttings should not be in direct sunlight, since extremely high heat will build up inside the tent and burn the leaves. Except with deciduous hollies, too dark an area will cause the leaves to drop, and a leafless cutting will fail to root.

Under optimum conditions, the first root should appear in about two to 2-1/2 weeks. Rooting is delayed if the variable conditions are on the negative side. As roots develop, the cuttings are gradually exposed to the air and the plastic covering removed. After they are well-rooted, they may be potted or left in the propagation box until spring and then be potted.

Volume Production

When several hundred or a large volume of cuttings are required, a misting system is used. Although there are variations in the system, the essential parts are very simple: 1) a steady supply of clean water under pressure; 2) misting nozzles (placed about 30 inches apart on 16-inch risers in beds not over 3-1/2 to four feet wide); and 3) a means of turning the water on and off. The misting cycle may be controlled by a time clock (allowing six seconds of misting every five minutes) or by the weight of water falling on a tilting screen which activates a solenoid valve in the water line. In either of these two systems, or any variation of them, the important point is to keep the leaves moist at all times.

Constant misting, in which the water is turned on at sunrise and off at sunset, has been practised quite often. Only a mist nozzle connected into a water line is needed for this purpose. Although it is easily set up, it has several disadvantages; rooting is slower, because the medium is kept cooler by the constant supply of water; the medium is usually waterlogged; and the system must be turned on and off manually. Constant misting also tends to leach nutrients from the leaves of the cuttings. Intermittent misting is much more satisfactory than constant misting.

The rooting medium for volume production is the same as previously described and should be handled in the same way. The bed may be on the ground outdoors or in benches in the greenhouse. Good drainage is always required and also protection from wind so that the mist will cover all the cuttings.

If the cuttings are struck in late fall, heating cables or bench heat will be necessary for rooting and as an aid in the prevention of freezing during winter. Even in a heated greenhouse, heating cables or heated beds will aid rooting.

In preparing a large bed or bench, first pea gravel should be spread several inches thick, then a very thin layer of sand over the gravel. The heating

Left, rooted Christmas cuttings of *Ilex opaca*. Right, tall cuttings of *Ilex opaca*.

J. Bon Hartline

cables are placed on the sand so that the heat is evenly distributed. To protect the cables from being damaged, the entire area should be covered with 1/2-inch hardware cloth. On top of this goes the rooting medium or mixture.

Deciduous hollies may be propagated as described above, but must be struck by the time their leaves have dropped in the fall. Cuttings of such hollies, if struck in midwinter, will not have had enough cold weather to satisfy the chilling requirements. They will leaf out before rooting and die.

Deciduous hollies, unlike evergreen hollies, root well from softwood cuttings. These are taken in very early summer when the twigs are long enough and slightly hardened. Because softwood cuttings must never be allowed to wilt, misting is a necessity.

Hollies can also be grown from root cuttings. Roots the size of a pencil are the most desirable and are handled in the same way as branch cuttings, except they are inserted in the rooting medium so that only the tip shows. Species which are known to increase well from root cuttings include *I. decidua*, *I. cornuta*, and *I. glabra*; undoubtedly other species would do equally as well.

Budding and Grafting

There is nothing mysterious about budding and grafting, and an amateur often obtains as good results as a professional when certain rules are understood and followed. Budding and grafting are processes in which one part of a plant, a bud or scion, is placed on another plant, called the "stock," in such a manner that the two unite and growth is resumed. Grafting is almost always done with dormant plant material, while budding unites plants in active growth.

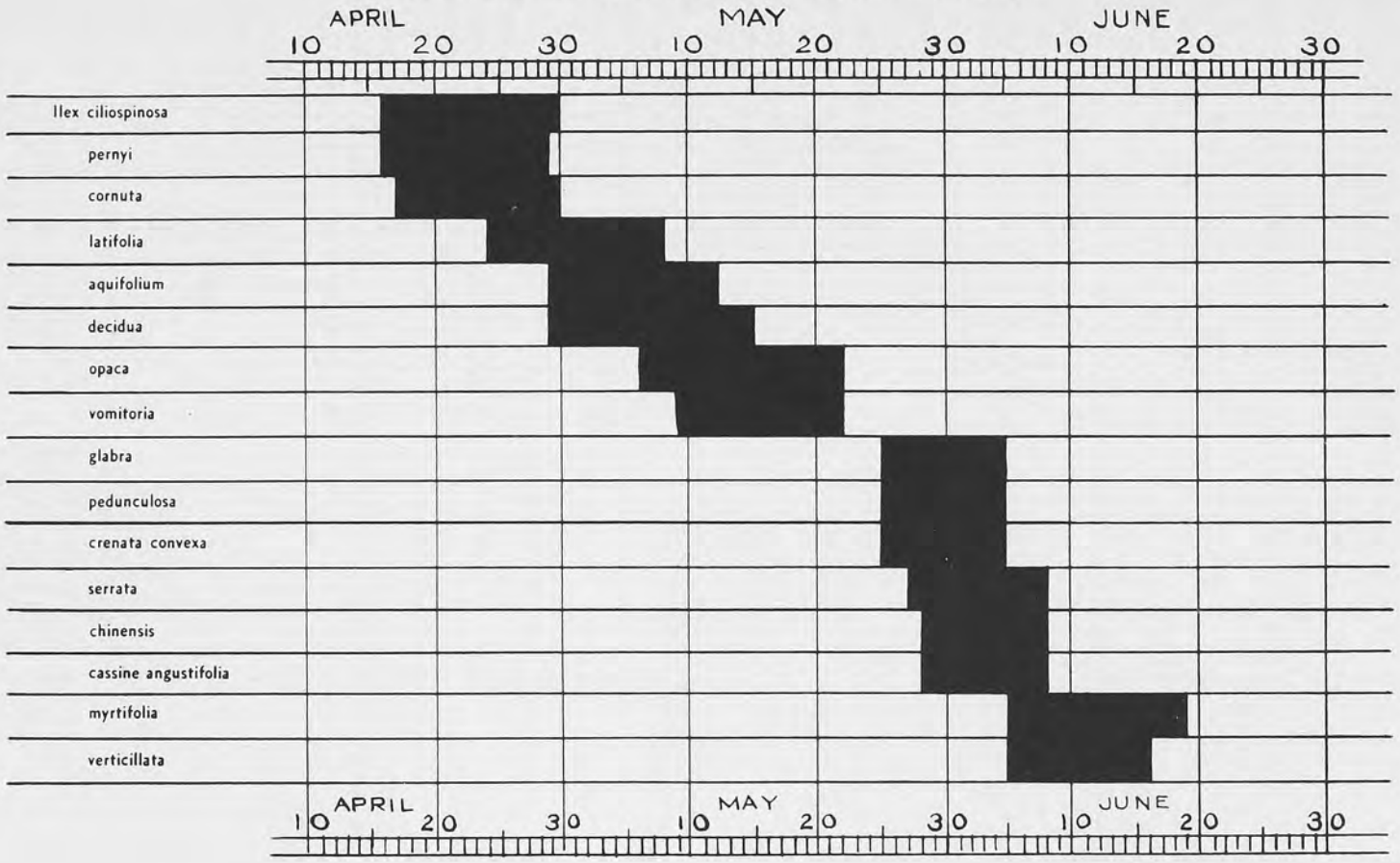
Seedlings are more adaptable as understock than are plants from cuttings, because they generally have a deeper penetrating root system. Understock should be selected for its adaptability to the soil and other conditions in which they are to be planted. Plant hardiness and the type of root growth should be taken into consideration. A large, heavy type of tree, such as *I. opaca* or *I. aquifolium*, should not be budded or grafted onto the root portion of *I. verticillata* or similar type. *Ilex opaca* and *I. decidua* make good understock.

Grafting or budding would be desirable in placing a male twig onto a female tree for pollination; to obtain a bush or tree with both red and yellow berries; to grow very hard-to-root species or cultivars on root systems which are better adapted to local soil conditions. Scarce material for propagating purposes can be budded and by this method more plants can be obtained than by any other method. It would even be possible to have a number of cultivars budded or grafted to one specimen.

Cleft, side, and whip grafts, inverted and shield or chip budding are the methods most frequently employed. It is recommended that those who are interested in learning about these practices consult books and articles on the subject —all apply to the propagation of holly.

Mr. Hartline is owner of Hartline's Holly Nursery, member and past president of the Illinois State Horticultural Society, member of the Holly Society of America, Inc., and past president of its Great Rivers Chapter.

Flowering Sequence of Holly Species at the National Arboretum



Recorded by William F. Kosar, geneticist
United States National Arboretum
Washington, D.C.

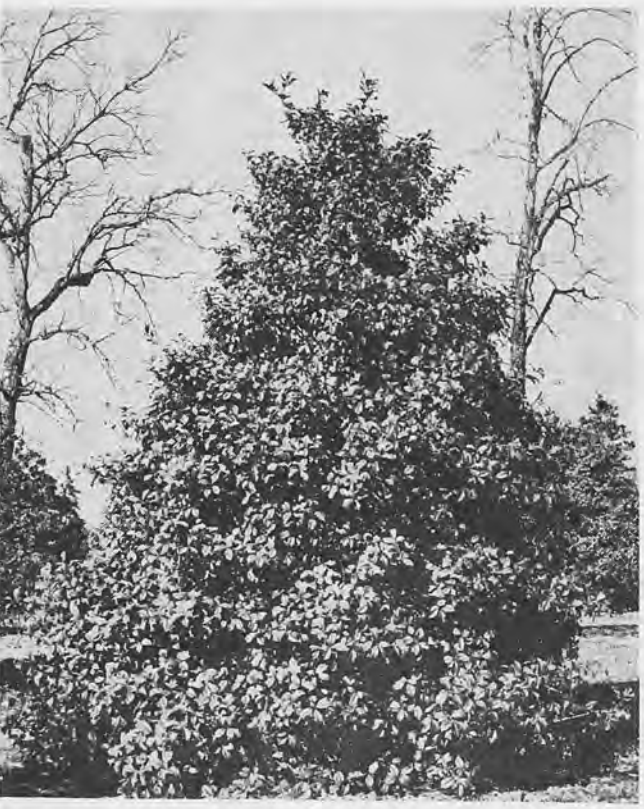
Hybridizing Hollies

ELWIN R. ORTON

ALL PHOTOS RUTGERS UNIVERSITY—V. ABBATIELLO

The fine specimens of American hollies, illustrated on this and the opposite page, are growing in the Holly Arboretum, Rutgers—the State University, New Brunswick, New Jersey.

Above, *Ilex opaca* 'Manig'. Below, *I. opaca* 'Farage'.



The development of new cultivars which are novel and/or superior to those presently available in the commercial trade is the primary objective of current programs of holly hybridization. Interest in and support for such programs result from an increased awareness on the part of plantsmen of the potential value of hollies to the nursery industry, as well as from an increased demand by holly growers and home owners for attractive hollies to use in orcharding and landscaping. An interim report (1969) of the International Checklist of Hollies Committee lists 2,600 cultivar names of hollies recorded in nursery catalogs and various horticultural and botanical publications. The vast majority of these hollies are selections from the wild; only a very few have ever received widespread distribution and/or acceptance.

Evaluation of Cultivars

The disparity between the number of hollies which have been given cultivar names and the number which have proven worthy of commercial production attests to the need for thorough testing of current and future cultivars.

A cultivar performance trial is an essential starting point of any plant breeding program. Such trials make it possible to evaluate plants of existing cultivars under reasonably uniform conditions at each test site and, thus, to assess the genetic variability present within the cultivated plants of the species of interest. Performance trials also provide parent material for hybridization and various standards of comparison for evaluating new selections from the wild as well as any seedlings resulting from controlled matings in the breeding program.

Fortunately, numerous test sites have been established in recent years. Certain plantings of holly have been designated

Official Holly Arboreta and others Official Holly Test Centers by the Holly Society of America, Inc. (These are listed elsewhere in this Handbook.) The best cultivars in such collections as these, plus the more recent introductions of *Ilex* from regions of the world to which hollies are indigenous, constitute the basic raw materials for holly breeding programs now in progress.

Objectives

The specific objectives of a holly breeding program vary with the breeder, the plant species, and the climatic considerations. One purpose may be to develop cultivars which thrive beyond the natural geographic range of plants of that species: considerable work is being devoted to the development of cultivars of American holly (*Ilex opaca* Ait.) which will survive lower winter temperatures than are encountered in the areas to which plants of this species are indigenous. Similarly, breeders are attempting to develop cultivars of English holly (*Ilex aquifolium* L.) which will thrive under the relatively hot and dry climatic conditions of the Southeast. Another goal of the plant breeder may be to develop cultivars which possess characteristics quite novel to plants of a particular species. The development of cultivars which exhibit habits of growth similar to various clones of *I. crenata* Thunb. and I. *glabra* (L) Gray, but which produce brilliant red fruit as opposed to the inconspicuous black fruit typical of plants of these species is another objective of current breeding work at several institutions.

Genetic Variability

Close examination of the hollies in a performance trial reveals tremendous variability between clones in regard to nearly every plant characteristic of interest to horticulturists. Some of this variability is due to nonuniformity of soil conditions or of site exposure within the test area and is environmental in nature; but much of the variation observed is the result of differences in the hereditary constitution of the plant material. This wealth of naturally occur-

Above, *Ilex opaca* 'Judge Brown'. Below *I. opaca* 'Jersey Knight'.

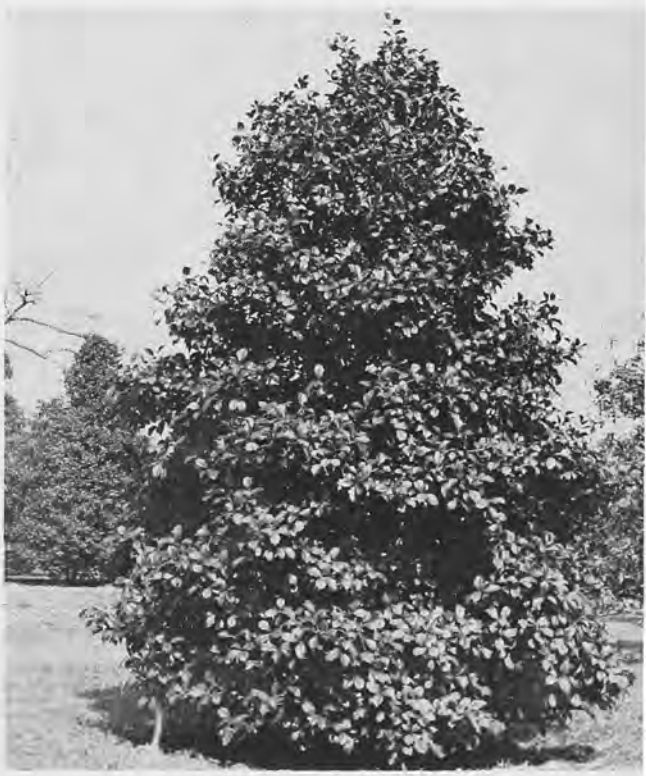


Illustration 1—sex expression in *Ilex opaca*. Left, female flowers characterized by enlarged pistil surrounded by rudimentary stamens. Right, male flowers characterized by well-developed stamens surrounding a rudimentary pistil.

ring genetic variability, which is present within each species of *Ilex*, is sufficient for the needs of the plant breeder. Thus, the potential for developing new and superior cultivars of holly in a well-planned program of hybridization and selection is very good.

Sex Expression

The heterozygosity of the genic material of hollies is a natural result of the dioecious nature of the crop: with minor exceptions, hollies are exclusively male or female and cross-pollination is the rule.

Differences in floral structure and habit of flowering exist between various species of *Ilex*. The following description of flowers of American holly (*I. opaca*) will serve to illustrate the basic differences between male and female flowers of holly. The female flowers arise singly and consist of a well-developed pistil (small green knob terminated by a conspicuous stigmatic surface) surrounded by four small, white petals (see Illustration 1). The male flowers are usually borne three on a stalk; the green center portion (aborted pistil) is much smaller than that of a female flower (see Illustration 1). Furthermore the male flowers are characterized by the presence of plump, yellow anthers (sacs), which release a sticky mass of pollen when the flowers are fully open. Each yellow anther is supported by a thin, whitish filament which arises near the base of a petal. The anthers are present in female flowers, but they remain undeveloped and do not produce pollen.

Pollination Techniques

In addition to insuring ample genetic variability for the plant breeder to manipulate, the dioecious nature of hollies simplifies the mechanics of achieving controlled pollinations. All that is required to achieve a mating of known parentage is to transfer pollen from the anthers of a male flower to the stigmatic surface of the pistil of a female flower under conditions which prevent the introduction of foreign pollen. This is readily achieved under greenhouse conditions by the use of small, potted flowering plants of the two parent selections.

Several days before the flowers are expected to open, a wire cage covered with a fine grade of cheesecloth is placed over the plants to exclude insects which may be present in the greenhouse. After the flowers have opened, the cloth cage is removed to permit the pollinator to detach flowers from the male plant with a pair of forceps and lightly touch, or brush, the pollen-bearing anthers to the viscid stigmatic surface of the pistil of each female flower. The cage is then replaced over the plants for a week or 10 days, or until all danger of contamination is past. Screening the greenhouse and fumigating with an insecticide before the season of such pollination work to exclude insects are simple precautions

which further reduce the possibility of unplanned crosses by insects.

With large field-grown plants, each flower-bearing branch selected for hybridization work can be enclosed within a small, water-resistant kraft bag to exclude insects which might bring in foreign pollen. It is important that both the male and female flowers be protected. Should male flowers be open at the time of bagging foreign pollen may be present as a result of previous visits by bees or other insects. This is of no concern, since pollen shed this early would not be expected to be viable by the time pollen is collected for the controlled crosses. However, any female flowers which are open must be removed before bagging. After bagging, a small piece of nonabsorbent cotton is wrapped around the stem of the branch just inside the open end of the bag; a "Twistem" will suffice to close the bag over the cotton and thus prevent insects from entering the bag. A record tag is then attached to the branch just below the base of the protective bag. This tag is marked to indicate the number of flowers enclosed within the bag and the date the bag was attached.

Three to seven days later, depending on weather, the bag is removed and the desired pollinations are accomplished. A single male flower can generally be used to pollinate four or five female flowers. If the number of male flowers is very limited, an individual anther, rather than the whole flower. can be handled with the aid of forceps. With care, as many as 30 or more female flowers can be pollinated with one male flower. The pollinator should keep a wide-mouthed bottle containing 70 percent ethyl alcohol at hand for cleansing his hands periodically and also any pollinating tools to lessen the danger of contamination. It is very essential, of course, to follow this procedure when changing from one pollen parent to another.

Female flowers which have not opened at the time of pollination should be removed. Immediately upon completion of the desired pollinations, the bags should be replaced over the flowering branch and kept intact for seven to ten days, or until the female flowers are no longer receptive. The protective bags can then be safely removed. At this stage, most of the petals will appear discolored, and the stigmatic surface of the pistil will appear dry and darkened in color. If any female flowers remain fresh in appearance at the time of unbagging, they should be removed. The number of pollinated flowers remaining on the branch should be recorded for future reference.

Handling Seed and Seedlings

Early in the fall, it is desirable to bag the fruited branches to prevent birds or other wildlife from pilfering the ripening fruit. Harvesting can begin as soon as the fruits are well-pigmented. The number of fruits harvested from each branch should be recorded. The pulp should be cleaned from the seed soon after harvesting. With only a few fruits, the seed can be cleaned by squeezing the contents of the fruits onto absorbent paper toweling and wiping off any fruit pulp which adheres to the seed. With large numbers of fruits, the fruits can be macerated in a container of water and allowed to ferment. After a few days the viable seed will separate from the pulp and sink to the bottom of the container. If the seed possesses a hard seed-coat, the seed can be cleaned quickly in a waring blendor. Reversing the cutting edge of the blades will help to reduce damage to the seed.

It is best to plant the seed immediately after extraction from the fruit. Milled sphagnum moss or a mixture of milled sphagnum moss and coarse sand is satisfactory medium for seed germination. If weather or other circumstances make it necessary to store the seed for planting at a later date, the seed can be mixed in a small packet of moist sphagnum moss and coarse sand (50-50 mixture), placed in a small plastic bag, and stored at a temperature of 38° F until planted. Seedlings can be safely transplanted to a light soil mixture as soon as the first true leaves appear. Freshly transplanted seed-

lings are readily established and maintained in 2-1/4-inch pots until they are sufficiently large to warrant transplanting to six-inch containers. Subsequent handling of the seedlings will depend upon the nature of the cross and the intended use of the seedlings. If the objective is to be expected in seedlings of the first generation, the plants can be field-planted directly from six-inch containers; if the F_1 seedlings are produced solely to provide a means of obtaining subsequent generations and the F_1 plants are not expected to survive under field conditions, they should be maintained under greenhouse conditions.

Intraspecific Hybridization

Hybridization between holly clones of the same species (intraspecific) is relatively simple. A given species of *Ilex* may include an array of morphologically and physiologically diverse genetic types, but a similarity of genes or a more or less free interchange of genes is maintained between individuals within the species. Thus, sterility barriers are relatively uncommon in crosses between different clones of the same species. Controlled crosses, conducted within a carefully planned schedule of matings, of select clones followed by critical evaluation of large populations of seedlings over an extended period of time constitute the essentials of such a program. Once a truly superior plant has been identified, many plants of the same genotype can be produced by asexual means (primarily stem cuttings). There is no need to stabilize the breeding behavior of the hybrid as is usual with crops which are propagated by seed.

Interspecific Hybridization

Interspecific hybridization is usually more difficult than intraspecific hybridization, since the former involves the crossing of plants of different species, each of which was produced by some form of reproductive isolation which prevented or restricted the exchange of genes between the members of different species.

The initial concern in programs of interspecific hybridization is whether F_1 hybrid plants can be obtained. Chromosome numbers of plants of various species are often a basis for deciding which interspecific crosses might succeed. The following information on chromosome numbers in *Ilex* is provided by John L. Frierson's doctoral dissertation, entitled "Cytotaxonomic study of selected indigenous and introduced species of the genus *Ilex* commonly grown in the United States."

SPECIES OF ILEX	SOMATIC CHROMOSOME NO.	
I. aquifolium L.	40	
I. cassine L.	40	
I. chinensis Sims.	40	
I. ciliospinosa Loes.	40	
I. cornuta Lindl. & Paxton	40	
I. crenata Thunb.	40	
I. glabra (L.) Gray	40	
I. integra Thunb.	40	80?
I. latifolia Thunb.	40	80?
I. liukiuensis Loes.	40	
I. montana Torr. & Gray	40	
I. mutchagara Makino	40	
I. myrtifolia Walt.	40	
I. opaca Ait.	40	
I. paraguariensis St. Hil.	40	
I. pedunculosa Miq.	110	
I. pernyi Franch.	40	
I. rotunda Thunb.	40	
I. serrata Thunb.	40	
I. vomitoria Ait.	40	

? cells containing 80 chromosomes were infrequent.

On the basis of the above chromosome numbers, one would anticipate that crosses of plants of *I. pedunculosa* with plants of any of the other 19 species tested would be unsuccessful. However, the fact that 19 of the species reportedly possess 40 somatic chromosomes provides no assurance that any two of these species will produce viable F_1 hybrids. This can only be determined by a trial-and-error approach. Even though an initial cross may be compatible, sterility may be encountered in the hybrid plants. The degree of sterility may bear little or no relationship to morphological similarities of parent plants or to the vigor of the F_1 seedlings.

Sterility in interspecific hybrids may be broadly categorized as genic or chro-

mosomal, or both, in nature. The chromosomes of plants of different species may possess similar genic material, but the arrangement of the genic material in the chromosomes may be quite different. Interference with the normal meiotic process may occur in hybrids which possess nonhomologous parental chromosomes. Sterility resulting from such interference is considered chromosomal in origin. Genic sterility includes all types of sterility resulting from a disturbance, or breakdown, of the harmonious gene combinations, which have been achieved within the genetic system of each parent species over a period of thousands of years.

From a practical point of view, it matters little whether any sterility is labeled chromosomal or genic in nature. However, it is important to recognize that sterility is not uncommon in interspecific hybrids, since these hybrids bridge a natural barrier or system of barriers of reproductive isolation. Nevertheless, interspecific hybridization has made important contributions to the list of ornamental plants, including hollies, which are grown commercially.

Future success in the use of controlled interspecific hybridization to develop new cultivars of hollies will probably be achieved in the following ways:

1. Through the selection, and vegetative propagation, of an attractive F_1 hybrid seedling which exhibits vigorous growth and is sufficiently fertile to provide for the production of a satisfactory display of fruit. Such individuals would be expected to be intermediate in appearance to the parent plants in most characteristics of horticultural interest (see Illustration 2), but considerable variation among the seedlings may be evident (see Illustration 3). The vast majority of hollies of interspecific origin in the trade at present are F_1 hybrids.

2. Through the selection of a partially fertile F_1 hybrid, followed by repeated backcrossing to one of the parent plants to transfer genes conditioning a specific characteristic. This approach is being utilized by holly breeders in an attempt to incorporate the red fruit characteristic of various species into plants of *I. crenata* type as well as *I. glabra* type (see Illustration 4). When a high degree of sterility is encountered in the F_1 hybrids, the chance of success in obtaining backcross progeny is better if the hybrid plants are used as the female parent, since female gametogenesis is less easily upset by chromosomal disharmonies than is male gametogenesis.

3. Through the "sibbing" (brother-sister mating) of relatively fertile F_1 hybrids to obtain a large F_2 population. This approach is being utilized in an

Illustration 2, *Ilex glabra* 'Ivory Queen' (left) crossed with *I. crenata* 'John Nosal' (right and resulting F_1 hybrid (center).

Illustration 3, *Ilex cassine* var. *angustifolia* (left) crossed with *I. sugerokii* (right) and resulting hybrids. Note the variation among the seedlings.

attempt to develop hybrid cultivars which possess a degree of winter hardiness equal to that of the better clones of *I. opaca* in combination with the attractive foliage and fruiting characteristics of *I. aquifolium* (see Illustration 5). Since a tremendous diversity of types can be expected to appear in the F_2 generation as a result of the extreme heterozygosity of the F_1 interspecific hybrids, the possibility exists that novel types unlike either parent will be present. Such types can be perpetuated by asexual propagation. It should be noted that the variation present in certain F_2 populations may be similar to that resulting from backcross matings to one or the other parent. This situation may occur if a high proportion of the male gametes are nonviable; in such cases, it is very likely that the few male gametes which are functional are those gametes which are genotypically similar to the gametes produced by one or the other of the parent plants.

4. Through the hybridization of F_1 interspecific hybrids with plants of a third species or with interspecific hybrids of a different origin (see *Ilex* × 'Clusterberry' under the subhead "Interspecific Hybrids"). Many hybrids involving three or more species of *Ilex* are being tested in various parts of the country. New introductions of this type will undoubtedly be introduced to the trade in the near future.

Seedling Evaluation

Once field plantings are established, selection of the better seedlings becomes the primary concern. Various procedures for increasing selection pressure to aid in evaluating the seedlings for specific plant characteristics may be useful. A planting site which provides maximum exposure to the elements can be used to advantage, if winter hardiness is a major consideration. Similarly, if natural resistance to insects of a particular species is of interest, measures can be taken to help insure a heavy infestation of that pest in the field plantings. For example, in evaluating a population of seedlings of *I. crenata* for resistance to mites, an annual spray of "Sevin," applied early in the spring, will kill many

of the natural predators of mites and aid in establishing the desired infestation within the planting. In any event, the major task for the holly breeder is repeated evaluation of the seedlings to eliminate the least desirable plants as quickly as possible. Each new evaluation of the remaining seedlings must be progressively more critical. It is not sufficient that the seedlings are attractive plants: with the exception of distinctly novel types, only those seedlings which *appear* equal to, and preferably superior to, plants of the best cultivars available in the trade warrant propagation and further evaluation. Throughout the period of selection and evaluation, the breeder should remain attentive to the possibility of detecting "bud sports," which may have direct commercial value. Many of the variegated hollies now in production trace to a single mutant branch selected and propagated by an observant holly grower.

Hollies propagated for additional testing should be planted at numerous locations to permit evaluation of each selection under varied soil types and climatic conditions. At each test site, evaluation of the seedling selections should include comparisons with the standard cultivars known to perform well in that area. Only selections which prove to be superior to, or equal to, but distinctly different from, the standard cultivars should be introduced as new cultivars.

Aids to Pollination

Interspecific hybridization often involves the crossing of plants which normally flower at different times during the year. Coincident periods of bloom, which avoid the necessity of using stored pollen, can generally be obtained by using small container-grown plants; these are readily shifted from one set of environmental conditions to another. The period of bloom of an early flowering species can be delayed by holding dormant plants at a temperature of 38°F for the appropriate period of time. Conversely, the period of bloom of a late-flowering species can be advanced by moving small plants into a warm greenhouse before the onset of the normal growing season. Normally the male plants are manipulated in this manner, since a small, container-grown male

Illustration 4, *Ilex crenata* 'Mariesii' (left) crossed with *I. yunnanensis* (right) and a resulting F_1 hybrid. Characteristics of both parents are evident in the twig and foliage characteristics of the seedling (center).

Illustration 5. *Ilex opaca* 'Hedgeholly' (left) crossed with *I. aquifolium* (right) and resulting F_1 hybrids. Abnormal plants, such as the genetic dwarf illustrated in the center, appear frequently among progeny from interspecific hybridization.

plant will produce sufficient pollen to pollinate a large, field-grown female plant.

Where female plants to be pollinated are maintained in a greenhouse during the early spring months, a steady supply of pollen can often be obtained from freshly rooted cuttings of the male parent. Cuttings of *I. opaca,* for example, usually produce new growth and flower shortly after rooting if held at 70-80° F under long-day conditions. If rooting is accomplished in 2-1/4-inch or three-inch peat pots, the plants are readily transferred to other areas of the greenhouse where they can be forced into flower, as desired, by varying the temperature and supplemental lighting. Thus, a constant supply of fresh pollen from one male parent becomes available over a period of two to three months. This procedure is especially useful if one- and two-year old, container-grown plants are not available for forcing at various times throughout the spring.

Special Techniques

MUTATION BREEDING. Numerous chemical mutagens, as well as high energy radiation, have been used in breeding programs with various crops. Such treatments have been used in an attempt to induce *additional* genetic variability of value to the plant breeder. In hollies, the naturally occurring genetic variability present within each species is so great that plant breeders have scarcely begun to study the diversity of forms which can be obtained through the standard techniques of intraspecific hybridization. Thus, there is little need to resort to mutagenic agents in present holly breed-

ing programs.

INDUCED POLYPLOIDY. The use of colchicine to induce chromosome doubling to obtain tetraploid or octoploid plants has been highly publicized, even though this technique has not resulted in the direct production of many superior cultivars. Since the genetic variability exhibited by diploid cultivars of holly provides such promising potential for plant improvement, holly breeders have had little reason to investigate induced polyploidy as a direct means of producing superior hollies. Induced polyploidy may prove of some value in the direct production of novel cultivars of hollies but, with the increasing use of interspecific hybridization, the primary value of induced polyploidy in holly breeding is more likely to come from using colchicine to double the chromosome complement of sterile interspecific hybrids to produce fertile amphidiploids.

Future Possibilities

EMBRYO CULTURE. The culturing of embryos on nutrient agar under sterile conditions is often cited as a means of accelerating breeding work with plant species which normally exhibit an extended period of seed dormancy. Seeds of *I. opaca*, for example, contain immature embryos which yield an extremely delayed and distributed pattern of germination. In tests conducted at Rutgers University, seed lots of *I. opaca* usually produce an initial flush of emerging seedlings 13 to 14 months after planting under greenhouse conditions, with subsequent flushes of germination at yearly intervals for the next two to four years. Refinements of experimental embryo culture techniques, which would enable one to appreciably shorten this period of germination, would accelerate the breeding of plants of *I. opaca*. However, the most time-consuming aspect of holly breeding is the period devoted to seedling selection, propagation, and further testing at additional sites before the final selection and introduction of superior plants. Accelerated germination of the seed would be advantageous, but in the final analysis holly breeding will still remain a long-range program.

POLLEN CULTURE—Haploid plants (with gametic number of chromosomes) of tobacco and tomato have been grown from pollen grains cultured on nutrient agar under aseptic conditions. Proper treatment of these haploid plants with colchicine induces chromosome doubling and produces diploid tobacco and tomato plants. These auto-diploids, by definition, possess two identical sets of chromosomes and exhibit a high degree of homozygosity (theoretically 100 percent). If similar techniques for culturing plants from pollen grains are developed for woody plant species, holly breeders will have a powerful new tool. Completely homozygous lines could be obtained in one generation. This would greatly facilitate inheritance studies and make it possible to produce uniform hybrid lines from seed.

Interspecific Hybrids

Plants found in the wild and described as naturally occurring interspecific hybrids are listed below:

Ilex × *kuisiana* Hatusima (= *I. buergeri* × *I. integra*)

Ilex × *makinoi* Hara (= *I. leucoclada* × *I. rugosa*)

Ilex × *attenuata* Ashe (= *I. cassine* × *I. opaca*)

Some of the putative, or suspected, interspecific hybrids listed in the trade are presented below. Although there is little reason to question the hybrid nature of the plants in this grouping the term "putative hybrid" is applied, since these clones originated in cultivation as seedling selections and did not result from controlled crosses. Male and female plants are designated (M) and (F), respectively. The name of the originator is given for each cultivar.

Ilex × *altaclarensis* (Dallim.) Rehd. (= *aquifolium* × *perado*)
many cultivars, including 'Camelliaefolia', 'James G. Esson', and 'Pyramidalis'

Ilex × *aquipernyi* Gable (= *aquifolium* × *pernyi*)
'Aquipern' (M), (Joseph Gable, Stewartstown, Pa.

Ilex × *attenuata* Ashe

'East Palatka' (F); Hume #1 (F); Hume #2 (F), (the late Dr. H. Harold Hume, Gainesville, Fla.).

Ilex × *koehneana* Loes.
(= *aquifolium* × *latifolia*)
'Wirt L. Winn' (F), H.S. of A. Reg. No. 5-66 (Winn Nursery, Norfolk, Va.).
'Chieftain' (M), H.S. of A. Reg. No. 1-67 (Stewart H. Mclean, Baltimore, Md.).

Ilex aquifolium × *cornuta*
'Nellie R. Stevens' (F), H.S. of A. Reg. No. 8-67;
'Edward J. Stevens' (M), H.S. of A. Reg. No. 9-67;
'Maplehurst' (M), H.S. of A. Reg. No. 10-67 (Gustav A. van Lennep, St. Michaels, Md.).

Interspecific hybrids, which have been obtained as a result of controlled matings and are now, or soon will be, available to the commercial trade, are listed below.

Ilex cornuta 'Burfordii' × *pernyi*
'Lydia Morris' (F), H.S. of A. Reg. No. 7-61;
'John T. Morris' (M), H.S. of A. Reg. No. 8-61 (Dr. Henry T. Skinner, U.S. National Arboretum, Washington, D.C.).

Ilex × *meserveae* S.Y. Hu
(= *I. rugosa* × *I. aquifolium*)
'Blue Girl' (F), Plant Patent No. 2434;
'Blue Boy' (M), Plant Patent No. 2435 (Mrs. Kathleen K. Meserve, St. James, Long Island, N.Y.).

Ilex myrtifolia × *opaca* F_2
'Tanager' (F), H.S. of A. Reg. No. 3-65;
'Oriole' (F), H.S. of A. Reg. No. 4-66 (William F. Kosar, U.S. National Arboretum, Washington, D.C.).

Ilex myrtifolia × *opaca*
'Monongahela' (F), H.S. of A. Reg. No. 2-66 (Dr. O. M. Neal, West Virginia University, Morgantown, W.Va.).

Ilex × 'Nellie R. Stevens' × *leucoclada*
'Clusterberry' (F), H.S. of A. Reg. No. 3-66 (William F. Kosar, U.S. National Arboretum, Washington, D.C.).

Ilex integra × *pernyi*
'Elegance' (F), H.S. of A. Reg. No. 6-66;
'Accent' (M), H.S. of A. Reg. No. 7-66 (William F. Kosar, U.S. National Arboretum, Washington, D.C.).

Ilex × *koehneana*
'Ruby' (F), H.S. of A. Reg. No. 3-67;
'Jade' (M), H.S. of A. Reg. No. 4-67 (William F. Kosar, U.S. National Arboretum, Washington, D.C.).

Ilex pernyi × *ciliospinosa*
'Byam K. Stevens' (F), H.S. of A. Reg. No. 11-67 (Tom Dilatush, Robbinsville, N.J.).

Ilex cornuta × *ciliospinosa*
'Albert Close' (F), H.S. of A. Reg. No. 1-69;
'William Cowgill' (F), H.S. of A. Reg. No. 2-69;
'Howard Dorsett' (M), H.S. of A. Reg. No. 3-69;
'Edward Goucher' (F), H.S. of A. Reg. No. 4-69;
'Harry Gunning' (M), H.S. of A. Reg. No. 5-69 (Dr. William L. Ackerman and Dr. John L. Creech, U.S. Plant Introduction Station, Glenn Dale, Md.).

Ilex serrata × *verticillata*
'Autumn Glow' (F), H.S. of A. Reg. No. 7-69;
'Harvest Red' (F), H.S. of A. Reg. No. 8-69 (Dr. Elwin R. Orton, Jr., Rutgers University, New Brunswick, N.J.).

The 20 cultivars named above attest to the success that has been achieved in initial efforts at holly hybridizing. Species of holly exhibit generation cycles ranging from three to ten years, so breeding programs are still in their infancy and many new hybrids will be forthcoming.

The most extensive holly breeding programs at present are being conducted at the U. S. National Arboretum and at Rutgers University—The State University of New Jersey. Since these programs involve extensive field trials and years of evaluation, it is appropriate that this work be conducted at state and federally supported institutions which can provide both the facilities and the continuity of personnel essential to long-range breeding programs. If no addi-

tional crosses were made in either of the breeding programs cited, another 20 years would be required to assess properly the plant material now on hand. Cultivars of holly from controlled crosses in carefully planned programs of hybridization will undoubtedly merit prominence among commercial hollies of the future.

Elwin R. Orton, Jr., is an associate research professor at Rutgers University—The State University of New Jersey, New Brunswick. He is in charge of the woody ornamentals breeding program in the Department of Horticulture and Forestry and is conducting extensive hybridization studies with plants of the genus *Ilex*. Dr. Orton is editor of *Holly Letter* and of the *Proceedings* of the Holly Society of America, Inc.

Diseases of Holly in the Eastern United States

J. L. PETERSON

Holly has been cultivated for many years in the eastern United States. Usually plants grown so intensively in a given area are plagued by one or more serious diseases. Fortunately, however, diseases of this plant generally have not been serious. This is not to say that diseases are never a problem on holly. Although many organisms occur on holly, a large number of these appear as secondary organisms living on weakened or dead portions of the plant. Nearly all holly diseases are caused by fungi or unfavorable environmental conditions. A bacterial disease of holly has been reported from Massachusetts but apparently has not spread from the original area of description. No virus diseases have yet been reported on holly in the United States. Although several nematodes are known to be associated with holly roots, evidence at this time indicates only a few nematodes definitely contribute to the decline of holly. The root-knot nematode, *Meloidogyne,* and species of *Pratylenchus* are most destructive particularly in the Southeast.

The following diseases are considered the most prevalent and serious on holly in the East.

LEAF SPOTS. Tar spot, caused by the fungus *Phacidium,* is one of the more commonly observed leaf-spot diseases. Yellow spots appear on the leaves early in summer and generally turn reddish brown as the season progresses. By fall, small tarlike spots appear in the discolored areas (Figure 1). The disease is more severe during prolonged wet seasons or along shore areas. Avoiding plant crowding and pruning to improve air circulation in the lower branches will reduce the disease. Spraying the trees with ferbam or diclone fungicides at ten to 14-day intervals, when new leaves appear in the spring, is recommended for disease control. Copper fungicides, also recommended, will cause injury to holly in some locations. The practice of removing old leaves from the tree area as a sanitary measure will also reduce the disease potential.

Several other fungus leaf-spot diseases occur periodically, appearing as light tan to dark brown spots. Species of the fungi *Cercospora, Gloeosporium, Phyllosticta,* and *Macrophoma* most commonly cause these diseases. In general, such fungicides as ferbam, zineb, or maneb, together with the above-mentioned cultural practices, will help control these diseases.

Many leaf problems are caused by unfavorable environmental factors. Spine spot, caused by leaf spines puncturing adjacent leaves, is common. Young, tender leaves are easily punctured by the spines of older leaves as they rustle on windy days. The spots, found on either surface of the leaf, at first are very small but usually enlarge and appear tannish with purple margins as the leaf ages (Figure 2). Scald may appear on leaves as light tan to gray lesions up to one inch in diameter and with well-defined margins. (Figure 3) Hot, direct sunlight drying the tissue of succulent leaves will induce this disease.

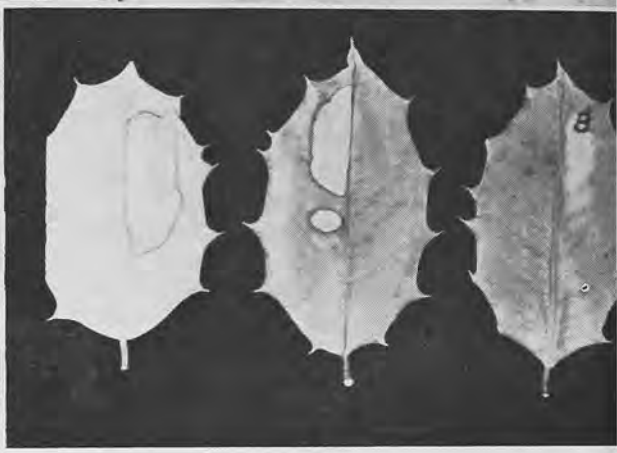


Figure 1, tar spot; figure 2, spine spot; figure 3, holly scald; and figure 4, purple blotch.

Secondary fungi eventually cover these lesions and are often thought to be the cause. Purple blotch of leaves is apparently due to a genetic weakness of certain holly cultivars and occurs whenever cultivars with this inherent weakness are grown. The purple blotches are of various sizes and will disfigure the leaves (Figure 4). Edema, another leaf disorder, appears as small, brown, corky, raised spots on lower leaf surfaces. This condition is a plant response to high soil moisture and extended cloudy, humid periods. Scorch or marginal leaf burning is quite common near the seashore. (Figure 5) This condition is thought to be caused by a high salt content in the soil or on the leaves. Salt is deposited in the area by winds blowing in from the ocean. A similar condition may occur when holly is grown in windswept, dry areas. Leaves tend to wilt and develop a marginal browning because of insufficient moisture from the roots.

CANKERS AND DIE-BACK. Cankers are characterized by sunken, cracked areas on stems or limbs (Figure 6). The fungi *Botryosphaeria, Nectria,* and *Phomopsis,* which commonly cause these diseases, generally enter through wounds in the bark. Twig and branch die-back, usually associated with cankers, may also be caused by these fungi. Removal of the affected limbs by pruning well below the canker area will help control these diseases. Pruning cuts should be covered with a tree-wound paint.

GRAY MOLD. During prolonged moist weather the fungus *Botrytis* can cause a blossom blight of holly. In severe cases, the fungus will spread to adjacent leaves and twigs causing a die-back. (Figure 7) Because of the nature of the disease, sprays for control have not been too effective. A few days of dry weather will stop the fungus spread.

DAMPING-OFF AND ROOT-ROT. This disease, generally caused by *Rhizoctonia,* will affect seedlings or cuttings in propagating benches. Plants may rot at the soil level or at the base of the cuttings. Careful sterilizing of propagating medium and benches, keeping the propagating medium on the dry side, spacing the cuttings for better air circulation, and

Figure 5, holly scorch; figure 6, botryosphaeria canker; figure 7, gray mold, and figure 8, sooty mold.

drenching the plants and soil with "Captan" twice at a 14-day interval will help reduce disease spread.

WOOD-ROT. Large, conspicuous fungi often appear on dead or dying holly branches. These are secondary fungi which rot wood previously killed by some other cause. *Polyporous, Schizophyllum, Poria,* and *Stereum* are commonly encountered fungi. Where possible, it is best to prune out the dead wood of affected holly.

SOOTY MOLD. A superficial black soot-like covering on the upper surfaces of leaves is caused by *Fumago* and other species of fungi (Figure 8). The unsightly covering can be easily rubbed off the leaf. The leaf is not directly damaged, since the fungi live on insect droppings or "honeydew" covering the leaf surface. Leaves may tend to yellow beneath the heavy sooty coverings. Ridding the area of "honeydew"-producing insects, such as aphids or scales, with appropriate insecticides will reduce the sooty mold problem. These insects can be located in the upper holly branches or in overhanging trees.

LEAF-DROP AND BROWNING. Holly leaves may often turn yellow or brown and fall. This may be caused by natural leaf drop, severe drought periods, or winter injury. If the holly is subject to a severe drought during summer, leaf-drop may be particularly noticeable the following spring. During cold windy winters, unprotected holly may lose leaves and branches fail to leaf out the following year. Continued severe winters may cause susceptible plants to die eventually. Since holly cultivars differ in winter hardiness, it is best to select cultivars which are adapted to the particular area.

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Pests of Holly in the Eastern United States

HERBERT T. STREU and LOUIS M. VASVARY

This paper is a revision of the paper "Holly Pests in the East" published by the late Clyde C. Hamilton, that appeared in the 1957 special issue of the *National Horticultural Magazine*, Vol. 36, *Handbook of Hollies*.

There are approximately thirty insects and mites which have been listed as pasts of holly in the East. Of these, however, only a few are considered serious problems in the growing of holly. Several more are of concern to home owners with one or more different hollies in the home landscape.

Hamilton (1957) listed the following pests of hollies in the East:

Spider Mites:
- *Oligonychus ilicis* (McGregor)—the southern red mite

Scale Insects:
- *Aspidiotus pseudospinosus* Woglum—rhododendron scale
- *Aspidiotus hederae* (Vallet)—oleander scale
- *Aspidiotus juglansregiae* Comstock—walnut scale
- *Asterolecanium puteanum* Russell—holly pitmaking scale
- *Coccus hesperidium* L.—brown soft scale
- *Lecanium corni* Bouché—European fruit lecanium

Aphids:
- *Macrosiphum rosae* (L.)—rose aphid

Mealybugs:
- *Pseudococcus comstocki* (Kuwana)—Comstock mealybug

Whitefly:
- *Tetraleurodes mori* (Quaintance)—mulberry whitefly

Leaf or Berry Miners:
- *Phytomyza ilicis* (Curtis)—holly leafminer
- *Phytomyza ilicicola* Loew—native holly leafminer
- *Rhopobota naevana ilicifoliana* Kearfort—holly bud moth
- *Asphondylia ilicicola* Foote—holly midge

Leafeaters:
- *Popillia japonica* Newman—Japanese beetle
- *Epicaudata pennsylvanica* (DeGeer)—black blister beetle
- *Porthetria dispar* (L.)—gypsy moth
- *Pseudocnerorhinus bifasciatus* Roelofs—Japanese weevil
- Grasshoppers—several species

Root feeders:
- *Brachyrhinus sulcatus* (Fabricius)—black vine weevil

Borers:
- *Xylosandrus germanus* (Bldfd.)—ambrosia beetle

Hamilton (1957) also listed as pests an unidentified species of scale *Aspidiotus* (which he later, in 1959, named "near *Aspidiotus ansylus*") as well as "*Phytomyza weidhausii*," a leaf miner reared from *Ilex glabra*. However, in his later work Hamilton (1959) also uses the name *Phytomyza* sp. and applied the name "glabra holly leaf miner." Weidhaas (1969) commented that the use of this name *P. weidhausii* was unfortunate and stated that work by Kulp (1968) had resolved the problem by naming the insect "*Phytomyza glabrae*," as well as listing four new species of leaf miners.

In 1959 Hamilton also included "an unidentified species of an eriophyid mite," about which apparently nothing further has been written. Furthermore, other authors (Johnson and Russell 1962, Kulp 1968, McComb 1967, and Weidhaas 1969) have added to Hamilton's list, several other species of insects as pests of holly in the East. These have also been included in this revision. At this writing, the naming of some of the insects and mites associated with holly in the East is still somewhat unclear. It is hoped that this paper will clarify some of this problem.

The insects and mites listed and dis-

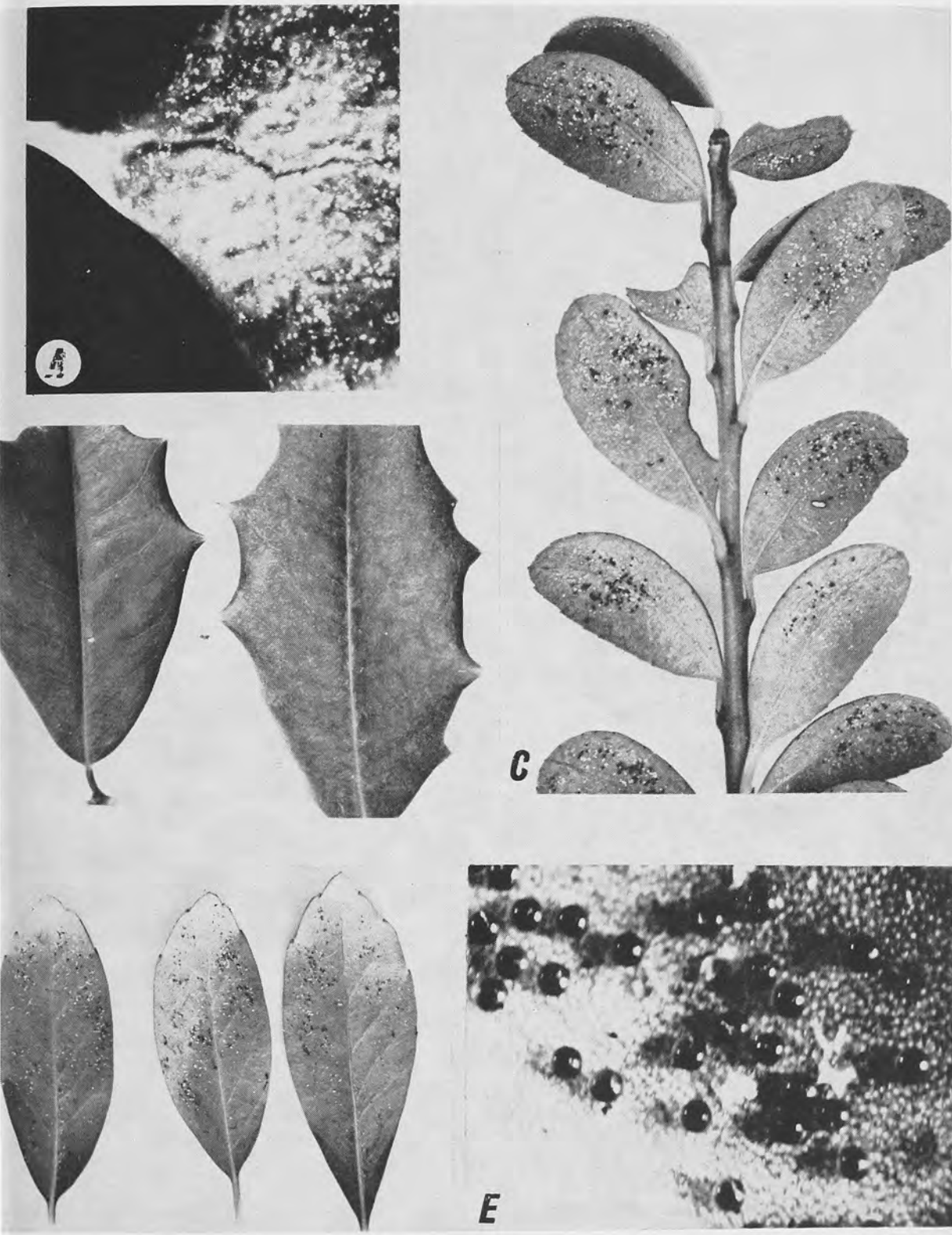

Figure 1.

cussed are pests of most cultivars of the major species of holly grown in the East—American holly (*Ilex opaca*); English holly (*Ilex aquifolium*); Chinese holly (*Ilex cornuta*); and Japanese holly (*Ilex crenata*).

Southern Red Mite

(Acarina: Tetranychidae)

The southern red mite, *Oligonychus ilicis* (McGregor) is the most common and important mite attacking hollies in the East. Reeves (1963) and Pritchard and Baker (1955) list only *O. ilicis* on holly, and include *Ilex opaca, I. crenata* 'Convexa', *I. crenata,* and *Ilex sp.* as hosts.

Feeding primarily on the under sides of the leaves, the mites withdraw plant juices with mouthparts fitted for piercing leaf tissue. As a result foliage becomes discolored, turning a typical gray-green when compared to the bright green of normal foliage (Figure 1-B). Some cultivars of *Ilex opaca* and *Ilex crenata* 'Convexa' are severely injured by southern red mites. Foliage turns brownish green, growth is stunted, and severe economic loss may result.

The female mite is about one-fiftieth of an inch in length. Its body is rounded to oval, dark reddish or purplish, with a somewhat lighter anterior part. Eggs are amber with a dorsal stalk (Figure 1-E). Eggs may be found on almost any aerial plant part; however, the majority are found on the under surfaces of leaves. First stage larvae are bright red and quickly develop into mature individuals. The mites overwinter as eggs and several hundred eggs may be found on the under side of one leaf (Figure 1-D)—even on small-leaved forms such as *I. crenata* 'Convexa' (Figure 1-C).

Mite populations are greater in the spring and fall, with overwintering eggs hatching about the time new growth begins. Numbers increase rapidly during cool spring weather, and in New Jersey damage from feeding activity is greatest during May and June. During the hot, dry summer months populations decrease, probably a result of decreased mite activity and predation, with increases in numbers again occurring during the fall. Cool summers tend to favor population build-up, and severe mite damage can usually be expected the following spring from the large populations which develop from the overwintering eggs.

Presence of southern red mites is usually recognized by the appearance of the holly foliage. Some cultivars of *Ilex opaca* are severely discolored and heavy infestations can be easily diagnosed from a distance. Feeding damage is most noticeable during the summer, when growers begin to apply miticidal sprays. The damage, however, has already occurred and the sprays are frequently judged ineffective.

Diagnosis of mite infestation should be made during late March or early April by examining the under sides of leaves for overwintering eggs, either with a good hand lens or by drawing the leaves between the fingers or over white paper to produce a reddish stain by crushing the eggs. Treatment at this time with a two percent dormant oil spray will control damaging spring populations. Late spring or summer sprays with selective miticides, such as dicofol ("Kelthane"), chlorobenzilate, or tetradifon ("Tedion") will satisfactorily control mites without adversely affecting predator and/or other beneficial insect populations.

An alternate control measure is the use of a systemic insecticide such as disulfoton ("DiSyston") or phorate ("Thimet"). Applications to the root zones of *Ilex crenata* 'Convexa' in early June gave effective control of southern red mite for ten weeks after treatment (Streu 1965). In addition, enhanced growth following treatment was associated with the nematicidal properties of these materials, especially at the high rate of 16 pounds of active ingredient per acre. Local state recommendations concerning timing and rates of application of systemic insecticides should be consulted before use. Systemic materials are hazardous to handle, and label directions must be followed explicitly.

Figure 2.

Holly Leaf Miners

(Diptera: Agromyzidae)

Holly leaf miners are among the most serious pests of holly. Severely mined leaves may drop from trees during the fall and only partially bare twigs remain until new growth is initiated in the spring. This condition is especially noticeable during periods of drought.

Infested trees have an unsightly appearance, and commercial nurserymen suffer economic losses from poor quality trees and injured foliage when sprays are cut for the Christmas season. In addition to leaf-mining damage, serious injury to foliage occurs when female flies insert their ovipositors into young, tender leaf tissue and feed upon plant juices which exude from the punctures. Extensive feeding injury will distort new growth and further reduce foliage quality. Since both leaf mining and ovipositor punctures affect the quality of holly foliage, control measures are usually directed to prevent both types of injury.

Hamilton (1957) states that two, and possibly a third species of fly larvae mine the leaves of holly: *Phytomyza ilicis* (Curtis), *Phytomyza ilicicola* Loew, and *Phytomyza weidhausii* Crafts; the latter species he reared from native inkberry or gallberry, *Ilex glabra*. Fortunately, Kulp (1968) provided a description and new name for the third species, *Phytomyza glabricola*, which should eliminate any further taxonomic uncertainty. Moreover, Kulp's investigations indicate that the two populations referred to as *P. ilicicola* and *P. ilicis* actually form a species complex, as evidenced by structural characteristics of adults, type of larval mines, host specificity, life cycles, and host specificity of parasites. Kulp's paper (1968) will be used as a basis for the following review of species in order to minimize the past confusion concerning the taxonomic status of holly leaf miners.

Phytomyza ilicicola Loew

In New Jersey adult flies emerge during mid-May or about the time new twig growth is three to four inches long and has three to five leaves. Emergence may continue over a period of several weeks; however, by early June adult activity is complete. Female flies do not begin to lay eggs until ten days to two weeks after emergence. Meanwhile, they make their feeding punctures and thereby cause injury to newly developing leaves. Leaf-mining damage first appears as slender, narrow mines not more than one-half of an inch long. Later the mines begin to spread into broad, blotchlike mines until late fall. Hamilton (1957) mentions that the winter is passed as young larvae; however, Kulp (1968), working with samples from the College Park area of Maryland, found that overwintering takes place as second or third instar larvae or pupae. Overwintering larvae resume feeding in the early spring and expand mines into larger blotches which may become one-half inch or more in diameter before they pupate in April or early May (Figure 2-E).

P. ilicicola mines the foliage of *Ilex opaca* and its cultivars. Kulp (1968) also lists *I. opaca* 'Foster #2', *I. opaca* 'Hume #2', *I. opaca* 'East Palatka', *I. opaca* XI, *I. myrtifolia*, *I. cumulicola*, and *I. aquifolium* 'Shepherdii'.

Phytomyza ilicis Curtis

Kulp (1968) states that the life history is similar to that of *Phytomyza ilicicola* and that the only known host is *Ilex aquifolium*. Miall and Taylor (1907) studied the life history and habits and presented the results of a detailed investigation of the larval, pupal, and adult structures. According to Miall and Taylor, eggs are deposited in the midribs of young holly leaves. After a short incubation period the eggs hatch and larvae remain in the midribs for about two months where they mine the central vessel. Larvae later enter the blade and produce irregular-shaped mines. Pupation occurs during early spring, and adults are present during May. There is one generation each year.

Phytomyza glabricola Kulp

A species described by Kulp (1968), and previously referred to by Hamilton

(1957) as *Phytomyza weidhausii* Crafts, has at present only one known host: *Ilex glabra*. Hamilton (1959) reported that eggs deposited on new growth during the middle to late May hatch in early July. After a rapid larval development, adults emerge in late July or August and deposit eggs which may develop into a second generation by fall. Hamilton also mentions that in some years larvae which hatch from eggs deposited in May do not become fully grown until fall. At this time some pupate and the remainder overwinter as larvae which enter the pupal stage next spring. Adults emerge in late March or April. Matthysse (1954), in an earlier investigation, reported that adults emerge during the spring and midsummer and that two generations occur each year. Kulp (1968) indicates that yellowish brown to dark reddish brown, linear-blotch mines are produced and the pupal stage is the overwintering form (Figure 2-B).

Phytomyza opacae Kulp

A new species described by Kulp (1968) from *Ilex opaca*, *I. cumulicola*, and interspecific hybrids 'John T. Morris' and 'Eldridge'. Kulp states that *P. opacae* is the only member of the *P. ilicicola-ilicis* complex where all three larval stages form linear mines. The mines transverse the leaves several times, and adults emerge from both the upper and lower surfaces of leaves.

He indicates that the insects are found in the College Park area during the third week of May and in Delaware as late as August. It appears that Hamilton (1959) in his discussion of the native holly leaf miner, *Phytomyza ilicicola*, provides a reasonable description of leaf mining injury and brief comments on *P. opacae*. He indicates that mines are one-eighth of an inch in diameter, long and slender, and may traverse the length of the leaf two or three times. Mines have a yellowish orange color and occur near the upper surface of the leaf. Frass or borings from larval activity are present within the mines. Adults emerge through the lower leaf surface. Eggs are deposited in the spring shortly after new growth appears and hatch soon afterwards. Adults are present from mid-July to August, September, and October. Hamilton assumes that overwintering occurs in the adult stage. Additional research is necessary to define precisely the habits and life history of *P. opacae*.

Phytomyza verticillatae Kulp

A new species described by Kulp (1968), which has but a single known host, *Ilex verticillata*. He states that linear-blotch mines are first observed during mid-May in Beltsville, Maryland, and that larvae or pupae can be found in mines from May to November. Overwintering takes place as pupae in fallen leaves with adults emerging in May. Kulp indicates that *P. verticillatae* has more than one generation a year.

Phytomyza vomitoriae Kulp

A new species described by Kulp (1968) which forms linear-irregular mines in *Ilex vomitoria*.

Phytomyza ditmani Kulp

Kulp (1968) described this new species from *Ilex decidua* and *I. serrata*, the only known hosts. First instar larvae cause blotch-type mines on lower leaf surfaces, while second and third instars form serpentine-blotch mines on the upper surfaces of leaves. Kulp states that overwintering takes place in the pupal stage in fallen leaves. Adults emerge and deposit eggs in early May. A very rapid incubation period, larval development, and pupal stage follow with adults appearing in mid-May. First stage larvae can be found from June to August.

Holly Leaf Miner Control

To prevent feeding injury, a spray application should be made when adult flies begin to emerge. In New Jersey the beginning of the emergence period occurs during mid-May when current twig growth displays three to five new leaves. This initial period of adult activity will vary from one state to another as well as within a single state. However, an examination of mines and pupal cases will disclose whether the adults have

emerged. Frequently, the small flies will be active around the sunny exposures of trees.

The second stage of control should be applied after eggs have hatched and larval mines are still quite small. A foliar application of a systemic insecticide is usually applied to prevent leaf mining damage. Commercial nurserymen can apply granular systemic insecticides as a soil treatment about two or three weeks before adult flies emerge.

Insecticides for holly leaf miner control have evolved in a close relationship with the development of new materials by the chemical industry. For early contributions the reader is directed to Hartzell and McKenna (1941) and Hartzell, Collins, and Blauvelt (1943). Hamilton (1957, 1959) discusses DDT and lindane sprays which have been "standard" for several years, as well as an early review of the systemic materials phorate ("Thimet"), demeton ("Systox"), and disulfoton ("Di-Syston"). He indicates that systemic soil treatments should be deferred until more accurate information becomes available. Shread (1959, 1960) and Kulp (1963) reported on experiments with systemics and other insecticides for leaf miner control. Many other investigators (Duda 1960, Matthysse 1954, Neiswander 1963, and others) have made contributions to holly leaf miner control, and their efforts have been appreciated by holly enthusiasts.

In light of the controversy pertaining to DDT and other persistent chlorinated hydrocarbons, there has been a trend towards systemic insecticides and organic phosphate materials for holly leaf miner control. Dimethoate ("Cygon") has been used on American holly for several years as a foliage spray with excellent results. However, holly has been removed from the current label (1970).

Commercial nurserymen who wish to apply granular systemic insecticides can apply phorate ("Thimet") or disulfoton ("Di-Syston") from late April to early May or about two or three weeks before egg deposition. Most commercial growers prefer to treat only young trees, because medium to large trees require an appreciable amount of material, time, and labor.

To prevent feeding damage, diazinon can be applied when flies begin to emerge. A spreader-sticker should be included in wettable powder sprays.

To prevent leaf mining damage oxydemetonmethyl ("Meta-Systox-R") can be applied as a foliage spray after eggs have been deposited and mines begin to show.

Commercial nurserymen can apply either oxydemetonmethyl ("Meta-Systox-R") or demeton ("Systox").

Control recommendations vary from state to state, depending upon research experience and policies on adherence to labeled uses on oramental plants and the application of certain chlorinated hydrocarbon insecticides. Therefore, the reader is urged to obtain the current control recommendations for his area by writing to his county agricultural agent.

Scale Insects (Homoptera)

A large number of scale insects infest hollies in the East, including several which may cause serious economic damage. Most species overwinter as mature females. Eggs are laid under the scale and hatch to nymphs or "crawlers," which move out from under the scale to new feeding sites. After finding a favorable site, the crawlers begin to feed with long, needle-like mouthparts and suck out plant juices. The nymph loses its legs and antennae with the first molt, and the cast skin, or exuvium, is incorporated into a secretion which hardens into the protective scale. A by-product of the feeding of many scales is a substance called "honey-dew," often seen as a shiny, sticky covering on leaves under or near an infestation. The sugary "honeydew" often attracts other insects and serves as the subtrate for a black sooty-mold fungus, which causes an infested plant to have an unsightly appearance.

The crawler is the stage most susceptible to contact sprays, such as malathion, parathion, etc., and carefully timed applications can be useful in controlling scale insects. In general, however, dor-

mant oil sprays provide better control through effective penetration of the scale covering, thereby killing the overwintering stage.

Among the more serious of the scale insects in the Northeast is a species described by Hamilton (1959) as near *Aspidiotus ansylus* Putnam. The insect is characterized by a round, grayish to black scale with a reddish orange exuvium located centrally or slightly to one side. In heavy infestations the scales may be covered with a grayish or greenish algal-like growth which obscures the insects. Heavy infestations cause a blackening of the cambium which results in death of twigs and branches. Crawlers appear in May and early June in New Jersey, and there may be several generations per year.

Several other species of *Aspidiotus* are also found on holly, including walnut scale (*A. juglans-regiae*), oleander scale (*A. hederae*), and rhododendron scale (*A. pseudospinosus*); but these insects are not considered major holly pests. All have similar life histories, overwintering as mature or partly mature females.

The holly pitmaking scale, *Asterolecanium puteanum*, is a common and serious pest of American holly in the East. The greenish yellow, slightly convex scales range from one-twentieth to one-thirtieth of an inch in diameter and cause injury to twigs from one-eighth of an inch to more than one-half inch in diameter. Feeding by this scale results in shallow to deep pits in the bark which contain the insects. Crawlers appear in late June when sprays of malathion are effective. The pitmaking scale is also found occasionally on Japanese and Chinese holly.

The European fruit lecanium, *Lecanium corni*, although not too common, has been responsible for considerable damage to American hollies in the East. Damage occurs from feeding injury as well as heavy deposits of "honey-dew" and sooty mold. The mature scales are hemispherical in shape, about one-quarter of an inch long and three-sixteenth of an inch wide, and dark brown.

The soft scale, *Coccus hesperidium* (L.) is often found on young and crowded hollies. The scale is flattened and about one-eighth to one-sixteenth of an inch when full-grown. It secretes large amounts of "honey-dew" with the subsequent development of heavy deposits of the sooty-mold fungus.

Weidhaas (1969) lists the tea scale (*Fiorinea theae* Green) as a general feeder in the Southeast and states it is found frequently on Chinese holly. The wax scale, *Ceroplastes ceriferus* (Anderson) is a more serious pest of hollies in the Southeast (McComb 1967, Weidhaas 1969), becoming abundant as far north as Maryland. The scale is about one-quarter of an inch long and secretes a thick, sticky, white, cottony or waxy substance over its convex surface, with the exuvium located near the posterior end. The wax scale overwinters as an adult, laying eggs in late April and May; crawlers appear in late to mid-June in Virginia (Weidhaas 1969) or late June in Maryland (McComb 1967). Development procedes through the summer until the females mature in October. Malathion sprays are effective in controlling the crawlers.

Weidhaas (1969) states that the latania scale, *Hemiberlesia lataniae* Signoret, is a problem on *Ilex crenata* 'Microphylla' in Virginia, and that the Forbes scale, *Quadraspidiotus forbesi* (Johnson), is an infrequent pest on *Ilex opaca*. McComb (1967) states that the Japanese maple scale, *Leucaspis japonica* Cockerell, also may attack holly.

Other Insect Pests

Several insects may be occasional pests on holly. Hamilton (1957) lists the rose aphid (*Macrosiphum rosae* (L.)) on young nursery stock; and Johnson and Russell (1962) reported the black citrus aphid (*Toxoptera aurantii* (Fonscolombe)) feeding on *Ilex aquifolium* and other hollies in Maryland. Comstock's mealybug (*Pseudococcus comstocki* (Kuwana)) and the whitefly *Tetraleurodes mori* (Quaintance) (Figure 2-D) are only infrequent holly pests.

A number of leaf-eating insects also

attack hollies (Figure 2-A). The Japanese beetle (*Popillia japonica* Newman), the black blister beetle, (*Epicaudata pennsylvanica* (DeGeer)), the gypsy moth (*Porthetria dispar* (L.)), and several species of grasshoppers. The Japanese weevil (*Pseudoneorhinus bifasciatus* Roelofs) is a common insect in the East and may feed on holly, although the damage is usually slight. The black vine weevil (*Brachyrhinus sulcatus* (Fabricius)) causes injury similar to that of the Japanese weevil and can be very serious when the larvae feed on the roots.

The Holly Midge

(Diptera: Cecidomyiidae)

Larvae of the holly midge *Asphondylia ilicicola* Foote) infest the berries of the American holly. The berries fail to ripen and turn red in the fall but remain green the entire year. The berries are smaller than uninfested ones (Figure 2-C) and the seeds fail to develop normally. Highland (1964) described the life history and reported a parasite, *Rileya cecidomyiae* Ashmead, attacking the midge larvae.

Midge adults emerge about the time of flowering and females oviposit in young developing fruit; the entire larval and pupal period is spent in the holly berry. The holly midge is found primarily in Maryland, Delaware, Virginia, and some other southern states. Several growers have reported this insect in southern New Jersey.

Infestations appear to be local in nature. There are now no known satisfactory control measures. Sprays at the time of oviposition would be unsatisfactory because of interference with pollination by bees.

A second "green berry" problem occurring on *Ilex opaca* is at this writing under investigation by N. H. Cannon of Bridgeville, Delaware, and R. L. Campbell of the USDA in Beltsville, Maryland. The chalcid wasp, *Torymus ruggleśi*, has been isolated from unripened berries, which, according to Campbell in a personal communication, feeds within the seeds of berries. These will turn red if not also infested with *A. ilicicola*; berries infested with the chalcid drop from the tree prematurely.

Weidhaas (1969) mentions the boxwood webworm, *Galasa nigrinodis* Zeller, as infesting *Ilex crenata* 'Stokes', although he states that it is not yet widespread. Another insect of minor importance is the ambrosia beetle (*Xylosandrus germanus* (Bldfd.) which, according to Hamilton (1957), has been found several times attacking holly. The black to dark brown beetles are quite small, only about one-eighth of an inch long, and bore into the woody tissue of the holly. Eggs, larvae, pupae, and adults live within the tunnels which become stained dark blue with a fungus. The beetles attack young twigs and limbs in the spring, killing them later in the season through their activities.

All stages of the ambrosia beetle are present in New Jersey from June to September (Hamilton 1967), with the complete life cycle taking about four to five weeks. No satisfactory control measure is known.

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Diseases of English Holly in the Pacific Northwest

IAIN C. MacSWAN AND ROY A. YOUNG

English holly, *Ilex aquifolium,* was introduced to the Pacific Northwest from England and Europe. One of the first recorded importations was in 1878, when Joseph Patrick Cronin had holly plants brought "around the Horn" to be used in the landscaping of his home in Portland, Oregon. Undoubtedly, other similar importations by nurserymen served as sources for further propagation, selection, and establishment of English holly in the Northwest, first as a landscape plant and later as a horticultural specialty crop. Today this area is the principal source of cut English holly sold throughout the United States for Christmas greenery and all holly nursery stocks sold for landscape planting. Approximately two thousand acres of green and variegated holly are grown in the region—a million dollar industry.

English hollies are affected by relatively few serious plant diseases. The most serious disease is the leaf and twig blight caused by *Phytophthora ilicis* (described by Buddenhagen and Young in *Phytopathology* 47:95-100, February, 1957).

Less severe is the disease holly scab, produced by *Sclerophoma sp.* (described by W. M. Brown, Jr. in a 1965 Oregon State University Ph.D. thesis and in Phytopathology 60:1144, July, 1970). Other abnormal conditions on English holly are copper leaf spot, boron deficiency, phomopsis canker, green algae, sooty molds, heat canker, cold injury, and mechanical damage, such as rodent injury, wind whipping, and spine punctures of the leaves.

Phytophthora Leaf and Twig Blight

The leaf and twig blight disease of hollies has caused severe losses in some plantings. This disease develops during cool, rainy weather and subsides during warm, dry summer months. The disease consists of the development of dark leaf spots, subsequent defoliation, and the development of black stem cankers. In cool, rainy fall weather spotting develops first on the lower leaves and progresses upward during the late fall and winter months. Infections may result in

dieback of young twigs. Young plants in nursery beds are also affected and may be defoliated and completely killed by the disease. Stem cankers are black at first but become brown with age. The causal fungus is spread to healthy plant parts by sporangia produced on infected leaves and carried short distances by wind or splashing water. Oospores, thick-walled spores which resist unfavorable conditions, develop in leaf and twig tissues and are believed to be the form in which the pathogen survives during warm summer months.

The disease was identified first and has been most severe in certain orchards in the coastal region, but in recent years it has become established in some orchards in drier areas such as the Willamette Valley, Oregon. The disease is often severe in orchards where restricted air movement caused by topography, surrounding vegetation, or too close planting of the holly results in high humidity. In such orchards, defoliation and twig blighting may be very severe, appearing by late October and continuing to develop through the winter months. The disease has not been severe

Symptons of holly scab on field-collected leaves.
a. Scab on cultivar 'OSU 1': left, lower leaf surface; right, upper surface.
b. Scab on cultivar 'Special'; left, upper leaf surface; right, lower surface.
c. Scab on cultivar 'Dr. Huckleberry', lower leaf surface.
d. Scab. Large blister-like spots occur on some cultivars; lower leaf surface.

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in orchards planted on moderately open sites where air movement is not greatly restricted.

Failure of the disease to become destructive in young or less dense orchards indicates that it may be prevented by (1) selection of moderately open and well-drained planting sites, (2) proper spacing of trees, and (3) pruning to permit air movement. In infested plantings, spread may be retarded by the application of protectant fungicides at the beginning of cool, rainy fall weather.

Scab

Holly scab caused by *Sclerophoma sp.* results in economic loss to some Northwest holly growers. Scab appears first as small, dark spots around the stomata of the current year's leaves. By fall the small, dark spots may form an irregular aggregate and become swollen and blister-like. Spotting occurs most often on the lower leaf surface, but the spots may be visible and swollen on both leaf surfaces. Spots on the second-and third-year leaves are usually larger and more deeply colored. Color of the spots ranges from gray to dark red. The spots may be discreet or aggregated to form larger spots up to 10 millimeters in diameter. Cultivars vary considerably in susceptibility. In contrast to phytophthora leaf and twig blight, leaf scab does not cause defoliation.

Method of spread of the fungus and chemical control measures for the disease are not known.

Boydia Canker

The so-called boydia canker disease of the hollies is actually caused by *Phytophthora ilicis* rather than by *Boydia insculpta* as was believed for many years. *Boydia insculpta* quickly invades tissues killed by *Phytophthora ilicis* and fruits abundantly in the diseased tissue. *Boydia insculpta* appears to be saprophytic and in controlled inoculation trials has not infected healthy holly leaves and twigs.

Phomopsis Stem Canker

Phomopsis crustosa has been reported also to cause a brown stem canker disease of hollies in the Northwest, but this pathogen was not found during recent studies in Oregon.

Green Algae

The development of green algae on the surface of holly leaves, although not particularly damaging to the leaves, is a serious problem for many commercial growers, since the presence of the dull green coating on the upper surface of leaves renders the foliage unsalable as cut holly. A species of *Protococcus* may develop rapidly and extensively on the bark and foliage of holly trees in dense plantings where air movement is restricted. The alga usually develops first on bark on the north side of trees and spreads from there to outer leaves and twigs. Selection of a moderately open planting site and the proper spacing and pruning of trees to permit air movement are usually sufficient to avoid development of algae on holly trees. If cultural methods do not suffice, the development of algae can be reduced by the application of one of the following fungicides in the spring: (1) nabam 2 quarts plus zinc sulfate 1 pound per 100 gallons of water and (2) lime sulfur 5 to 8 gallons per 100 gallons of water. Apply in early spring when the weather is cool. Defoliation may occur if the spray is applied during warm weather. (3) tribasic copper sulfate 2 pounds per 100 gallons of water (see restrictions about the use of this fungicide under copper spot).

Sooty Molds

The growth of sooty mold fungi renders foliage unsightly and unsalable and reduces the amount of photosynthesis. These fungi do not actually parasitize holly leaves but grow on honey-dew from scale insects and form a dark green to black layer on the upper surface of the leaves. Growth of sooty molds may be prevented by keeping holly free from insects.

Leaf Spots

Several different types of leaf spots occur:

Purple-red spots may appear on the up-

per leaf surface. These spots are large and may be associated with insect or spine punctures or with frost damage.

Chlorosis of several types may occur because of nutritional distrubances or deficiences. Chlorosis is common in late summer on heavily laden berry sprays, especially on the inner leaves. Chlorosis and dropping of old leaves are also common in spring, when new growth is initiated.

Copper Spot

The application of tribasic copper sulfate for control of phytophthora leaf and twig blight and green algae may cause spotting of leaves. Conditions predisposing holly to copper-spotting are not known; however, some observations indicate that spotting occurs on the leaves of some cultivars if the temperature at the time of spray application is below 65° F. Small, discreet, purple spots with light-colored centers occur on the under sides of the leaves. On bluestem cultivars, such as those on the French English Group, the spots on the under sides of the leaves often produce purple blotches on the upper leaf surface. A corresponding purple blotching may not appear on the upper surface of leaves of green stem cultivars.

Only growers who have used tribasic copper sulfate successfully in the past and are confident that they can use it without risking the leaf spotting injury should apply tribasic copper sulfate to English holly.

Boron Deficiency

Incipient boron deficiency occurs in many holly plantings and causes slight to severe loss. Boron deficiency can be controlled by fall applications of boron to the soil around each tree. The amount of boron to be used will depend on the severity of the deficiency and the age of the trees. For a description of boron deficiency, see "Commercial Production of English Holly in the Pacific Northwest," by A. N. Roberts and R. L. Ticknor in this Handbook.

Heat Cankers

Brown cankers frequently develop near ground level on the main stem of young holly plants shortly after they are removed from lath houses or cutting beds and planted in an open space. Usually these cankers result from heat injury to the bark on the south side of the exposed stem. Such injury offers a point for entry of mildly parasitic fungi which may continue to grow and girdle the entire stem. To prevent development of heat cankers, care should be taken to avoid exposing tender young plants to the full heat of the sun.

Cold Injury

Holly trees may be damaged severely by cold temperatures in the range of 10° F to 15° F and lower. If trees have been conditioned by a cool fall and have hardened properly, they are not so susceptible to cold injury. In years, however, when temperatures remain mild through most of the fall and early winter, a sudden drop to 10° F or 15° F may result in general browning of the leaves and injury to the wood. Young trees may be killed to the ground line. When this happens, it is usually possible to cut off the dead tops and develop a new tree from sprouts which grow from the uninjured roots. Freezing injury may also result in injury to bark at the ground line.

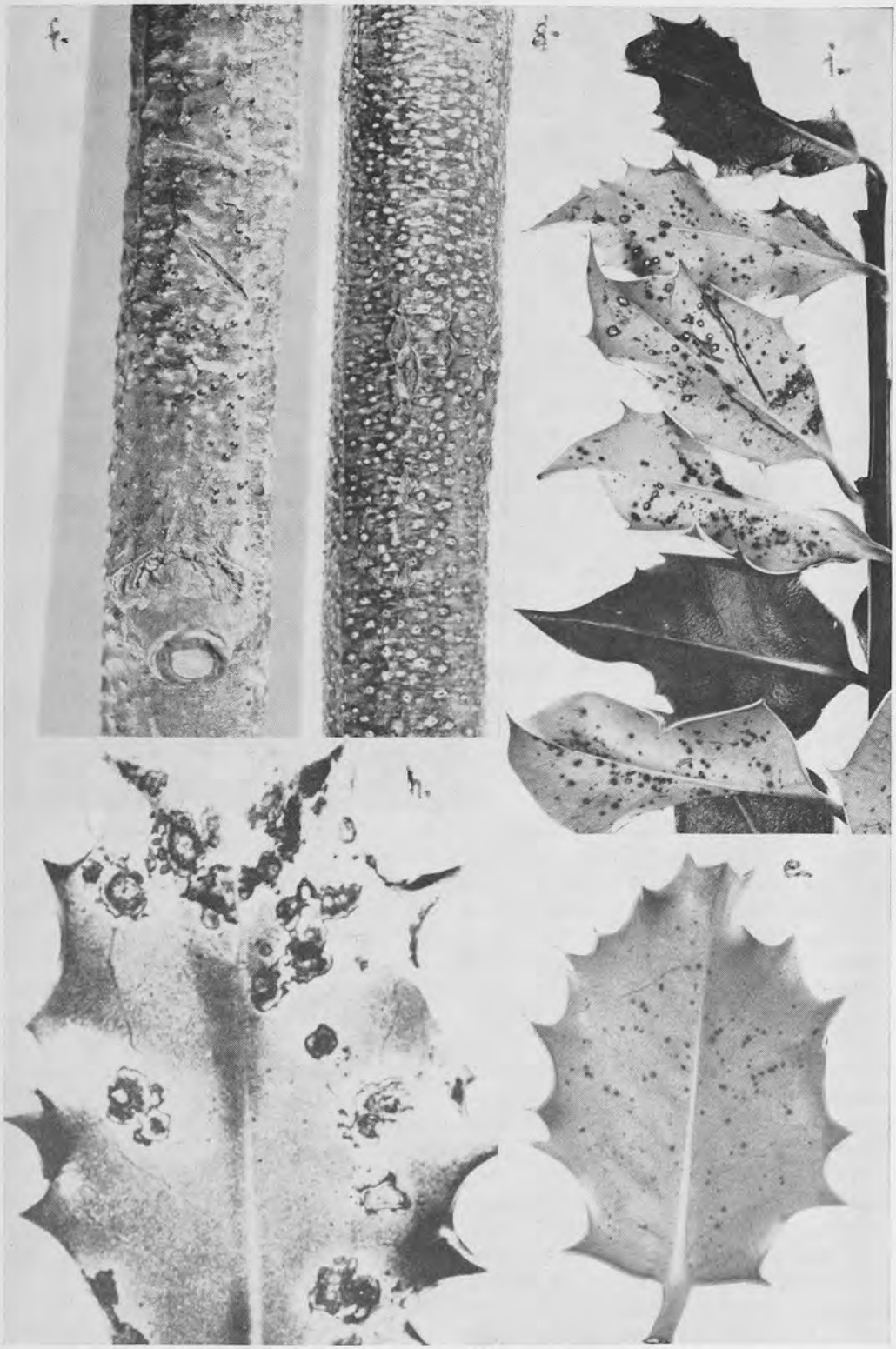
Mechanical Injury

Young holly trees may be girdled and destroyed by mice or other rodents. When trees are planted where they are exposed to the full force of the wind, leaves may be seriously marred from the scratching or puncturing by spines on other leaves. Such injury may result in the development of corky, roughened areas on the lower leaf surface and an accumulation of red-pigmented material which causes a red-leaf-spotting appearance on the upper surface of such leaves.

Control of Holly Diseases

To avoid or control the various diseases which affect hollies, the following steps should be carried out:

1. Select a site which is sufficiently open to allow moderate movement of air through a planting and located where it



e. Copper spot caused by spray of tribasic copper sulfate; under side of leaf.
f. *Boydia insculpta* fruiting on branch; the fungus invades tissues killed by *Phytophthora ilicis.*
g. *Phomopsis crustosa* fruiting on branch; the fungus is believed to be saprophytic.
h. Boron defiency symptons on lower leaf surface, showing target-like spotting.
i. Mechanical injury, leaves showing spine punctures and wind injury (long, dark gashes).

Phytophthora leaf and twig blight.
j. Black marginal spots on leaves.
k. Stem canker beneath infected berry cluster.
h. Partially defoliated orchard trees.

will not receive the full force of strong winds. If air movement is too restricted, humidity may remain high and favor disease infection and surface growth of algae and fungi.

2. Space trees sufficiently far apart to allow air movement through the orchard and to permit movement of spray equipment.

3. Prune trees sufficiently to allow air movement through the trees.

4. Prune out and destroy all cankered and diseased twigs to remove a potential source of infection.

5. Carry out a chemical program for control of green algae and phytophthora leaf and twig blight if necessary.

a. To control green algae spray with nabam 2 quarts plus 1 pound zinc sulfate per 100 gallons of water (may be applied spring, summer, or fall); or with lime sulfur 5 to 8 gallons per 100 gallons of water, in the early spring while weather is cool; or with tribasic copper sulfate 2 pounds per 100 gallons of water (see restrictions under copper spot).

b. To control phytophthora leaf and twig blight, spray with nabam 2 quarts plus 1 pound zinc sulfate per 100 gallons of water. The first application should be made when cool, rainy weather begins in the fall, usually by the middle of October; additional applications can be made during the winter as deemed necessary. The use of nabam plus zinc sulfate in October has not left an undesirable residue on hollies cut in November for Christmas sales.

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Insect Pests of English Holly in the Pacific Northwest

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The group of insect pests of English hollies in the Pacific Northwest differs considerably from that of American hollies in the East. Holly bud moth, holly leaf miner, and scale insects are the principal pests of English hollies. Bud moth and leaf miner are the more serious pests. Once they become established in an area, annual control measures are likely to be necessary in all orchards and nurseries. Scale insects can cause severe losses, but such occurrences are due to negligence in allowing infestations to develop, now that efficient insecticides are available.

The general approach used in this article is first to list the insect pests of English holly (*Ilex aquifolium* L.) including identification of the insect, the annual cycle of development, and some comments on control. Detailed recommendations for control are given in the last section, "Use of Insecticides on Holly."

Holly Bud Moth

The holly bud moth, *Rhopobota naevana ilicifoliana* Kearfott, has been present in the Pacific Northwest for more than 40 years (Downes 1931).* It was accidentally introduced from Europe into British Columbia and subsequently spread southward into Washington and Oregon. Injury results from the feeding and webbing of caterpillars in the new growth (Figure 1). These caterpillars hatch just after leaf growth begins in the spring. After completion of the larval stage, most of the caterpillars drop to the ground to pupate. Moths emerge from the pupae and lay eggs during July and August. The eggs are not easy to find, since they are laid singly on the leaves and twigs—not in clusters as are the eggs of many moths. Winter is passed in the egg stage; there is only one generation a year. Holly is the only known host. The increasing importance of the bud moth and inconsistent results with the oil-nicotine sprays led to the evaluation of newer insecticides (Swenson 1958). More than 99 percent control was obtained with one application of an organic phosphate insecticide (malathion, parathion, diazinon) or carbaryl ("Sevin") just after new growth started but before blossoming.

Oblique-Banded Leaf Roller

This insect, *Archips rosaceana* (Harris), sometimes infests holly but is not a serious problem. Unlike the holly bud moth, the oblique-banded leaf roller infests many plants other than holly. The winter is spent in the larval stage, and these wintering larvae cause most of their damage when they begin to feed again in April and May. Injury is similar to that caused by the bud moth, but the larvae are quite different. The mature oblique-banded leaf roller larva is about one inch long and bright green, with a shiny black head. The mature holly bud moth larva is a paler grayish green and about half as long. The oblique-banded leaf roller is most likely to be a problem in nurseries where irrigation and fertilization practices keep trees actively growing for a longer time. The application of organic phosphate insecticides for bud moth also controls this leaf roller.

Holly Leaf Miner

The holly leaf miner, *Phytomyza ilicis* (Curtis), is another native of Europe

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Figure 1, left, stage of holly growth when holly bud moth eggs hatch. Mutilated leaves are the result of feeding by moth larvae in the previous growing season.
Figure 2, right, brown soft scales on holly leaf. Note different sizes.

which was introduced into British Columbia more than 40 years ago (Downes 1931). It has since become established in most of the holly-growing areas of the Pacific Northwest.

The leaf miner is the larval stage of a small fly. The flies are present in May and June and lay eggs in the young holly leaves. The maggots which hatch from these eggs feed between the upper and lower layers of the leaf cells. Evidence of their injury is first apparent in August as small, red spots. By midwinter, feeding of the larvae has been extensive enough so that light-colored blotches, one-half inch or more in diameter, are present. The larvae pupate within the leaves in late winter or early spring, and the life cycle is completed when flies emerge from these pupae in May. Control consists of the use of diazinon sprays (Schread 1961). Emergence of flies from the pupal stage is likely to begin during blossoming.

Since insecticides applied during blossoming would be injurious to honeybees, the control measures should precede the opening of blossoms. This is accomplished by the holly bud moth spray. The flies emerge over a period of time so that a second spray might be necessary after blossoming. Various insecticides, including diazinon, may kill leaf miners in holly leaves. This is not a practical approach to leaf miner control in commercial orchards, because damage to one season's growth will have already occurred by the time the insecticide is applied. Also, in a well-managed orchard, the source of egg-laying flies may be unsprayed trees outside the orchard.

BROWN SOFT SCALE

Three soft scales occur on holly. Of these the brown soft scale, *Coccus hesperidum* L., is the most common (Figure 2). The other two soft scales on holly are the cottony camellia scale and a lecanium scale. The principal injury caused by soft scales results from the sooty mold that develops in the honeydew or excrement of the scales. This mold becomes a problem long before the scales are abundant enough to injure the trees by their feeding. Besides holly, the brown soft scale infests many woody plants, particularly camellia and daphne in the Pacific Northwest.

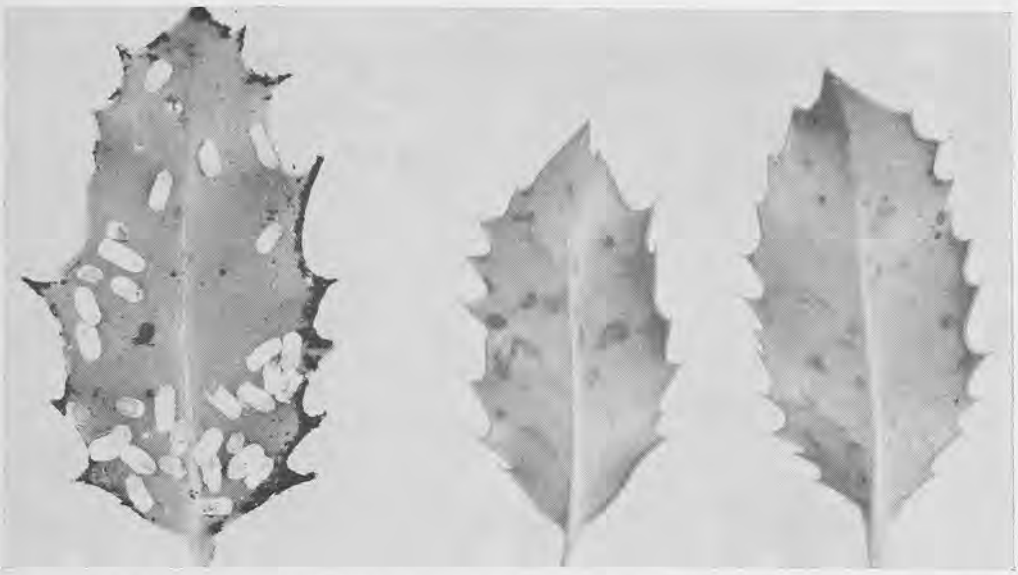

Figure 3, left, cottony camellia scale on lower side of holly leaf. Note sooty mold around edges. Upper surface of this leaf was uniformly coated with sooty mold.
Figure 7, right, discoloration due to aphid feeding.

The young are born alive and remain under the female scale for a short time. In Oregon the first of these crawlers can be found under the adult scales about the first of July, but they do not mature in time to produce offspring during the same year. Therefore, there is only one generation per year. However, each female produces a series of offspring during the summer so that brown soft scale infestations are characterized by great variation in size of the scales present (Figure 2).

The brown soft scale can be controlled with a number of insecticides, including diazinon, carbaryl ("Sevin"), dimethoate ("Cygon"), and azinphosmethyl ("Guthion"). Summer oil sprays applied in the spring before blossoming are also effective (Swenson 1959). Selection of an insecticide should be based on its usefulness in the overall holly spray program.

Cottony Camellia Scale

This soft scale, *Pulvinaria floccifera* Westwood, infests only holly and camellia in Oregon. It commonly occurs in mixed infestations with the brown soft scale, from which it can be distinguished by the white egg masses which may stick to the leaves for weeks after the eggs have hatched. It is also characterized by a uniform size of the scale at any particular time.

The cottony camellia scale can be controlled by the same insecticides which are effective against the brown soft scale. These insecticides are not effective against the eggs, which are laid soon after blossoms have dropped.

Lecanium Scale

Lecanium scales are sometimes found on holly in Oregon. The exact species is not known. The adult scales lay eggs in late spring; these are deposited in a mass under the turtle-shaped adult scales (Figure 4). The adults die after laying eggs but remain in place on the twigs, covering the eggs. The eggs hatch in late July, and the crawlers move from the twigs to the leaves. In the fall the insects move back to the twigs, where they complete their development during the following spring. Lecanium scales are controlled by the same insecticides used for other soft scales. Timing is important to be sure that insecticides are not applied while the scales are in the egg stage (see application times which are in the last section).

Holly Scale

The holly scale, *Aspidiotus brittanicus* Newstead, is quite different from the soft

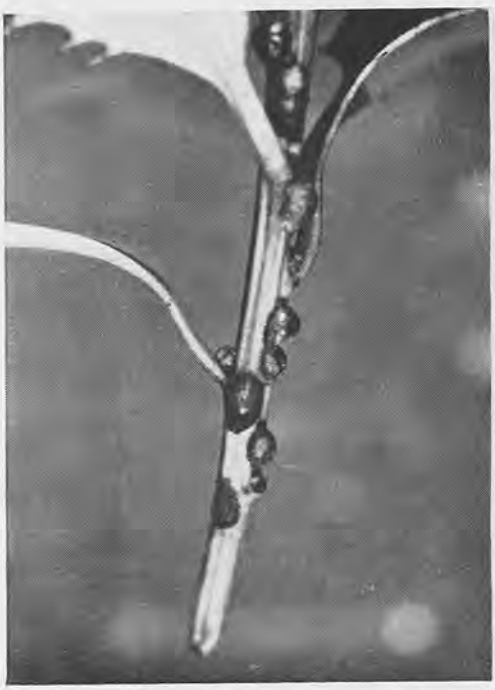

Figure 4, left, lecanium scales on holly. Figure 5, right, holly scale.

scales (Figure 5). The female scales are round, almost one-eighth inch in diameter, flat, and brown, with a small yellow spot in the center of the scale. In most years, eggs are present under old female scales during June and July; but in some years, they do not hatch until August (Roaf and Mote 1935). Therefore, sprays should not be applied until late August (see late-summer spray, section on control). After hatching, the crawlers move to a feeding site on the leaves. Here they molt, losing their legs, eyes, and antennae in contrast to the soft scales, which remain mobile and able to change feeding sites throughout their lives.

Eriophyid Mites

These mites are much smaller than the spider mites commonly found on ornamental plants and on fruit trees and are visible only with magnification. When examined with adequate magnification, they are found to be elongate and of two kinds: one species, *Acaricalus hederae* Keifer, is orange-yellow and the other species, *Diptacus swensoni* Keifer, is gray. Their feeding is restricted to the under side of the leaves. They were not discovered on holly until after 1950, but since then have been found abundantly in every Oregon holly orchard where they have been sought (Welton and Swenson 1962). They exhibit remarkable biological properties in that their populations begin to increase in June or July and continue to increase into the fall and winter until checked by frosts (Figure 6). They are not, however, eliminated by the usual minimal winter temperatures in western Oregon. The mite populations decline naturally each year in all orchards about the time new growth starts. The mites leave the old leaves then, but very few of them get to the new growth. This coincides with the translocation of nitrogen and phosphorus from the old leaves to the new growth (Roberts & Tichnor 1970). Only rarely are visible effects of mite feeding observed, even though more than 500 mites per leaf commonly occur and, on one occasion, 2,070 mites were found on a single leaf. The effects attributed to feeding of the mites consist of russetting on the lower surface of the leaves and a yellowish mottle on the upper surface. Such symptoms appeared when mites became numerous in the summer on

new holly leaves before they had hardened-off. Ordinarily, the leaves harden-off before the mites become numerous in late summer.

The extreme infrequency of injury by mites makes any special sprays for mite control of doubtful value. Mite populations decline from natural causes about the time insecticides are applied to control bud moth and leaf miner. There has been no evidence that sprays applied at this time had any subsequent effect on development of mite populations in late summer or fall. Diazinon was applied on June 14 in one orchard in Corvallis. This was the only spray application made at this "late" date to any of the orchards where mite populations were studied. No mite population developed in this orchard during the following fall and winter. This was the only one among eight holly orchards during a two-year period when mites failed to develop. Lime sulfur sprays, used for control of algae, are effective against eriophyid mites. So is the fungicide, nabam, which is used for *Phytophthora* leaf and twig blight on holly (personal communication from Harry Andison, Canada Dept. Agr., Sanichton, B. C.).

A third species of eriophyid mite, *Cecidophyes verilicis*, occurs on holly and is found in both leaf and flower buds and under the sepals at the base of the berries. It is not found on the open leaf surfaces; nor is it known to be injurious to holly.

Aphids

Aphid infestations sometimes occur on English holly in Oregon. Relatively few trees are infested, and only a few leaves are infested on any one tree. The signs of aphid feeding are present long after the aphids leave (Figure 7). Two species have been identified from English holly: the foxglove aphid (*Acyrthosiphon solani* (Kaltenbach)) and the potato aphid (*Macrosiphum euphorbiae* (Thomas)). These two species infest many other plants in the same sporadic way that they infest holly. Aphid control on holly usually is not warranted.

Orange Tortrix

Larvae of this moth, *Argyrotaenia citrana* (Fernald), have been found feeding on holly berries in late summer and early fall in Oregon. There are no indications, however, that this is a problem of any consequence.

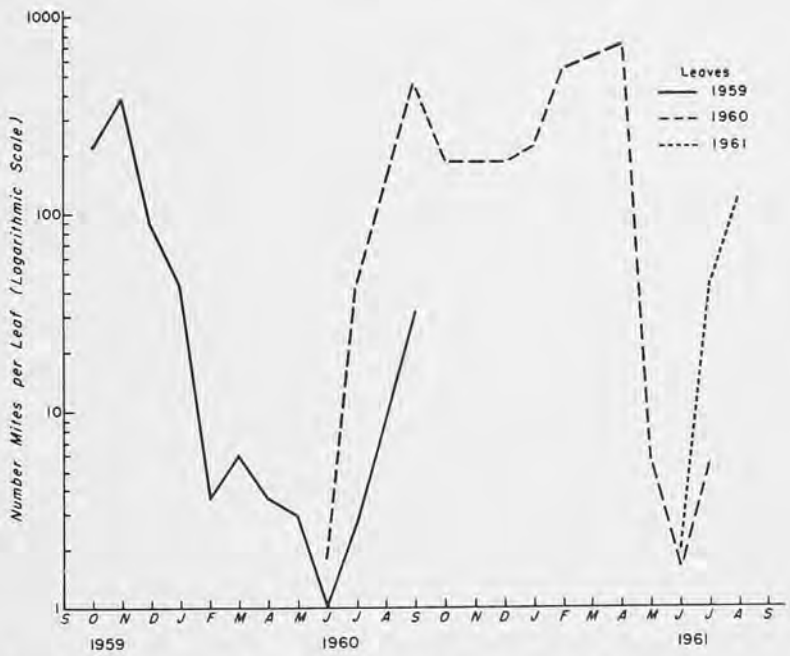

Figure 6, population cycles of the mite, *Dictacus swensoni*, in holly.

Use of Insecticides on Holly

There are several times of the year when insecticides can be applied to control holly insects. Far better control is obtained at some times than at others, even when the same insecticides are used, because the susceptibility of insects varies at different stages. One of the aims of research on holly insects at the Oregon Agricultural Experiment Station has been to understand the biology of the various holly pests well enough to control them all with one annual spray. In most well-managed orchards, the preblossom spray will be the only insecticide application needed, unless there are nearby unsprayed trees infested with leaf miner.

The dates given in this article are only approximate, since they apply specifically to the inland valleys of western Oregon. Holly and holly insects would reach similar developmental stages at a different time in coastal orchards, in areas farther north, and in orchards at higher elevations. The development of plant-feeding insects is closely synchronized with the development of their host plants. Therefore, timing of sprays should be related to seasonal development of the holly trees.

The times for applying insecticides follow:

PREBLOSSOM SPRAY. This is the period of 10 to 14 days between the time new leaf growth begins and the opening of the blossoms. A diazinon spray applied at this time will control bud moth and is necessary for leaf miner. This spray must be applied every year in areas where bud moth and leaf miner are established. Sprayed orchrads may be infested by egg-laying moths and flies from unsprayed trees in the area. The seriousness of such infestations will depend on the proximity and numbers of unsprayed trees.

Diazinon is highly effective for control of soft scales, and an annual spray at this time should prevent the establishment of soft scale infestations. Some control of holly scale will be obtained, although we have little information on this point. A postblossom spray may be necessary to get satisfactory control of the holly leaf miner. This will depend on how well the insect has been controlled in previous years and the uncontrolled sources of leaf miner in the area. With present knowledge, the necessity for a second application must depend on the grower's experience with his own orchard.

POSTBLOSSOM SPRAY. This should be applied right after blossoming, if needed. It has two main uses: (1) to kill any leaf miner flies which were not killed by the first insecticide application and (2) to control the brown soft scale and the cottony camellia scale. This is the best time to control these two soft scales in areas where bud moth and leaf miner do not occur, or on ornamental trees where concern about bud moth and leaf miner is not great. Diazinon or carbaryl ("Sevin") will give more than 99 percent control of brown soft scale and cottony camellia scale when applied at this time, being somewhat more effective than when applied before blossoming.

LATE-SUMMER SPRAY. This should be applied during the last half of August. However, a spray at this time will rarely be necessary if the preblossom spray is applied annually. One aim is to control lecanium scale which was in the egg stage at the time of the postblossom spray, but which will have hatched by this time. The other objective is to control holly scale, which will also have completed its egg stage and hatched by this time. Use diazinon or carbaryl ("Sevin").

AMOUNTS OF INSECTICIDE PER 100 GALLONS OF WATER

INSECTICIDE	AMOUNT
Diazinon	
Wettable powder	3 lbs., 50%
Emulsifiable concentrate	3 pts., 48%
Carbaryl ("Sevin")	
Wettable powder	2 lbs., 50%

Comments on the Use of Insecticides on Holly

1. The insecticides suggested for control of holly insects are not highly toxic to humans. Nonetheless, they should be handled carefully. They should not be spilled on the skin or clothing. They should be stored out of reach of chil-

dren, or people who are not familiar with them, and empty containers should be disposed of carefully.

2. No insecticide will be effective, if it is not applied properly. Concentrate airblast spraying will be satisfactory in orchards which have had an effective insect control program. Where severe insect infestations exist, trees should be sprayed thoroughly with a hand gun. The waxy holly foliage necessitates the use of a spreader-sticker to get adequate spray coverage.

3. Do not spray during blossoming or pollinating bees will be killed. Berry-set depends on them. Also do not move bees into an orchard before holly blossoms open. Otherwise, they will seek another source of food and may continue working it, ignoring the holly blossoms when they do open. A useful practice is to cut or otherwise remove any blooms in the ground cover of the orchard before bringing in the hives.

4. Diazinon and carbaryl ("Sevin") are compatible with the fungicide combination, nabam plus zinc sulfate, which is used to control holly diseases. The insecticides have been applied to many acres of holly for several years without any evidence of plant injury. No residue was present at cutting time, when wettable powders were applied as late as August.

5. Do not experiment with an entire orchard. Understand the how's and why's of the insecticides used. Any changes in the spray program should be based on reliable advice, or applied to only a few trees at first.

6. Diazinon and carbaryl ("Sevin") are not long-lasting insecticides and do not contribute to the accumulation of pesticides in the environment.

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Dr. Swenson is a professor of entomology at Oregon State University, Corvallis, Oregon, working on insect problems in the production of ornamental plants and nursery stock and on transmission of plant viruses by insects.

Hollies And Landscape Architecture

ROBERT E. MARVIN

Since the past is an important part of the present, a look at hollies in American garden's through the years will be helpful in discussing hollies for present-day landscaping.

First came a formal type of landscape architecture in America. The formality and exactness demanded that the hollies be integrally related to the pattern of the garden. They were generally balanced by walks, walls, gates, borders, and other items included in the garden.

Next, there was a great movement toward naturalizing plants in the landscape. This tended to scatter the hollies in no particular pattern throughout large flower beds.

During the Victorian Era, the next period of landscaping in America, the scientific development of new cultivars not only of hollies but of many other plants—was so great that landscaping became a matter of choosing beautiful plants and scattering them throughout the lawn so that each individual plant could be seen at its best.

Today, in many gardens, hollies are used in two or more of the above styles. Understanding the good and bad practices of these periods will help one make better use of hollies in a manner acceptable to the landscape design fashionable. The formal period was probably the best as far as art is concerned, since its rigid design demanded that the hollies become part of the composition. This forced unity through the elements and principles of design.

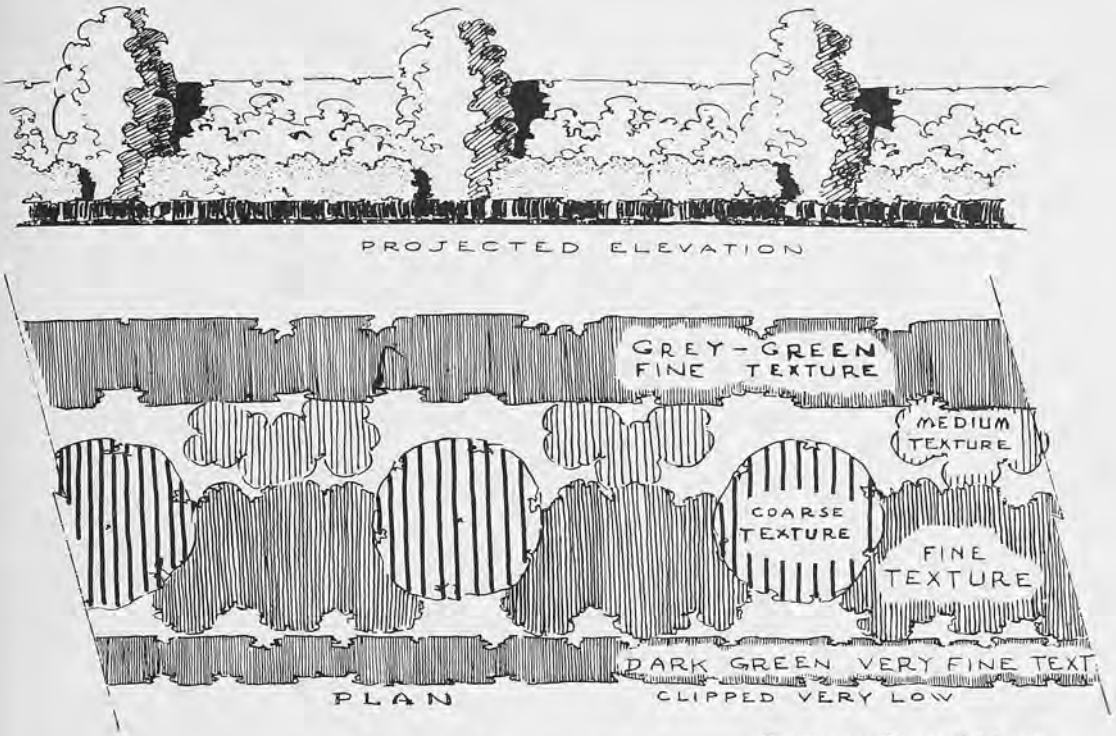
In the other two periods, the hollies were often not part of a pattern but were scattered individuals as the collection increased. Of course, design and unity are sacrificed when plants bear little relationship to other objects in the yard. Although the holly berries, leaves, and entire plant are pretty, this is not enough; they do not create a beautiful work of art, unless they become a pleasing part of the overall landscape.

There are two distinct factors to consider in landscaping a yard. Everything must be arranged for the convenience of its users—walks, walls, services, drives, hollies, and other plants. These elements must be combined to form a pleasing design employing all the elements and principles of all fine arts. From these considerations one may conclude that hollies must be located in relationship to everything else in the landscape; that before the hollies can be placed, a plan must be prepared for their proper location; and that planting a yard is a skillful art. This art is called landscape architecture.

As a general rule, the yard should be divided into three parts; the front, or public area, which should be simple and dignified; the service area, which should be designed for usefulness and as a work area; and the family area. The family area should contain not only the hollies but, all the hobbies and outdoor living facilities. This area should be screened from the public by fences, walls, screens, or hedges. In it could be a terrace barbecue pit, play yard for the children, rose garden for the mother, and holly collection for the father. It should be a continuation of the home, extending the living area to the lot lines of the property.

Hollies have several characteristics which make them one of the more popular plants in America today. Their red, yellow, orange, black, and even white berries lend color to landscape plans. They have beautiful foliage, varying from very fine to very coarse textures and from dark greens to grays and into other variegated forms. Many cultivars also have spines and beautifully shaped leaves, some smooth, some crinkly, some cupped, and other interesting shapes.

Hollies are found in many different shapes and sizes. There are spreading,



Drawings by Robert E. Marvin

Landscape Sketch No. 1.
Texture symbols in Sketches No. 2 and No. 3 are the same as those penned in Sketch No. 1.

columnar, and vase shapes—almost every shape one might want or need in the landscape. From a cultural standpoint, hollies have many advantages; they will grow in a wide variety of soils and in the range of climates which extends over almost all of America.

One can see from these characteristics that hollies have unlimited possibilities, and the people who predict that hollies will become even more important in landscape planting are undoubtedly correct.

Hollies, because of their tremendous variance, can be used in many different ways. Some of the most obvious and important ways will be discussed in detail in the following paragraphs.

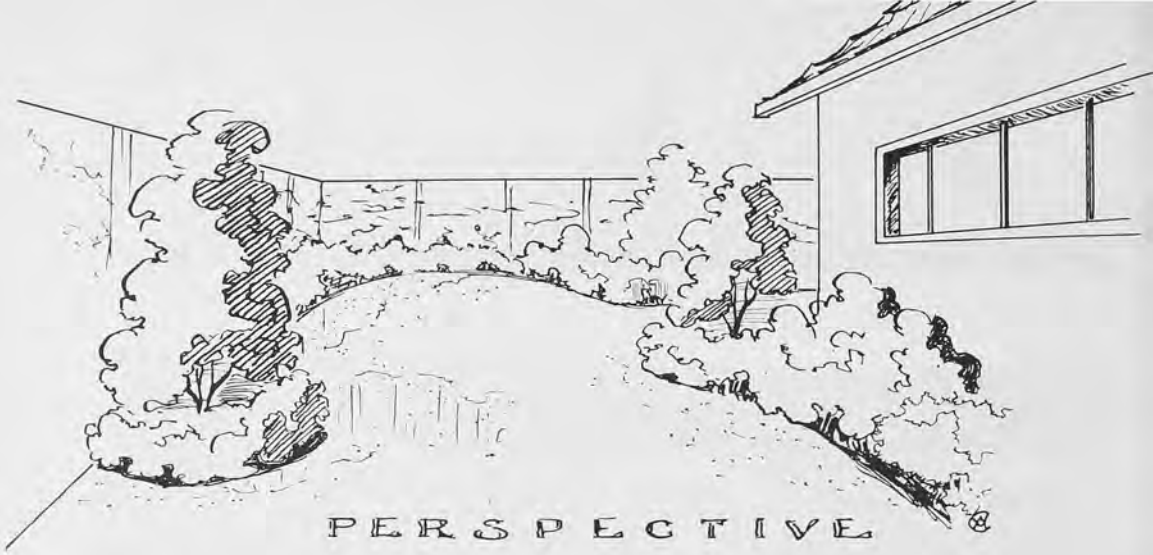
Some holly cultivars make excellent tree specimens on which the foliage commences at the ground and follows to the top. The branch texture and berries will make these the talk of the town. The tree forms of hollies vary from large specimens to small trees, ten or fifteen feet in height, from which the lower limbs have been removed to expose the trunk or to show an interesting trunk formation. This last type will increase in demand in the future and will be used in foundation planting to replace the pyramidal cedars at the corners of buildings.

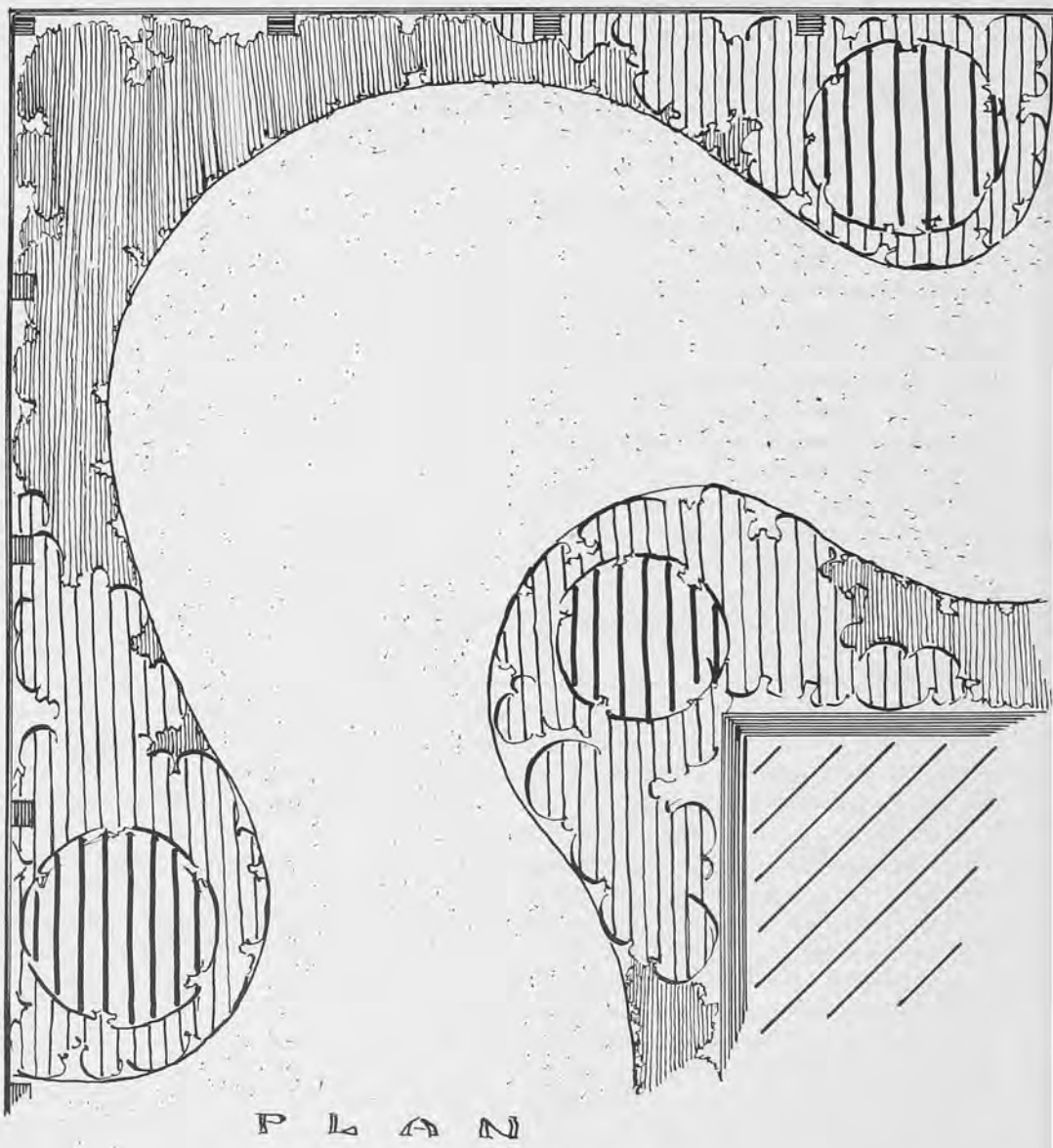
They can be used as the motif of a garden where their beautiful foliage, texture, form, and wonderful berries will completely dominate the scene. In this instance, the garden should be designed so that these hollies become an integral part of the overall design and lend themselves to the complete picture.

Hollies can also be used with other plants in flower beds. In this case, extreme care must be given to foliage, texture, shape, and size, as related to other plants used, and all man-made objects in the flower beds or bordering areas.

Hollies lend themselves especially well to foundation plantings, because they are available in almost any size, texture, and form and thus compatible to various building materials and architectural styles.

Hollies can also be used in tubs and moved from place to place in a garden. During their fruiting season, they can be moved to the patio, thus bringing their

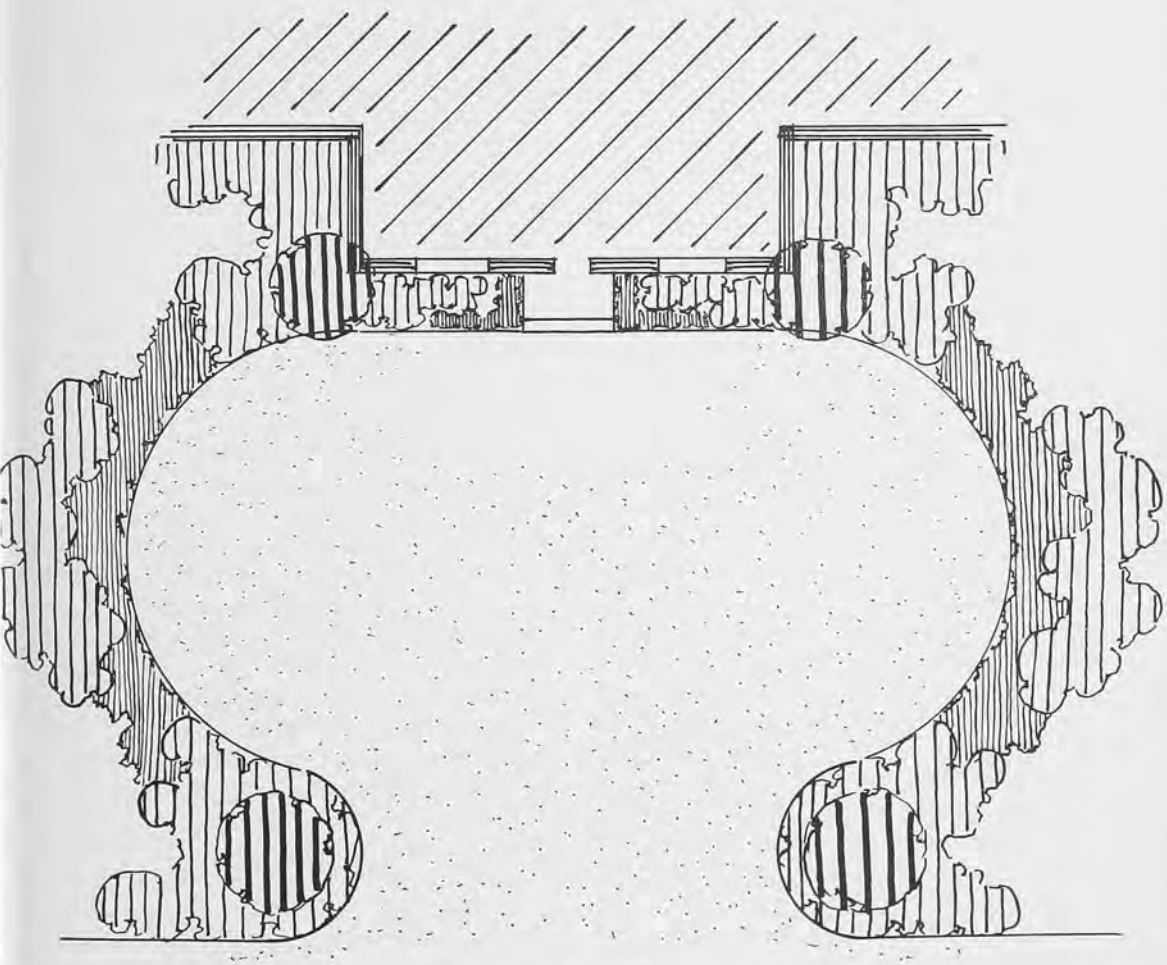




Landscape Sketch No. 2.

—American Horticultural Society

PERSPECTIVE



PLAN

Landscape Sketch No. 3.

red berries just outside a picture window.

Hollies are one of the best plants for hedges, screens, and barriers. They will form a hedge of almost any size or shape. Most cultivars can be sheared to form an almost flat, green wall; they can be pruned to form a looser, though still dense wall; or they may be left free-standing in which case the different cultivars will give an unlimited field from which to choose.

Hollies may be espaliered against a brick wall or fence. They are being used very successfully for this purpose, and this is one of the uses which will be expanded greatly as experiments increase in the future.

Hollies scattered as individual specimens throughout the yard are generally not desirable, since this leads to disunity, as well as increased maintenance. Hollies should be placed as a definite part of the landscape plan.

Many types of hollies serve as edgings for beds and as ground covers.

A knowledge and understanding of holly plants is not enough to create a beautiful, artistic garden. One must also have an understanding of the elements and principles of art to be able to take all the above characteristics and possibilities and combine them into a creative design. It would be impossible to discuss completely art as it applies to landscape architecture. The following suggestions, however, are some which may help in combining hollies with other plants and the architecture in the yard.

The exact uses of specific hollies for individual purposes have been purposely avoided in this article. The wide selection of kinds available, their versatility for landscape uses, their hardiness in the locality in which they are to be planted, and the amount of money on hand for their purchase make such general recommendations difficult. The services of a landscape architect are always advisable, yet the home owner wishing a holly garden can design his own. A leisurely and purposeful visit to an arboretum or holly nurseryman will help the homeowner in determining the plants required for the effects he wishes to achieve.

Sketch No. 1

This is a plant border which could be any length over forty-five feet. It could be used to hide clotheslines, to screen the neighbor's dog run, or to give privacy for outdoor living. The way to use this sketch would be to choose plants—for the sake of this article, hollies—to fit each requirement in textures, forms, and colors.

For the background, have a hedge which will grow six feet or higher and will have a dull gray color for contrast with the more striking textures and colors of the foreground planting. This hedge should be of a fine texture, or a fence could be substituted in its place. The bed should be a minimum of eight feet wide and have a low, clipped border in front, six to eight inches tall, dark green and of a fine texture.

The specimens should be the tallest plants in the bed and spaced fifteen to twenty feet apart, depending on their ultimate size, and should be of the coarsest textures. The taller plants in the background against the back hedge should be lower in height than the specimens. They would be massed for an airy effect, using three to five plants in a group. Their textures should be medium and a definite step-down from the specimen plants. In front of this, choose a much lower plant of a medium fine texture which will be another definite step-down in size and texture from the plants just discussed. Probably some twelve to fifteen plants would be used in this group. The ideal way to plant a border properly is to design it first. This will determine the size, shape, texture, and color of the foliage. Finally, choose specific plants which meet these requirements.

Sketch No. 2

Sketch No. 2 follows the same principles as described for the border above, except that for this problem it is assumed that there is a six-foot stockade fence around a corner of the yard and that the fence and the home seem too

close together. Therefore, locate the specimen plants, which will be the tallest and of heaviest textures, in strategic spots as shown in the above sketch. Then graduate downward to medium textures and finally to fine textures in the far corner just as was done in the border above. This will create unity and harmony but, in addition, because of this arrangement depth will be gained, since one will be looking past the heavy textures toward the small textures which will create a definite illusion in size and depth for this corner.

SKETCH NO. 3

Next is an illustration showing a home and proposed yard. Notice that the foundation planting is not considered just a strip of plants around the house. The plants for the foundation of the house must be chosen not only with thought of the house but in relation to all other plant borders and architecture. Notice also that small trees are suggested for the corner planting instead of pyramidal arborivitae and other evergreens so commonly used. The trees could be hollies with the lower limbs removed to show their branch structure and to form pretty, small, evergreen trees which would never grow out of scale. Notice, also, that a few dwarf specimen plants are used and connected with a low, mass planting or ground cover.

In summary, it should be emphasized that plants alone cannot spell the success of one's landscaping. Success is realized through artistic design which molds plants, architecture, and ground forms into a useful and beautiful garden.

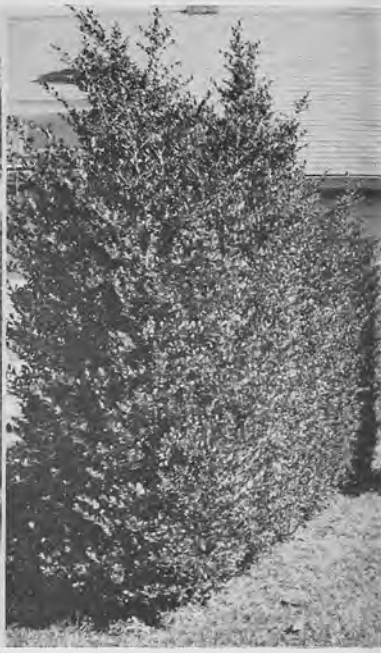
Mr. Marvin, a native of the South Carolina low country, became interested in landscape architecture as a small boy, while watching Innocenti and Webbel, landscape architects of New York, develop the grounds of the Bonnie Doone Plantation. A landscape architect since 1947, Mr. Marvin has been the recipient of several awards: the National Industrial and Institutional Landscape Award of 1958 and 1963; the Slater Wright Award of the Southern Nursery Association; and a special Judges' Award of the American Nurserymen's Association presented, on October 15, 1969, by Mrs. Richard Nixon, honorary chairman of the awards program of the Association.

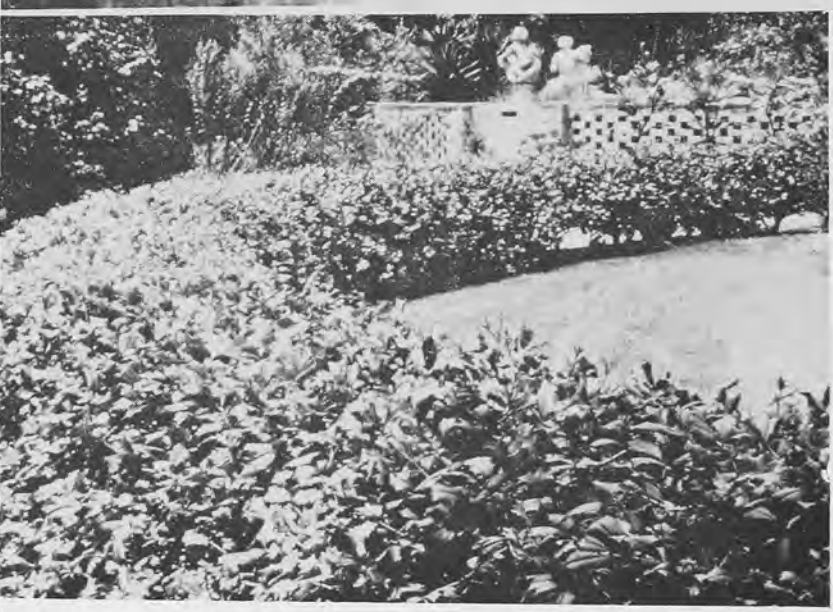
Hollies for Hedges, Screens, and Barriers

DONALD WYMAN

Some of the evergreen hollies make excellent hedge plants because of their dense, twiggy growth and the ease with which they recover from shearing. The deciduous species are not often used for this purpose, however, since there are many better and more vigorous deciduous hedge-making plants available. Evergreen holly hedges and screens are not new in North American gardens, since they were used in the days of Colonial Williamsburg and in the garden of George Washington at Mount Vernon. Today, even with many more species of plants available for ornamental planting, they are still popular, for, with some of the more recently introduced Oriental species, there are evergreen hollies of dense habit, and some with prickly leaves. Thus, they are ideal for hedges, screens, and barriers in areas where they have proved thoroughly hardy.

The planting of a hedge requires special consideration. In the first place, it should be decided exactly where the hedge is to be placed, what it is supposed to accomplish, and how tall it will be allowed to grow. Some of the older holly hedges, planted fifty or more years ago, are maintained at about six feet in height. Others, planted specifically for screening purposes, are allowed to grow much taller. It is essential that this plan for the future be considered at the start





UPPER RIGHT PHOTO BY
NORMAN H. CANNON
OTHER PHOTOS BY ROBERT L. BAKER

Upper left. English holly, *Ilex aquifolium,* as a clipped hedge in a southern garden. Upper right, *Ilex crenata* 'Sentinel' as a hedge plant. Lower left. American holly, *Ilex opaca,* pruned as a low-growing, formal hedge.

so that sufficient lateral space can be allowed for the proper growth of the plants.

For example, a hedge to be planted to border a permanent walk would be placed four feet from the walk if it were to be maintained at about five feet in height, but considerably farther back if it were to be allowed to grow to ten, fourteen, or more feet in height. Too many hedges are ruined because there is little foresight in planning for the definite line where the plants are to be placed. If too near the walk, the plants would be sheared to prevent them from crowding the walk before they reached the desired height. The base of the plants would then become open, lacking branches, and the entire hedge would be unsightly and possibly even useless.

In allowing for space on the ground for the width of the hedge, it should be remembered that all hedges should be wider at the base than at the top, especially hollies, if they are to be covered with branches directly to the ground. Admittedly, there are some faster growing plants, such as privets and barberries, which are sheared with their sides perpendicular, but there are many other plants which cannot withstand this type of pruning. Hollies are definitely in this latter category. More lateral space is needed at the base to allow for

sufficient light, air, and even moisture to the lower branches. So often one sees an older hedge, sheared perpendicularly, with the lower branches dead or dying and hence plenty of room for animals to run through it. Such hedges are not satisfactory chiefly because the lower branches are not allowed to grow out naturally and reach for sunshine. So it is best, if one wants a dense hedge covered with branches to the ground, to trim them so that they are wider at the base than at the top.

Another important rule of thumb is: never plant a hedge exactly on the property line, no matter how congenial one's present neighbors may be. Properties can change hands unexpectedly. That part of a hedge hanging over the property line on the abutting property belongs to that property owner, and he can do with it as he sees fit. In other words, when planting along a property line, be certain to place the hedge so that at its desired height it can be maintained all on one's own property. In this way, one retains full control of the planting, manner of clipping, and removal of the plants if and when desired.

The size of the plants used can be an economic question. Small plants cost less, are more easily handled, and are less expensive to replace. On the other hand, it takes longer, sometimes, for small plants to serve effectively as a hedge than larger plants. However, in hedge planting, it is frequently more desirable to use smaller plants since then they can be spaced closer together at planting time. Three or four feet apart is about right to space three-foot plants. If this proves too costly and one is willing to wait for growth, they can be spaced farther apart and not be expected to serve as a barrier for several years. On the other hand, if the hedge is desired to look and act as a hedge immediately, one should select large plants, space them so that their branches touch, with the resulting increased initial cost.

When small plants, three to four feet high, are to be used, it is best, if possible, not to dig individual holes for each plant. A long ditch is preferable, excavated deeper than necessary, especially if the soil is poor, and filled in the bottom with well-rotted manure and, on top of that, good loam. Hedges planted with this care get off to good growth at the start. Also, during dry periods, it is much easier to keep the hedge watered. A slight depression can be left along the ditch which will be much more conducive to easy watering than if each plant has to be watered separately.

Hollies, planted as screens, are usually of the larger sizes which are planted as individual trees, and are seldom sheared except to improve the density of their branching when desired. It is often best to restrain the tops of such screens by judicious pruning until the side branches are sufficiently numerous and well-grown to provide the needed screen. Sometimes an overall sharing, or even a pruning of the tips of the branches here and there, is sufficient to bring about vigorous growth. Once one has planted hollies

Left, Yaupon holly, *Ilex vomitoria*, hedge in Brookgreen Gardens, Murrells Inlet, South Carolina. Right, A wooden template is used in Brookgreen Gardens as a guide in shearing the hedge. ROBERT L. BAKER

and noted their growth habits, it is not long before he acquires the skill to bring about more dense gowth. Some species like *Ilex crenata,* the Japanese holly, are more dense in their growth habits than say *I. opaca,* the American holly, and so require less attention in this respect.

Trimming requires a knowledge of the growth habits of the different species used. For instance, *Ilex crenata, I. glabra, I. cassine,* and *I. vomitoria,* are all vigorous-growing shrubs or small trees which tend to grow vigorously from the base of the plant, although they sometimes do grow with a single trunk. Because of this base-growing tendency, these can be cut to within six to twelve inches from the base, if desired, early in the spring and be expected to form many buds and new shoots at this point during the current year. This has been done with a planting of *I. glabra,* inkberry, in the Arnold Arboretum at Jamaica Plain, Massachusetts, because it was very weak and spindly at the base. Eight-foot plants were cut down to six to twelve inches in height in April. At the end of that growing season, they were excellent dense, bushy plants about twelve to eighteen inches high.

The English and American hollies are normally trees, usually with a single trunk, and one should be extremely careful in treating them this roughly. In fact, it is better not to cut them in this fashion unless one has had experience in so doing in one's particular locality. Some of the American hollies in their native habitat are frequently handled this way, but in other areas, where climate may not be congenial, they would suffer materially. Hence, these species are best treated with more care and cut back this much only after careful investigation has proved that it can be done.

When the small plants are first planted, they might well be pruned back heavily on a majority of their shoots, for in this way dense growth is encouraged. It is much better to restrain the plants in height at this period in order to encourage basal branches, since young plants produce these more quickly than older plants.

Actual shearing of most kinds of holly hedges need only be done once a year—in the very late spring when they have completed their current growth. Shearing in the late summer may cause new growth to form which will not have sufficient time to mature before winter and so may be killed by winter cold. Heavy shearing in the winter should be discouraged, for it may let in more sunlight and wind to branches normally accustomed to shade and protection, and these in turn may be burned by winter sun or winter cold.

Making an early barrier of a young hedge is not always possible with small, young plants. However, if, after the plants are properly planted, chicken wire is worked into the line of living foliage, this will do the job, and probably will rust out of usefulness by the time the plants have grown sufficiently to serve the purpose.

Evergreen hollies in larger sizes have been used as sound deadeners along noisy thoroughfares in some ornamental plantings and serve well in this capacity. As protection from winter winds, they seldom are satisfactory, for high, dry winds tend to burn the foliage and make the plants unsightly. But as hedges, screens, and barrier plants, the following hollies serve well in many an area:

Ilex aquifolium, English holly. The lustrous, prickly, evergreen leaves of this species make its use as a hedge and screen especially desirable. Normally, it grows as a tree, but with the right kind of pruning when it is very young, it can be forced to grow with several leaders from the base—an asset for any hedge plant. A careful study of the many cultivars of this species will undoubtedly show several which, because of smaller foliage and more dense branching, regardless of fruit production, make better plants for hedges. Being tall, the English holly is one of the better screens. Zone 6.*

Ilex cassine, dahoon holly. A vigorous-growing, southern evergreen, considerably used in making hedges. Zone 7.

* Plant Hardiness Zone Map, The Arnold Arboretum of Jamaica Plain, Massachusetts.

FRED C. GALLE

The extensive hedge of *Ilex cornuta* 'Burfordii' at Callaway Gardens, Pine Mountain, Georgia.

Ilex cornuta, Chinese holly. Especially mentioned here for its cultivar 'Burfordii', which is the Oriental holly most resistant to the dry climate in many parts of the South. One landscape architect in Dallas, Texas, told me that if he could have only one evergreen for planting in that hot, often dry area, it would be the Burford holly. Zone 7.

Ilex crenata, Japanese holly. There are many named cultivars of this species, some very hardy such as *I. crenata* 'Convexa', convexleaf Japanese holly, and *I. crenata* 'Microphylla', littleleaf Japanese holly, which are hardy in Zone 5; others are low and excellent for bordering walks such as 'Helleri' and 'Kingsville Dwarf'. All are extremely dense and very amenable to shearing and, because of their small leaves and dark green color, are widely used as hedges. *I. crenata* 'Convexa' has been termed the "hardiest substitute for boxwood in New England" and justly so. It is a vase-shaped plant which needs little shearing as a hedge and can be easily restrained at almost any height from one to eight feet. Other useful cultivars of the Japanese holly include: 'Stokes', 'Hetzi', 'Glass', 'Green Island', and 'Kingsville Green Cushion'. All the Japanese hollies are among the most desirable as evergreen hedge-making materials, especially suited for formal planting. They constitute the few hollies which can be kept in fairly good condition by shearing the sides vertically. Old plants of the taller-growing types make excellent screens. Zone 6.

Ilex glabra, inkberry. Another good, hardy evergreen holly, with comparatively small boxlike leaves, this species does best in moist or wet soils. Because of this, it may not do so well under city conditions as *I. crenata* and its cultivars. Nevertheless, the inkberry is an excellent evergreen, not nearly so stiff in habit, hence not so good a barrier as *I. crenata* cultivars. However, its lustrous dark green leaves and its ability to recover quickly from heavy spring pruning make it one of the hollies to be considered for hedges. Zone 3.

Ilex opaca. American holly. The maze of American hollies at Williamsburg, Virginia, and another at Mount Vernon are ample proof that the hedge-making qualities of this native plant were well known to the early American settlers. Many cultivars have been named, some better than others for hedge-making because of better foliage or more dense growth. In any event, because this holly

varies so much when grown from seed, it is highly advisable, if one wants a uniform-appearing hedge, to buy plants of one named cultivar (produced by vegetative means) rather than grown from seed or from plants collected in the wild. A hedge of seed-grown plants will vary in sex, habits, leaf color, and size which will be most noticeable and spoil the effect of an otherwise congruous hedge. This species, like the English holly, is a tree with spiny leaves, but pruning it properly while young can force it to produce several leaders from the base. Because this species is a tree, it also makes a good screen. Zone 5

Ilex vomitoria, yaupon holly. Another southern evergreen used considerably in the South for hedge and screening purposes. Informal, unpruned hedges of well-colored, heavily berried plants of the yaupon holly are breathtaking sights and a joy to behold. Zone 7.

As more of the now rarer hollies become more generally available, as their hardiness ranges become more thoroughly known, and as their values become more readily appreciated, more and more of these versatile plants will be used for hedges, screens and barriers.

Donald Wyman, horticulturist of the Arnold Arboretum of Harvard University, Jamaica Plain, Massachusetts, for thirty-five years, retired August 31, 1970. A member of the Board of Directors and a past president of the American Horticultural Society, he is past vice president, a former trustee for 16 years, and now honorary trustee of the Massachusetts Horticultural Society. He is a well-known lecturer and author of *Shrubs and Vines for American Gardens; Trees for American Gardens; The Arnold Arboretum Garden Book; and Ground Cover Plants.*

In 1969, Dr. Wyman was awarded a Veitch Memorial Medal by the Royal Horticultural Society of London, England.

In May 1970, he received the George Robert White Medal of the Massachusetts Horticultural Society, recognizing him as "the virtual embodiment of horticulture in New England."

Hollies for Topiary

ALDEN HOPKINS

Topiarius—"an ornamental gardener, one skilled in fanciful landscape-gardening"—refers, of course, to the art of training and clipping trees or other plant material into fanciful, artificial shapes. It is a project requiring time and patience, the "art of a leisurely age." The landscape architect whose diploma from a professional graduate school may relate that he is a *magistri in arte topiaria* indicates the historical background of the modern practitioner and his reliance in part on the formality of Rome and the later great seventeenth- and eighteenth-century gardens, when formality in training plants was at its height. Today we are all trainers of plant material, yet with a far broader meaning than that of the *topiarius.*

The *opus topiarum,* popular ornamentation for the Roman garden, returned to fashion again in early Tudor times to remain a highly prized feature of gardens, large and small, for over two hundred years. The Dutch appeared to be particularly fond of this ornament and developed a fine sense in its use in their flat canal-encompassed gardens. With the arrival of William and Mary in the seventeenth century, English gardens soon reflected the court interest in topiary work, one of the fancies of a King intensely interested in gardening. Hampton Court received his particular attention, and with the revisions undertaken by the two famous gardeners, George London and Henry Wise, the former superintendent of the Royal Gardens, much of the old design was removed and the yews in fashionable clipped shapes set out in the fountain garden. Many of these now long-unclipped trees exist today as mere accents in that garden.

In the first years of the eighteenth century (1703), a gardening book, *The Theory and Practice of Gardening,* by D'Argenville (Alexander Le Blond), translated from the French by John James of Greenwich, had considerable

ALL PHOTOS COLONIAL WILLIAMSBURG, INC.

Portion of a copper plate (c.1732) from the Bodleian Library, Oxford, England, of the original grounds of the College of William and Mary. While this may be the earliest record of trimmed plants in the United States, it is not known whether the plants so treated were hollies, yews, or box.

influence on the English garden design. In one chapter, he writes of topiary work and its fashion—"Heretofore they gave them a thousand extravagant forms, which are yet much in use in the gardens of Italy and Spain: some shaped out men on horseback, boars, stags, dogs; in short an entire Hunting-piece. Others cut them into Pyramids, Obelisks, Balls and Scrolls—This practice still continues in Holland and Flanders, where these whimsical Designs are more in vogue than in any other country."

Soon after 1700, there arose a voluble reaction to these collections over which the gardeners with their shears had reigned so long. Topiary work had been carried to such extremes that little was free from the cutting and snipping. People were tiring of it all. This reaction was instigated, no doubt, in great part by the columnists of that day who recognized that the time was ripe for a complete reversal of fashion in gardening. The artists of picturesque and romantic landscapes were also in the fore with their persuasive back-to-nature paintings, illustrating the peace and simplicity of rustic surroundings unhampered by scythe and shears.

This rediscovery of the beauty of natural plant shapes in the garden, the freedom from "the work of the scissors upon every plant and bush," was heartily encouraged by Joseph Addison in his *Spectator* articles. He wrote (*Spectator 414*, June 25, 1712) that the British gardener, instead of humoring nature, loved to deviate from it as much as possible. "... I would rather look upon a tree in all its Luxuriance and Diffusion of Boughs and Branches, than when it is then cut and trimmed into a mathematical figure; and cannot best fancy that an orchard in flower looks infinitely more delightful than all the little labyrinths of the most finished Parterre."

These early years of the eighteenth century saw the beginning of the revolution in the use of topiary pieces. In 1713, at the same time Addison was criticizing, Alexander Pope broke out in poetry and derisive descriptions of the art and especially the abundance of work now cluttering many fashionable gardens. In the *Guardian*, he wittily quotes from a listed sale of nursery stock—"Adam and Eve in yew, Adam a little shattered by the fall of the tree of knowledge in the great storm; Eve and the serpent very flourishing. St. George in box, his arm scarce long enough, but will be in condition to stick the dragon by next April; a green dragon of the same, with tail of ground ivy for the present. (NB—These two not sold separately) Divers eminent poets in bay, somewhat blighted, to be disposed of a penny worth. A quickset bay, shot up into a porcupine, by its being forgot a week in rainy weather." In all, this trend to extremes of topiary art, soon to cause its complete downfall, can be summed up in a further quote from Pope—"We seem to make it our study to recede from nature, not only in the various tonsure of greens into the most regular and formal shapes—and are yet better pleased to have our trees in the most awkward figures of men and animals than in the most regular of their own."

Thus the topiary fad, fashionable for over two hundred years, slowly passed away. Many gardens were completely

Topiary hollies around the ballroom wing of the Governor's Palace, Colonial Williamsburg. These are informally called "Apostles," because there are twelve, six on either side of the main walk.

torn apart to follow the new natural style so well publicized at Stowe. There were a few places, however, which escaped and, today, display antique specimens of yew topiary scattered and arranged throughout the plain parterres. Levens Hall and Packwood House still show their great clipped "Greens."

In the Colonies, this art, so prized under William and Mary, held on for a considerable period after its termination in England. Here, too, its popularity was considerable and we have numerous records of topiary "greens" from New England to Virginia. The early years of the seventeenth century provided few references, but the eighteenth, with more prosperity, brought many. In Boston, yews were ordered from England in 1736 by Thomas Hancock—". . . 100 small yew trees in the rough which I'd frame up here to my own fancy." It appears from this quotation that yew topiary in considerable quantity, perhaps for bordering a parterre, was planned for this new garden.

The most authentic evidence of the popularity and use of clipped evergreens in Virginia is the Bodleian Plate, believed made between 1733 and 1747. This copper plate engraving, discovered at Oxford's Bodleian Library, shows the several important public buildings of Williamsburg, the Capital of the Colony. Among them the main building of the College of William and Mary is clearly illustrated. Here is discovered a wonderful display of topiary lining the three parallel entrance walks in an exact planned manner. Although these examples have long since disappeared, there is additional evidence of their having existed and that the impression created by the plate of this use of topiary is correct. A quotation from E. Hazard, who traveled in Virginia in 1777, gives

one eye-witness proof of the use of topiary as ornament at the College—"At this Front of the College is a large court yard, ornamented with gravel walks, trees cut into different forms, and grass." There is no indication of the kind of plant material, whether holly, box, yew, or other green.

An even earlier reference to these topiary pieces at the College was made in 1732 by Reverend William Dawson, Professor of Divinity, in addressing the Bishop of London describing the various buildings and ". . . the East front of the College, before which is a garden planted with evergreens kept in very good order."

With the College as a nearby example, there is little reason to doubt but that domestic yards and gardens held fashioned greens still in style there. We do know of one place, owned by Colonel John Custis, an early student of botany and correspondent of many eminent European men of similar interests. In a letter to Peter Collinson in 1738, he writes, ". . . I have had silver and gold hollies, yews, phillereus, etc. come flourishing to me three feet high, the balls or standards having heads a big as a peck and the pyramids in full shape and are at this time flourishing in my garden; but these every individual tree was put into a basket with earth and the basket and tree buried together the basket soon rotted so that the tree was never stunted in the least—." Of these evergreens so carefully planted and enjoyed so fully by Colonel Custis, one yew still survives in this garden, now part of the Eastern State Hospital grounds. Of great size and age, and green rather than silver or gold, it has long since lost any of its former topiary appearance.

Though the keen interest and support of John D. Rockefeller, Jr., the restoration of Williamsburg has been made possible. Research into the life, activity, and appearance of the city at the period of its greatest glory in the eighteenth

The maze of American holly, *Ilex opaca*, at the Governor's Palace in Colonial Williamsburg. The maze consists of four large American holly specimens in free form at the center or "goal" of the maze. The hedges of American holly vary in height from five feet at the center to eight feet at the edge. The maze is trapizoidal in shape and about ninety feet in length of side.

Yaupon (*Ilex vomitoria*) hedge and topiary in the Jotta Blair herb garden, Colonial Williamsburg.

century was one of the first requirements. Among these many lines of study, the first were concerned with architecture and landscape architecture, including the garden locations, pattern, ornamentation, and plant materials. In this new land, the first gardeners soon recognized the great abundance of native plants, collecting and sending them in a continuous stream to collectors and botanists in the mother country. The native evergreen hollies were among these—American holly (*Ilex opaca*), yaupon holly (*I. vomitoria*), and dahoon holly (*I. cassine*).

The formation of "greens" in geometric and fanciful shapes is somewhat of an art in itself as anyone knows who has attempted, with shears in hand, to cut his way into a piece of boxwood or holly. In the formation of an animal form, the selection of the basic plant or grouping of plants is the most important step. Many times, a particularly odd-shaped plant may suggest an animal in general outline or it may form a portion of a figure, which, with the addition of another, may result in the beginning of an amusing realistic form. By trimming here and drastically cutting there in another part of the plant, a ragged form may eventually appear. To undertake this, a study of the branching habit is necessary, for the more the plant is developed through natural pruning rather than by the use of wire and forms, the easier the general maintenance will ultimately be. The use of artificial support was not neglected in the early years of topiary construction. From D'Argenville we learn that many times ". . . Verdures, which are the fewer in number on account of the continual charge they require, as well as Wood and Wire for the constant Repair of their frames, as in their clipping four times a year." D'Argenville was quite correct, too, on the need for constant care in the clipping and the forming. At several recent restoration plantings in Virginia, there have been developed a peacock, a frog, a setting hen, and geometric forms—all

started from a plant or grouping of plants which gave some semblance of these objects to commence with.

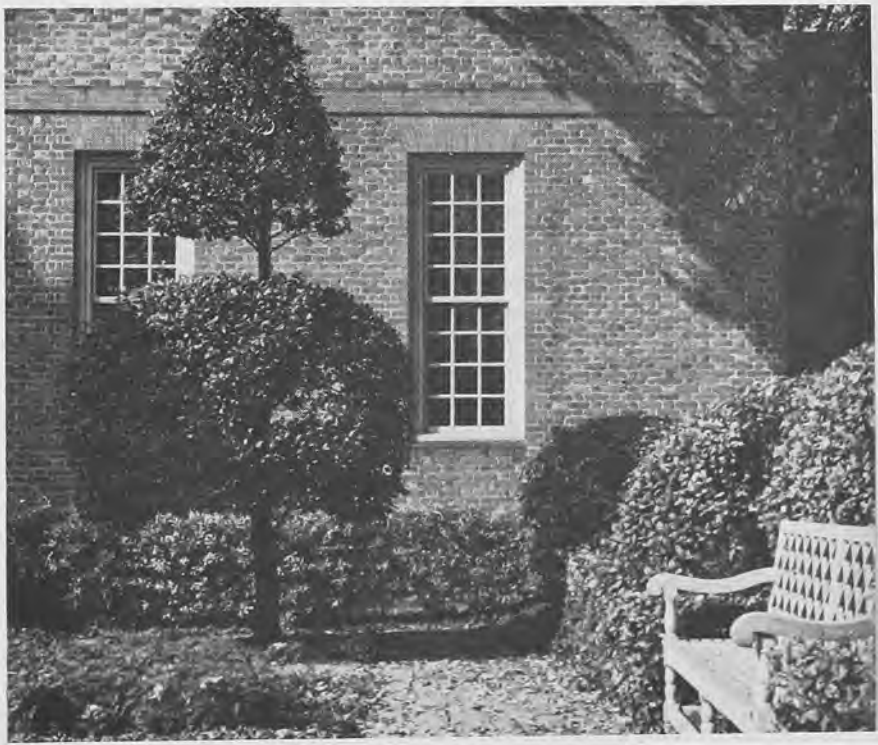
The formation of a geometric form in holly or other material is a much more simple project. For a tall interrupted cone, select a plant with a central trunk and side branches so arranged that a severe cutting back will still leave a sufficient number of branches to furnish with new growth the remaining basic form. It will require a number of years' growth before the piece is well filled in and takes shape. For other forms, pyramids, corkscrews, globes, and cylinders, the same careful selection and severe pruning are required. No forms and very few wires are necessary, if the plant to be formed is selected with care.

Other geometric forms may be made by the combination of several plants grouped around a center accent, or a series of repeating accents to form a screen or backdrop. A simple hedge, the lowest form of topiary work, can gradually be developed with the addition of knobs, points, waving variations, and swoops in profile into a most imaginative and interesting sight.

In Williamsburg, our selection of holly species for topiary work has been limited to those known before the year 1800. The section of the country is most fortunate to have at hand three native evergreen hollies of great beauty and ease of culture. The American holly fills the woods and from the earliest days was transferred into gardens for use as shade, natural accents, hedges, and topiary. The other two, yaupon and dahoon, are among the most beautiful evergreens. This is especially true of the yaupon holly. Its ease of clipping into any form and its great beauty in its native growth, in foliage, and in glistening red berries make it outstanding among evergreen shrubs. Its native habitat covers the South from Virginia to Florida and west to Arkansas and Texas.

Topiary hollies in the restored gardens at Colonial Williamsburg serve as decorative garden features, as conversation pieces, and to create an atmosphere reminiscent of the eighteenth century.

The late Alden Hopkins, F.A.S.L.A., resident landscape architect for Colonial Williamsburg, Inc., 1941-1960, in Williamsburg, Virginia, was a Garden Club of America Fellow and recipient of its Sarah Gildersleeve Fife Award. His private landscape design consultations were extensive over a thirty-year period, including many private commissions and such typical public restoration projects as "Hampton" and "West St. Mary's Manor" in Maryland; the Dickinson mansion in Delaware; the Cornwallis headquarters in North Carolina; and Gunston Hall, Woodlawn Plantation, Adam Thoroughgood House, and West Lawn and East Lawn at the University, all in Virginia. Mr. Hopkins was a popular lecturer and authored many articles on period landscape design.



A large American holly topiary in the east holly garden of the Governor's Palace, Colonial Williamsburg.

Bonsai Hollies

GEORGE S. AVERY, JR.

A love of small things, coupled with a deep feeling for nature, led the Japanese centuries ago to catch in miniature the spirit of ancient trees growing in the forests and on the high mountains. These diminutive, container-grown, replicas of nature's venerable specimens are called *bonsai* (singular or plural), the Japanese word that literally translates as a dwarfed potted tree or trees.

Such trees are kept small by rather simple cultural techniques, and may reach an age of several hundred years. They are frequently handed down from father to son, and are affairs of the spirit as well as tangible little, but old, trees. While grown and kept out-of-doors by the Japanese, they are brought into the almost unheated home on special occasions for exhibit and appreciation. Peaceful is the soul of the Japanese bonsai fancier who has fashioned in miniature a diminutive likeness of a spruce forest—or perhaps a single venerable mountain pine—a symbol of longevity.

In brief, the principal objective in shaping the life of a good bonsai specimen is to give it a natural look of great age, perhaps as if it had been exposed to the elements for a century or two. A large and often gnarled trunk, with sometimes twisted or drooping side branches, helps create this effect. Some specimens are trained to give a distorted appearance, as if they had grown in a remote mountain cranny.

Whether hollies will lend themselves to this type of training is for enterprising bonsai enthusiasts to discover, but whatever the form one works to achieve, the tree must be growing in a small and generally shallow container—not necessarily during the early training period, but certainly after it begins to attain the desired character.

The secret of growing hollies or other forest-sized species as bonsai is to root-prune, pinch back, or otherwise prune branches, and occasionally apply copper wire to young branches to train their growth for a year or two—to achieve the desired form. Large-leaved specimens of holly are not so desirable as those with smaller leaves, and if a berried specimen is chosen, remember that the berries as well as the leaves will be the same size as if the tree had been allowed to grow to its normal large size, thus producing another problem in artistic training.

One short-cut is to transplant and retransplant small holly plants in the nursery. This should be done in early spring and makes for a compact and shallow root system. During these same years, selective pruning of branches can also be done. They may then be moved to the small, authentic Japanese-style containers, after pruning the root system to fit the container. Some Americans think a clay pot painted in gay colors and with many different gadgets in it, as well as the tree, lends an air of authenticity. This would be heresy to the Japanese whose art it is.

A bit of information worth remembering is that bonsai are dwarfed, but not by starving. It is important to apply fertilizer three or four times during the growing season, beginning about a month before new growth starts in the spring. It is also important to water properly, just as one would any well-grown potted plant.

Special Tips for Holly Bonsai

1. Any small-leaved species of evergreen or deciduous holly can be trained as bonsai, including small-leaved selections of American or English hollies. Many think the best is Japanese holly (*I. crenata*) and its cultivar 'Helleri'.
2. If berried plants are desired, insure pollination by placing female bonsai in the proximity of male trees when specimens are in flower.
3. In general, keep holly bonsai out-of-

Japanese holly, *Ilex crenata*, trained as bonsai. Specimen is about twelve years old.

THE AMERICAN BONSAI SOCIETY—F. L. BALLARD

Assorted bonsai containers from Japan; the largest is 9½ inches long, the smallest is 1½ inches in diameter.

THE AMERICAN BONSAI SOCIETY—DOROTHY YOUNG

doors, in partial shade. Where winter temperatures are low, place in deep coldframe or cold greenhouse. Bring indoors for occasional exhibit.

Those feeling the urge to grow holly bonsai (or any other species) should take a short course of instruction, if possible. People have come from far and near to take such a course at the Brooklyn Botanic Garden. Those not within commuting distance of that garden may find the listed publications of help:

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* Available from Brooklyn Botanic Garden, Brooklyn, New York 11225.

Dr. Avery retired on September 30, 1969, as director of the Brooklyn Botanic Garden, Brooklyn, New York. He is a past president of the Botanical Society of America and editor-in-chief of the first two volumes of the *Survey of Botanical Progress*. Dr. Avery is the author of more than fifty articles and reports of research, chiefly in the field of plant hormones, also co-author of two books on plant hormones.

Hollies In Cut Arrangements

HENRY P. ORR

Hollies provide wonderful source material for flower arrangements: for use in the thought-provoking, linear arrangements of the Orient; the massive, picturesque compositions of the golden periods of Europe; or the more pleasing, informal combinations of line and mass for a truly American arrangement. Often it will be desirable to use hollies alone; at other times, in combination with flowers. As a result of careful corrective pruning of branches and sprigs of hollies for arrangements, the plants become more desirable as landscape specimens. The more hollies are used in arrangements through the year, the more desirable it will be to add new cultivars to the planting. One with a more linear habit, or one furnishing more massive form for arrangements, or one with a more distinctive leaf pattern might be required.

In the past, we have thought of hollies for Christmas use only. Great branches of heavily berried American hollies were frequently placed in vases, or used to enframe pictures, or to make traditional garlands. Without being placed in water, these decorations may have lasted through the holiday period but were quite often a fire hazard. This excessive use of hollies resulted in the disfiguration or destruction of many natural stands. If only the smaller branches had been cut for arrangements, many of our native stands would still be attractive along our highways.

What could be more traditional than a candelabra arrangement of hollies? The plant material to be used would constitute a very light pruning of one or more species or cultivars of hollies. The construction of the arrangement is simple. A block of florist's "Oasis" or other water-absorbing plastic, approximately four inches square and two inches thick, is thoroughly soaked in water until wet throughout. Then it is formed into a doughnut shape by rounding the edges and carving out a center hole. Chicken wire is fitted around the doughnut to strengthen it. The completed doughnut is placed in a glass epergnette in the center holder of the three-branched silver candelabra, and a candle fitted into the center of the "Oasis" doughnut. The vertical, lateral, and forward lines of the arrangement are developed from linear branches of Chinese hollies. Slanting cuts should be made on the basal ends of these branches, after soaking them overnight in deep containers of water.

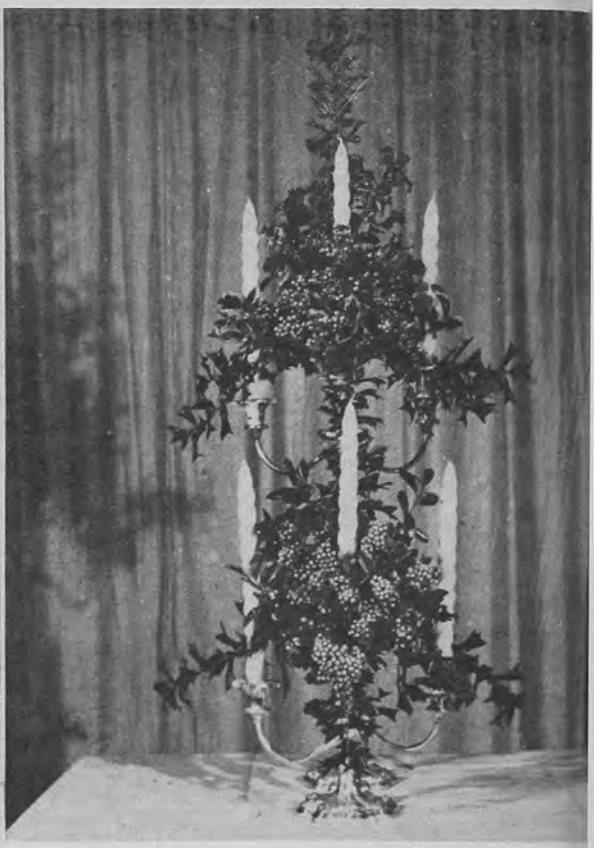
Wherever used, hollies will be more lasting if they are properly conditioned. Preferably, they should be cut with a sharp knife late in the afternoon and the stem ends immediately placed deep in water in a cool, non-drafty location. The next morning the arrangements can be made with these water-filled branches. Suitable containers should be selected to hold water or plans should include the use of a water-absorbing plastic such as "Oasis." Pinholders or chicken wire should be securely mounted in the containers, or chicken wire should be wrapped around the "Oasis" to hold the stems firmly in position.

The slanting cuts are easily inserted into the "Oasis" but should not penetrate entirely through the soaked material. To insure easy burning of the candles, the branches, especially the vertical one, should slant away from the candle. Once the outline of the arrangement is established, the lightening lines of the variegated English hollies can be placed. Then the focal area of short, heavily fruited branches of 'Foster's #2', the American holly 'Howard', and dahoon holly can be developed.

A plastic coating, sprayed on the fruit after the arrangement has been chilled for a few hours, gives a delightful frosted

New Jersey Silica Sand Co.

This candle with berried holly attached, beautiful in its simplicity, may be displayed on a hall table or in a window.



HENRY P. ORR

Upper left. A traditional candelabra arrangement of hollies.

Upper right. A candelabra arrangement of hollies with a double tier effect.

An autumn arrangement of hollies, cattails, and "rainroses" in a duck decoy.

appearance. Such arrangements last for three weeks in rooms with temperatures of about 70° F.

If a higher arrangement is desired, the double-tiered effect of the two three-branched candelabra can be created. The removable shank of the front candelabra is added to the one in the rear to give increased height. Where a wider effect is desired, the basal arrangement can be broadened by increasing the length of the laterals.

Each year as we approach the Christmas holiday season, our thoughts naturally return to the traditional use of hollies. Hollies may enhance the beauty of the festive table for punch or egg-nog or form the base for a lovely candle arrangement for a table, buffet, or end table.

Throughout the summer, we can en-

joy hollies as living arrangements indoors in planters or outside in containers for patio or terrace. Dwarf Chinese holly and Japanese holly 'Helleri' develop well in planters. Topiary or espaliered forms can be rather easily developed. *Ilex cornuta* 'Rotunda' and the *I. crenata* cultivars seem to withstand the rigors of culture in restrictive containers, if they are not overwatered.

In autumn, an arrangement of holly, cattail, and "rainrose" in a duck decoy might delight the heart of the huntsman of the family. "Oasis" holds the necessary water to keep the arrangement fresh. Cattails furnish the height and are accompanied by 'Foster's #2' and inkberry or gallberry. English holly 'Wilsonii' and a green-leaved English holly form the base and width of the arrangement. Sitting on a woven mat, the decoy seems to be floating among a group of water-lillies; these are actually "rainroses" produced by grouping the fruiting structures of the Chinese parasol tree (*Firmiana simplex*) and centering the grouping with a cone of China-fir (*Cunninghamia lanceolata*).

To symbolize the gaiety associated with the New Year, an arrangement depicts the antics of three celebrating tipplers. A cup-type pinholder is attached with florist's clay at the larger end of a free-form ceramic container. Chinese hollies with a very interesting leaf pattern are used to develop a vertical line and American hollies to complete the lateral spread of the arrangement. English holly 'Wilsonii' strengthens the focal area of this arrangement because of its heavy, glossy, dark green leaves and whorled leaf and branch effect. When sprayed with plastic and quickly sprinkled with glitter, an icy, sparkling effect is given to the arrangement. The linear, focal arrangement of the gardenias extends around the carousing revelers to simulate their having thrown their boutonnieres to the icy carpet of holly, as they grab for their respective lamp posts. Variegated English hollies add life and sparkle to the dark background and make a pleasant textural transition from the coarseness of the English holly 'Wilsonii' to the smoothness of the gardenias.

A traditional candelabra or vase arrangement for the New Year might feature hollies complete with berries, but centered with bells in pealing position. Another novel arrangement of hollies might feature a small statue of "Father Time" limping out with a gay, plump "New Year's Baby" bursting from the focal point.

In the period from January to June, the foliaged stems of hollies are effective complements to everyday flower arrangements. A symmetrical, compote foliage and fruit arrangement of American holly 'Croonenberg' and Chinese holly 'Burfordii' can quickly be converted to a flowered arrangement by adding snapdragons and carnations. Hollies can be combined with the traditional flowers of special holidays. Red satin hearts, backed with a frill of holly leaves and centered with a white carnation pierced with a holly-leaf arrow, would be a conversation piece as the central feature of a table on Saint Valentine's Day or as individual place markers. Four Chinese holly leaves can be centered with a vivid green rosette to simulate abstract shamrock leaves for Saint Patrick's Day. Easter lilies, rising majestically from a wreath of *Ilex aquifolium* 'Ferox' or a similar coarsely prickled holly, create a symbolic arrangement. An arrangement of rugged driftwood accented with native American hollies, to emphasize bursting linear branches of forsythia and a focal grouping of daffodils, is the very essence of transition from winter to spring.

For many occasions, especially throughout the winter, holly sprigs can be combined gracefully with flowers to create truly distinctive corsages. Cattleya orchids may be backed, for example, with the glossy, dark green leaves of an English holly. The linear pattern of the spray orchids may be accented by the tiny leaves from the tops of variegated English holly. If the corsage is to be worn on a fine-textured fabric or next to the skin of the wearer, silhouettes of velvet or puffs of maline will soften the prickly effect. The question may be

HENRY P. ORR

Right. A symmetrical foliage and fruit arrangement of American and Chinese hollies.
Left. A similar symmetrical arrangement to which snapdragons and carnations have been added.

asked about the coarseness of hollies as contrasted with orchids. Such a contrast naturally exists between the orchid flower and its own foliage. The true beauty of the orchid flower is accented by this natural contrast.

Other charming corsages can be fashioned with hollies and other flowers, or hollies and fruits or cones. The tiny 'Garnet' rose is a pleasing companion for the leaves of *Ilex pernyi* or that of *I. aquifolium* 'Angustifolia'. The leaves of 'Foster's # 2' will give a pleasing twisted line effect to an arrangement with clusters of berries and cones, to wear on a tweed suit.

Hollies are being blended more and more in the landscape because of their desirable year-round effect. They can also be used throughout the year to beautify the interiors of our homes. Hollies have long been a tradition during the winter season; why not extend that tradition year-round!

Dr. Orr, who is a professor of horticulture and head of the Ornamental Horticulture Division, Auburn University, Auburn, Alabama, arranges flowers as a hobby and as a profession. He is accredited with the National Council of Garden Clubs as an instructor in horticulture and flower show practices and has taught judging courses in Alabama, Georgia, Michigan, and Ohio.

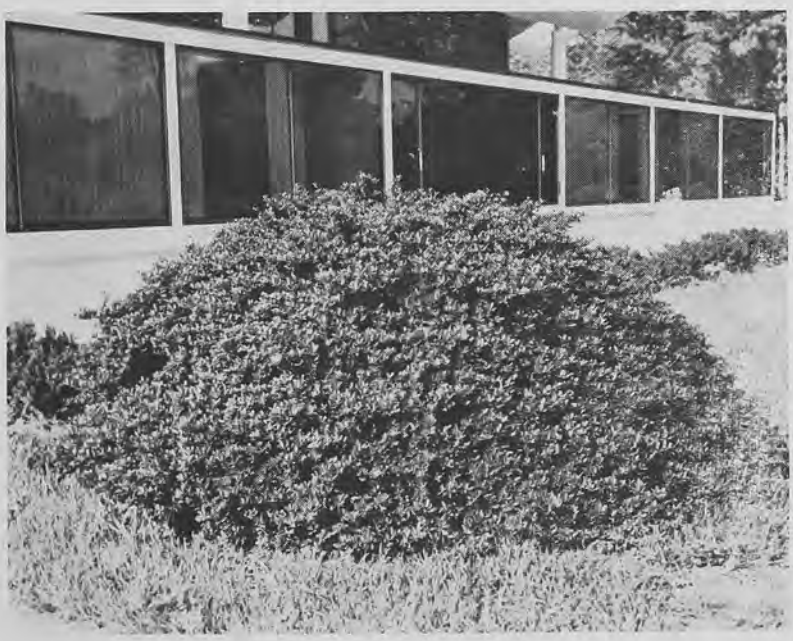
Hollies as Landscape Plants

CLARENCE E. LEWIS

The only genus of woody plants that will provide colorful fruits for six to ten months is *Ilex*. There is also a wide range of plant forms in the group, including shrubs of low, dense, cushion-like habit, spreading and rounded types, and pyramidals which are slightly irregular but sometimes dense. These are all well-suited to small or large home grounds, office buildings, and even public gardens and associated buildings. Some hollies grow to 40 or 50 feet after many years, and several have a wide range of hardiness.

The greater number of species are evergreen but a few are deciduous, such as the common winterberry (*Ilex verticillata*), and provide contrast in the landscape. The fruits are red in all hardy species except *Ilex crenata* (and its cultivars) and *Ilex glabra,* both having glossy, black fruits. The red fruits of *Ilex opaca* and *Ilex aquifolium* often persist in a firm state as late as August of the following year. Many times the new green fruits are apparent, while the red fruits of the previous year are very much in evidence. The leaves, in most cases, are a bright green, but there are also selections with variegated leaves and some with an absence of marginal leaf spines.

Shrubs and small trees combine well with hollies, including many cotoneasters, *Abelia, Osmanthus,* barberries, blueberries, boxwood such as *Buxus sempervirens* 'Vardar Valley', camellias, flowering quince, cherry-laurel, *Elaeagnus pungens* and *E. multiflora, Euonymus, Fothergilla,* and *Hamamelis* for contrast. Other broadleaf evergreens might include mountain-laurel, *Mahonia aquifolium* and *M. bealei,* Japanese and American *Pieris* and *Leucothoë,* and northern bayberry. Hollies combine well with small trees such as flowering and kousa dogwoods, *Stewartia pseudocamellia* and *S. koreana, Oxydendrum arboreum, Styrax japonica,* and many yews and junipers. Shrubs which may be used with holly include *Viburnum* × *burkwoodii, V. rufidulum, V. tinus; Vaccinium; Skimmia japonica;* and *Sarcococca hookeriana* var. *humilis.*



U.S. NATIONAL ARBORETUM

Specimen of *Ilex crenata* 'Helleri' in front of the Administration Building of the United States National Arboretum, Washington, D.C. It is 10 feet wide at the base, three feet tall, and about 30 years old.

U.S. National Arboretum

Hedge of *Ilex cornuta* 'Rotunda', about four feet tall, encircles a black oak in the United States National Arboretum. The plants are about 15 years old.

Ground covers, such as *Pachysandra terminalis, Vinca minor,* and selections of ivy (*Hedera helix*), are planted effectively beneath hollies.

Unclipped, several hollies make attractive informal massed or specimen plantings; shearing adapts them to formal settings. Bright leaves and red berries add appeal to entrances, doorways, and building corners.

Most hollies respond well to pruning; so there is practically no limit to creating what you deem appropriate for a given landscape. Many hollies can be

U.S. National Arboretum

Possum-haw, *Ilex decidua,* which is a deciduous holly with red fruit, can be effective in an appropriate situation as it is here in Colonial Williamsburg, Virginia.

U.S. National Arboretum

This hedge of American holly, *Ilex opaca*, is a permanent evergreen foil as wind protection and as background for perennials at the University of Maryland, College Park, Maryland.

trained as espaliers. Some, such as American (*I. opaca*), English (*I. aquifolium*), Chinese (*I. cornuta*), and Japanese (*I. crenata*), can be pruned into tight hedges which vary from two to eight or ten feet in height, depending on the species and cultivars selected. Japanese hollies, such as 'Helleri' and 'Stokes', are adaptable for very low hedges.

English and some selections of American holly make excellent tall hedges or

Clarence E. Lewis

Ilex crenata 'Helleri', left of walk, and *I. crenata* 'Convexa', right of walk, show the relative difference in size of these two cultivars when used for the same purpose. 'Helleri' is naturally a lower growing plant and more spreading compared with 'Convexa' which is taller and more upright.

CLARENCE E. LEWIS
Ilex crenata 'Stokes', low-growing, dense, and nearly ball-shaped in habit, is excellent for a low hedge or for massing to fill an open space.

barriers. The bank of bright shiny leaves is most attractive. Even though pruning is done, a reasonable number of bright red berries will still add to the display. Most holly hedges are excellent for enjoying privacy and directing foot traffic.

Pruning helps to guide branches in desired patterns of growth. For example, Hetz holly (*I. crenata* 'Hetzi') tends to grow somewhat laterally. Experienced plantsmen can encourage this trait by thinning interfering upright branches. Even tall-growing English and American hollies can be trained to grow flat by cutting out the leaders and allowing the distinct horizontal branches to become dominant. By regulated thinning, tiers or broad plateaus can also be created and maintained.

Requisite soil conditions and locations vary according to species and cultivar (see table). In general, good drainage, particularly in the area below the root system; a liberal supply of organic matter in the root area, to maintain a regulated water supply; and slightly acid soil will give a holly what it needs. Most hollies tolerate sun or shade, although they usually are more compact and fruitful in sun.

Variation in soils, water table, and climatic conditions make blanket recommendations for fertilizing or liming inadvisable. Consult local growers and extension agents for specific local cultural recommendations and advice on which species and cultivars are suitable for local conditions.

Evergreen hollies are best transplanted in the spring, particularly in northerly areas. Purchase balled and burlapped or container-grown, never bare-root stock. Deciduous species can be planted in spring or fall; bare-root stock or container-grown is acceptable.

Be sure deciduous and evergreen hollies get plenty of water for several weeks after they have been transplanted. The first years after transplanting are the most critical, particularly in areas where extended freezing temperatures prevail. Protection from severe damage by pests and diseases and a little winter shelter from wind, and possibly sun, are important. There is less likelihood that severe damage will be widespread once a planting has been established for five years.

Hollies are dioecious. Be sure you remember this when selecting holly for your landscape. Each tree or shrub is either female (pistillate) or male (staminate). Though both sexes flower, only the female produces fruit. For most species (see table for exceptions) there must be at least one male plant within 40 feet of several females to insure fruiting. The staminate plant should be planted so that prevailing winds blow

BROWNELL FARM

Ilex aquifolium, planted in 1941, accents pillars of the garden gate and then continues as a hedge on this home property in Portland, Oregon.

toward the pistillate plants. Alternatives are to plant a male and female in the same hole and keep the male pruned small, or to buy a female plant on which one male branch has been grafted.

Do not expect one species of holly to pollinate another, although this sometimes occurs; the flowers often open at different times. Most growers and distributors mark their plants as to sex. Through most of the seasons, fruits will be present on the female.

The following chart lists some of the most popular hollies grown in the United States and gives their hardiness range, other characteristics, and suggested landscape uses. This list is intended to aid holly growers in borderline hardiness regions where information of this kind has not been generally available, particularly at the cultivar level.

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Some Outstanding Hollies for the Home Landscape

Scientific & Common Names	Color of Fruit	Type**	Hardiness Zone***	Landscape Height****	Form or Shape	Cultural Aids	Landscape Suggestions
Ilex × *altaclarensis* 'Wilsonii' (Wilson holly)	red	E	7	6′–8′ (shrub) 15′–25′ (tree)	Shrub or tree.	Takes some sun and wind; soil well-drained but with organic matter.	One of best for warmer regions; use as tree, espalier, shrub, screen, clipped hedge; large, leathery leaves; heavy berry producer.
I. × *altaclarensis* 'James G. Esson' and *I.* × *altaclarensis* 'Eldridge'	red	E	6	15′–25′	Broadly pyramidal.	Wind protection recommended.	One of the hardiest cultivars; large, flat, glossy, deep green leaves; stems turn purple in cold weather; good with *I. opaca*.
I. aquifolium† (English holly)	red	E	5–6	variable 20′–40′	More or less pyramidal; often dense.	Needs protection from sun and wind in warm, dry areas.	Shiny, dark green, spiny leaves; red fruits, interesting through May; hedges, mass plantings, combines well with camellias and azaleas.
I. aquifolium 'Balkans'	red	E	5–6	15′–20′	Upright.	Plant where protected from direct winds.	One of the hardiest cultivars; smooth, dark green leaves; not readily available.

† There are many cultivars of *Ilex aquifolium*, some of weeping habit, some with either golden- or silver-variegated leaves, and a few with yellow fruits. Check with growers and extension agents for what is best in your area.

I. cassine (dahoon holly)	red	E	7–8	20′–25′	Semirounded; dense branching.	Grows well in high water table soils, also in average garden.	Prolific fruiter; fine plant for southern U.S.
I. cornuta (Chinese holly)	red*	E	5–6	6′–10′	Broadly pyramidal; sometimes boxy.	Needs long, warm season to color fruit; prefers eastern or northern exposure in desert climates.	Rectangular-shaped, shiny leaves often with few spines at the tip; shape can be altered by pruning; very picturesque; unusual leaves and red fruits most attractive; responds well to pruning; makes good espalier and contrasts with evergreen privet.

* May not need pollinator to set fruit.

** D-deciduous; E-evergreen.

*** *Ilex* species, varieties, and cultivars will grow to the minimum hardiness zones indicated, if soil pH and general climatic conditions are amenable to broadleaf evergreen culture. Where two zone ratings are given, optimum performance would be expected in the warmer zone. The hardiness zone and numbers refer to those recommended by the U. S. Department of Agriculture in *Miscellaneous Publication No. 814*.

**** Refers to ultimate landscape height which should be considered in planting, not the ultimate height it may reach as a wild specimen in its native habitat.

I. cornuta 'Burfordii' (Burford holly)	red*	E	5–6	6′–20′	Broad and often narrow globular.	Same as for *I. cornuta*.	Shiny leaves with few spines; responds well to pruning; makes good espalier and contrasts with evergreen privet.
I. cornuta 'Dwarf Burford' (dwarf Burford holly)	red*	E	5–6	3′–8′	Same as Burford holly, but more compact and slower growing.	Same as for *I. cornuta*.	Same as Burford holly, but to be used where a shorter plant is desired.
I. cornuta 'National'	red	E	5–6	6′–20′	Similar to Burford holly.	Same as for *I. cornuta*.	Same as Burford holly.
I. crenata (Japanese holly)	black	E	4–5	3′–10′ sometimes to 15′	Stiff branches; broadly spreading to erect; resembles boxwood.	Very hardy; useful where extreme cold limits choice of polished evergreens for hedges and edgings; tolerates sun or shade; best in slightly acid soil.	Grown for its foliage; narrow, finely toothed leaves ½ to 1 in. long; responds well to pruning; good as a tub specimen, for hedges, and for texture contrast.
I. crenata 'Compacta'	black	E	5–6	3′–6′	Dense growth habit.	Same as for *I. crenata*.	Small, deep green leaves; requires little pruning to hold shape; useful for hedges.
I. crenata 'Convexa' (convex-leaved holly)	black	E	4–5	3′–6′	Compact, rounded shrub with a loose mound shape.	Plant in part shade or full sun.	Grown for its foliage; shiny, small, convex leaves; good with needled evergreens or deciduous shrubs; excellent for hedges and espaliers; also good specimen.
I. crenata 'Green Island' (Green Island holly)	black	E	5	2′–3′	Usually broader than high, almost horizontally branched; often a broad globe.	Upright shoots need removing.	Very dense grower; light green foliage, sometimes tinged purplish brown; drought-resistant; for entrances, hedges.
I. crenata 'Helleri' (Heller holly)	black	E	5	1′–3′	Dense,cushion-like dwarf, usually broader than high.	Same as *I. crenata*.	Slow-growing; small, dark green leaves; tight, twiggy appearance; good for dwarf hedges.
I. crenata 'Hetzi' (Hetz holly)	black	E	5	3′–5′	Similar to 'Convexa' but with larger leaves, hardier, and a more vigorous grower; semi-spreader.	Occasionally, upright shoots need removing.	Shiny, rich, dark green leaves; spread greater than 'Convexa'; makes good espalier or low flat hedge, good for massed plantings.
I. crenata 'Kingsville Dwarf' (Kingsville holly)	black	E	5–6	2′–3′	Good texture; very dense cushion.	Similar to 'Helleri' and 'Convexa'.	Narrow leaves; good form; a denser variation is 'Kingsville Green Cushion'; good for low hedge.

SOME OUTSTANDING HOLLIES FOR THE HOME LANDSCAPE—(continued)

SCIENTIFIC & COMMON NAMES	COLOR OF FRUIT	TYPE**	HARDINESS ZONE***	LANDSCAPE HEIGHT****	FORM OR SHAPE	CULTURAL AIDS	LANDSCAPE SUGGESTIONS
I. crenata 'Microphylla' (little-leaf Japanese holly)	black	E	5	3′–4′	Compact, twiggy.	Same as for *I. crenata*.	Small leaves; excellent for low hedges, background for perennials, and block plantings.
I. crenata 'Stokes' (Stokes holly)	black	E	5	2′–3′	Dense cushion; broader than high.	Same as other *I. crenata*.	Lighter green leaves than those of 'Helleri'; good for edging and low hedging.
I. decidua (possum-haw holly)	red	D	4–5	8′–20′	Large shrub or small tree.	Accepts wide range of locations; prefers abundant moisture but needs good drainage.	Retains fruit well into winter, longer than do other deciduous hollies.
I. glabra (inkberry)	black	E	5	6′–8′	Often loose, boxwood appearance; upright branching.	Prefers full sun but accepts some shade with good air circulation.	May drop leaves in very severe winter; good hedge or foundation plant; hardier than *I. crenata* and its varieties and cultivars; dark green specimens are best—they vary.
I. laevigata (smooth winterberry)	red	D	5	8′–10′	Upright branching; semiarching.	Best in moist areas with high water table; in undergrowth of woodland becomes almost treelike; tolerates dry soil but then slower growing.	Used massed or as a border planting.
I. latifolia (lusterleaf holly)	red	E	7–8	30′–35′	Large, oval leaves (6 in.); gives coarse effect.	Prefers wind protection and filtered shade.	Large leaves provide excellent contrast with English, Chinese, and American hollies; blend with camellias and rhododendrons.
I. × '*Nellie R. Stevens*'	red	E	5	15′–25′	Pyramidal; fast-growing.	Has been grown in Zone 5 if near lake areas.	Dense, shiny leaves suggest the *I. cornuta* and *I. aquifolium* parents but sometimes lighter green than either; can be grown as a tree or trained to emphasize lateral growth.
I. opaca‡ (American holly)	red	E	5–6	25′–30′ (shorter in zone 5)	Large tree, slow-growing; densely pyramidal; round-headed; horizontal-branching habit.	Needs well-drained, fertile soil; in the North, shade and wind protection beneficial in winter; suitable for sandy soils.	Spiny, saw-tooth-edged leaves; light grey bark; berries borne Oct. through Apr. or longer; very decorative in front of coniferous evergreens; hedges screens, espaliers, and background for flower borders.

‡ Many *I. opaca* selections have been introduced over the past 40 years. Many cultivars are hardy; some have excellent, shiny leaves and a profusion of red berries. Check with growers and extension agents for what is best in your area. If possible visit a nursery, which specializes in holly, in late autumn to see hollies in berry before buying.

I. pedunculosa (long-stalked holly)	red	E	5-6	6′–15′	Loose-growing shrub or small tree; sometimes pyramidal.	One of the hardiest evergreen hollies.	Spineless leaves are large, oval, glossy, dark green; bright red attractive fruits on long peduncles (similar to cherry); makes good espalier; loose growth should be emphasized.
I. pernyi (Perny holly)	red	E	6–7	10′–15′	Irregular, often with narrow head; sometimes distinct space between branch clusters.	Place out of the wind; excessive feeding causes loose habit.	Fine texture of foliage contrasts well with English holly.
I. serrata (fine-toothed* holly or Japanese winterberry)	red	D	5	6′–8′	Semiupright; often lateral, dense growth habit.	Can be grown in full sun.	Light, grey branches; saw-tooth leaf edges; finer texture than other deciduous hollies; develops twiggy appearance; use with upright crenatas.
I. verticillata (black alder or winterberry)	red	D	4–5	10′–12′	Upright and arching.	Best in moist areas with high water table; in the undergrowth of woodland becomes almost treelike; tolerates dry soil but slower growing.	Extremely hardy; smooth grey branches; leaves turn black after first frost; plant massed or in borders; use small plants, large ones difficult to transplant; can be trained dense, wide-spreading, or basal-growing.
I. vomitoria (yaupon holly)	red*	E	6–7	15′–20′	Large shrub or small tree; sometimes pendulous habit; often sheared into columnar form.	More tolerant of extremely alkaline soils than other hollies.	Profusion of tiny, scarlet berries; narrow, dark green leaves, 1 in. long; native of the southeastern states as far north as Virginia.
Ilex vomitoria 'Nana' (dwarf yaupon holly)	red	E	7	to 18″	Low, compact shrub; twice as wide as high.	Same as for *I. vomitoria*.	Formal when sheared.
I. yunnanensis (Yunnan holly)	red	E	6–7	6′–10′	Irregularly pyramidal.	Seems to grow well in parts of the Northeast; elsewhere difficult to grow and not readily available.	A fine-textured, red-berried species; combines nicely with *crenata* cultivars and *I. pernyi*.

Holly is My Hobby

ANTHONY R. GOULD

A pair of large American hollies, *Ilex opaca,* already graced the garden when I was given the popular Chinese holly, *I. cornuta* 'Burfordii'. But what I really admired was the English hollies, *I. aquifolium.* This was in 1949, and in those days few nurseries stocked more than American hollies. When I found a nursery with other kinds, I discovered I liked not only the English, but two species from China, *I. pernyi* and *I. ciliospinosa.* Of course, I needed both made and female plants in the species. My two original hollies had suddenly become nine.

A friend, learning I had bought some small hollies, offered me cuttings of an unusual Chinese holly, *I. cornuta* 'Rotunda'. I didn't take one or two, I took a handful and they all rooted. With more than I needed, I took some potted plants on a vacation to New England, visiting holly growers on the way and leaving a plant at each call. I left six and came back with eight new plants!

All thrive in my garden in Bethesda, Maryland, 10 miles from the White House. Just about every holly which grows between Richmond, and Cape Cod, Massachusetts, does well here. So do many from farther south.

It was all very well to collect two- and three-foot specimens. But, for me, they grew six to twelve inches a year. Before long I had a problem—what to do with so many in a garden slightly more than a half acre. I was not ready to sacrifice my native shade trees nor my lawn.

Borders and Screens

The kinds which become trees, such as American and English hollies, can be used in borders and are especially useful in screening unwanted views. Such a screen in my own garden has cultivars of American holly interplanted with hemlock, white pine, and blue spruce, thinned with crape-myrtle and pin oak at the ends. The opposite border is a more open planting with cultivars of English holly mixed with golden-rain tree, locust, persimmon, and dogwood.

With Other Plants

Ideally, holly specimens should be viewed from windows looking north or east so that all winter one can watch the sun bring out the beauty of the red berries and evergreen foliage. A striking contrast results when dogwoods, such as *Cornus florida* and *C. kousa,* are used with hollies; their white bloom against the dark green holly in the spring and their flaming foliage against the rich green of the hollies in the fall provide memorable views.

Most of the popular garden shrubs can be grown with, and will benefit from the contrast with, evergreen hollies—*Forsythia, Rhododendron* species including azaleas, *Abelia, Caryopteris, Hypericum.* Spring bulbs also look well near hollies, although they should not be planted beneath hollies. The dense shade will prevent the bulbs from maturing as they should for the following year.

Driveway Plantings

My cuttings of *I. cornuta* 'Rotunda' have grown into huge bushes, five feet high and eight to ten feet across. I have used these to mark one side of the driveway where it joins the road. They give the billowing effect of boxwood but, of course, with heavier foliage. Planted at six- to eight-foot intervals, they provide a dense mass of vicious spines which no dog can possibly penetrate. In fact, the neighborhood dogs do not even approach the hedge.

Foundation Plantings

Several hollies are ideal for foundation plantings. For this purpose, I have culti-

vars of *I. crenata* at the front of the house. However, I must keep pruning such cultivars as 'Convexa' and 'Rotundifolia'. For low plantings, *I. crenata* 'Helleri' is hard to equal. All the *I. crenata* cultivars are twiggy—there is no better word to describe the short branches at frequent intervals. They make ideal shelters for birds, particularly in winter, but birds do not seem to eat the black berries.

Hedges

In more formal settings hollies can be planted for sheared hedges. For boundaries or to screen a work area, American and English hollies are desirable. For a low, clipped hedge near a patio, some of the dwarf forms of *I. crenata* are choice. The subejct of hedges is treated in a special chapter in this volume, including selection of plants and their care.

Pruning

Like many other home owners I first planted my Burford holly, *I. cornuta* 'Burfordii', near the front door. But I moved it after I had discovered that it was a fast grower and needed constant pruning, even shearing, once it reached the desired size. Left to itself, it will grow to at least 15 feet tall.

When a holly reaches five or six feet, it should be pruned but not sheared. This means cutting off branches which protrude and pruning others to increase density. Usually two or more twigs will develop because of each cutting.

But pruning isn't the chore it might seem, if you wait until a week or 10 days before Christmas and use the cuttings for decoration. Because of holly's rapid growth, you can begin to give generous branches to your friends in a few years. For the friend "who has everything," there is no gift to equal holly from your own garden.

Species

For the benefit of gardeners in my area, I have compiled a list of species, but let me add that not every cultivar I have tried in all these species has prospered. I have lost three *I.* × *altaclarensis* 'Wilsonii', although it thrives in a garden only three miles away.

I am growing the following evergreen hollies: *I. aquifolium, I.* × *altaclarensis, I.* × *aquipernyi, I. aquifolium* × *I. cornuta, I. crenata, I. ciliospinosa, I. cornuta, I. glabra, I. latifolia, I. opaca, I. pedunculosa, I. perado, I. pernyi,* and *I. rugosa.*

For a small garden I like *I. pernyi* and its cross with *I. aquifolium, I.* × *aquipernyi,* because of their modest size, small leaves, and heavy crop of red berries. Since their growth habit is dense, I use them in clumps to screen camellias from winter winds.

Deciduous Hollies

I haven't said anything about the deciduous hollies. They are a conversation piece. However, pressure for space will prompt me, sooner or later, to remove *I. serrata* and *I. verticillata* which have not fruited well for me. I shall keep possumhaw holly, *I. decidua.* Its red berries last longer and are showy against the silvery gray twigs.

Pests

Pests are the least of my worries. The holly leaf miner on American holly can be controlled by malathion or 'Sevin'. If I don't spray in time, I find punctures also on the under side of English holly but no tunnels. The other pests are moles which tunnel in the deep leaf mulch under the hollies and come out in spring and again in late summer to plow up my lawn. The birds don't bother my holly berries until late spring, by which time azaleas and bulbs are in bloom and I no longer need the cheery red berries and rich green foliage to remind me of the richness and generosity of nature.

As a hobby, collecting holly is unlike collecting stamps or sea shells. A holly collection not only grows by additions; it also grows *while you sleep* into most attractive and satisfying bushes and trees.

Mr. Gould is a retired vice-president and business manager of *U. S. News and World Report.* He is a dedicated amateur gardener and, for the past 21 years, has had a special interest in growing hollies.

Orcharding In the Middle Atlantic Area

DANIEL G. FENTON

Hollies are found growing in the wild along the eastern seaboard. Because of vandalism, the female hollies are fast becoming very scarce in some localities, and very little of good quality is available for the market at Christmas. The poor appearance of this wild holly in comparison with that of cultivated selections makes it undesirable for holiday greenery.

There is a definite need for holly orchards in the Middle Atlantic area. The nearness to the country's largest markets hastens delivery and keeps shipping cost at a minimum.

The first problem to be considered when establishing an orchard is the site. Care must be taken to select a site with good air drainage to lessen the possibilities of spring frosts. Frost will reduce the amount of berries by injuring the new growth, thus killing the flower buds. Avoid frost pockets. It is easier to prevent poor location than it is to overcome it after a planting is made.

The selection of the proper soil type is also of utmost importance. A fertile, sandy loam soil will grow hollies quite well. The soil should be well-drained and well-aerated to insure the best results. Hollies do not want "wet feet."

Care should be exercised in selecting the cultivars to be planted. Some hollies which have been selected for landscaping and ornamental use may not be satisfactory for orchard use. The cultivars which grow well in the South may not be satisfactory in the climate of the Middle Atlantic area. Also, the market demand should be considered in selecting cultivars. *Ilex* hybrids 'Howard' and 'East Palatka' grow well in the orchard at Millville, New Jersey, but they are spineless types not in demand in the market. A good cultivar for orchard use should have sprigs twelve to eighteen inches in length. It should produce enough growth to insure being pruned each year.

It is not possible here to name all which are suitable for orchard planting, but a few of the American holly cultivars are listed which experience has shown as satisfactory. 'Cumberland', with its very glossy, dark green leaves, is outstanding but the supply of the basic stock is limited. Other acceptable cultivars are 'Lady Alice', 'Eleanor', 'Mamie Eisenhower', 'Old Heavy Berry', 'Arden', 'Maurice River', 'Menantico', 'Cardinal Hedge', 'Farage', and 'Natale'. The male cultivars should be good pollinators such as 'David', 'Silica King', and 'Makepeace'.

The hardiness of the English hollies (*Ilex aquifolium*) is considered somewhat questionable. Much more work needs to be done before cultivars can be definitely recommended for suitable orcharding in this area.

Male hollies must be planted in this area at a ratio of one male to fifteen females to insure a plentiful set of berries. The fact that hollies have separate sexes and only the female produces berries, of course, makes this necessary. It is good practice to have several hives of bees located near or in the orchard during the season when the trees are in blossom. This will insure the fertilization of the female flower which is necessary before the berry will develop. The male flowers contain the pollen which fertilizes the pistils located on the female tree.

It is better to plant trees too far apart than too close to one another. Trees should be planted approximately twenty-five feet apart or about seventy trees to the acre. This distance may appear far apart, when the trees are small; but when they are ten to fifteen years old, this space will be needed for cultivating, spraying, and harvesting. It must be remembered that hollies will spread to a

distance nearly equal to their height.

A holly orchard is long-lived and, once planted, will remain productive many years longer than a normal fruit orchard. Holly orchards may be kept in sod or cultivated cleanly. If sod is preferred, it should be kept clipped and the weeds and sod must be cleaned away from the tree in order for it to get the benefit of water and fertilizer. Field mice prefer to live in sod and may damage trees during cold weather, when other food is not readily available.

Clean cultivation is the preferred method used by the few orchards already established. This is true of fruit orchards in the Middle Atlantic states also. It is well to sow a cover crop for the winter season to build up soil fertility and prevent soil erosion. A new orchard should be kept in a cover crop, preferably a leguminous one, to build up the soil. This should be clipped and the clippings left on the soil.

Hollies require a good supply of water just as do many other orchard crops. Young trees, which are newly planted, must be watered at least once a week unless there is sufficient rainfall. Their small and shallow root system makes this necessary. Established orchards need not be watered quite so often.

It takes at least three years for young hollies to become well-established and nine years to produce enough fruit to harvest in any quantity.

Fertilizing is essential in a commercial planting, where a high quality of sprigs is necessary. Poultry manure, applied during the winter months and supplemented by a 5-10-10 chemical fertilizer in April or early May, gives excellent results. Hollies should be fertilized in early October with one-half the amount applied in the spring to maintain winter color. It is well to remember that the holly tree roots extend as deep or deeper in the soil than the branches extend above it. Too much fertilizer may produce branches too long for the number of berries and may also cause them to keep growing so late that their tender shoots shrivel under the impact of winter weather. It is well to consult the local county agricultural agent to determine the amount of fertilizer to use on the particular type of soil in the area. A light sandy soil will require more than a heavy loamy soil.

Holly trees need some of the trace elements—copper, magnesium, boron, manganese, sulfur, and other minor elements, to grow properly. The proper dosage is one-quarter to one-half pound for a six-foot tree.

The pH of the soil should be kept

An orchard of American holly, *Ilex opaca*, in Millville, New Jersey.
ALL PHOTOS NEW JERSEY SILICA SAND CO.

"Holly House," a small museum of holly memorabilia located in the holly orchard of the New Jersey Silica Sand Co., Millville, New Jersey.

Daniel G. Fenton and assistants cutting American holly for Christmas greens.

slightly acid, around 6.0 to 6.2. Hollies will grow on a more acid soil, but they do not prefer it.

Small hollies should be mulched with peat moss, straw, pebbles, or other suitable materials to prevent freezing of the roots. A mulch keeps the soil temperature more uniform and prevents drying out of the roots beneath. One caution should be noted in the use of mulch. A mulch may harbor field mice which will gnaw the bark and eventually kill the tree. It is well to pull the mulch at least twelve inches from the trunk in winter months.

A rigid spray schedule should be maintained to insure a good quality of foliage. The insects which must be sprayed to prevent infestation are leaf miner, red spider mite, and scale. There are no known serious diseases attacking American hollies in the Middle Atlantic area.

Holly harvest in this area can begin

later than in other sections of the country because of the nearness of the markets. Sprigs are harvested beginning about the second week of December, then pruned and placed in crates in the orchard. The crates are about four feet in length, three feet across, and two feet deep, constructed of open wood slats to permit circulation of air and water, and hold approximately 75 pounds. Crates are taken in trucks to the packing sheds, where, upon arrival, they may be dipped in alpha-naphthalene-acetic acid which prevents defoliation. The concentration recommended is one ounce dissolved in a small quantity of alcohol and then mixed in 200 gallons of water. The sprigs should be dipped while still in the crate to prevent excessive handling. The vat should be large enough to hold the entire crate.

The crate should be allowed to drain; then the hollies are packed directly into the paper cartons lined with waxed paper. The cartons should be of sufficient size to hold ten to fifteen pounds of hollies, which the wholesale market prefers. Smaller cartons are used for the retail trade. After the cartons are filled and weighed, they are sealed with gummed tape. They may be shipped immediately or put in storage at a temperature of 40° F until shipped.

Mr. Fenton, president of New Jersey Silica Sand Co., Millville, New Jersey, is one of the founders and permanent trustee of the Holly Society of America, Inc., and president for 1969-71. He is active in civic affairs and is a popular speaker on topics relating to holly.

Orcharding In the South

JACKSON M. BATCHELOR

Holly orcharding is a long-term horticultural pursuit which requires patience, a love of plants, a knowledge of their requirements, and, above all, optimism for the future despite pestilence, hurricanes, floods, and freezes. There are many moments of discouragement and loss of faith; but as the box tops are sealed on the hollies' red berries and glossy green foliage, one knows that the fruits of his efforts will bring enjoyment to many during the Christmas seasons. He is grateful then for his faith in and love of hollies.

The southern states are particularly blessed with a long growing season and excellent growing conditions, both with respect to soils and a moderate climate, for commercial holly growing. Land prices are reasonable and not as prohibitively high as in many sections of the North. Likewise, pre-Christmas harvesting labor is generally obtainable throughout most sections of the agricultural South at lower costs than for the average of the United States. Truck and rail facilities provide quick delivery of greens to the northern markets. The demand for holly greens and other decorative materials is present and growing with an increase in population.

My serious interest in hollies goes back to the period of 1937 to 1942 when I was associated with the Hillculture Division, Soil Conservation Service, United States Department of Agriculture. One of the objectives then of the Division was to bring to light and usage those tree and shrub crops which, when grown under suitable ecological and cultural conditions, would provide soil stabilization, supplement the farm income, and retire land from soil-depleting crops, such as corn, cotton, and tobacco. Hollies, particularly the English, *Ilex aquifolium* cultivars, were being grown commercially in the Pacific Northwest, whereas the American holly, *I. opaca*, was being ruthlessly destroyed in the wild in New Jersey, Maryland, and elsewhere in the East.

The American hollies, with their wide range of soils and climatic adaptability from Massachusetts to Florida, appeared to offer great commercial orcharding promise for the eastern and southern

ALL PHOTOS,
JACKSON BATCHELOR

A fine specimen of 'Nellie R. Stevens' in the holly orchard of Jackson Batchelor, Willard, North Carolina.

A wind-machine combats spring freezes in the holly orchard.

United States. Extensive selection and evaluation were undertaken in collaboration with the late Wilfrid Wheeler of Massachusetts, Earle Dilatush, and the late Elizabeth C. White of New Jersey, and other holly enthusiasts.

It was, therefore, inevitable that this interest in hollies and holly orcharding was continued when we moved to a new home in North Carolina in the spring of 1946. Our home is located at Penderlea Farms, Willard, North Carolina, eigh-

teen miles from the shore of the Atlantic Ocean, and thirty miles north of Wilmington. The soil consists of Lynchburg and Coxville fine sandy loam, phases of the greater Portsmouth series, having a pH of 4.7 to 5.2 and excellent moisture and nutrient-retaining capacities. The soil types and climatic conditions are suitable in every respect for commercial holly planting.

Test Planting

The first consideration was to determine those holly species and cultivars most adaptable to commercial growing under the existing climatic and soil conditions. The secondary and monetary consideration concerned the desirability of having a profitable income during the period required to establish a holly orchard. In 1947, a test planting was made of eighteen cultivars of *Ilex opaca*, numerous selections of *I. aquifolium*, *I. cornuta*, and several other apparently promising commercial species. One acre of strawberries was set in September in three-foot rows and later in the fall the holly plants were set on twelve-foot centers in the strawberry rows. Approximately one-half bushel of poultry compost was mixed with the soil at each plant hole. The following April $600 worth of strawberries was sold, and the hollies were cultivated with only negligible additional expense. Strawberries were included in this integrated planting for five growing seasons, which provided an early cash income from $600 to $1200 a year until the area was converted totally to hollies. Toulouse geese, brought in during the second season to keep the area grass free, reduced labor costs of hand-hoeing by 75 percent. Other early cash-income crops could be integrated with long-term woody crops, such as hollies, to provide both complete utilization of the land and an economical method of bringing into production the tree crop involved. At the end of the fifth season, the first cutting of hollies was made.

Test Planting Results

AMERICAN HOLLIES. Ten years later, it was concluded that northern selections of the American hollies had not done as well as many of the southern forms. Both 'Aalto' and 'St. Ann' are slow-growing and almost dwarfed in habit. Eighty-four percent of 'Brooks' died within four seasons. Five-year-old replants of 'Howard' are well filled out to fifteen feet in height compared with the remaining 'Brooks', which are eight to ten feet high and only lightly berried. 'Mt. Vernon' is a very slow grower, excellent berry producer, but has poor foliage color; 'Richards' has an excellent and attractive upright habit of a good lawn specimen, but the berries are hidden beneath the flat, wreath-type leaves. It is not considered a showy, commercial selection.

Of the southern forms tested, including 'Taber #3', 'Howard', 'East Palatka', and 'Lake City', 'Howard' is much superior to the others. 'Taber #3' does not produce the weight of sprays per tree, the foliage is not so profuse nor the color so good as 'Howard', and the trees have been very susceptible to hurricane damage. This cultivar has been most severely injured by spring freezes. 'East Palatka' fruits profusely, but its light green foliage and its characteristic production of long sprays of new growth beyond the berried wood considerably detract from its value as cut Christmas greens. 'Lake City' is a profuse bearer of bright, attractive fruits but does not have the fine foliage texture and color of 'Howard' nor the yields of cut sprays of the latter. 'Howard' is superior with respect to growth response, profusion of berries, foliage color, and general attractiveness, within the florist trade, to other American hollies tested. Ten-year-old 'Howard' trees range from twenty to twenty-four feet in height, are ten to fourteen feet across, and have a profusion of berries each season. After Hurricane Hazel (1954) the ground beneath the 'Howard' trees was red with windfall berries; however, a full crop of berries persisted for preChristmas harvesting of greens.

ENGLISH HOLLIES. Of the several cultivars of English holly, *Ilex aquifolium*, tested, none has proved satisfactory.

Eighty percent have died from spring freezes, excessive moisture, and general unsuitability to our climatic and growing conditions. The few remaining plants look unhealthy. Plants of English holly are only six to eight feet high as compared to plants of American holly 'Howard' of the same age, in adjacent rows, which are twenty feet or more high. No further planting of the cultivars of *I. aquifolium* for commercial purposes is deemed advisable.

CHINESE HOLLIES. Several seedling selections of the Chinese hollies have been tested, with *Ilex cornuta* 'Shangri-La', offering the finest promise for commercial production. This cultivar resulted from a cross made by the author in 1939 of a large-berried female selection having typically large leaves and a handsome male with small leaves. 'Shangri-La' was selected and named in 1947, because of its excellent growth rate, treelike and upright, symmetrical habit of growth, the dark green and high gloss of its small, finely textured leaves, and its heavy production of large, attractive red berries.

It is not uncommon for three- and four-year-old orchard-grown plants of 'Shangri-La' to produce three to six feet of terminal growth in one season or for bed-grown liners to grow three to four feet in one summer. Lateral shoots are produced the following growing season to fill out and maintain the good form of the plants. Ten-year-old trees have been topped to a height of twenty feet to provide easier cropping with pole pruners.

The leaves of 'Shangri-La' are rich, dark green with an attractive high gloss and from one inch and a quarter to one and three-fourth inches long. The fine color and waxy glossiness of the leaves and the small leaf characteristic make this cultivar particularly attractive for flower arrangements and decorations. Juvenile leaves of the younger plants are often two to three inches long, but reduced soil fertility and maturity of the tree will insure the small leaf characteristic. The leaf tissue is also much thicker than that of the American and English hollies which were tested. This factor greatly enhances the keeping qualities of the cut sprays.

It was observed during several Christmas seasons that cut, berried sprays, kept at room temperature and without water, resulted in deterioration of foliage and berry color at the following rate: *Ilex* hybrid 'Howard', three to four days; *I. aquifolium* cultivars, six to seven days; *I. cornuta* 'Shangri-La', ten to fourteen days. The berries of 'Shangri-La' persist without shattering even when the sprays are dry. This is not true of most American hollies.

The 'Shangri-La' fruits are large, to over one-half inch in diameter, of an attractive deep red, and borne in great profusion throughout the plant. Consequently, this cultivar has yielded three times more poundage of cut hollies than American holly plants of the same age and, because of its beauty, has brought twice as much per pound when sold.

Ilex cornuta 'Shangri-La' flowers some three to four weeks before American holly cultivars, and berry production has been reduced once every four years during the past twenty seasons. A 40-acre windmachine has been installed to increase the air temperature above the critical 32° of bloom damage. A 4° rise in temperature is obtained through the use of the windmachine on a cold wind-free night without the use of smudgepots. Normally the fruits of holly 'Shangri-La' are fully formed by late May, turning red in late October; midsummer droughts have neither reduced the fruit size nor crop.

The late March, 1955, freeze, with its temperature drop to 21° F coming after several weeks of warm weather, seriously injured two-three- and four-year-old plants of 'Shangri-La'. This freeze also damaged two- and three-year wood of 'Taber #3' and two-year wood of 'Howard' and other cultivars of American hollies. At the same time, it totally destroyed all fruit and nut crops in the South and killed 30 percent of the two- and three-year-old plants of other hardy ornamental plants in nursery rows. 'Shangri-La' and 'Howard' have made ex-

cellent recovery; 'Taber #3' did not respond so well.

'Shangri-La' is remarkably free from insect and disease pests and has been noticeably free from the leaf and stem scale that attacks *I. cornuta* 'Burfordii'.

HYBRID HOLLIES. A newcomer to our orchard, Gardens Beautiful in North Carolina, *Ilex* hybrid 'Nellie R. Stevens', is proving most satisfactory. This hybrid holly is rapid-growing, of compact and dense habit, and has excellent dark green foliage and a profusion of cherry-red fruits in attractive large berry clusters. Staminate plants of *I. cornuta* are used throughout the orchard to provide pollination for this pistillate variety. The greens are of excellent quality and keep well after cutting. Systemic insecticides and miticide sprays must be used to control red spider and assure attractive foliage.

Based upon the results of our adaptability tests, the orchard area is composed of four acres of 'Howard' and twenty-six acres of 'Shangri-La' with 'Nellie R. Stevens' replants. Yellow-fruited cultivars grown include *I. cornuta* 'D'Or' and several clones of *I. opaca,* including 'Fallaw'.

Holly Orcharding

PROPAGATION. Our hollies are satisfactorily propagated from vegetative cuttings in raised-ground beds covered with double polyethelene under intermittent mist with soil-heating cables. A media of 50 per cent peat and 50 percent horticultural "Perlite" and the use of root-growth stimulants have been giving excellent results.

The cyclonic winds of over 100 miles an hour during hurricane Donna (1959) destroyed over 25 per cent of our three- to five-year-old orchard plants and over ten percent of our six- to nine-year olds. Examination showed that much of this damage could be attributed to a poorly developed root system initiated in the cutting and liner phase. Our rooted cuttings are therefore hurricane-proofed and only diverse, heavily rooted cuttings are retained for nursery production.

The holly cuttings are made four to six inches long with the basal cut made just below a leaf node. On all American hollies, a vertical incision, three-fourths of an inch above basal cut, helps materially in providing a better root system. Cuttings of American hollies are taken in midsummer, and root-growth stimulants are used to insure better rooting. The cuttings are set one inch to one-and-a-half inches deep in the beds and one inch apart in two and one-half inch rows. Mist-spray propagation of American hollies in clean, coarse sand has produced better rooting than propagation without mist spray in sand and peat moss.

Chinese hollies are propagated in late February; in June, after the first growth period; and in August, after the second growth period. Excellent rooting is obtained without mist in peat and sand.

The rooted cuttings are potted and plunged in frames until spring at which time they are set about ten inches apart in lining-out beds, which have been thoroughly conditioned with a liberal application of poultry compost, old pine sawdust, and 5-10-10 commercial fertilizer. Occasionally, with the late rooting of American hollies it is necessary to delay bed planting until spring. Fall-set Chinese hollies will produce a high percentage of planting stock two to four feet high in one season. Spring-set plants will remain generally too small for field planting the first season, and yet they are often too large if held over until the second season.

The beds are irrigated throughout the growing period. Fertilizing is done once a month from May through August; a complete water-soluble fertilizer is used. Each week all lateral shoots are removed to develop terminal dominance and a treelike habit. All plants, as may be necessary, are staked with two-foot bamboo stakes and "Twistems." Planting stock so handled will produce a larger orchard tree in two years' less time than stock grown in the conventional nursery rows; the plants are more easily looked after in a smaller area.

FIELD PLANTING. Fields are deeply plowed in 150-foot plots. Lime is added

to maintain a pH of 6.0 and superphosphate, to take care of any field deficiency. The ground is then thoroughly disked and leveled; water furrows are cut to provide good drainage before planting. All planting is done before January 1, since warm winter days stimulate the newly set plants to develop two or more inches of root growth before summer droughts. This results in increased growth over spring-planted stock.

Trees are planted in eighteen-foot check rows. The field is staked, holes four feet in diameter are dug, a half bushel of well-rotted poultry manure and commercial fertilizer (50 pounds of 5-10-10 mixed with each cubic yard of manure) is thoroughly mixed into the planting soil. Wire guards are set around all plants under two feet high as a protection against rabbits sharpening their teeth on the hard-earned terminal shoots of the planting stock. The guards consist of a piece of screen wire nailed to a treated stake. Guards are used only one season by which time the terminal shoots are larger than a lead pencil and no longer tender and savory to the rabbit population. There is usually no rabbit damage to larger trees after two years of field growth.

No male plants are necessary in the planting of 'Shangri-La', and good berry set results without staminate *I. cornuta* pollinators. Two staminate *I. opaca* plants are used per acre for the field planting of American hollies. I have found that this ratio is entirely adequate to provide excellent pollination. *I. opaca* 'David', which was originated at the Wolfe Holly Orchard in Millville, New Jersey, has proved to be most satisfactory and attractive staminate cultivar. Hives of bees should be added to further insure adequate pollination.

Planting stock is set at the same level as that grown in the nursery rows. After firming in place, guards are driven down about the plants and a 12- to 16-inch layer of hay is placed as mulch two feet around the plant. Within a few months the hay will decompose to a depth of about half a foot and will serve effectively in reducing weed competition and hoeing costs, will improve the general soil-growing conditions, and retain soil moisture during critical periods of drought.

SOIL-BUILDING GROUND COVER. A leguminous ground cover of 'Kobe' lespedeza is seeded at the rate of 25 pounds per acre in February or early March. This soil-building crop is important in enriching the soil and providing better soil drainage and aeration; it is also a valuable source of hay mulch material for our orchard.

ORCHARD MAINTENANCE

The orchard areas are mowed several times during the early summer. The lespedeza is then permitted to grow to a height of one foot or so. This is cut with a sickle-bar mower in mid-August or sufficiently early to produce new growth and a seed crop for the next year. The hay is applied about the trees to a depth of two feet, and the mulch area extended one foot beyond the outermost branches as the trees develop.

Sixty Toulouse geese are used to consume the grass which may persist around the mulched trees. The orchard plants are hoed twice during the summer months to remove any competing weed growth. Our hollies are making excellent growth under the above-described mulch soil-building, ground-cover program, and this program is much preferred to the clean-cultivation system.

Two spring sprays of "Sevin" are applied, as soon as the leaves of American hollies form, at two-week intervals to control leaf miner and are followed by an early August spray. Spring application of systemic insecticide is given to 'Shangri-La' and 'Nellie R. Stevens'; this is followed by two miticide sprays on the latter.

During the first five growing seasons, three applications of 5-10-10 fertilizer are applied at the rate of one-half pound per one-inch caliper of plant. The first application is made in March, the second in May, the final in July or early August. Old mulch material is raked

Mr. Batchelor inspects holly in the field collection box, while workmen harvest greens for the Christmas season.

back and the fertilizer applied in the outer root-zone area extending one foot beyond the outermost branches of the individual plant. The mulch is then replaced. After the fifth growing season, an application of 10-10-10 fertilizer is made in March, followed by an application of 5-10-5 in August at the above rates. Further reduction of fertilizer may be necessary on occasional plants of the American holly 'Howard' and the Chinese cultivars to prevent the trees from producing too much growth, which will detract from the beauty of the berried sprays.

The rate of applying fertilizer must be reduced as the trees approach cutting age in order to maintain good leaf color and fruiting balance. However, if insufficient fertilizer is applied to many hollies, an overproduction of berries may result in chlorosis of the foliage and severe damage to the plant. Such overcropping of the Chinese holly 'Burfordii' has occasionally resulted in the death of plants of this cultivar in our nursery rows. Likewise, the application of too much nitrogen may result in vegetative growth and subsequent light flower and berry crops.

Several years ago, I visited the holly orchard of the New Jersey Silica Sand Company near Millville, New Jersey. The rich, deep color of each and every plant, combined with a fine crop of berries, made this orchard an impressive sight. Manager Daniel G. Fenton attributed much of his success with good foliage color to the incorporation of minor trace elements in the commercial fertilizer. Today, this orchard does not have "fall leaf scorch" or leaf spot which was formerly considered an attacking fungus organism. It is, therefore, recommended that these minor elements be included in the commercial fertilizers used in holly orcharding. The added cost is low in comparison with the magnificent results obtained.

Berry color begins in early October, and migratory birds can destroy the American holly fruits within a few days, usually in early November. Carbide guns are used to dispel the flocks until harvesting is completed. Yellow-fruited American holly, 'Shangri-La', and 'Nellie

R. Stevens' fruits are not consumed until the northward migration in March and April.

Holly cutting and packaging begin in November as the berries mature and reach a full red color. Berried sprays are cut 12 to 24 inches long with hand shears and pole pruners and are removed from the field in collection boxes. The boxes are of light-weight construction with wood-skid bottoms and tapered sides to permit ease in handling and in storing. American holly greens are of generally excellent quality throughout the plants. This is also true with 'Nellie R. Stevens'. The best-quality 'Shangri-La' is often in the dense shade of the plants.

Care is exercised in cutting the sprays to avoid damaging the form of the tree.

In the packing shed, the greens are distributed over a chain conveyor and through a spray chamber where preservative and moisture are applied under pressure. The greens flow onto a 50-foot packing belt, which is manned by 12 to 14 packers who selectively pack the short sprays into small retail cartons and the larger sprays into gift and bulk-florist cartons. This system provides maximum packing production with a minimum of handling and berry litter.

All cartons are manufactured of high-humidity cardboard and pre-addressed and stored daily in humidified cold storage at 34° F. Tests have shown that greens handled in this manner have better keeping qualities than greens cut fresh from trees, which may be slightly desicated or frozen with subsequent desication after thawing.

Yields

Test-plot average yields of cut greens from each plant of 'Shangri-La' and 'Nellie R. Stevens' approximates 30 pounds per five-year-old plant; 40 pounds per seven-year-old plant; and 90 pounds per mature tree. 'Howard' averages ten pounds, 18 pounds, and 35 pounds, respectively.

Our orchard is approaching full production, and it is conservatively estimated that yields of one to two thousand pounds is reasonable. A five-acre orchard in northern Florida, planted to selected American hollies, mostly 'Howard', recorded yields exceeding 3,000 pounds per acre with a valuation of over $1,000. The income from holly orcharding may approximate that of other horticultural crops, if all elements required in culture, harvesting, and marketing are present.

Editor's Note: About the time a holly orchard was being planted in Albany, Georgia, in 1927 by William Marsh Van Cise, J. C. Penny began a five-acre orchard of Dr. Hume's selections of *Ilex opaca* at Penny Farms, Florida. Mr. Batchelor visited the Penny holly orchard in 1936. As he recalls, Penny Farms was a retirement institution for Methodist ministers.

Mr. Van Cise continued planting until he had 100 acres devoted only to 'Howard'. The oldest trees, which had been set too closely, were thinned out about 15 years ago. At the peak of his orcharding, Mr. Van Cise shipped 16 carloads of holly. Mr. Van Cise died November 16, 1969; he would have been ninety-one years old December 21, 1969. The larger part of his holly orchard is to be bought and called Holly Plantation by Dr. Charles Allen Thomas and Donald Danford.

While culture and the control of insect pests and diseases present no serious problems in holly orcharding today, Mr. Batchelor is reluctant to encourage anyone to undertake holly orcharding in the South because of other factors, including increased costs of operation and the difficulty in obtaining reliable help. There is the very important consideration of economic feasability; Mr. Batchelor believes that before one seriously plans to develop a holly orchard, he should look into every aspect carefully.

Mr. Batchelor, owner of Gardens Beautiful, Willard, North Carolina, is a landscape architect and holly and blueberry specialist. He was formerly associated with the Hillculture Division, Soil Conservation Service, United States Department of Agriculture, Washington, D.C. Mr. Batchelor is a past president and a former trustee of the Holly Society of America, Inc.

Commercial Production of English Holly in the Pacific Northwest

A. N. ROBERTS and R. L. TICKNOR

The culture and marketing of English holly, *Ilex aquifolium*, for Christmas has been a major item in the horticultural speciality crops industry of Oregon and Washington for the past 40 years. A relatively small number of commercial growers in this region west of the Cascade Mountains ship an average of 100-carload equivalents of holly greens and manufactured items by rail, truck, and air from early November until two weeks before Christmas. Conservative estimates are that this holly is grown on approximately 1200-1500 acres and returns over a million dollars to the region's economy. Over 1000 people work in the orchards, storage, and packing sheds during the peak of the season, making wreathes and grading, packing, and shipping the spray holly. Most of this acreage is now in production; very few new orchards are being planted at the present time. Considerable replanting of orchards of undesirable cultivars has taken place during the last 20 years, and the present acreage is of considerably higher quality.

Commercial Production Presents Problem

Production of quality sprays for Christmas use requires greater attention to detail than does holly in the landscape. Insects, diseases, algae, and weeds must be controlled and nutrition maintained at a high level. Pruning, cutting, and grading as well as repelling birds take time and money. Demands for quality sprays have all but eliminated the use of holly from landscape specimens and hedges.

Holly research at Oregon State University, and that carried on by progressive growers, has done much to improve the culture of this specialty.

Programs for controlling starlings, diseases, insects, algae, and weeds in the orchards have been developed over the years. Pollination requirements have been determined, and a leaf analysis service has been developed on which to base fertilizer recommendations.

Trials have determined the blooming and berry-ripening periods for over 60 cultivars and species. Some of these data are presented in Tables 1 and 2 for some of the more important cultivars of *Ilex aquifolium*. *I. cornuta* and *I. opaca* are included for comparison. Hollies from William F. Kosar's breeding program at the United States National Arboretum in Washington, D. C., are presently being observed at Oregon State University's North Willamette Experiment Station.

Species of Hollies

Although other species of holly which have red berries and evergreen leaves, such as *I. cornuta* and *I. opaca*, are grown in Northwest nurseries, they are not grown for greens. Most cultivars of *I. opaca* do not have the glossy leaves of *I. aquifolium*, and the berries of *I. cornuta* mature late and often turn black when frosted. The combination of glossy-spiny leaves, bright red, cold-tolerant berries found in *I. aquifolium* sprays have made them the product to match in the Christmas trade.

Cultivars of English Holly

Even in *I. aquifolium* there are many distinct cultivars, some of which are suitable for orchard production, while others are not. Several of the earliest orchards in the Northwest were planted with seedlings or clonal mixtures. Many of these have proved worthless for cut holly

TABLE 1—BLOOMING DATES OF *Ilex* SPECIES AND CULTIVARS AT CORVALLIS, OREGON, 7-YEAR AVERAGES 1957-63

SPECIES OR CULTIVAR*	DATE FULL BLOOM	DATE END BLOOM
cornuta (F)	4/28	5/19
opaca (M)	5/1	5/21
'Escort' (M)	5/1	5/28
'Dr. Huckleberry'	5/4	5/21
'Pinto'	5/5	5/19
'Little Bull' (M)	5/6	5/24
'Bleeg'	5/6	5/19
'Teufel's Silver Variegated'	5/6	5/24
'Beautyspra'	5/7	5/22
French-English Group	5/7	5/23
'Coronation'	5/7	5/22
'Beacon'	5/8	5/24
'Teufel's Hybrid' (F)	5/8	5/21
'Early Commercial'	5/9	5/24
'Teufel's Green Stem'	5/9	5/23
'Silvary'	5/10	5/26
'Rederly'	5/12	5/28
'Big Bull' (M)	5/17	
'Coleman'	5/12	5/28
opaca 'Arden'	5/30	6/17
opaca 'Cardinal'	6/3	6/22
opaca 'Taber #3'	6/4	6/21

*All cultivars are of *Ilex aquifolium*

TABLE 2—BERRY-RIPENING DATES* OF *Ilex* SPECIES AND CULTIVARS AT CORVALLIS, OREGON, 7-YEAR AVERAGES 1957-63

CULTIVARS	AVERAGE DATE RIPENING	SEASON
'Dr. Huckleberry'	Oct. 5	Early
'Teufel's Hybrid'	Oct. 7	
'Bleeg'	Oct. 11	
'Coleman'	Oct. 17	Mid-
'Coronation'	Oct. 17	Season
opaca 'Arden'	Oct. 17	
'Beacon'	Oct. 18	
'Yuleglow'	Oct. 18	
'Teufel's Silver Variegated'	Oct. 19	
'Beautyspra'	Oct. 19	
'Early Commercial'	Oct. 21	
'Rederly'	Oct. 21	
opaca 'Cardinal'	Oct. 23	
'Teufel's Green Stem'	Oct. 23	
'Pinto'	Oct. 24	
'Silvary'	Oct. 25	Late
French-English Group	Oct. 30	
opaca 'Taber #3'	Nov. 8	Very
cornuta	Nov. 10	Late

*Date at which commercial cutting could be started

Many of the cultivars used today were selected out of these early seedling orchards—'Rederly', 'Bleeg', 'Dr. Huckleberry'. Many of the early commercial orchards were planted as rooted cuttings of a mixture known as FRENCH-ENGLISH. The majority from this somewhat mixed group are attractive trees with large, spiny, glossy, dark green leaves and large, red berries. The trees are vigorous and the sprays durable. The principal fault is late ripening of the berries, and this limits the market to nearby areas for which the holly can be cut and delivered just before Christmas.

There are several different markets for holly with slightly different requirements. Flower arrangements require the larger-leaved types such as 'Bleeg', 'Coronation', and 'Teufel's Hybrid'. These are high-yielding types which require heavy fertilization to hold foliage color, particularly around the ripening berries. In small, one- and two-pound gift boxes, the finger-textured cultivars, such as 'Teufel's Green Stem' or 'Rederly', look better and are very useful for home arrangements. For wreaths, the leaves of 'Early Commercial', 'Dr. Huckleberry', and 'Coleman', as well as those of other cultivars, have the right amount of crinkle and spininess to be attractive. The berries used in wreath-making do not come from the cultivar that supplies the shoot tips for foliage. The "Dutch" hollies, which produce large, firm, bright red berries, often supply the berries for this product. Another product marketed from holly is boutonnieres made from fine-textured cultivars which are selected especially for this purpose.

The silver-variegated cultivars are used for many purposes and constitute 20 to 25 percent of the market. Because of their low berry production, approximately one-third of the acreage has been planted to variegated types to get the required tonnage.

There is a limited market for some of the novelty hollies, such as 'Pinto', 'Harlequin', 'Yellow Berry', 'Ferox', and the moonlight holly. Probably the most promising use developed for yellow-leaved or yellow-berried types is for

Thanksgiving and golden-wedding anniversary arrangements.

Berry Ripening is Important

In comparing cultivars, the question of berry-ripening should not be overlooked (Table 2). With the trend toward earlier cutting to spread the harvest period, the necessity for growing cultivars which ripen their berries well before Christmas becomes important. Berry-ripening will vary from year to year with seasonal climatic conditions, age of the trees, and the varied growing conditions in different locations. Studies have shown that berry seed complement (4 if fertilization is complete) can also affect berry-ripening. The more seeds, the earlier they ripen. Some cultivars, by nature, ripen their berries so late they are useless for commercial purposes. If the berries ripen too early, they may soften and turn dark in storage and shipping. Berry, as well as leaf quality after storage must be considered in selecting commercial cultivars with adequate shelf life.

Winter Hardiness

The common opinion that English hollies lack cold-resistance is true to a degree, but the subject should not be simplified to this extent. In the first place, cultivars of this species vary greatly in their resistance to winter-injury. Two or three cultivars in the plantings at Oregon State's Lewis-Brown Horticultural Farm at Corvallis survived temperatures of 14° below zero in January, 1950, while most of the other cultivars in the same planting were killed back to the snowline. This shows that considerable cold-resistance is inherent in *I. aquifolium,* and cultivars could be selected for this valuable characteristic.

Cold hardiness in hollies, as in other plants, is determined by various conditions. In November, 1955, an unsaesonable freeze in Oregon subjected the above-mentioned planting to temperatures of approximately 14° above zero. The same cultivars that survived 14° below zero temperatures in January, 1950, as well as the normally very hardy *Ilex opaca,* were severely injured by 14° above zero in November; the supposedly less hardy cultivars were not injured in the least. In the November freeze, cultivars with early maturing berries were less damaged than the late berry-ripening cultivars. In the latter case, berries were blackened and some leaf and twig damage resulted. It was also noted that the variegated forms were more subject to leaf-scorching from the low temperatures than were the entire green-leaved sorts.

The above results call attention to the fact that the acquisition of maximum cold-hardiness in hollies follows certain chilling requirements and maturity of tissues and berry crop. A cultivar maturing its berries early and having a fairly low chilling requirement for maximum cold-resistance will be less subject to low temperature injury in November and December than one with late-maturing berries and higher chilling requirements, even though the latter may have a much better chance of surviving in a very severe freeze in January or February. This can account for the confusion that now exists in hardiness ratings on holly cultivars across the continent. These ratings are only applicable where the cultivar has been subjected to the same low temperature conditions when in the same physiological condition.

The influence of soil management, drainage, irrigation, and other factors, on plant development and maturity has the same bearing on winter-hardiness in hollies as in other crops.

Location, Site, and Soils

The Pacific Northwest with its mild, moist winters and relatively cool summers is ideally suited to English holly. Holly can be grown successfully both in the interior valleys and along the coast in western Oregon and Washington. This area does not extend farther south than Douglas County in the interior valleys of Oregon, because the relatively hot, dry summers are unsuited to the best growth of English holly. The southern range of holly adaptation along the coast is not clear-cut, but individual spec-

imens of excellent growth are found throughout the coastal area, and at least one commercial orchard is found in the San Francisco Bay area.

COASTAL VERSUS INTERIOR VALLEYS. There are advantages to be found in both the coastal and interior locations. The cool, moisture-laden air of the coast, even in summer, is conducive to the development of the finest of holly foliage. These same conditions, however, delay tree maturity and berry production, are conducive to *Phytophthora* leaf spot and the growth of green algae on the foliage. Cultivars of the 'Bleeg' type are better suited to growing on the coast; cultivars which do well in the interior valleys are often not suited to the coast. The advantage in soils and nearness to shipping centers in the interior valley areas cannot be overlooked.

SELECTING THE SITE. The ideal site for the holly orchard has not been determined. The question of slope does not seem to be critical; Good orchards are growing on level sites on the valley floor and on slopes with all possible exposures. There seems to be some advantage in northern and eastern slopes for shade. Berry-ripening is earlier on shaded northeastern slopes. For the best growth of foilage and berry production, the site should be protected from strong, drying winds to prevent excessive desiccation.

The importance of good soil drainage should not be overlooked. Holly trees, like most other tree crops, are not adapted to wet, poorly drained locations. The orchard should not be exposed to seasonal river floods. If flooding does not actually interfere with harvesting operations, it will leave deposits of silt and debris which make the crop unfit for cutting. The orchard should be readily accessible at all times of the year.

Sites where late spring frosts occur should be avoided. Holly orchards, located on such sites in Oregon and Washington, have been injured to greater or lesser extent in some seasons. This injury may be confined to destruction of the flowers or may be accompanied by killing back of the new terminal growth.

SOIL REQUIREMENTS. A deep, fertile, well-drained orchard soil is a decided advantage in growing good hollies. Although English holly will grow on a wide range of soil types of high and low fertility, the planting should not be made on marginal tree land. The problem of maintaining foliage quality, along with heavy sets of berries, will not be solved unless the soil is naturally fertile. The soil should be retentive of moisture throughout the summer months. Soil three to four feet deep and liberally supplied with organic matter should grow good holly.

As do many of the other broadleaf evergreens, holly responds to soils high in organic matter. It is a generally accepted fact that the slightly acid soils are best. However, this does not seem to be critical, because fairly heavy applications of lime to benefit cover crops in holly test orchards have not appeared detrimental. It is probable that holly orchards on exceedingly acid soils may benefit from liming, if for no other reason than to promote cover-crop growth.

POLLINATION REQUIREMENTS

MALE AND FEMALE TREES. English holly is dioecious; male and female flowers are borne on separate trees. The female (pistillate) trees produce flowers and berries without viable pollen; they are dependent upon the male (staminate) trees, which produce no berries, for pollination. Certain cultivars set more berries than others in the absence of male trees (pollenizers). Such cultivars produce considerable numbers of parthenocarpic fruits (berries which develop sterile seeds). Of the leading commercial types studied, none produce sufficient berries for commercial purposes. It seems probable that the original concept of a "bisexual" condition (both male and female flowers on the same tree) in English holly was brought about by the observation that some cultivars produced berries in this manner. The FRENCH-ENGLISH GROUP is noted for its ability to set parthenocarpic berries.

POLLENIZERS NECESSARY. Studies made

by the Oregon Agricultural Experiment Station from 1946-51 showed conclusively the necessity of having a sufficient number of male trees in the holly orchard to provide adequate pollination and berry set (Figure 1). The number of pollenizers (male trees) required is small when compared with other tree crops. Experience has shown that one male tree for every 50 female or berry-bearing trees is sufficient to supply the necessary pollen in normal seasons, if they bloom at the same time. In some locations, where bee activity is restricted by weather conditions during bloom, it may be necessary to double the number of pollenizers. However, too many pollenizers may result in too heavy a set of berries in some years with a resultant loss in foliage color. Male trees should be selected which have desirable foliage for wreath-making and, in addition, a capacity for producing large amounts of viable pollen at the time the berry-bearing trees are in bloom.

A comparison of the fertilized berries and the sterile, parthenocarpic fruits produced by a given cultivar shows that the berries with seeds are considerably larger, heavier, earlier ripening, and are more likely to remain on the tree until harvest.

Experimental evidence indicates a correlation between adequate pollination and early maturation or ripening of the berries. Cultivars of English holly which have a tendency to mature their berries late and have poor color at cutting time may be helped materially by providing adquate pollination for a full seed complement. This is but one of the factors involved, however, and some cultivars are by nature so late in ripening their berries that they are worthless for commercial purposes. Orchards of mixed seedlings will almost always show a few specimens of this late-maturing type.

INTRODUCING POLLENIZERS. The introduction of pollenizer limbs by grafting or budding scions from male trees into the orchard is one method of providing pollen. The addition of male trees to the orchard will probably be the more economical method to use, since so few trees are required. In any case, they should be so placed as to be equally

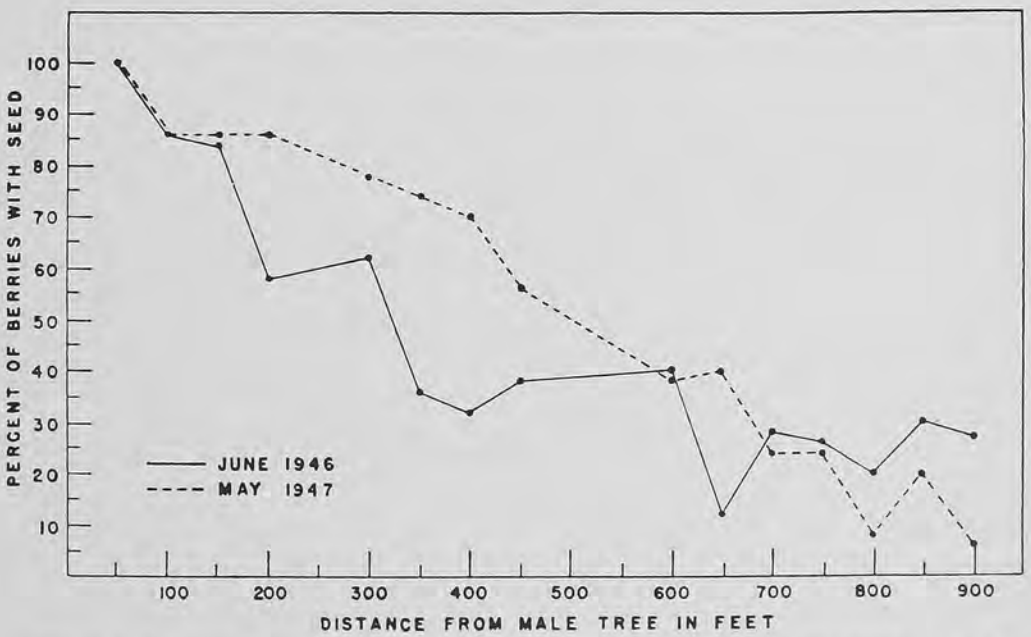

Figure 1. The importance of male trees for pollination is shown in this graph. Points on the graph show the percentage of berries with seed as a result of proper pollination. As the distance increased from the only male tree in the orchard, there were fewer seeded berries. The berries without seeds (parthenocarpic) tended to drop throughout the summer.

distributed among the fruiting trees. Bouquets of male blossoms in the orchard during the blossoming period will help until male trees can be introduced. Since English holly is insect pollinated, a few hives of bees in or near the planting will make the pollen that is present go farther.

Establishing the Planting

Young English holly trees are not easily established, but once established they are vigorous and easily managed. Before planting the trees, the soil should be well prepared by the addition of large amounts of organic matter in the form of barnyard manure and/or sod and cover crops. This treatment will help the problem of soil management during the early growth of the young trees. Serious weed pests should be brought under control at this time.

The question of planting distance for all orchard trees is always open to argument; no single recommendation can be made to cover all cultivars, situations, and plans for management. The present trend is toward closer planting and even hedgerow culture. This may help solve the bird-roosting problem in the future Holly cultivars which come into bearing early and are more or less slow-growing by nature can be planted rather close together (six to ten feet) in rows spaced 15 to 20 feet apart, if they are cut annually and kept in bounds. Even more rapidly growing cultivars can be grown in this manner, if properly managed with spur-renewal type of pruning. However, there is a limit as to how much growth control can be obtained by pruning. Some cultivars become overly vegetative and cease to bear if pruned excessively.

In either row-planting or conventional orchard style, sufficient space must be left for carrying out orchard operations, such as spraying, cutting, and hauling. Such spacing will depend in great measure on the growth rate of the cultivar, how early it comes into bearing, how much annual cutting is to be done, and the type of equipment to be used. Fifteen to twenty feet between trees are sufficient in most orchards. If row-planted, an additional tree can be planted between each tree in the row in one direction. The use of filler trees to be removed later does not seem feasible with holly, since the trees reach crowding size by the time there is sufficient production to offset the added cost of their establishment and later removal.

Young holly trees should be kept in the nursery row until they are three to four years old and three to four feet high, when they can be transplanted without undue shock. Well-balled trees can be moved to best advantage in late fall or early spring when frequent rains help them to become established before top growth starts.

Soil Management

Soil management practices, which are successful with other orchard crops in a given locality, will not be far wrong in the holly orchard. The practice of clean cultivation during the growing season, followed by a cover crop during the fall and winter months, is generally accepted by holly growers. If turned under at the proper time in the spring, the cover crop will tend to maintain the fertility of the soil, and will reduce soil erosion during the winter months. This is one of the best and most economical ways of maintaining the organic matter in the soil, so important in moisture conservation. A cover crop generally facilitates orchard traffic during harvesting operations.

Cultivation

Avoid excessive cultivation. Summer cultivation should be confined to killing weeds. Excessive cultivation, besides cutting off many feeder roots, tends to dry out the soil and to destroy humus. Where irrigation is feasible, the possibility of permanent legume or grass sods in the orchard should be explored. Holly, like other broadleaf evergreens, responds to cool, undisturbed soils of uniform moisture throughout the growing season.

Holly Nutrition

A great deal has been learned at the

Oregon Agricultural Experiment Station about the nutritional requirements of English holly. A survey of Oregon holly orchards in 1960-61 revealed only two serious deficiency problems[1]. Nitrogen was the most common deficiency problem in many small plantings. Boron was also found below the critical level, and even at the deficiency level, in some cultivars on certain soils in the Willamette Valley[2]. The other plant nutrients have not been established as deficient in Oregon holly orchards.

DEFICIENCY SYMPTOMS. Greenhouse sand cultures with Hoagland's nutrient solutions, leaf analyses, and field observations have been used at Oregon State University (1959-60) to study the symptomatology of holly nutrient deficiencies. A brief description of these symptoms may be of help to those diagnosing English holly problems. These will be described in the order of their appearance on rooted cuttings in controlled sand cultures without the nutrient in question:

NITROGEN DEFICIENCY. Overall pale yellow-green leaves which are much smaller than normal; all leaves affected; shoot growth restricted and no second growth flush; symptoms developed immediately.

SULFUR DEFICIENCY. Developed 50-75 days after growth flush started; clear yellowing of terminal leaves and at tips of leaves first; some areas of leaf remain green.

PHOSPHORUS DEFICIENCY. Leaves smaller than normal and dark green; at 100-120 days older basal leaves turned yellow and dropped prematurely.

CALCIUM DEFICIENCY. At 100-120 days a few midterminal leaves showed typical bronze to black interveinal breakdown; margins of leaves later showed same symptoms; surface of leaf cup downward and distorted; leaves dropped prematurely; dieback of terminal shoots.

BORON DEFICIENCY. Typical deficiency symptoms on midterminal leaves appeared 120-140 days after treatment started; irregularly shaped, reddish or purplish spots on the upper surface which, on the lower surface, were water-soaked in appearance; as the leaves aged, these spots progressively enlarged, developing a pattern of concentric rings bordered on the outside with yellow; sometimes an enlargement of the veins and finally defoliation; less frequent than spotting was a pitting of the upper leaf surface, apparently from buckling or collapse of the mesophyll; stem tip dieback a final result.

MANGANESE DEFICIENCY. At 140 days symptoms appeared first on subterminal (2 or 3 from tips) leaves as very small measle-like spots between the veins, increasing in number toward the leaf tip and margins; margins became dark and necrotic with time. Symptoms typical.

POTASSIUM DEFICIENCY. First symptoms evident at 210-220 days on second flush of growth. Leaf tips and margins first turned pale yellow, later progressed inward and developed reddish cast. Somewhat typical of K-deficiency in other species, but very slow in developing; some plants went into second year of growth before typical symptoms developed.

IRON DEFICIENCY. Slow to develop; but with second- and third-growth flush, leaves developed typical interveinal chlorosis and with time whole leaves became yellow and chlorotic.

MAGNESIUM DEFICIENCY. Very slow to develop, but lower leaves finally became chlorotic and dropped prematurely. Chlorosis developed at leaf tips and margins and progessed downward.

Seasonal Changes in Nutrient Status

Evergreen leaves, such as holly, persist on the tree for two to three years. Cultivars differ in their ability to retain leaves; those which are best suited for commercial cutting will maintain many leaves into the third year. Holly leaves have the ability to supply organic and inorganic nutrients to new shoots expanding in the spring and early summer and to replenish these again at other times of the year. This ability is evident in the leaf dry weight changes and the total nitrogen and phosphorus leaf contents found at various times of the year (Figure 2). These data show two periods

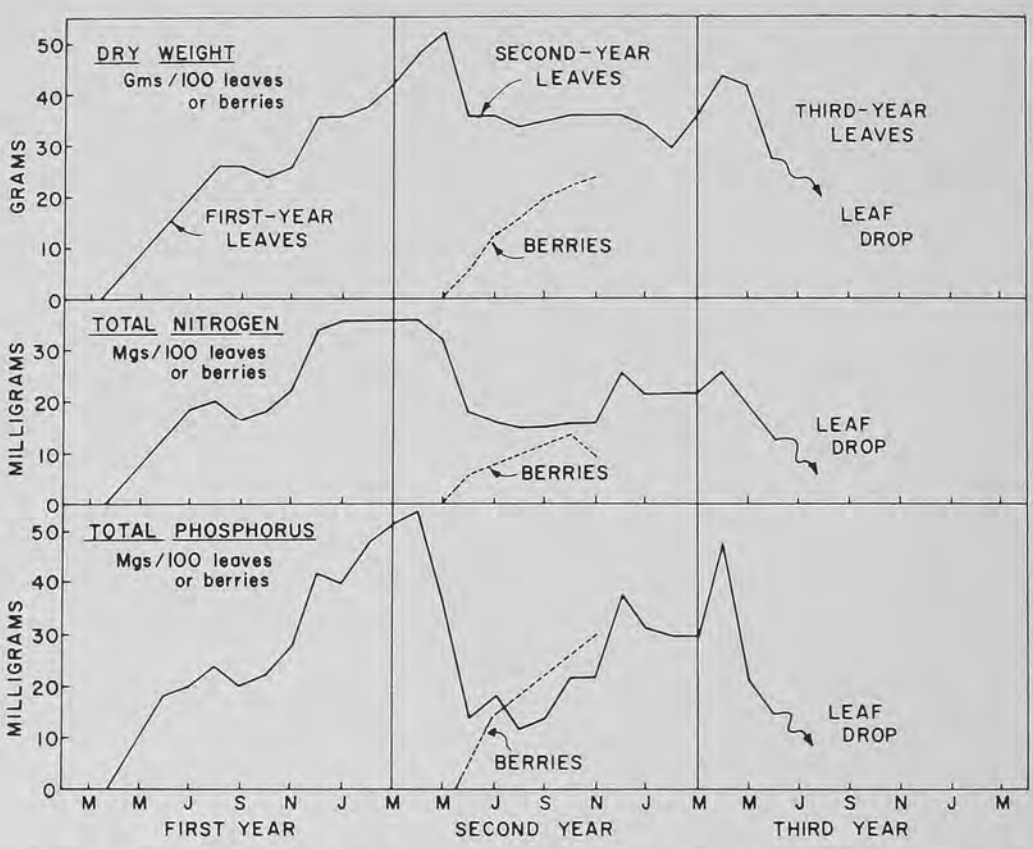

Figure 2. Seasonal changes in dry weight and total nitrogen and phosphorus content of one-, two-, and three-year-old leaves of *Ilex aquifolium* 'Oregon Select' at Lewis-Brown Horticultural Farm, Corvallis, Oregon, 1962-63.

when the older leaves are called upon to supply nutrients to new parts of the plant. First, when the buds are rapidly expanding into leafy shoots (May-July) and again in September and October when the berries are growing rapidly and filling their seeds. These seeds apparently put heavy demands on the two-year leaves for phosphorus. With some cultivars this demand during berry-ripening may bring about yellowing and premature drop of the leaves. The same condition may develop in the spring when new shoot growth is occurring, if nutrient levels are not sufficiently high in the plant.

For the above reasons, it is well to apply nitrogen and phosphorus fertilizers in early spring and fall. Fall application will assure adequate levels of nitrogen and phosphorus for optimum shoot growth and foliage color in the early spring and summer. The spring application will renew these tree reserves sufficiently to carry the foliage through the summer and fall, when the berries start making their demands.

We are presently in the process of establishing critical levels for various nutrients in more common commercial cultivars. These levels vary considerably in cultivars, with the green-stem, rapid-growing, early maturing cultivars having higher demands for principal nutrients. The surveys, made in Oregon and mentioned earlier, have provided some information on nutrient levels which are giving optimum growth for cut holly.[1] We say optimum growth, because maximum growth is not necessarily desirable, since spray balance requires that new shoot growth not exceed the two-year-old, berry-bearing wood in length but be somewhat shorter.

Insects and Diseases

The production of top-quality cut holly requires more than adequate nutrition. As with other farm and orchard crops, constant attention must be given to insect, disease, and alga prevention and control. These are described and their controls given elsewhere in this Handbook. Holly growers should thoroughly familiarize themselves with the identification and damage of these pests and be ever alert to keep them in check.

Harvesting and Pruning

Holly cultivars will vary in the age at which the first sprays are ready to be cut. Some cultivars make a tree of sufficient size and berry set to make commercial cutting possible in six to eight years. Most cultivars, however, should not be cut before ten years. This, of course, depends largely on growing conditions; no rule can be set.

Cutting should be light during the first few years of harvest to allow the trees to develop further its production surface. The early cutting of sprays can be combined with pruning, using this opportunity to space the branches properly to overcome crowding in the more dense parts of the tree. Multistemmed trees are not suited to the spacing of laterals and to developing a spur-renewal system of sustained yield, a cutting system whereby one-third to one-quarter of the berried sprays are cut off the laterals each year, leaving stubs with strong buds to renew the shoot. In two to three years these will again be of sufficient length, and berried, to provide cutting material.

It is often necessary to top back the central leader and strong laterals to force out new growth on older wood. There is some danger of crowding with resultant development of poor quality sprays, if all leaders are allowed to compete. They should be spaced and trained in a manner which will allow ample room for proper development.

As the tree becomes older, the old and devitalized wood should be removed, whether marketable or not. This treatment will tend to promote the development of vigorous sprays of good quality on new wood. If the trees are properly fertilized and ample moisture is available, there should be a minimum of unusable material.

All photos by Paul Alexander, *Hillsboro Argus*
Cutting holly from mature tree in early December near Sherwood, Oregon.

Amount of cutting varies. Harvest can begin at any itme after the berries are red ripe, provided the sprays can be preserved in good condition till they reach the consumer. Holly berries do not develop further red color after being removed from the tree. The amount of wood or sprays to remove in a single harvest is a controversial question. The holly tree will tolerate severe cutting one year, but such cutting will tend to take the tree out of production for at least two and possibly three years, depending on the vigor of the tree. Unduly heavy cutting also has a dwarfing effect on the tree. However, pruning tests showed that heavy annual cutting produced the greatest amount of marketable holly over a five-year period. Yet it would seem advisable to remove only a portion of the marketable sprays each

Cutting holly in a young planting.

year to maintain a sustained yield from a closer balance between roots and top. If the trees are not trimmed too heavily, they will increase in size and quantity of foliage more rapidly and return large yields later. However, the failure of some cultivars to produce good crops of berries in some years might make it desirable to cut more heavily in years of heavy berry set.

Combining Pruning With Harvesting

In cutting the sprays, care should be taken to avoid cutting back the central leader of the tree and its several scaffold or main lateral branches. Heading-back may become necessary when the tree gets excessively tall or widespread, but on the young tree heading-back will tend to delay the expansion of its bearing surface. Some growers prefer to remove the limbs around the base of the tree to facilitate cultivation and to eliminate inferior basal sprays. This may not always be desirable, however, since those lower limbs, when left, shade the ground sufficiently to keep down weed growth and prevent too close cultivation near the trunk.

The cutting should be distributed over the entire tree, with a certain amount being removed from each branch system. The smaller laterals to be used for sprays may be cut in one of two ways. Ordinarily, it is necessary to leave a stub a few inches long at the base of the lateral so that a new spray can develop from its latent buds. However, if the growth is too dense so that the lateral should be removed permanently, the cut is made flush at its point of origin on the main branch. This will not leave buds to replace the branch with new growth and thus will elimate it.

In combining the harvesting and pruning operations, the cutter should be instructed to discard all unmarketable hollies in the field, since the extra labor and cost of hauling this material into the packing shed for grading are not justified. Some growers prefer to cut only marketable holly and let the pruning go until the rush period is over. This, of course, means another operation and too often is avoided altogether.

The tips of the previous season's terminal growth are used in wreath making. Heavy cutting of these tips from trees to be used for spray production is not recommended. The return from these tips may not be sufficient to offset the loss in well-balanced sprays later on. The return from sprays is somewhat more per pound, and cutting is much faster, if the sprays are well-balanced both in branch and berries.

Handling Cut Holly

A PERISHABLE PRODUCT. One reason that holly is used for Christmas greenery is that its foliage retains its shape and color even when partially withered. Nevertheless, holly must be considered a perishable product. Its bright, fresh appearance may be seriously depreciated by exposure to dry air. It is also subject

to defoliation and browning of the leaves.

With the present practice of early cutting, the problems of storing cut holly are most important. Early cutting reduces the facilities and personnel required to handle large quantities of holly. The earliest date for cutting depends on the date of berry maturity and the storage life of the holly. Some growers begin cutting three to four weeks ahead of the latest shipping date, which is usually around the tenth of December for express or mail shipments from Portland to New York. Thus, a storage period of two to six weeks is required, if the product is to reach the ultimate consumer in first-class condition. Wreath makers will begin cutting the first of November or even earlier, if they can be assured of successful storage.

Holly cultivars differ greatly in length of time they can be stored. One cultivar may have twice the storage life of another under the same storage conditions.

Handling Cut Holly in the Field

After deciding on the day to begin harvesting, the next problem is to plan the field operations for the maintenance of quality. Quality may be lost by (1) withering, (2) mechanical injury, (3) defoliation, and (4) browning of the leaves.

Withering is prevented by avoiding exposure to direct sunlight and drying winds and storage in heated rooms. If holly is cut in warm, dry weather, it should be moved to a cool, moist place within the hour.

Cut holly is often thrown from the tops of trees into the crates or onto a canvas and dumped into the crates. Most cultivars seem to tolerate this treatment, but excessively rough handling may cause cracks and scratches on the leaves. These injuries are inconspicuous at first, but form discolored areas during storage. Severe damage may result if holly is handled when frozen. Cutting should be postponed if the temperature is much below 32° F.

DEFOLIATION AND ITS PREVENTION. Holly sprays which are kept moist from the time they are cut will begin to drop their leaves in a week or ten days—the time depends on the cultivars and storage temperatures. There are three means of controlling defoliation in cut holly: (1) partial drying, (2) hormone treatment, and (3) cold storage.

Allowing holly to dry out slightly before packing or using a porous package to permit slow drying during transit may be used as a means to prevent defoliation. A serious objection to this method is that the drying may proceed too far before the holly reaches the consumer, resulting in an inferior product.

Hormone treatment is now used successfully to prevent defoliation for about two weeks, if the holly is held at common storage temperatures. In trials at the Oregon Experiment Station, the most effective treatments have prevented defoliation of the FRENCH-ENGLISH GROUP for four weeks at 50° F. This was as long as holly of this group could be stored at this temperature without discoloration. Thus, in long storage, the major prob-

Loading crates of cut holly on a trailer.

lem is not to keep the leaves on, but to prevent the tissues from drying or turning brown if moisture is present. Cut holly is alive and must be kept alive if it is to retain its best appearance.

The life of detached plant parts can be prolonged by reducing the rate of respiration. This is accomplished by cold storage. In storing holly longer than two weeks, a combination of hormone treatment and cold storage is necessary.

Preparation and Use of Hormone Dip

The hormone used is alpha-naphthaleneacetic acid (NAA). A concentration of 40 ppm is recommended as a minimum. Higher concentrations give a more lasting effect and may be needed where defoliating conditions are severe. Concentrations as high as 120 ppm have caused no injury to cut holly. There is some evidence that higher concentrations increase respiration rate and shorten the storage life of holly.

Alpha-naphthaleneacetic acid may be purchased in pure form from chemical supply companies, or obtained in commercial preparations for delaying apple drop. If the pure compound is used, it should be dissolved in alcohol (just enough to dissolve it) before being added to the water. One ounce of the acid to 200 gallons of water gives a solution of 37 ppm. The addition of a spreader, such as used in sprays for pest control, may give better wetting of the waxy holly leaf.

Most growers find the commercial preparations easier to use. A concentration of 40 ppm is obtained by using four times the strength recommended for spraying apples to prevent drop. Treatment is usually applied by dipping. If the dipping vat is large enough, the crate containing the holly may be immersed. Some of the larger growers have developed vats with agitators and flow racks for continuous movement of the cut holly through the dip. Cleaning the solution is simplified by having drains and valves of sufficient capacity for removing loose berries and other debris which accumulate in the tank.

Cut holly is not allowed to soak in the solution, but is merely dipped or passed through the solution and then allowed to drain. Some mechanical device should be used for lowering and raising the crates if a simple dipping vat is used. The operation may be speeded up with a sloping drainboard beside the tank. To keep the solution as clean as possible, crates must be kept clean. Dirt in the solution necessitates its frequent renewal; this is one good reason for a continuous flow system where the dip solution is pumped through filters and only the cut holly is passed through the vat on belts or racks.

If the holly is dry when dipped, the volume of the solution will be gradually reduced. Tests show that one ton of dipped holly will retain 30-40 gallons of

Left. Rinsing holly in water before treating with hormone solution. Right. Dipping holly in hormone solution to minimize leaf drop.

Left. Packing large cartons of variegated English holly. Right. Packing a small box of cut English holly.

water after it has drained. To compensate for this loss, fresh solution can be added as required until it becomes necessary to drain and refill the tank.

If the holly is wet before it is dipped, as is often the case, the dipping solution will be diluted. If the liquid level in the tank is not lowered at all, it may be assumed that every ton of holly adds 30-40 gallons of water and removes an equal amount of solution. Thus, five tons of wet holly dipped in 400 gallons will reduce the concentration from 30 ppm to about 20 ppm. The solution could be brought up to its original strength at this point by adding the hormone, one-third the amount originally used. These calculations are approximations and apply only when the holly being treated is so wet that the liquid level in the tank remains constant. When the holly coming in from the field is wet but not saturated, calculations based on changes of level in the tank might be made. The operator may prefer to start with a solution of double strength (provided the chemical used is known to be safe at this concentration) and to refill the tank after five to ten tons of holly have passed through.

Dirt, depletion, and dilution have been mentioned as reasons for renewing the solution. Another reason for renewing it is deterioration of the ingredients. The rate of deterioration depends on temperature, aeration, and other factors. Until more information is available, it is not advisable to use the solution for more than three to four days.

PACKING AND STORING. Holly is packed after it is dipped and before it dries. It should be drained sufficiently to prevent the package from dripping. Usually sprays are culled, trimmed, and packed by hand from a bench or conveyor.

Holly is usually packed soon after it is cut and is then stored in the package. The storage period includes the time in transit and in the hands of the distributor, as well as the time it remains in the packing house. During this period its quality may be affected by the following environmental factors: (1) humidity, (2) temperature, and (3) presence of ethylene in the atmosphere.

Humidity is maintained by proper packaging. Cartons holding three, five, ten and 25 pounds are commonly used. Smaller packages may be used for the mail-order trade. The cartons are lined with a moisture-barrier of polyethylene film, foil, or wax-lined paper and are sealed with gummed tape. This type of package is not completely moisture-proof, but retains some moisture on the surface of the foliage for at least two weeks under reasonably good storage

conditions.

In tests conducted at the Oregon Experiment Station, holly remained in good condition 50 percent longer at 32° F than at 45° F. It is not a safe practice to store holly longer than two weeks without the use of cold storage. Most holly shipped from Portland to New York is by refrigerated express. Holly should not be exposed to temperatures much below freezing. If it is frozen, injury will be minimized by allowing it to thaw out slowly without handling or shaking the package.

Minute quantities of ethylene in the atmosphere will accelerate defoliation. Ethylene gas is produced by ripening apples, pears, and bananas; therefore holly should not be stored with these fruits. Another source of ethylene contamination is leaky gas pipes and incomplete combustion of gas and oil.

Holly for wreaths or corsages may be stored in bulk. The same principles apply in bulk storage as in storing within the package. To check discoloration from bruising, berries for wreaths and corsages sometimes are allowed to dry slightly before use.

There have been reports of severe defoliation and discoloration from the use of transparent wrapping materials for small packages of holly. Storage tests at Oregon State have shown both defoliation and discoloration to be more rapid at a relative humidity of 98 percent than at 85 percent. Most holly packages are not moisture-proof and therefore not likely to maintain a relative humidity near 100 percent, especially when subjected to high temperature and long storage periods. On the other hand, certain transparent wrapping materials can maintain a saturated atmosphere within the package. It is probable that the severe deterioration of holly, which sometimes occurs in these packages, is caused by high humidity in combination with high temperature and long storage periods. If holly must be exposed to high temperatures, it may be advisable to use a package which will allow it to dry out slowly, since dry holly is less objectionable than brown holly. The many types of transparent wrapping materials now available have widely different permeability to water vapor. Some are excessively permeable for this purpose.

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Nomenclature—Practice and Procedure

THEODORE R. DUDLEY AND
GENE K. EISENBEISS

Perhaps the greatest bone of contention for amateur and professional horticulturists and plantsmen is the seemingly never-ending changing of names of plants which are of horticultural and economic importance. Botanists and taxonomists often incur great wrath when they publish name changes and alterations, even though done in good faith and strictly within established and internationally accepted rules and procedural boundaries. And even when names are changed with the strongest of justifications, it often takes years for the new names to overcome prejudicial resistance and to be accepted and substituted in literature or conversation for the incorrect names. Difficulties, and also diffidence, have accrued for decades between botanists and horticulturists before coming to terms with the development and adoption of feasible and commercially acceptable procedures for the naming of cultivated plants. Great progress and improvement have been made since the publication of the *Handbook of Hollies* (1957). Paramount has been the international recognition and acceptance of rules of nomenclature.

The technical editors of this Handbook are delighted to report that no new changes of botanical names of cultivated *Ilex* are proposed in this Handbook. However, all readers will notice, and we trust will not be overly disturbed, by some orthographic corrections and some changes in rank. One highly significant nomenclatural improvement will be noticed when comparing the 1957 edition of the Handbook with the 1970 edition. We have conscientiously used, where applicable, the term cultivar consistently throughout all contributed articles. Every possible effort has been made to update and correct the botanical and cultivar names of all hollies enumerated in the text.

The compound word cultivar, which is applied exclusively to named selections of cultivated plants, was derived from the English words "cultivated" and "variety." This coined word is well known and extensively used in international botanical and horticultural parlance. It is fully defined in the *International Code of Nomenclature of Cultivated Plants—1969*, and in Article 28 of the *International Code of Botanical Nomenclature, 1966* (both of which were published by the International Bureau for Plant Taxonomy and Nomenclature, Utrecht, Netherlands). The term cultivar is synonymous with "horticultural variety" or "cultivated variety," and several other ambiguous terms combined with horticultural and cultivated, such as "type," "form," etc. The concept and the usage of the word cultivar have been formally adopted as an editorial policy by the American Horticultural Society.

The horticultural term cultivar is reserved strictly for individual cultivated selections, or indivdual plants which may or may not have been originally discovered in the wild and subsequently brought into cultivation and propagated. It may not be applied to plants occurring in their natural habitats. The term "botanical variety," designated by the abbreviation "var.," equates to the Latin term *"varietas"* which is not homologous nor synonymous, nomenclaturally or biologically, with horticultural variety or cultivar. *"Varietas"* and several other botanical terms, such as "forma" and "subspecies," specifically designate and identify normally sexually reproducing populations or assemblages of individuals which possess definite, or at least predictable, natural distribution patterns.

The genus *Ilex* has a world-wide distribution and contains more than 450 distinct species. Each of these species

may be regarded as a sexually reproducing population in the wild which maintains the morphological characteristics distinguishing all individuals of the population as members of the particular species.

An example of a readily recognizable and well-known species is *Ilex opaca* Ait., native to eastern North America. It is obvious that all individuals within the entire geographic range of this species are not identical in all characters. If a group of individuals or a population differs in one or several characters and may or may not be geographically or ecologically isolated from the rest of the species, it may be given a botanical rank. Such is the case of *I. opaca* forma *subintegra* Weatherby. Depending upon the taxonomic opinions of the botanical experts, the smooth-leaved American holly could easily have been, or may yet be relegated to the botanical rank of *varietas* (var.) or *subspecies* (subsp.). Scattered or sporadic individuals in a natural population, which differ from the norm by a single, observable character, such as fruit color, may also be given botanical rank. *I. opaca* provides the example of forma *xanthocarpa* Rehder. Separate selections made from the wild, brought into cultivation, and propagated may be given cultivar names in any modern language. Examples are the smooth-leaved *I. opaca* 'Taber #3', and the yellow-fruited *I. opaca* 'Canary'. A taxonomic purist would be obliged to call these plants respectively: *I. opaca* forma *subintegra* 'Taber #3', and *I. opaca* forma *xanthocarpa* 'Canary'. However, we feel that this type of awkward designation should be discouraged in horticultural practice.

Two typographic devices may be used to designate cultivar names. The name may be enclosed in single quotation marks (with the comma outside the quotation marks), such as *Ilex cornuta* 'Avery Island', or the name may be preceded with the abbreviation cv., such as *I. cornuta* cv. Avery Island. The International Registration Authority, International Registration Committee, and the International Checklist Committee for Cultivated *Ilex* define a holly cultivar as a "clone" which must be originally propagated asexually by cuttings, divisions, or grafts from a single, selected individual. It is also stressed that a single, designated clone may have only one valid and legitimate cultivar name.

In at least one article in this Handbook, several cultivar names are indicated as being "invalid." In order for "new" cultivar names of cultivated hollies to be valid, they must fulfill the following precepts as set up in the *International Code of Nomenclature of Cultivated Plants—1969*.

1. Since January 1, 1959, a cultivar name may be in any *modern* language, but may *not* be in Latin, nor have a Latinized ending.

2. Since January 1, 1959, it must consist of not more than three words.

3. It must be suitably published and must be accompanied by a description or a reference to a previous description, either at the cultivar rank or at any botanical category.

The Code further strongly recommends that, when possible, an illustration should be provided with the description and that an illustration and/or an herbarium specimens be deposited in an herbarium.

Obviously, before January 1, 1959, many holly cultivar names were published without a description, and in Latin. Fortunately, these earlier names are not invalid. Some readers may regret that many of the cultivar names of hollies in current usage are invalid. However, international stabilization of cultivated and botanical nomenclature serves the very best interests of present and future generations who regard plants as a profession, avocation, or ephemeral interest.

For more information on the proper and internationally accepted construction and publication of cultivar names, we advise readers to refer to the *International Code of Nomenclature of Cultivated Plants—1969*, available at a modest price from the American Horticultural Society, 2401 Calvert Street, N.W., Washington, D.C. 20008.

A frequent source of confusion to the layman is the difficulty, possibly delusionary, of distinguishing between common, botanical, and cultivar names. A common name is a colloquial or local name applied to a plant native to a particular geographical area. While common names may have some importance when applied to native plants of a limited area, the identical common name often applies to different species of plants which may occur in widely separated geographical areas. Conversely, the same species of plant may grow in different areas and have different common names.

Since common names have little scientific basis in origin or usage, attempts to standardize them nationally or internationally have been notably unsuccessful. In contrast, Latin botanical names were originated for the most part with great care, are universal in application, and are documented and published according to the rules and recommendations of the prescribed International Botanical Code. Cultivar names are likewise distinct from, and must not be used interchangeably with, common names. It is imperative that common names be clearly identified as such to avoid fallacious application of common, botanical, and cultivar names.

The process of recording and establishing correct and valid names for new cultivars of *Ilex* is international registration of all new names with the Holly Society of America, which is the appointed International Registration Authority for cultivated hollies. The main objective of registration is to stabilize and standardize naming of new cultivars. This goal is accomplished by recording, documenting, and publicizing the origin and the discoverer, namer, and introducer of new cultivar names. The modest information extant for older cultivar names in many languages is scattered in multitudinous nursery catalogues and in horticultural and botanical literature. Such information is often of dubious authenticity, with the unfortunate result that the names of most individuals who discovered or originated holly selections are lost to posterity. Likewise, the history of introduction and origin of many cultivars and their names is so obscure that numerous nomenclatural conflicts may never be satisfactorily resolved. Registration gives permanent recognition to persons involved with the discovery and introduction of new cultivars by documentation and publication of their names. It also preserves the cultivar names and guarantees, in good faith, that the names of originators and selectors or introducers will always be associated with their valid and registered cultivar names. The practice of registration prevents the confusion that results from duplication of cultivar names and also prevents the application of two or more different names to a single cultivar. Registration clearly distinguishes cultivar names from botanical names and common names.

Inquiries concerning registration of cultivated hollies are invited by the Holly Society of America and should be directed to Gene K. Eisenbeiss, chairman, International Holly Registration Committee, U.S. National Arboretum, Washington, D.C. 20002.

Holly Introductions
by the United States Department of Agriculture

H. H. FISHER

Every major crop owes its development to plant introduction. The hollies are no exception. For the purpose of this discussion, plant introduction is defined as the successful propagation of plant material brought to a country from any source. While plants may be introduced by other means, concern in this article is confined to introductions of the genus *Ilex* received in the United States since 1956 through the facilities of the Crops Research Division, United States Department of Agriculture.

Plant introductions of holly were often obtained through exchange with foreign research institutions, gifts, and occasionally by purchase. Obtaining specific new introductions (often referred to as germ plasm) for research purposes often requires planned plant exploration.

A few of the introductions listed were collected incidentally by explorers on missions not specifically for ornamentals. Much of the material was introduced by plant explorers collecting ornamentals under an Agriculture Research Service-Longwood Gardens cooperative program.

In 1949 Hu[1] stated that the genus *Ilex* consisted of over 400 species, worldwide. This number was confirmed by Willis[2] and others. In an accumulation of unpublished data, Eisenbeiss[3] has evidence of the existence of at least an additional 31 species. With the probability that many undescribed species also exist, particularly in Malaysia, southeast Asia, and South America, 450 would appear to be a more reasonable total number of *Ilex* species. Of this number, 74 species have been introduced to cultivation in various countries. The following 14 species have been introduced since 1956, e.g., since the first edition of *The Handbook of Hollies* (1957):

Ilex anomala Hook. & Arn.
**buergeri* Miq.
brevicuspis Reiss.
championii Loes.
**colchica* Pojark.
cyrtura Merr.
graciliflora Champ. ex Benth.
integerrima Reiss.
**× kiusiana* Hatusima
**liukiuensis* Loes.
**× makinoi* Hara
**mutchagara* Makino
repanda Griseb.
**viridis* Champ. ex Benth.

Those with asterisks were introduced to the United States for the first time by the Crops Research Division. In collecting living plants from the wild, both male and female plants were obtained whenever possible. *Ilex liukiuensis*, P.I.* 237877, was introduced to cultivation for the first time, according to available records.

The importance of plant introduction to crop development cannot be overemphasized. Most introduced plant material is used as a gene source in breeding programs. Occosionally, plants are useful in their wild form as well as parents for breeding. Introduced from eastern China a century and a quarter ago, *I. cornuta* became one of the more widely used hollies in warmer areas of this country. A mutant, *I. cornuta* 'Burfordii', extends the hardiness range of the species into colder regions. *Ilex crenata* from Japan may be used in its smaller-leaved kinds to replace *Buxus sempervirens* in northern areas where boxwood is not hardy.

A more recent introduction suitable for commercial use without undergoing improvement by breeding or selection is

P.I.* 237878 *I. mutchagara*. The latter, along with P.I. 307276 *I. intricata* and three accessions of *I. sugerokii*, is currently in use by Kosar[4] in his holly breeding program at the United States National Arboretum, Washington, D. C. This program demonstrates the use of recently introduced holly germ plasm for the improvement and development of new garden hollies.

During the period 1956-1970, the Crops Research Division received 601 accessions of *Ilex*, which included 62 species, 25 botanical varieties and forms, five interspecific hybrids, and horticultural selections, including cultivars, derived from breeding programs and selections made by botanic gardens and nurseries.

Of particular interest to plant breeders are the 152 *Ilex* introductions, listed in the chart, that were collected mostly as seed and some as cuttings from the wild or from remote sources. This new holly germ plasm is listed together with sources, collectors' or donors' names, and year received. In some cases, little more is known about the material. In other instances, the collectors' notes may be available and may give some information about the plant itself or the collection site. All available data are published in the printed and numbered Plant Inventory by the United States Department of Agriculture, Washington, D.C. 20025.

Normally, new introductions received by the Department are released through its collaborators for further use. None of this material is available for public distribution by the Department.

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4. Kosar, W. F. National Arboretum, Washington, D. C. (personal communication)

*P.I.—Plant Introduction accession number of the U. S. Department of Agriculture.

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ILEX INTRODUCTIONS, 1956–1970
by the United States Department of Agriculture

P. I. NUMBER	MATERIAL		SOURCE	DATE
aquifolium L.				
288703	Seed	Japan	Aritaki Arboretum, Saitama-Ken	1963
305310	Do	Denmark	Universitetets Botaniske Have, Copenhagen	1965
306368	Do	Germany	Botanic Garden, Bremen	1965
318652	Do	Norway	Institute for Dendrology of Planteskuledrix, Vollebekk	1967
319168	Do	Soviet Union	Botanic Garden, Soczi	1967
331001	Do	Do	Main Botanic Garden, Moscow	1968
331026	Do	Do	Do	1968
331086	Do	Do	Botanic Garden, Soczi	1968
aquifolium var. *chinensis* Loes.				
279951	Seed	Japan	Aritaki Arboretum, Saitama-Ken	1962
296985 to 296986	Do	Do	Do	1964
asprella Champ. ex Benth.				
265898	Seed	Hong Kong	Urban Services Department	1960
276339	Do	Do	Botanic Garden, J. L. Creech, USDA	1961
282697	Do	Do	Urban Services Department	1962
299436	Do	Do	Do	1964
308634	Do	Do	Do	1965
buergeri Miq.				
263648	Seed	Japan	The Kyushu University, Fukuoka	1960
canariensis Poir.				
317035	Seed	Canary Islands	Jardin de Aclimatac de La Orotava, Tenerife	1966

crenata var. *paludosa* Hara ex Ohwi				
260385 to 260386	Seed	Japan	Government Forest Experiment Station, Okidate, Aomori	1959
266339	Do	Do	H. Kubota, Tochigi-Prefecture	1960
269256	Do	Do	Do	1960
275850 to 275857	Do	Do	J. L. Creech, USDA	1961
275788 to 275795	Do	Do	Do	1961
276079 to 276082	Plants	Do	Do	1961
276112	Seed	Do	Do	1961
276128 to 276129	Plants	Do	Do	1961
276162	Seed	Do	Do	1961
276558	Do	Do	Do	1961
dipyrena Wall.				
274982	Seed	India	J. R. Harlan, USDA	1961
285445	Do	Nepal	J. L. Creech and F. deVos, USDA	1962
excelsa Wall.				
285365	Seed	Nepal	J. L. Creech and F. deVos, USDA	1962
ficoidea Hemsl.				
243101	Cuttings	England	F. G. Meyer, USDA	1957
243260 to 243261	Seed	Do	Do	1957
254594	Plants	Do	Hillier & Sons, Winchester	1958
geniculata Maxim.				
272052	Seed	Japan	H. Kubota, Tochigi-Prefecture	1961
glabra f. *leucocarpa* F. W. Woods				
275847	Plants	Florida	Gulf Coast Research Center, Mariana	1961
cinerea Champ.				
265899	Seed	Hong Kong	Urban Services Department	1960
299437	Do	Do	Do	1964
344113	Do	Do	Do	1969

colchica Pojark.				
274589	Seed	Soviet Union	Botanic Garden, Batum	1961
315213	Do	Do	Botanic Garden, Soczi	1966
319169	Do	Do	Do	1967
crassifolia Hook.				
267266	Seed	Scotland	Royal Botanic Garden, Edinburgh	1960
crenata Thunb.				
263838	Seed	Japan	Yokohama Plant Protection Station, Tokyo	1960
266338	Do	Do	H. Kubota, Tochigi-Prefecture	1960
274538	Cuttings	Do	J. L. Creech, USDA	1961
274802	Do	Do	Do	1961
274870	Branches	Do	Do	1961
275056	Seedlings	Do	Do	1961
275077	Plants	Do	Do	1961
275395	Seedlings	Do	Do	1961
279006	Seed	Do	National Horticultural Experiment Station. Kanagawaken	1962
304944	Do	Do	Department of Agriculture, Ehime University, Matuyama	1965
crenata 'Convexa'				
263840	Seed	Japan	Yokohama Plant Protection Station, Tokyo	1960
crenata var. *fukasawana* Makino				
269255	Seed	Japan	H. Kubota, Tochigi-Prefecture	1960
274539	Cuttings	Do	J. L. Creech, USDA	1961
crenata f. *microphylla* Rehd.				
317234 to 317235	Seed	Korea	E. G. Corbett and R. W. Lighty, USDA	1966
318549	Do	Do	Do	1967
graciliflora Champ. ex Benth.				
299438	Seed	Hong Kong	Urban Services Department	1964
hanceana Maxim.				
237875	Seed	Japan	J. L. Creech, USDA	1957
282698	Do	Hong Kong	Urban Services Department	1962
hookeri King				
243097	Cuttings	England	F. G. Meyer, USDA	1957
251769	Do	Do	Hillier & Sons, Winchester	1958
254596	Plants	Do	Do	1958
261234	Cuttings	Do	Do	1959
307274	Plants	India	F. deVos and E. G. Corbett, USDA	1965
integerrima Reiss.				
247177	Plants	Brazil	Llewelyn Williams, USDA	1958

integra Thunb.				
237876	Seed	Japan	J. L. Creech, USDA	1957
intricata Hook. f.				
307276	Plants	India	F. deVos and E. G. Corbett, USDA	1965
311301	Seed	Do	Lloyd Botanic Garden, Darjeeling, West Bengal	1966
× *kiusiana* Hatusima				
274837	Seed	Japan	J. L. Creech, USDA	1961
latifolia Thunb.				
274838	Seed	Japan	J. L. Creech, USDA	1961
leucoclada Makino				
276130 to 276133	Plants	Japan	J. L. Creech, USDA	1961
liukiuensis Loes.				
237877	Seed	Japan	J. L. Creech, USDA	1957
237880	Do	Do	Do	1957
× *makinoi* Hara				
275796 to 275797	Plants	Japan	J. L. Creech, USDA	1961
melanotricha Merr.				
251772	Cuttings	England	Hillier & Sons, Winchester	1958
261216	Seed	Do	F. G. Meyer, USDA	1959
261235	Cuttings	Do	Hillier & Sons, Winchester	1959
memecylifolia Champ. ex Benth.				
299439	Seed	Hong Kong	Urban Services Department	1964
344114	Do	Do	Do	1969
mitis Radlk.				
247042	Seed	Republic of South Africa	National Botanic Gardens, Cape Province	1958
292361	Do	Do	Do	1963
298031	Plants	Do	Bloom Erf Nurseries, Cape Province	1964
299399	Seed	Do	National Botanic Gardens, Cape Province	1964
317040	Do	Do	Do	1966
331211	Do	Do	Do	1968
montana var. *macropoda* (Miq.) Fern.				
316603	Seed	Korea	E. G. Corbett and R. W. Lighty, USDA	1966
316703 to 316704	Do	Do	Do	1966
mutchagara Makino				
237878	Seed	Japan	J. L. Creech, USDA	1957

nobilis Gumbleton				
307275	Seed	India	F. deVos and E. G. Corbett, USDA	1965
318660	Do	Do	Lloyd Botanic Garden, Darjeeling, West Bengal	1967
pubescens Hook. & Arn.				
324987 to 324988	Seed	Taiwan	J. L. Creech, USDA	1968
rotunda Thunb.				
237879	Seed	Japan	J. L. Creech, USDA	1957
rubra Wats.				
240715	Seed	Mexico	H. S. Gentry, USDA	1957
rugosa Fr. Schmidt				
275798 to 275799	Plants	Japan	J. L. Creech, USDA	1961
276083 to 276084	Do	Do	Do	1961
sugerokii Maxim.				
275800 to 275808	Cuttings	Japan	J. L. Creech, USDA	1961
275858 to 275862	Seed	Do	Do	1961
276085	Plants	Do	Do	1961
276134	Cuttings	Do	Do	1961
276163 to 276164	Seed	Do	Do	1961
viridis Champ. ex. Benth.				
275779	Seed	Hong Kong	Urban Services Department	1961
276342	Do	Do	J. L. Creech, USDA	1961
308636	Do	Do	Urban Services Department	1965
344115	Do	Do	Do	1969
wightiana Wall. ex Wight				
307277 to 307278	Seed	India	F. deVos and E. G. Corbett, USDA	1965
318661	Do	Do	Lloyd Botanic Garden, Darjeeling, West Bengal	1967

Hollies Currently Available in the Trade

GENE K. EISENBEISS

The designation of species and cultivars currently available in the trade is not definitive (nor all inclusive) and includes only those names thought to be the most widely distributed, correctly named, and validly published.

Species of Ilex

I. aquifolium
I. cassine
I. ciliospinosa
I. chinensis
I. cornuta
I. crenata
I. decidua
I. dipyrena
I. fargesii
I. glabra
I. integra
I. latifolia
I. myrtifolia
I. opaca
I. pedunculosa
I. pernyi
I. rotunda
I. rugosa
I. serrata
I. verticillata
I. vomitoria

Cultivars of Ilex aquifolium

'Amber'
'Angustifolia'
'Argentea Marginata Pendula'
'Bacciflava'
'Balearica'
'Balkans'
'Barnes'
'Beacon'
'Beautyspra'
'Big Bull'
'Boulder Creek'
'Bonanza'
'Ciliata Major'
'Colburn'
'Covergirl'
'Deluxe'
'Dr. Huckleberry'
'Dude'
'Earlygold'
'Echo'
'Favorite'
'Ferox'
'Ferox Argentea'
'Ferox Aurea'
'Flavescens'
'Golden Beau'
'Golden King'
'Green Plane'
'Hastata'
'J. C. van Tol'
'Lillibet'
'Lilliput'
'Little Bull'
'Longspra'
'Louise'
'Madam Briot'
'Orange Gem'
'Oregon Select'
'Ovata'
'Pendula'
'Pilkington'
'Pinto'
'Rederly'
'Sparkler'
'Special'
'Teufel's Hybrid'
'Whitesail'
'Wieman's Globe'
'Yellow Beam'
'Zero'

Cultivars of Ilex crenata

'Angelica'
'Biloxi'
'Bruns'
'Buxifolia'
'Convexa'
'Cherokee'
'Divaricata'
'Glass'
'Green Island'
'Green Lustre'
'Green Pygmy'
'Green Thumb'
'Hatfield'
'Hetzii'
'Highlander'
'Kingsville Dwarf'
'Kingsville Green Cushion'
'Little Gem'
'Magda'
'Mariesii'
'Maxwell'
'Mentor Glossy'
'Morris Dwarf'
'Oconee River'
'Oleafera'
'Red Lion'
'Repandens'
'Schowbeli'
'Sentinel'
'Stokes'
'Vaseyi'
'Willowleaf'
'Zwischenahn'

Cultivars of Ilex cornuta

'Anicet Delcambre'
'Anna Mae'
'Avery Island'
'Azusa'
'Big Leaf'
'Burfordii'
'Cajun Gold'
'Cartwright's Compacta'
'Dazzler'
'D'Or'
'Dwarf Burford'
'Giant Beauty'
'Grandview'
'Hume'
'National'
'O'Spring'
'Rotunda'
'Shangri-La'
'Shiu-Ying'
'Spiny'
'Tabletop'

Cultivars of Ilex glabra

'Ivory Queen'

Cultivars of Ilex opaca

'Albert Pride'
'Arlene Leach'
'Arthur Pride'
'Arden'
'Betty Pride'
'Bountiful'
'Canary'
'Carnival'
'Cheerful'
'Christmas Carol'
'Clarendon Spreading'
'Clark'
'Croonenberg'
'Cumberland'
'Delia Bradley'
'Dr. Cribbs'
'Edith May'
'Elizabeth'
'Emily'
'Fair Lady'
'Farage'
'Hedgeholly'
'Howard'
'Homer'
'Isaiah'
'Jersey Knight'
'Joyce'
'Judge Brown'
'Lake City'
'Laura'
'Mae'
'Manig'
'Mary Holman'
'Maurice River'
'Menantico'
'Merry Christmas'
'Miss Helen'
'Mrs. F. J. Close'
'Mrs. Santa'
'Old Heavy Berry'
'Pride of Butler'
'Red Flush'
'Red Spice'
'Red Velvet'
'Sleigh Bells'
'St. Mary'
'Susan'
'Taber #3'
'Tom Brown'
'Valentine'
'Yule'

Cultivars of Ilex vomitoria

'DeWerth'
'Grey's Littleleaf'
'Grey's Weeping'
'Jewel'
'Pride of Texas'
'Stokes Dwarf'

Interspecific Hybrids

'Aquipern'
'Belgica'
'Blue Boy'
'Blue Girl'
'Brilliant'
'Camelliaefolia'
'East Palatka'
'Edward J. Stevens'
'Eldridge'
'Foster #1'
'Foster #2'
'Hendersonii'

'Hodginsii'
'Hume #1'
'Hume #2'
'James G. Esson'
'John T. Morris'
'Lawsoniana'
'Lydia Morris'
'Marnokii'
'Mundyi'
'Nellie R. Stevens'
'Nobilis'
'San Jose'*
'Savannah'
'Wilsonii'
'Wirt L. Winn'

* This hybrid is reported to be *Ilex* × *altaclarensis* 'Wilsonii' × *I. Sikkimensis* and is not to be confused with a cultivar of *I.* × *aquipernyi* of the same name.

Mr. Eisenbeiss is research technician at the United States National Arboretum, Washington, D.C., a trustee of the Holly Society of America, Inc., and chairman of its Holly Checklist Committee. He is also registrar for the Holly Society of America, Inc., the International Registration Authority for cultivated *Ilex*.

Official Holly Arboreta and Experimental Holly Test Centers

WILLIAM F. KOSAR

The Trustees of the Holly Society of America, Inc., have designated nineteen official Holly Arboreta and four Experimental Holly Test Centers, as follows:

OFFICIAL HOLLY ARBORETA

NO.	PLANT HARDINESS ZONE	LOCATION
1.	(5b)	Secrest Arboretum, Ohio Agricultural Research and Development Center, Wooster, Ohio 44691.
2.	(6b)	Missouri Botanical Garden, 2315 Tower Grove Avenue, St. Louis, Missouri 63110.
3.	(6b)	Rutgers—The State University, Department of Horticulture and Environmental Science, Horticultural Farm No. 1. New Brunswick, New Jersey 08903.
4.	(7a)	Planting Fields Arboretum, Oyster Bay, Long Island, New York 11771.
5.	(7a)	Morris Arboretum, 9414 Meadowbrook Lane, Philadelphia, Pennsylvania 19118.
6.	(7a)	Arthur Hoyt Scott Horticultural Foundation, Swarthmore College, Swarthmore, Pennsylvania 19081.
7.	(7b)	U.S. National Arboretum, Washington, D.C. 20002.
8.	(7b)	Agricultural Experiment Station Arboretum, The University of Tennessee, 794 Bethel Valley Road, Oak Ridge, Tennessee 37832.
9.	(8a)	Piedmont Holly Arboretum, Horticulture Science Department, North Carolina State University, Raleigh, North Carolina 27607.
10.	(8b)	Grandpappy Holly Arboretum, New Bern, North Carolina. Horticulture Science Department, North Carolina State University, Raleigh, North Carolina 27607.
11.	(8b)	Callaway Gardens, Pine Mountain, Georgia 31822.
12.	(8b)	University of Washington Arboretum, Seattle, Washington 98105.
13.	(7a)	Ashumet Holly Reservation and Wildlife Sanctuary, Ashumet Road, East Falmouth, Massachusetts 02536.
14.	(5b)	Dawes Arboretum, Rural Route No. 5, Newark, Ohio 43055.
15.	(7a)	Campus of the University of Delaware, Newark, Delaware 19711.
16.	(7a)	Southern Illinois University Outdoor Laboratory, Carbondale, Illinois 62901.
17.	(7a)	John J. Tyler (Painter) Arboretum, Painter and Forge Roads, P.O. Box 216, Lima, Delaware County, Pennsylvania 19060.
18.	(6b)	Highland Park, County of Monroe, Department of Parks, 375 Westfall Road, Rochester, New York 14620.
19.	(7b)	Clemson Horticultural Arboretum, Clemson University, Clemson, South Carolina 29631.

OFFICAL EXPERIMENTAL HOLLY TEST CENTERS

1.	(6b)	Rutgers—The State University, Department of Horticulture and Environmental Science, Horticultural Farm No. 1, New Brunswick, New Jersey 08903.
2.	(7b)	Oregon State University, North Willamette Experiment Station, Aurora, Oregon 97002.
3.	(5b)	Secrest Arboretum, Ohio Agricultural Research and Development Center, Wooster, Ohio 44691.
4.	(7b)	U.S. National Arboretum, Washington, D.C. 20002.

Procedure for qualification as an official holly arboretum.

Application shall be directed, in writing, to the chairman of the Arboretum Committee. The following factors will be considered:

1. The holly arboretum shall be maintained as a public or semi public institution for the edification of plant lovers in the use of holly in the landscape.

2. The holly collection shall be properly labeled.

3. An accurate record system shall be maintained so that each plant in the collection can be identified by its location, valid name, source, date received, size or age when received, and any other pertinent facts.

4. The name of the person acting as liaison shall be submitted to the Holly Society of America. Timely reports about the progress of the collection shall be sent to the editor of *Holly Letter*.

Mr. Kosar is geneticist, United States National Arboretum, Washington, D.C., administrative vice-prseident of the Holly Society of America, Inc, and the former chairman of its Arboretum Committee.

THE ZONES OF PLANT HARDINESS

Agricultural Research Service
United States Department of Agriculture

Holly Society of America, Inc.

was organized in 1947 to bring together those people who are interested in the genus *Ilex* and for the following aims and purposes:

To collect and dessiminate information about the culture of hollies and their many uses as landscape and decorative material.

To promote research in the cultural and physiological aspects of growing holly.

To encourage the investigation and control of insect pests and diseases.

To locate, evaluate, select, and (designate superior clones or cultivars.

To locate and preserve holly stands of extraordinary natural beauty.

The Holly Society of America has designated seventeen official holly arboreta and four official experimental holly test centers; these are listed elsewhere in this Handbook. It serves as the International Registration Authority for cultivated *Ilex*.

The Society has five chapters: Great Lakes (Illinois, Ohio, Pennsylvania); Great Rivers (Illinois, Indiana, Kentucky, Missouri, Ohio); Long Island (New York); Mount Holly (New Jersey); and Central Pa. (Pennsylvania).

The Society publishes *Holly Letter* and the *Proceedings* of the annual meeting in the fall of the year. These publications are included in the annual dues of Personal Membership $5.00, Sustaining Membership $10.00.

Further information about membership in the Holly Society of America or in any of the local chapters may be obtained by writing to Bluett C. Green, Jr., Secretary-Treasurer, P.O. Box 8445, Baltimore, Maryland 21234.

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BULLETINS

BULLETIN 2 *Insects and Spider Mites Attacking Holly* by Clyde C. Hamilton. 23 pgs. 50 cents prepaid.

BULLETIN 3 *Practical Suggestions for Growing Holly* by Daniel G. Fenton. 1962. 12 pgs. 75 cents prepaid.

BULLETIN 5 *Evergreen Hollies for the South* and *Ilex Cornuta 'Burfordii'—Periclinal Chimera* by Fred C. Galle; and *Hollies and Their Uses* by Henry Hohman. 1952. 20 pgs. 50 cents prepaid.

BULLETIN 7 *The History of Holly in Murals* by Harry W. Dengler. Copyright 1954. 24 pgs. This Bulletin is a companion to the eight murals depicting the cultural, traditional, and economic aspects of holly culture on display in the Millville, New Jersey, Y.M.C.A. 50 cents prepaid.

BULLETIN 8 *Bibliography on Holly* by Betty Flanders Thomson, 1955. 36 pgs. The author cites 313 articles and books of scientific information about the genus *Ilex*. The original of nearly all references cited was examined and the contents classified under 30 headings. An index of authors is included in the headings. 50 cents prepaid.

BULLETIN 10 *Holly Pyrenes* (seeds) by H. Harold Hume, 1959. 16 pgs. This study is based on a collection of pyrenes of 30 species, native and exotic, growing in the United States. The pyrenes of 36 species have been photographed on a scaled background to assist in identification, and lined drawings illustrate all descriptive material. 50 cents prepaid.

Bulletins 1, 4, 6 and 9 are currently out of print.

A new bulletin, *Insect Pests of Holly*, is being written by Charles W. McComb, Department of Entomology, University of Maryland. When ready for publication, it will replace Bulletin 2.

In ordering Bulletins, make check payable to Holly Society of America, Inc., and send to Bluett C. Green, Jr., P.O. Box 8445, Baltimore, Maryland 21234.

In addition, the Society maintains a library of 2″ x 2″ colored slides depicting phases of the production, culture, and the use of hollies in the landscape and in floral arrangements. These slides are available to Society members for lectures or demonstrations before garden clubs, civic organizations, or any group of interested persons.

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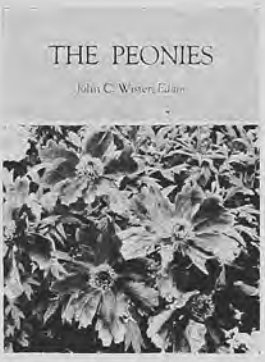

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