

A STUDY OF THE GENUS TAXUS

DISSERTATION

Presented in Partial Fulfillment of the Requirements
for the Degree Doctor of Philosophy in the
Graduate School of The Ohio State
University

By

RAY ALBERT KEEN, B. S., M. S.

The Ohio State University
1956

Approved by:



Adviser
Department of Horticulture and
Forestry

ACKNOWLEDGMENT

The author wishes to acknowledge and express his grateful thanks to Professor L. C. Chadwick of the Division of Floriculture and Ornamental Horticulture for his patient guidance and cheerful encouragement in the pursuit of this study and for his foresight in establishing the Living Herbarium of Taxus in the Secrest Arboretum as a service to the nurserymen of Ohio and America.

Space does not permit the naming of the many nurserymen, gardeners, directors of arboretums, and others who have freely shared plant materials and time. But special mention should be made of the Arnold Arboretum, Jamaica Plain, Massachusetts; of Mr. Walter Hunnewell and Mr. William H. Hatfield for permission to study the plants and records of the late Mr. T. D. Hatfield; and of the Ohio Nurserymen's Association for financial assistance.

TABLE OF CONTENTS

	Page
List of Illustrations	iv
Introduction	1
Purpose of This Study	3
Review of Literature	3
Methods of Study	11
Morphology	14
Chromosome Number in <i>Taxus</i>	22
Discussion	30
Descriptions of Species and Clons	39
Summary	193
Bibliography	195

List of Illustrations

Figure	Page
1 Planting Plan of the Living Herbarium of <u>Taxus</u> , Secret Arboretum, Wooster, Ohio	4
2 The Living Herbarium of <u>Taxus</u> of Secret Arbor- etum from the West	5
3 Winter Buds of <u>Taxus</u>	16
4 Male and Female Flowers of <u>Taxus</u> at Anthesis ...	18
5 Seed of the Yew	20
6 Monoecious Twig of the Male Clon BROWN ANGLOJAP YEW	21
7 Diploid Somatic Chromosomes of <u>Taxus</u>	24
8 <u>Taxus</u> Chromosomes at Metaphase I in Meiosis	27
9 Removing Female Gametophyte from <u>Taxus</u> Seed	28
10 Haploid Somatic Chromosomes of <u>Taxus</u>	29
11 Unpruned Four-year-old Yew from a Lateral Branch	33
12 <u>Taxus baccata</u> L., White Marsh Plantation	40
13 <u>Taxus baccata</u> L., Longwood Gardens	43
14 Clon BROOM ENGLISH YEW, Secret Arboretum	45
15 Clon CHESHUNT ENGLISH YEW, Secret Arboretum ...	47
16 Clon COMPACT ENGLISH YEW, Secret Arboretum	49
17 Clon DOVASTON ENGLISH YEW, Newport, Rhode Island	51
18 Clon GLAUCOUS ENGLISH YEW, Secret Arboretum ...	53
19 GOLDEN ENGLISH YEW, Tyler Arboretum, Lima, Pa. .	55
20 Mixed Yew Seedlings, Fairview (Pa.) Nursery	57
21 Clon GRACEFUL ENGLISH YEW, Longwood Gardens	59

Figure		Page
22	Branch Growth Habit of Clon GRACEFUL ENGLISH YEW	60
23	Clon HEATH ENGLISH YEW, Secrest Arboretum	62
24	Clon IRISH ENGLISH YEW, Richmond, Va.	64
25	Clon GOLDEN IRISH ENGLISH YEW, Tyler Arboretum	66
26	Clon MICHELL ENGLISH YEW, Secrest Arboretum ...	68
27	Clon OVEREYNDER ENGLISH YEW, Secrest Arboretum	70
28	Clon ROUNDTOP ENGLISH YEW, Secrest Arboretum ..	72
29	Clon SHORTLEAF ENGLISH, Young Plant	74
30	Clon SHORTLEAF ENGLISH YEW, Old Plant	75
31	Clon SPREADING ENGLISH YEW, Old Plant	78
32	Clon SPREADING ENGLISH YEW, Young Plant	79
33	Foliage Characteristics of Some Yew Species and Clons in the Tyler Arboretum, Lima, Pa.	81
34	Clon WASHINGTON ENGLISH YEW, Tyler Arboretum ..	83
35	Clon YELLOW BROOM ENGLISH YEW, Tyler Arboretum	85
36	Clon YELLOW DOVASTON ENGLISH YEW, Masonic Homes, Elizabethtown, Pa.	86
37	English Yew, in Christ Church Cemetery, Green- wich, Conn.	89
38	<u>Taxus canadensis</u> Marsh, in the Arnold Arboretum	93
39	<u>Taxus chinensis</u> Rehder, at the Hunnewell Estate	96
40	<u>Taxus chinensis</u> , Rehder, at the Morris Arbor- etum	97
41	<u>Taxus cuspidata</u> Sieb. & Zucc. at the Hall Estate, Bristol, R. I.	100
42	"SIEBOLD" JAPANESE YEW and Clon GOLDTIP JAPANESE YEW, South Wilton (Conn.), Nursery	102

Figure	Page
43 Nursery Block of Large "TAXUS CUSPIDATA CAPITATA"	103
44 Clon ADAMS JAPANESE YEW, Secrest Arboretum	105
45 Clon BOBBINK JAPANESE YEW, Secrest Arboretum ..	107
46 Clon CUSHION JAPANESE YEW, Arnold Arboretum ...	109
47 DWARF JAPANESE YEW, Dense Type, Youngstown, Ohio	112
48 DWARF JAPANESE YEW, Loose Type, Hunnewell Estate	113
49 DWARF JAPANESE YEW, Dense Type, Hunnewell Estate	114
50 Clon BLUE JAPANESE YEW, Type Plant, Hiti Nursery	116
51 Clon GOLDTIP JAPANESE YEW, G. R. Hall Estate ..	119
52 Clon HITI JAPANESE YEW, Hiti Nursery, Pomfret, Conn.	121
53 "TAXUS HITI" at the Arnold Arboretum	122
54 Clon INTERMEDIATE JAPANESE YEW, Secrest Arboretum	125
55 Clon PROSTRATE JAPANESE YEW	127
56 Clon PYGMY JAPANESE YEW, Highland Park, Rochester, N. Y.	129
57 THAYER JAPANESE YEW, Arnold Arboretum	133
58 HUNNEWELL YEW, Arnold Arboretum	139
59 HUNNEWELL YEW, Formal Hedge of Seedling Plants at the Hunnewell Estate	140
60 ANGLOJAP YEW, Arnold Arboretum	142
61 ANGLOJAP YEW Hedge on Hunnewell Estate	143
62 T. D. Hatfield's List of Numbered Plants	146

Figure		Page
63	Clon ANDORRA ANGLOJAP YEW, Secrest Arboretum ..	151
64	Clon BLACK ANGLOJAP YEW, Arnold Arboretum	153
65	Clon BROWN ANGLOJAP YEW, Parent Plant	155
66	Clon COLE ANGLOJAP YEW, Secrest Arboretum	158
67	Clon COSTICH ANGLOJAP YEW, Secrest Arboretum ..	160
68	Clon DUTWEILER ANGLOJAP YEW, Secrest Arboretum	161
69	Clon HATFIELD ANGLOJAP YEW, Young Plant	165
70	Clon HATFIELD ANGLOJAP YEW, Old Plant	166
71	Clon HENRY ANGLOJAP YEW, Type Plant, Henry Verkade Nursery, New London, Conn.	168
72	Clon HICKS ANGLOJAP YEW, Type Plant	171
73	Clon HILL ANGLOJAP YEW, Secrest Arboretum	173
74	Clon KELSEY ANGLOJAP YEW, Secrest Arboretum ...	175
75	Clon MOON ANGLOJAP YEW, Secrest Arboretum	177
76	Clon ROBUST ANGLOJAP YEW, Secrest Arboretum ...	179
77	Clon SEBIAN ANGLOJAP YEW, Secrest Arboretum ...	181
78	Clon STOVEKEN ANGLOJAP YEW, Secrest Arboretum .	183
79	Clon TOTEM ANGLOJAP YEW, Secrest Arboretum	185
80	Clon VERMEULEN ANGLOJAP YEW, Secrest Arboretum	187
81	Clon WARD ANGLOJAP YEW, Secrest Arboretum	190
82	Clon WELLESLEY ANGLOJAP YEW, Secrest Arboretum	192

A STUDY OF THE GENUS TAXUS

Introduction

In American gardens the Yews have always been associated with quality. Their foreign origin, moderate growth rate and limited supply restricted their use to the estates of the wealthy. The few mature specimens in America today are to be found in the antebellum plantation gardens and cemeteries of the South, and on the grounds of the rapidly disappearing estates on Long Island and near Boston and other large cities on the Eastern Seaboard.

With the passing of Quarantine 37, which prevented the importation of nursery stock, the nurserymen of America were forced to start propagating evergreens. Yews were considered difficult to propagate and slow to reach marketable size; consequently, the demands of the American gardener were met with quick growing and often inferior evergreens, such as Juniperus, Thuja and Chamaecyprus.

Undoubtedly the biggest factor in increasing the popularity of the Yews has been the introduction of hardiness via the Japanese Yews, and the production of a wide variety of useful landscape forms in the clons and hybrids of this species. With the exception of some of the golden clons the English Yew is not reliably hardy north of Long Island and Philadelphia. The Japanese Yews are hardy in southern Canada. This increase in range has permitted the use of

this most valuable plant in the most populous region of the country.

In order to meet the demand of the public for quality evergreens, the nurserymen have propagated Yews from almost any available source. Cuttings were taken from local estates and park plantings and plants in the nursery. Seed was collected from mixed plantings anywhere. The resulting plants were usually salable, though well described as "mongrels" by one nurseryman. Others, less conscientious, would supply a name, or worse, market the plants to a gullible public under some name which had current demand.

The confusion of names resulting from such practices did not enhance the popularity of the Yews nor the nursery industry. The taxonomic difficulties of this genus remain today as a distinct handicap to the trade, and none will admit it more readily than the nurserymen.

The varieties and clons of the English Yew have been produced over a period of centuries. Their introduction, evaluation and description have been slow and more or less orderly by reason of the time involved and the single species as a source.

By contrast, the Japanese Yew was brought to America less than a century ago, and the first hybrids were planted since 1900. Since few records were kept by those who introduced the new clons, the problem of taxonomy is doubly difficult.

The Living Herbarium of Taxus, a part of the Secrest Arboretum at the Ohio Agricultural Experiment Station, Wooster, Ohio, was established jointly by the Ohio Association of Nurserymen and the Ohio Agricultural Experiment Station, for the purpose of studying the taxonomy of this genus. The first plants were received and planted in May, 1942. These plants were planted in groups of mostly five of a kind, from a single source if possible. The sizes were eighteen to twenty-four inches, or twenty-four to thirty inches in height or spread, whichever was greater. The rows were twelve feet apart, and distance between plants in each row was ten feet. Additional plants and replacements, where needed, are planted each season as received. The present planting includes 108 accessions, with a total of 513 plants as indicated in Figure 1.

Purpose of This Study

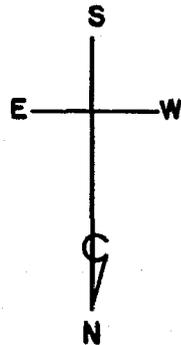
It is the purpose of this study to identify the Yews in the Secrest Arboretum, and to classify, name and describe the Yews in the American horticultural trade in so far as practicable.

Review of Literature

The earliest Greek and Roman authors mentioned the Yew in connection with its quality as a wood for bows and its effectiveness as a poison, according to Coltman-Rogers (19).

A	B	C	D	E	A	B	C	D	E	A	B	C	D	E	A	B	C	D	E	A	B	C	D	E	A	B	C	D	E	A	B	C	D	E	A	B	C	D	E							
1	*	⊙	*	⊙	*10*	*	*	⊙	*19*	*	⊙	*	-	-	⊙	⊙37*	*	*	*	⊙46*	*	*	⊙	*55*	⊙	*64*	*	*	⊙73*	*	*	*	*82*	*	*	*	*91*	*	⊙	*	*10*0	*	*	⊙		
2	*	⊙	*	⊙	*11*	*	*	⊙	*20*	⊙	-	-	⊙29*	*	*	-	⊙38*	*	*	*	-	⊙47*	⊙	*	-	*56*	-	*65*	⊙	*	*74*	*	⊙	*	*83*	*	*	*	*92*	⊙	*	*	*10*1	*	*	⊙
-3*	*	*	⊙	⊙12*	*	*	*	-	*21*	-	⊙	*	⊙30*	-	-	*	⊙39*	*	⊙	-	*48*	*	⊙	*	*57*	-	*66*	*	⊙	*75*	*	⊙	*	*84*	⊙	*	*	*93*	⊙	*	*	*10*2	*	*	⊙	
4	*	*	*	⊙13*	*	*	*	-	*22*	-	*	*	*31*	*	*	⊙	*40*	*	⊙	*	*49*	*	⊙	*	*58*	-	*67*	*	⊙	*76*	*	*	*	*85*	*	-	*	*94*	⊙	*	*	*10*3	*	*	⊙	
⊙5*	*	⊙	*	*14*	*	*	*	*23*	*	*	⊙	*32*	-	⊙	*	*41*	*	-	⊙	*50*	⊙	-	*	*59*	*	⊙68*	*	⊙	*77*	*	⊙	*	*86*	*	*	*	*95*	⊙	*	*	*10*4	*	*	*		
6	*	*	⊙	*15*	*	⊙	*	⊙24*	*	*	*	*33*	*	⊙	*	⊙42*	-	-	-	*51*	*	*	*	⊙60*	-	⊙69*	*	-	*78*	*	*	*	*87*	*	⊙	*	*96*	*	-	⊙	*10*5	*	*	*		
7	*	*	*	⊙16*	*	⊙	*	*25*	*	⊙	*	*34*	*	*	*	*43*	*	*	⊙	*52*	*	⊙	-	*61*	-	⊙70*	*	*	*79*	⊙	*	*	*88*	*	*	*	*97*	⊙	*	-	*10*6	*	*	*		
8	*	*	*	⊙17*	*	*	*	⊙26*	-	-	*	*35*	⊙	-	*	*44*	⊙	-	-	⊙53*	-	-	-	*62*	*	*71*	⊙	*	⊙80*	⊙	-	-	*89*	*	⊙	*	*98*	*	*	⊙	*10*7	*	*	*		
-9*	*	*	⊙	*18*	⊙	*	*	*27*	*	⊙	⊙	*36*	*	⊙	*	⊙45*	*	*	*	⊙54*	-	-	-	*63*	-	*72*	⊙	*	⊙81*	*	-	-	*90*	*	⊙	*	*99*	*	*	*	*10*8	*	*	*		

PLANTING PLAN OF
 THE LIVING HERBARIUM OF TAXUS
 SECREST ARBORETUM
 OHIO AGRICULTURAL EXPERIMENT STATION
 WOOSTER, OHIO
 MARCH, 1954



LEGEND
 * PLANTED
 ⊙ PHOTOGRAPHED
 - UNPLANTED
 - MISSING

Figure 1. Planting Plan of the Taxus Section, Secrest Arboretum.

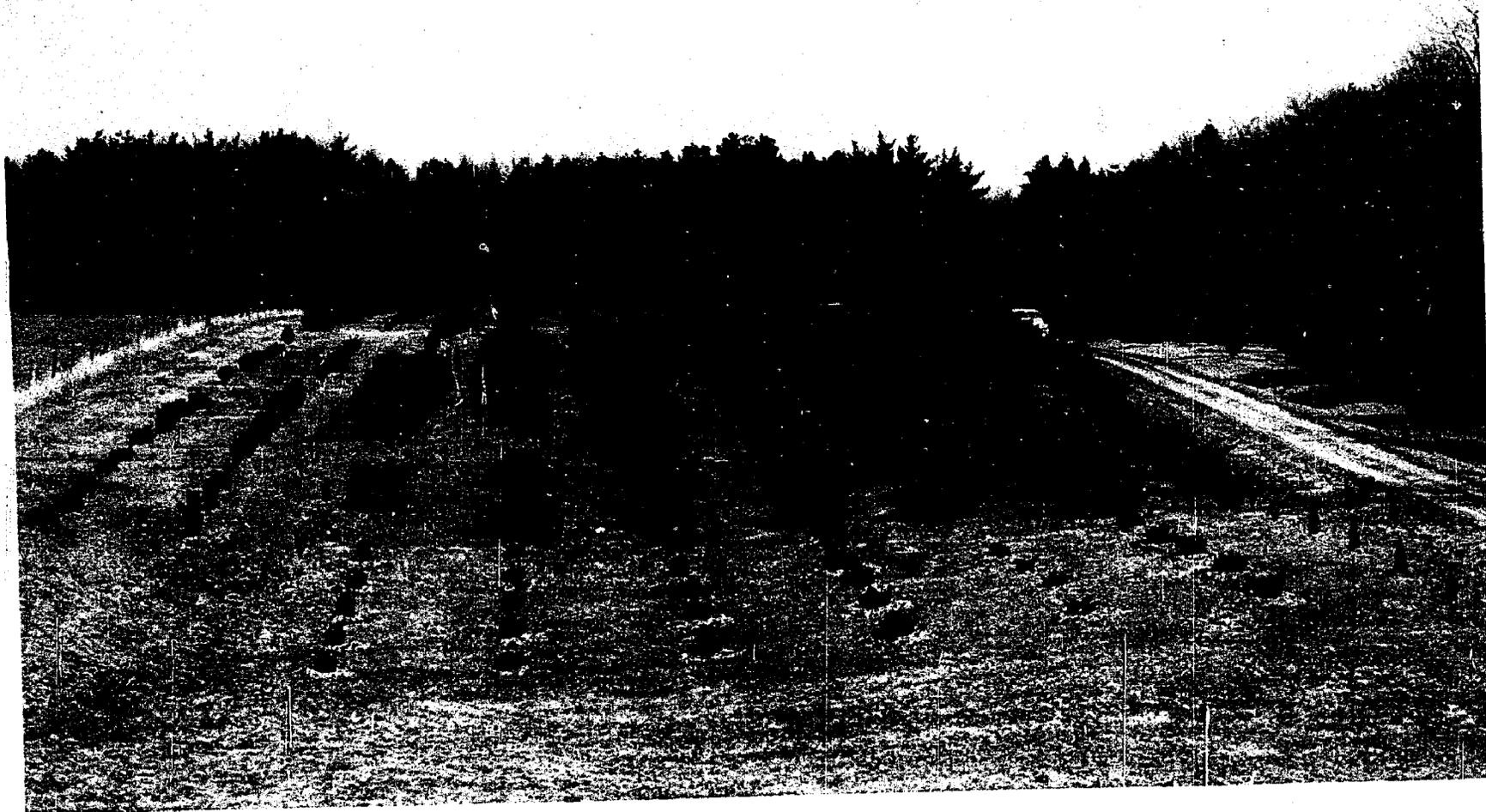


Figure 2. Taxus Plantation of Secret Arboretum from the west, March 1954.

1
5

Loudon (53) pointed out that Theophrastus considered the leaves poisonous to horses and that Caesar told of a king who poisoned himself with the juice of the Yew. These poisonous properties were exaggerated to the point that Loudon credited Plutarch with the statement that it is fatal to sleep in the shade of the Yew when the tree was in flower. To which Pliny added, "that the berries of the male yew are a mortal poison, particularly in Spain..." Yew poisoning continues to be a problem, especially in cattle (10). Dalimore (20) stressed the durability of the wood in citing ancient references to its use for axle trees, cabinet work and inlaying.

Before firearms displaced the bow as a weapon, references to Yew as a wood for bows were most abundant. Homer told of the inhabitants of ancient Crete being "dreadful with the bended yew," while Virgil, in the Aeneid, told of an archer whose draw, "...almost join'd, the horns of the tough yew," according to Loudon (53), who cited a long series of English laws regulating the production and importation of bow staves.

Loudon (54) derived the name Yew "from the Celtic word Iw, sometimes pronounced if, and signifying verdure, alluding to the yew as being evergreen; and this will also explain the French name, if." The rules of etymology would permit the German Eib to be included in the same way. However, Loudon (54) was unable to determine whether the name

Taxus was derived from taxon, a bow; taxis, the arrangement of the leaves like the teeth of a comb; or from the Greek word for poison, toxicum. Coltman-Rogers (19) took the opposite view, that "The Greek word toxon, (a bow) was evolved from another Greek word, taxos (a yew)..."

The name Taxus was first proposed for the genus by Tournefort in 1717, and adopted by Linnaeus (52) in 1753 in his Species Plantarum. The second species of his genus Taxus, T. nucifera, is now classed as Torreya nucifera.

According to Hooker (41), the genus received but little attention until the early part of the nineteenth century, when Aiton de Jussieu and Lambert published lists or descriptions of the conifers, including Taxus, and Richard in 1826 proposed the separation of the Taxaceae as an order distinct from coniferae, or true cone-bearing plants. Under the tribe Salisburineae Richard placed Ginkgo, Cephalotaxus, and Torreya. Under the tribe Taxineae he placed Taxaeae and Podocarpeae. This classification has been followed, with slight modification by other botanists, to the present time.

The type species has been recently classified by Rehder (70) as follows:

Division Spermatophyta
Subdivision Gymnospermae (Lindl.)
Class Coniferales
Family Taxaceae (Lindl.)
Tribe Taxaeae (Endl.)

Genus Taxus (Linnaeus)

Species T. baccata L. ENGLISH YEW

The first mention of varieties of the English Yew was in 1686 by Plot, who described a golden Yew which occurred in the County of Staffordshire, England, according to Elwes and Henry (28).

Leighton (1) described the Dovaston English Yew (dovastoniana) in his Flora of Shropshire in 1841. Loudon (53) in 1844 lists seven "varieties," including T. canadensis, as a variety of T. baccata, and recognizes the range of T. baccata to include all Yews in eastern Asia. His other "varieties" were the IRISH ENGLISH YEW and its seedling erecta, T. b. procumbens (which he considered almost identical to T. canadensis), the VARIEGATED ENGLISH YEW and T. b. fructo luteo, having yellow "berries." Paul (62) in 1861, listed nineteen varieties of T. baccata.

Carriere (13) and Gordon (32) described most of the distinct varieties in England and on the continent prior to 1900. Since then, Beissner (9), Dallimore (20), Bean (8) and Gibbs (31) have added to the growing list of clons, with Hornibrook (43), den Ouden (23) and Krüssmann (49) listing additional clons to the present time.

In America, Hoopes (42) had a fairly complete list in 1868. He was unaware of the introduction of T. cuspidata six years earlier in Rhode Island by R. Hall, according to Wilson (90). Rehder described many of the new cultivars and

clons in Bailey (3) (5) and the Journal of Arnold Arboretum.

Following the development and introduction of the hybrid media and hunnewelliana lines by Hatfield (35), the catalogs and trade papers have mentioned over a hundred new named selections of Yews. These have largely been ignored by the taxonomists, and perhaps rightly so, as many of them were of little merit. Other than the two hybrids mentioned above, Standardized Plant Names (48) lists sixteen clons of T. cuspidata and T. media. The clons of T. baccata listed are all from Europe, with the possible exception of the clon T. b. repandens Parsons, the SPREADING ENGLISH YEW.

Exclusive of the works on taxonomy, there has been considerable interest in the genus Taxus. Hofmeister (40) included the Yew in his early work on fertilization and embryo development in Coniferae in the 1850's. The anatomy of the vascular system of the female flowers was studied by Worsdell (93) before 1899. Hill and de Fraine (39) confirmed Strasburger's 1872 studies on seedling structure in 1906, the exterior gross appearance having been reported and illustrated by Lubbock (56) sixteen years earlier. Most of the general works contain a section on Taxus in relation to the problem being studied: on woody plants, Jeffrey (45); evolution of higher plants, Campbell (12); Gymnosperms, Chamberlain (17); Conifers, Beissner (9); and Taxoideae, Robertson (74). These and similar works are treated in detail under their respective headings.

Dupler (25) (26) reported on the gametophytes and ovuliferous structures of T. canadensis in 1917 and 1920. This work was duplicated on T. cuspidata by Sterling (84) (85) (86) in 1948.

The interest in the chromosomes of Taxus reached a peak in the 1930's, when Hawker (37) reported $n = 8$ for T. baccata. Dark (21) reported $n = 12$, which was confirmed by Sax and Sax (78) with some slight variations. Matsuura and Suto (57) found $n = 12$, but also reported a monoecious plant of T. cuspidata with 13 chromosomes, and believed that there were sex-linked differences in the chromosomes of male and female plants. This general disagreement on chromosome number and morphology led the author to study them for their possible taxonomic value.

According to Wilson (89), the range of Taxus baccata includes most of Europe from southern Norway and Finland, south to the high mountains of North Africa, and also the Canary and British Isles. T. wallichiana is found on the mountains of northern India, in the East Indies and the Philippines. T. chinensis from China and T. cuspidata from Korea and Japan complete the Asiatic species. T. brevifolia is found along the Pacific coast of North America from northern California to British Columbia and inland in the mountains to Idaho. T. globosa is found at higher elevations on limestone mountains in Mexico. The bluffs, coves and ravines along a short section of the Apalachicola River

in Florida is the habitat of T. floridana. T. canadensis is native to the northeastern United States and eastern Canada, being found in relict plant communities as far south as Iowa, Kentucky and Virginia.

Throughout their range the Yews are consistent in being understory trees or shrubs along the borders of coniferous and deciduous or broadleaf forests on limestone or chalk, or soils high in calcium.

Methods of Study

A study of the plants in the Living Herbarium of *Taxus* in Secret Arboretum by the author (46) in 1947 had revealed that the answers to many of the taxonomic problems mentioned on page 2 could be found only by locating the original or type plants in arboretums or nurseries, and by studying herbarium specimens used by taxonomists such as Rehder (64).

In August of 1952, the author visited the Arnold Arboretum, and photographed the *Taxus* plants on 35 mm. Kodachrome. The card record in the office was copied on microfilm. One day was spent on the Hunnewell estate, Wellesley, Massachusetts, in the company of Mr. Walter Hunnewell and his gardener, Mr. John Ellis, examining and photographing the old specimen plants and the nursery plots planted before 1920 by Mr. T. D. Hatfield. The record kept by Mr. H. H. Hunnewell (44) was copied. The Arboretums at Highland Park

and Durand Eastman Park in Rochester, New York, were visited and the records of the Rochester Park system were abstracted.

From the records of this trip and the previous histories of the plants in the Secret Arboretum, a second trip was planned for 1954. Correspondence with nurserymen, gardeners, horticulturists and the directors of cemeteries and arboretums increased the number of large old specimens to be studied, especially in Virginia, Maryland and Pennsylvania. Through correspondence with Mr. William H. Hatfield of Silver Springs, Maryland, arrangements were made for copying the records, correspondence and unpublished speeches and notes of his late father, Mr. T. D. Hatfield, which he had made while head gardener on the Hunnewell estate mentioned above.

In August 1954, the author motored from Columbus, Ohio, to southern Virginia, then northward along the Atlantic seaboard, studying, photographing and collecting herbarium specimens from all the large and unusual Yews located. Old plantations and cemeteries were the best sources in the South. Farther north, arboretums, parks, nurseries, and large private estates were of increasing importance. Time did not suffice to trace all the additional Yews mentioned by persons visited in the various localities. Many of the Yews are directly connected with historical persons or events. Outstanding specimens are mentioned under the

descriptions of the individual species and clons.

The value of preserved herbarium specimens was impressed upon the author by the specimens at Arnold Arboretum. Rehder (66) records a "T. cuspidata nana" on the Hall estate, in September 1919, as being "26 feet tall and 130 feet around," but his herbarium specimen and identical record on the sheet of that date is not identical with any of his other T. cuspidata nana specimens, but appears to be T. cuspidata. Consequently, specimens were collected, dried, preserved with mercuric chloride and mounted for each plant photographed and studied on this trip. The descriptions in this study are based on the photographs, notes, herbarium specimens and information in the literature on each species, cultivar and clon.

The nomenclature of Standardized Plant Names (48), which follows the International Code for Botanical Nomenclature, has been followed in preparing the names for this study. These rules are in accord with the International Code of Nomenclature for Cultivated Plants (82) adopted in 1952 at London. Since all of the corrections and changes proposed are at the species, clon, or cultivar level, these rules apply equally well for this study. However, in order to make this work comparable to that of Rehder (71), Bailey (4), Den Ouden (23) and other recognized authorities, a latin trinomial is retained for the clons along with the citation of the authority first describing the clon.

The methods used in the cytogenetic study are discussed under that heading.

Morphology

The evergreen plants of the genus Taxus are small trees, 20 to 40 feet, rarely to 80 feet in T. brevifolia in the Pacific Coast, or shrubs of relatively slow growth. The branching habit of the excurrent tree is such that unpruned trees frequently have a square outline when young, becoming more rectangular or conical with age, Figure 36. The spread of the plant usually exceeds the height on plants grown as specimens.

The bark is reddish or purplish to dark chestnut brown, scaly or exfoliating from the trunk and larger branches in thin flakes or long strips or rhytidomes. The bark is usually less than one-eighth inch thick, with the inner bark about one-sixteenth inch thick, according to Chang (16), who stresses the regularity of the alternate layers of secondary phloem tissue. Along a radial axis the cells of the secondary phloem occur in this order: fiber, sieve cell, parenchyma, sieve cell, and fiber again. Thus a tangential layer of sieve cells is between a tangential layer of phloem fibers on one side and parenchyma on the other. The presence of numerous small crystals in cell walls of the phloem fiber of T. brevifolia agrees with the findings of earlier workers who studied T. baccata, according to Chang (18).

The wood is hard, dense, flexible, elastic and fine-grained without resin ducts or parenchyma, according to Eames and McDaniels (27). The average dry weight is 39 pounds per cubic foot, while the color ranges from dark reddish brown to white. Coltman-Rogers (19) notes the durability of the wood in contact with soil and moisture.

The leaves are simple, flat, linear, often falcate, with distinct but short petioles attached to the branches by decurrent bases; arranged spirally, opposite on small seedlings, but often pectinate and appearing two-ranked. The margins entire and in T. canadensis slightly revolute. The species have two more or less broad stomate bands on the under side of the leaf, which are yellowish to gray-green but lighter than the margins and mid-rib. The stomate bands may not be very distinct on the exposed leaves of some clons. The single, unbranched midrib or vein is more or less prominent on the upper or lower surface of the leaf; it is without resin ducts. The color of the leaves is dark, glossy green in the species, but many clons are recognized by the glaucous or varying amounts of yellow or white coloring. The leaves may be thin and leathery to thick, succulent and almost fleshy.

The branchlets are slender, yellowish or dark olive green to bright reddish orange, usually green in the shade. The change in bark color on the two-year twig is of taxonomic use. The bark texture of the twig may be thin and

smooth, or thick, wrinkled and leathery on some clons. The branchlets are arranged irregularly alternate but sometimes constant within a clon producing a definite, recognizable branching habit and determinate or indeterminate form of growth which is especially susceptible to alteration by shearing.

The winter buds, Figure 3, are ovate, axillary or terminal with imbricate scales which are useful in taxonomy. The bud scales are persistent, except in T. chinensis, obtuse and thin, Figure 3A or acute, thickened and ridged or keeled, Figure 5B, 3C and 3D. The color is the same as that of the branchlet, or yellowish green.



Figure 3. Winter buds of *Taxus*. (A) T. baccata (B) T. cuspidata (C) T. canadensis (D) T. media.

A B C D

The flowers, Figure 4, are small, solitary, axillary, usually dioecious (monoecious in T. canadensis) and open in March or April. The female flower, Figure 4B, resembles an axillary vegetative bud, but is usually decurved or pendant, and is easily recognized on close inspection by the

micropyle opening in the exposed ovule. In order to retain the Taxads under Coniferales, Rehder (71) and others regard the ovule as being in the axil of the uppermost imbricate scale. Campbell (12), Fritsch and Salisbury (30), Worsdell (93) and others consider the ovule as terminal on the shoot with no strobilus or carpellary leaf present. If the latter is true, the Taxads should be removed from the Coniferales, or true cone-bearing plants.

The male flower or pollen cone, Figure 4A, has several sterile scales at the base with a stalked globose head of six to fourteen stamens, each with five to nine microsporangia or pollen sacs which are always on the lower surface as in the ferns and cycads, according to Campbell (12). However, being terminal and coherent, they are more comparable to the anther of angiosperms. The pollen is distributed by the wind.

Pollenation is effected by the anemophilous pollen grains adhering to the small "pollenation droplet" which fills and protrudes from the micropyle of the ovule, according to Dupler (25). Under moist humid conditions the droplet may fall, forming a long thin "thread" which is quite noticeable in the early morning. Upon contracting, the droplet carries the adhering pollen grains through the micropyle to the outer surface of the nucellus. Upon germination, the pollen tube or male gametophyte grows through the tissue of the nucellus to the egg cell in the



Figure 4A. Male flowers or pollen cones of the Yew at anthesis. X 2.



Figure 4B. Female flowers of the Yew. X 2.

archegonium of the female gametophyte where fertilization occurs from thirty to sixty days after pollination, according to Sterling (84) and Dupler (25).

The solitary seed of the Yew, which matures in late summer to fall of the same season, is sometimes called a "single seeded berry" or "berry-like fruit," Figure 5. The discoid to campanulate, fleshy, mucilaginous, scarlet outer seed coat, or arillus, with an open apex, is specific to the genus Taxus. However, in addition to all Taxads, arils are found in several genera of the angiosperms including Euonymus, Celastrus, Magnolia and others. The shape of the aril is affected by growing conditions, maturity and amount of seed set. The hard, ovoid, nut-like seed is about one-fourth inch in its greatest dimension, the apex is slightly 2-4 angled, the hilum is ovate, triangular or squarish and more or less depressed. The straight embryo, which has two cotyledons, is embedded in a uniform albumen of haploid endosperm and perisperm. However, the bulk of the stored food within the seed is in the enlarged female gametophyte, according to Rehder (70). The seed, which is distributed by birds, does not germinate until the second season. Germination is further discussed under "Propagation."

Deviations from the dioecious habit of the Yews have been observed by Dovaston (1), Matsuura and Suto (57), Elwes and Henry (28), Keen and Chadwick (47) and others. Usually a single branch or twig on a male tree will be observed

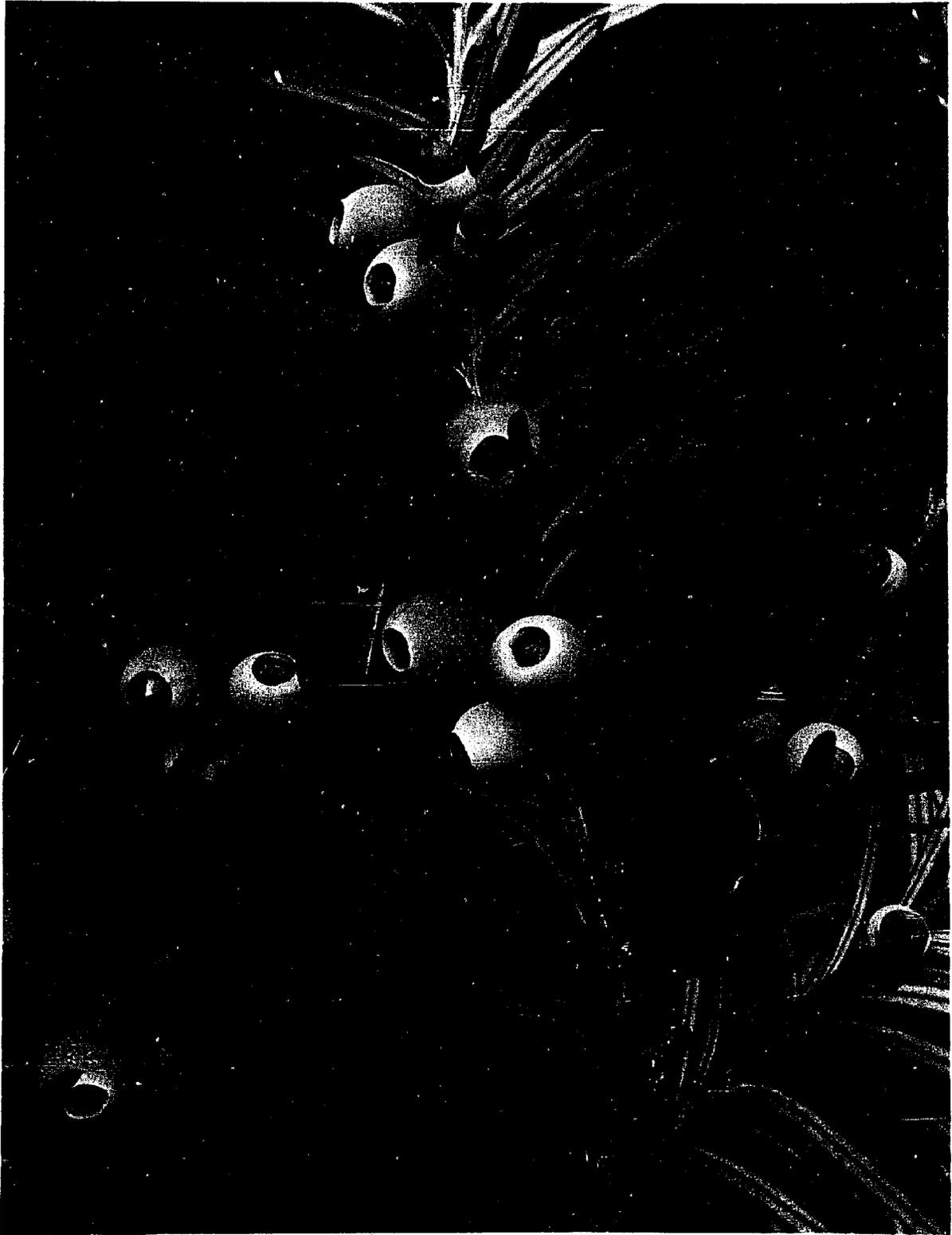


Figure 5. Seed of the Yew with fleshy cuplike aril exceeding the nutlet when fully ripe. The seeds of clon HICKS ANGLOJAP YEW do not ripen evenly when abundant. X 2.

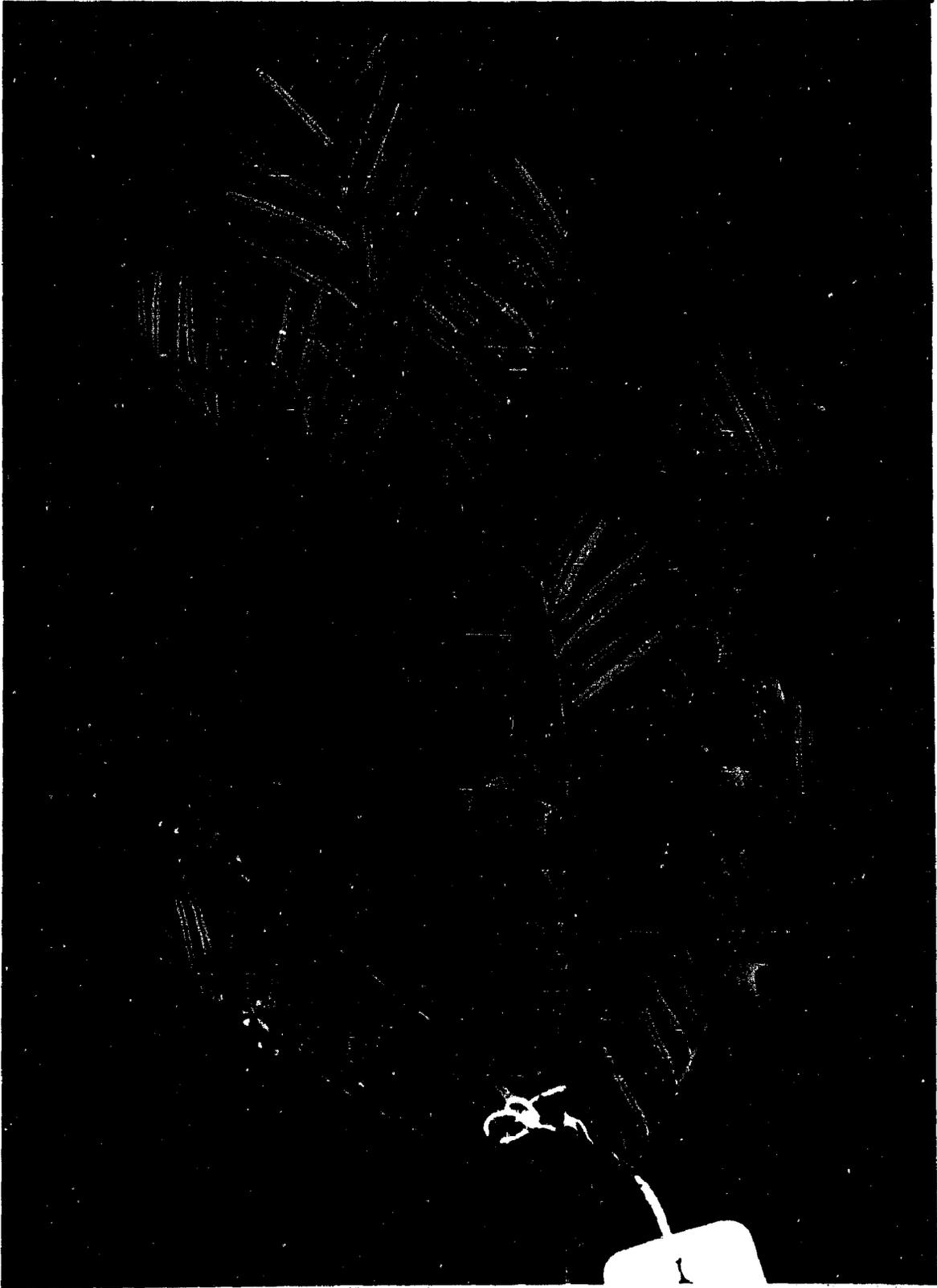


Figure 6. Apical twig of BROWN ANGLOJAP YEW bearing seed and female flowers on the right sector and male flowers on the left sector.

bearing seed. These and the sectorial chimaera appearance of the twig in Figure 6 would tend to support the hypothesis of Matsuura and Suto that such sports are true mutations of a sex-linked nature. However, Hatfield (35) and Chadwick (47) record observing entire young plants that changed from one sex to the other, which would support Schaffner's (79) view that sexuality in plants is physiological or ecological and not subject entirely to Mendelian laws. The fact that almost all plants of T. canadensis are monoecious, with each twig bearing flowers of both sexes, lends support to the former idea.

Chromosome Number in Taxus

A study of the chromosomes of the genus Taxus was initiated in order to determine whether the chromosomes would be of taxonomic value in recognizing the species and hybrids of Yew which are offered by the nursery trade in America. The relatively minor and obscure morphological differences between the species, hybrids and clones, especially among young plants growing in the nursery, encourages the search for more positive ways of recognizing and identifying these plants. Of even greater value would be the positive identification of the stock plants from which the nursery plants are propagated. The lack of agreement in the literature on the number of chromosomes in Taxus enhanced the possibility that a study of the chromosomes would be as

rewarding as it had been for Emsweller and Stewart (29) in Lilium, and for Camp (11) in Vaccinium.

According to Hawker (37), who probably worked with Taxus baccata, "By examination of whole living cells, the haploid number of chromosomes is seen to be eight and the diploid sixteen, as already shown by Strasburger." Excellent drawings support her findings. Dupler (25), working with T. canadensis, failed to state the number of chromosomes in this species, but a haploid count of eight can be made from his camera lucida drawings.

Dark (21), working with T. baccata and clons T. b. fastigiata and T. b. adpressa aurea, found twelve bivalents in each in the pollen mother cells (PMC) at meiosis. This material was collected in November. He found twenty-four chromosomes in root tip material of T. baccata and T. cuspidata and the clon T. c. contorta. He found twelve bivalents plus a fragment in "T. canadensis Willd. var. aurea," but could not determine the nature of the fragment in the PMC material available. Dark confined his efforts to study somatic chromosomes to root-tip sections and concluded, "Root-tip divisions... could be interpreted only in a few very favourable cases, owing to the long thin chromosomes being crowded at metaphase upon a very narrow equatorial plate."

Sax and Sax (78) confirmed the unsuitability of root-tip material for somatic chromosome study. They discovered

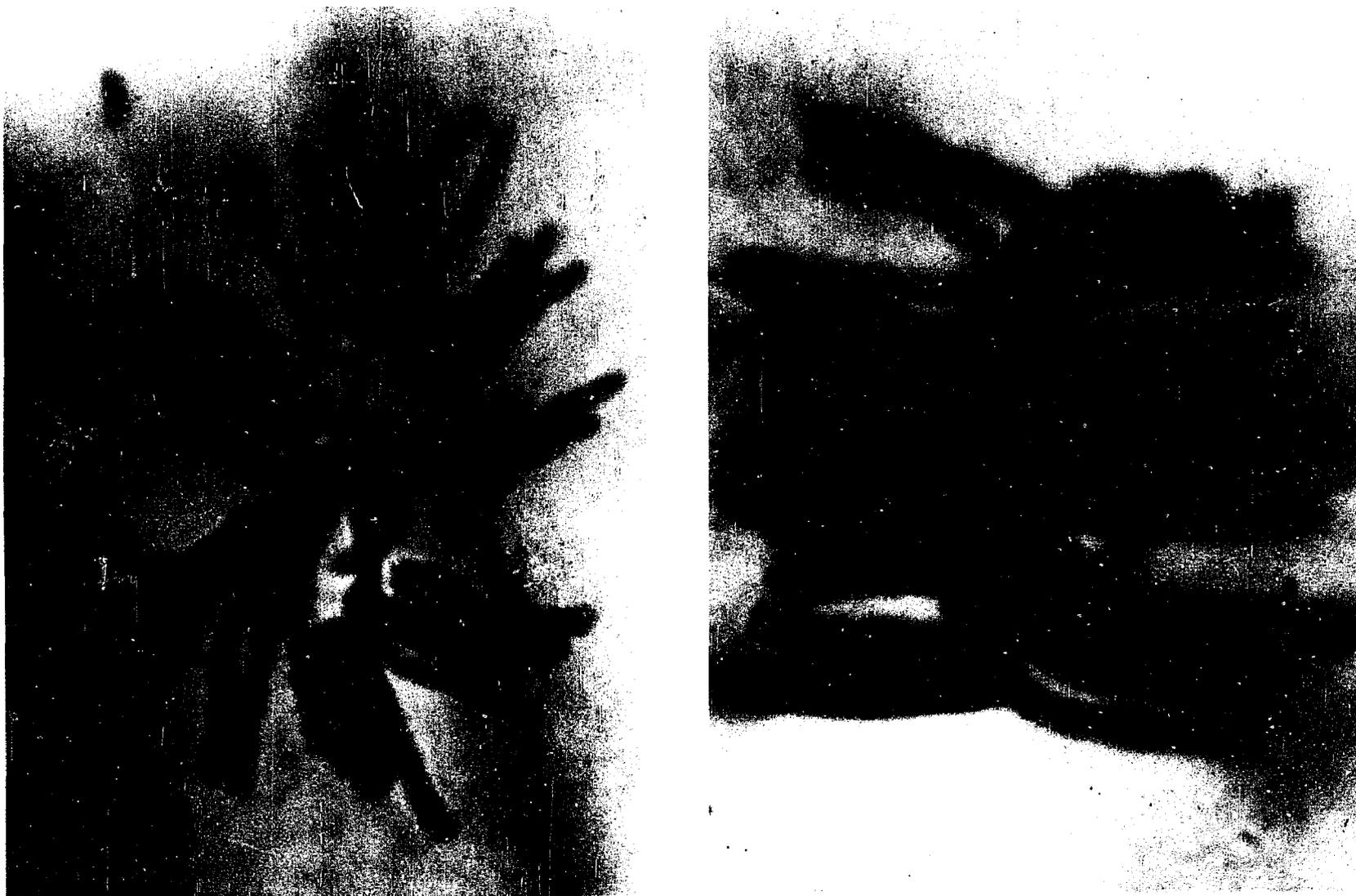


Figure 7. Diploid somatic chromosomes of the clon INTERMEDIATE JAPANESE YEW, left polar, right equatorial view. Better than average material, these were prepared from nucellar smears.

"endosperm tissue" in the early stages of development to be best for studying somatic chromosomes. According to the senior author, "The chromosomes in this tissue are haploid in number, divisions are numerous, and the chromosomes can be studied in either polar or side views when flattened in acetocarmine smears." He did not state the time of year nor the stage of development when this material was collected. The junior author studied the meiotic figures in PMC. She reported reduction divisions in Taxus in October at the Arnold Arboretum. They confirmed Dark's (21) findings of twelve chromosomes for the haploid number of all species studied. The lack of individuality is stressed as follows: "In each case one chromosome has a terminal or sub terminal attachment point, one is distinctly hetrobrachial, while the others are more or less isobrachial."

Matsuura and Suto (57), in the most recent paper, took exception to all previous work and reported thirteen bivalents in meiosis of PMC of an intersexual (monoecious) plant of T. cuspidata and ten bivalents plus four (probably) chromosomes associated together in either a ring or a chain as a constant characteristic of male plants.

The present study was initiated by attempting to have branches collected from male plants at the Secret Arboretum in October 1951 and shipped to Kansas where they would be matured in a propagation greenhouse and material collected for study. This material was found to have matured to the

microspore stage when received in late October. Since the papers by Dark (21) and Sax and Sax (78) were not currently available, the branches were made into cuttings, treated with Hormodin 3, and rooted in Vermiculite. Root-tip sections, both longitudinal and cross sections, were made and stained with crystal violet. These sections confirm the findings of Sax and Sax (78) and Dark (21) that root-tip sections are not suitable for studying somatic chromosomes of Taxus. Using the smear technique of Baldwin (6), identical unsuitable material was easily prepared from the tips of growing twigs, very small young leaves and immature nucelli, Figure 7.

Due to unexpected phenological differences between Wooster and Columbus, Ohio, only a few plants yielded suitable material for study of pollen mother cells (PMC) at meiosis in October 1953. However, this material, Figure 8, together with the abundant somatic material collected in July 1954, Figure 10, was sufficient to confirm the work of Sax and Sax (78) that, in spite of the aberrant numbers and figures reported in the literature, the haploid chromosome number is twelve, with insignificant differences in the number of chiasmata between the chromosomes of the different species.

"Taxus canadensis Willd. var. aurea" has not been available to study the fragment reported by Dark (21). A number of "intersexual" or monoecious plants have been located, as

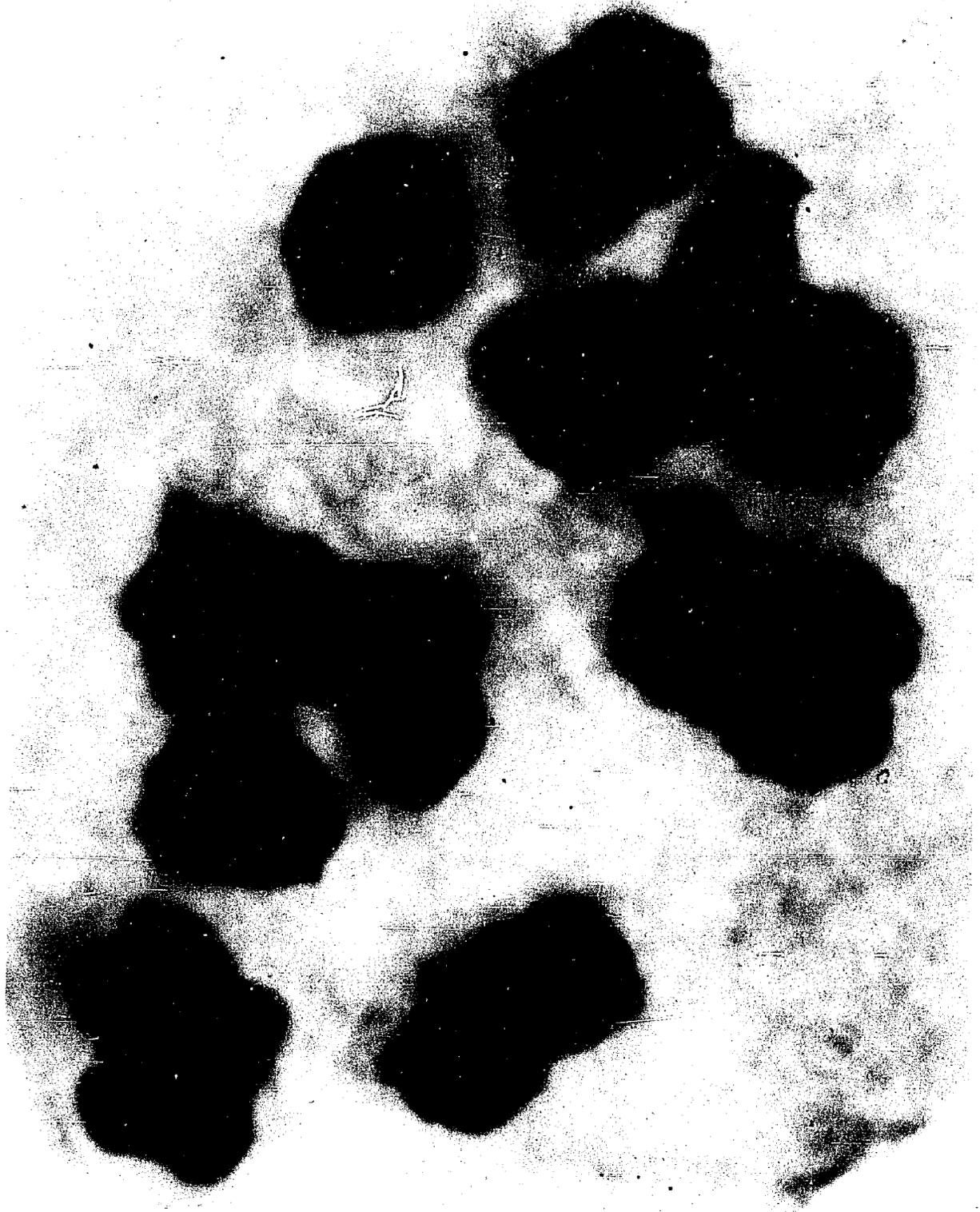


Figure 8. Chromosomes at metaphase I in meiosis of microspore mother cell. From an intersexual plant of the DWARF JAPANESE YEW.

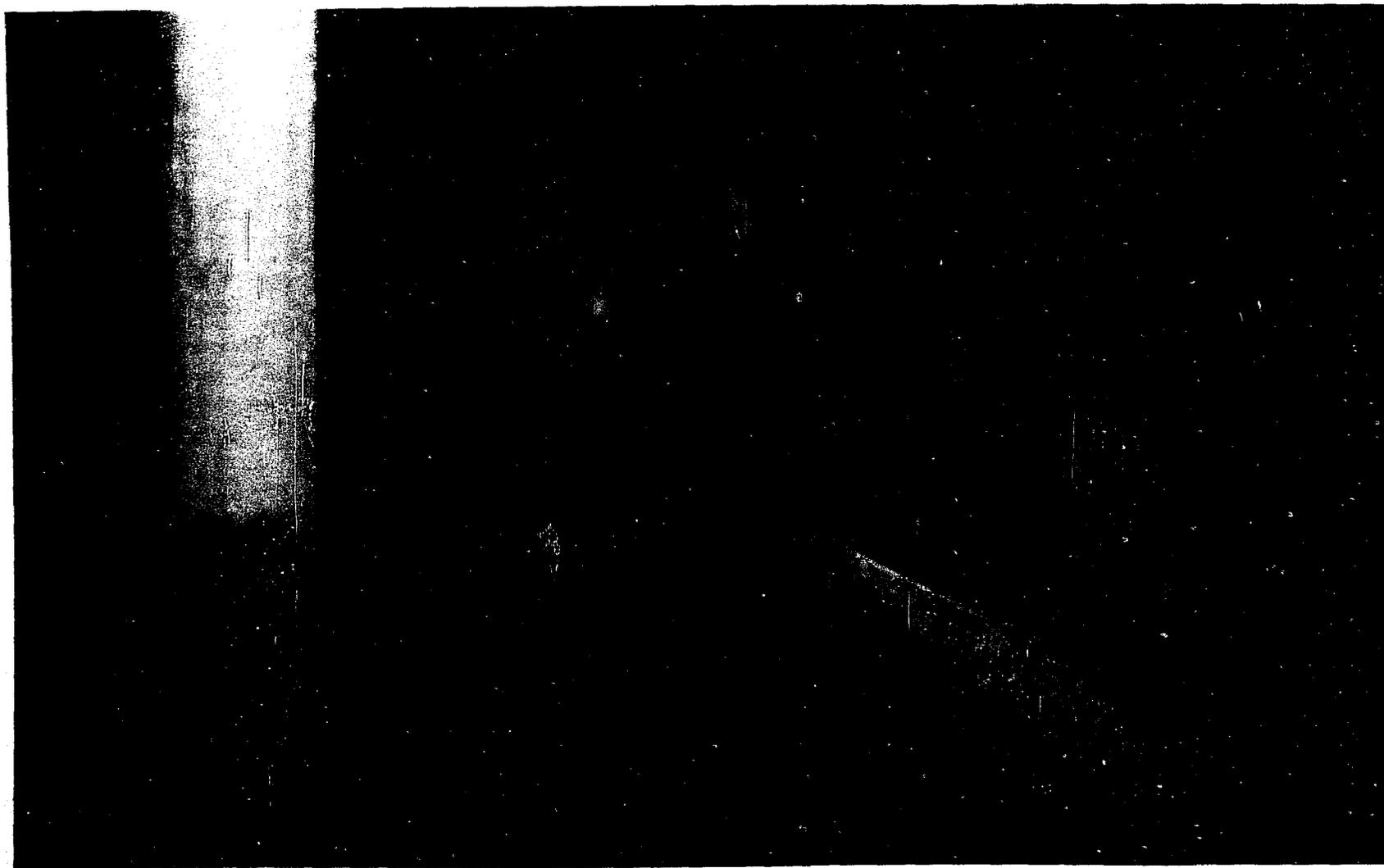


Figure 9. Young taxus seeds at the proper stage for collecting female gametophytes for haploid chromosome studies. The seeds reach "two-thirds match head size" in early July at Wooster, Ohio. A female gametophyte from the split seed is shown on the needle point. X 6.

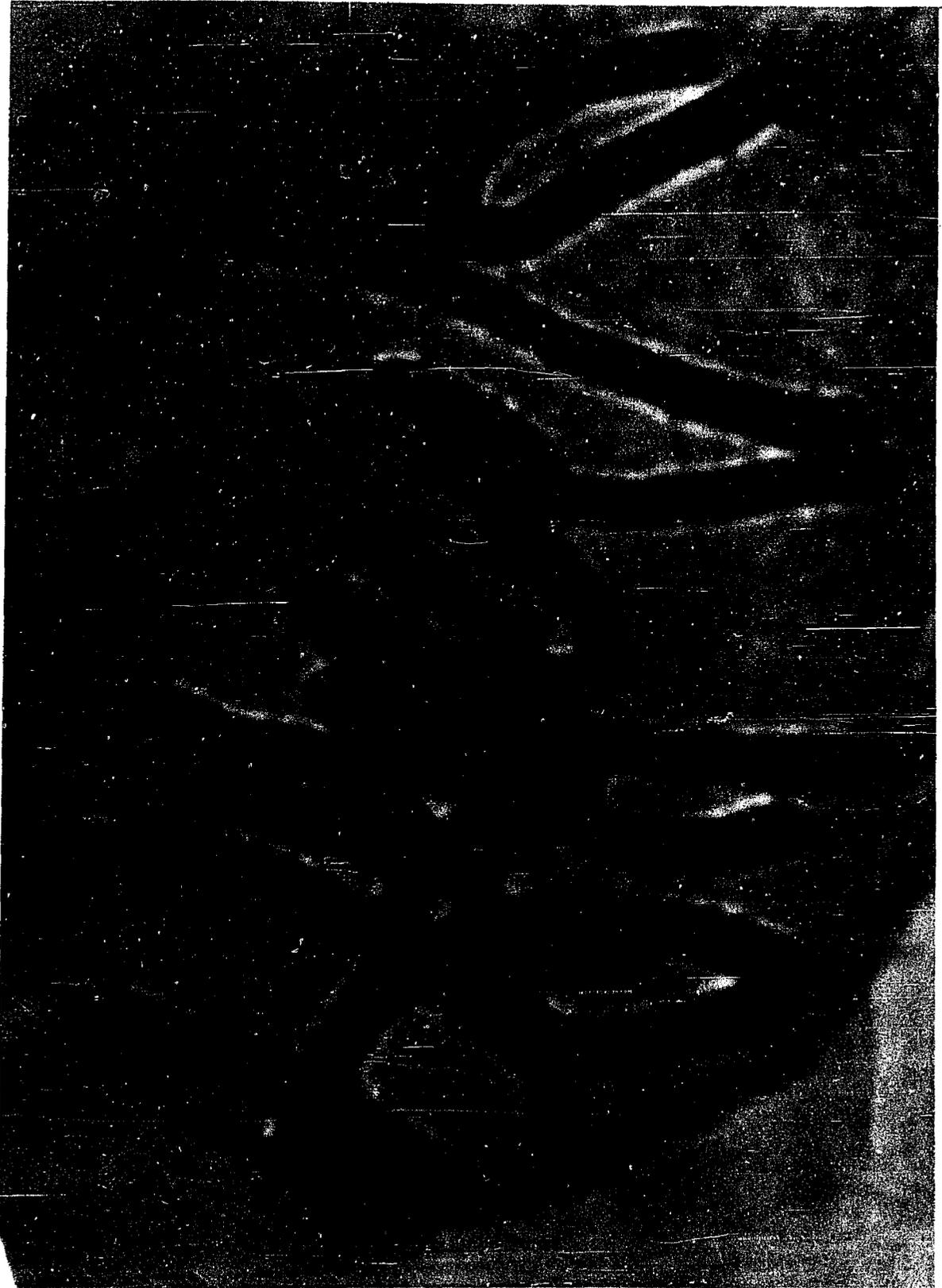


Figure 10. The twelve haploid somatic chromosomes from the female gametophyte of the clon SHORTLEAF ENGLISH YEW.

reported by Keen and Chadwick (47), and the chromosomes are receiving further study in order to confirm or explain the observations reported by Matsuura and Suto (57).

Discussion

The differences between the Yews are so slight that early taxonomists included them in a single species. Later workers separated them on the basis of geographical range and small, almost imperceptible differences which would not be accepted in other genera, except the conifers, in which this practice is common. Genetically they are even more alike than many other genera of similar range, for they hybridize freely with no apparent sterility.

Sax and Sax (78) regarded the existing conifers, including Taxus, as the survivors of a very old group of plants, and attribute the genetic stability to having passed the climax of evolution. While this post-climax explanation of genetic stability is untenable to the author's concept of genetic variability, the uniformity of the Yews cannot be denied. Fossil remains have been recognized as far back as the Jurassic, according to Elwes and Henry (28). The time required to acquire a circumglobal distribution in the northern hemisphere would not be inconsiderable. This is the more challenging when the present limited local range of the several species is considered. The Yews are indeed more

exacting in their growth requirements than the Ginkgo, but much less than the Sequoias and Metasequoia, all of which have very restricted natural ranges compared to the genus Taxus. When compared with the Pines, Firs and Spruces, which have comparable but greater distribution in the northern hemisphere, the stability and uniformity of the Yews is even more surprising.

This uniformity can be interpreted in terms of recent widespread distribution almost as well as by genetic stability due to post climax in evolution, especially when the variation observed in cultivated plants is considered. The variation of cultivated plants is not dependent upon hybridization of geographic species, e. g., the many clons of T. baccata. These variations can be discounted only by denying that they are of sufficient order to result in evolution, or by declaring these differences to be "lethal mutations" which would be lost if the plants were not preserved by cultivation.

While the importance of these variations is a moot question from the standpoint of evolution, their importance to horticulture is of the highest rank. The dwarf, variegated and fastigate forms, which are readily observed and recognized, have considerable commercial value; the generally invisible characteristics of winter hardiness and tolerance of adverse soil or moisture conditions are often of even more importance. Bailey (4), Loudon (54) and Kumlien

(50) point out that any large bed of seedlings will yield dwarf, erect, compact and other types, some of which recur rather frequently, that need only to be propagated asexually to become clons. Many nurserymen make a regular practice of planting such unusual specimens around their home or office grounds for further observation.

Of great concern to the propagator as well as to the taxonomist is the habit of growth of clons and cuttings used in the vegetative propagation of Yews, because these branches continue in the same habit of growth as if they were still attached to the parent plant, Figure 11. The Yews are not unique in this characteristic, since Coffee (59), Araucaria (63), Spruce (7) and some other genera exhibit the same characteristic. However, this has not always been recognized, because the early English gardeners complained of the "one sided" growth of vegetatively propagated GOLDEN ENGLISH YEW and therefore recommended growing this variety from seed. The French had solved the problem, because Baltet (7) recommends "the young shoots which spring from the amputated head of the parent tree in the uppermost whorl of branches" as the best clons because these orthotropic shoots developed into excurrent trees instead of one-sided shrubs.

The problem has commercial aspects which cannot be ignored, because it is most important, in executing a landscape planting, that the plant supplied be not only "true to



Figure 11. Four-year-old unpruned T. cuspidata plant from a lateral or plagiotropic cutting. The new growth shows frost damage.

name" but also of the desired habit of growth. An example of the nurseryman's solution to the problem involved is that of labeling the excurrent plants of the Japanese Yew, whether from seed or orthotropic cuttings, Taxus cuspidata capitata, meaning "having a head," while the name Taxus cuspidata is reserved for the spreading plants propagated from lateral or plagiotropic branches. The latter apparently acquired a "commercial priority" to the name Taxus cuspidata because the early plants were so propagated. Van Melle (88) advocated discarding the latin appellation "capitata" in favor of the terms "upright" and "spreading" for the excurrent and shrubby plants respectively. This has not had wide acceptance, but "Hatfield spreaders" and "Adams spreaders" are offered in the nursery trade. Rehder (71) regarded the excurrent tree as the true or "type" plant of the Japanese Yew, T. cuspidata, and proposed the epithet expansa for the spreading plants. He even published a latin description of this supposed "form" (95), but did not reveal the "trick of the trade" for producing it.

Taxonomically and genetically there is no problem involved, because, barring mutations, the several parts of a plant are yet the same plant, whether growing independently of the original plant as a clon or not. If the earlier taxonomists and writers had recognized this characteristic of the Yews, some of the present confusion of names and descriptions, based on habit of growth, would have been

avoided.

It is in this field of describing and distinguishing between clons that the horticulturist is more concerned than the taxonomist, since Rehder (73) considers them "...not part of botanical nomenclature." The planting of type plants in arboretums is highly important because of the ease with which they become lost or mixed in commercial plantations. This was well illustrated when the firm which introduced a clon donated five plants to the Secret Arboretum. Two plants were of the clon intended, two were a similar clon, HATFIELD ANGLOJAP YEW, while the fifth was BROWN ANGLOJAP YEW, an entirely different clon. As small plants in the nursery row, these differences were slight. Left unpruned a few years, the differences were quite apparent.

Since the differences between species are as much geographical as morphological, the terms used in describing the clons are relative. Broad leaves, or short, are broad or short in relation to other Yew leaves. While the author would prefer to give precise dimensions for comparison of clons, it was found to be impractical except where there are a great number of clons growing together under similar conditions. Even under such circumstances the linear dimensions of the plant parts will vary with the kind of season and even more with the age of the plant. The latter factor has been especially apparent in some of the plants under observation in the Secret Arboretum, which were rather dwarf

and slow-growing for five or more years. Then, when well established, they made more growth each year than in the entire five seasons of slow growth. The linear dimensions, the amount of seed set and even the habit of growth, were so changed that the donor was often unable to recognize the plants.

It can be readily seen that there is a sound basis for the discrepancy between a nurseryman's description and concept or opinion of a clon, and its performance in the garden. Due to the lag in growth, inferior clons, from the gardener's standpoint, may be grown and sold for years before their bad reputation decreases their demand. The same difficulty may be expressed in the habit of growth encouraged by the nurseryman versus that desired by the gardener. This is best expressed in the multileader fastigiate forms, which are so subject to ice and snow damage unless grown with a single leader.

Descriptions based on nursery-grown plants are thus subject to two primary sources of error: first, the clon described and offered for sale may not be true to name; second, the described form may be the result of training in the nursery row rather than the true habit of that clon. Another source of error in naming plants is the general lack of knowledge of the rules for naming plants and of the level of the taxon to be named. In this study there was no error found at the generic level. Errors were common at the

specific level, especially between the species media and cuspidata, though many growers ignored the species, using only the genus and cultivar names, e. g., "Taxus browni."

The clonal concept is foreign to some nurserymen, who select groups of plants toward an ideal with little regard for names or descriptions. This has been well illustrated by the many selections of "intermedia" which have been offered as "improvements" on the original clon. If these selections were from bud mutations or sports of the clon, the use of the name intermedia would be obligatory. However, most of the new plants are of seedling origin, and of hybrid parentage, which would necessitate their being included in the species, T. media. An extreme example of this is the designating of a group of similar seedlings selected from a bed of mixed plants as a "named variety," as practiced by some nurserymen. It has been charged that Mr. Hatfield was guilty of selecting such seedlings for his clons, but an examination of his records (36), correspondence and Rehder's description (67) will show that the mixture has occurred since his death.

The avoidance of such error could be easily achieved by following the recommendation of the International Code of Nomenclature for Cultivated Plants that a Register of Yew Names of national or international scope be established. This agency would act as a clearing house for all new names, and would be responsible for the proper registration,

description and naming of plants. The preservation of plant materials, herbarium specimens and records would be involved. It would not be difficult to make the Secrest Arboretum the basis for such a Register. It has the advantages of a large collection of plants, and the interest and support of industry. The chief disadvantage is the rigor of the climate which precludes the growing of the more tender of the European clons. Other possible agencies for an international Yew Register would be the Arnold Arboretum and the Kew Botanic Gardens. Interest appears to be lacking at both of these places. A national or international Yew Society would be an important adjunct to such a Register, giving it both support and the recognition essential for success.

The young plants which have been added to the Secrest Arboretum since 1953 and unobserved clons in the trade have been reserved for a future study. These newly planted plants have not assumed characteristic growth for the most part. New clons are introduced by nurserymen each year making a continuing study and evaluation necessary.

Descriptions of Species and Clons

Taxus baccata L.

ENGLISH YEW

This species is a tree, Figure 12, to sixty feet high, with thick, short, branching trunk and reddish bark which scales from the trunk and larger branches in thin flakes or long strips; or a shrub under adverse conditions or when propagated from lateral or plagiotropic branches. Mature branchlets or twigs, slender, greenish, scattered alternate arrangement, often close together near the apex of the previous season's growth, forming a pseudo whorl.

Leaves linear, tapering or gradually acuminate, flat, about one inch long, dark lustrous green above, with two pale green stomate bands below; midrib prominent above; petiole short and greenish. The leaves are attached spirally by decurrent bases, but take a two-ranked position in a single plane, forming flat sprays except on the leaders of excurrent plants and in some clons as in IRISH ENGLISH YEW, which characteristically have the leaves arranged radially.

The winter buds are ovate, rather small, with persistent, blunt, thin scales, which have no prominent ridge or keel, Figure 3A.

The seed of the English Yew is broad ellipsoid, dark brown, about $\frac{1}{4}$ inch long, and usually two-angled at the apex. The aril, or cupped disc, which covers the seed, is open at the end and usually exceeds the length of the seed. The aril is scarlet or bright red beneath a waxy bloom which



Figure 12. Taxus baccata L. 38 feet high. 51 feet spread. 12 feet 6 inches in circumference one foot above the ground. Among the finest English Yews in America is this specimen in the gardens of White Marsh Plantation, White Marsh, Virginia.

imparts a crimson appearance, except in the clon YELLOW-BERRY ENGLISH YEW.

The English Yew is native to the British Isles, most of Europe, and the mountains of adjacent parts of Asia and Africa, according to Rehder (71). In America, the species is not hardy north of Kentucky and Delaware, except on Long Island and the north shore of Long Island Sound. It is represented in the Living Herbarium of *Taxus* by some of the hardier clons of which the clon SPREADING ENGLISH YEW appears the most hardy.

Loudon (53), Dallimore (20), and Coltman-Rogers (19) gave elaborate and detailed accounts of the literature, folklore and history of the English Yew, from Grecian to the present time.

Taxus baccata L. is the type species of the genus, and was used as a standard of comparison by early taxonomists, who, as stated above, considered the later species but geographical forms or subspecies of *T. baccata* L.

There are many clons and cultivars of the English Yew in Europe. Most of them are well-described, having been in cultivation much longer than the hardier Japanese and Media Yews. With few exceptions, the clons of English Yew have not been widely planted in America, because of their limited hardiness. Hoopes (42) lists fifteen clons in America in 1868. Others were imported later, with rather large introductions occurring during and after World War I by

nurserymen who served abroad. The clons in America are the only ones described here. The excellent works of Dallimore (20), Hornibrook (43), Gibbs (31), Den Ouden (23), and Krüssman (49) adequately cover the European clons which are not available in America for study.

Fine specimens of English Yew can be seen in Virginia at Williamsburg, where the "Martha Custis Yew," under which George Washington proposed, is a landmark; at White Marsh and Sweet Briar are some large trees over a century old. Several large trees were moved from nearby Delaware and Maryland to Longwood Gardens at Kennett Square, Pennsylvania, Figure 13, for the late Percy Du Pont. In the Bishop's Garden of the National Cathedral, Washington, D. C., and Aberdeen Proving Grounds are specimens worth visiting. The fine old tree and collection of golden clons at the Tyler Arboretum, Lima, Pennsylvania, are outstanding specimens. On Long Island are several large specimens including those at the Dosoris Cemetery, Glen Cove. Many on Long Island are on private estates and inaccessible to the public. A large single-trunked male tree in the cemetery behind Christ Church at Greenwich, Connecticut, Figure 37, is the northernmost tree of the species to come to the author's attention.



Figure 13. T. baccata L. Large old tree 24 feet high by 38 feet spread on the grounds of Longwood Gardens, Kennett Square, Pennsylvania. This tree was moved to the present site in the 1930's.

Clon BROOM ENGLISH YEW

Taxus baccata erecta Loudon

T. baccata pyramidalis Carriere

This old male clon is described as a seedling of the clon IRISH ENGLISH YEW by Loudon (53), who listed several synonyms for it in 1838. It was well known in the trade in America by 1868, according to Hoopes (42), who mentions extensive plantings at the Parsons Nursery, Flushing, Long Island.

Like its seed parent, the branches grow erect with fastigate branchlets and twigs forming small spires in the top of old plants, Figure 14. Young plants are narrow columnar becoming broad ovate, and finally hemispherical with age. The leaves are dark glossy green above, lighter with somewhat glaucous stomate bands below; less than three-fourths of an inch long, straight and arranged flat in a single plane; more narrow and finer textured than those of the species.

This clon is among the hardier of the English Yews but has shown some winter damage in severe winters in the Secrest Arboretum, Wooster, Ohio, where it is represented by group 10. Fine specimens of this clon are common. There are large ones at the Morris Arboretum, Philadelphia, Pennsylvania; and the one at the Dosoris Cemetery, Glencove, Long Island is 18 feet high by 22 feet spread. San Angelo Plantation, Sweet Briar, Virginia, has a giant specimen 22 feet tall with a spread of 44 feet; the multileader trunk



Figure 14. BROOM ENGLISH YEW 12 feet high by 18 feet spread. One of a pair at the south entrance to the Yew garden, Longwood Gardens, Kennett Square, Pennsylvania.

was estimated to be 4 feet in diameter at 6 inches above ground level.

Clon CHESHUNT ENGLISH YEW

Taxus baccata cheshuntensis Gordon

T. baccata cheshuntensis Gordon

This male clon was raised by Paul (62) at the Cheshunt Nurseries, in England, some years before 1861, from seed of the IRISH ENGLISH YEW.

The growth habit is erect, Figure 15, similar to BROOM ENGLISH YEW, but less compact than its parent IRISH ENGLISH YEW. Leaf color dark glossy green above, somewhat glaucous and lighter below, like its parent, but shorter and more abruptly pointed. Leaves pectinate, arranged in flat plane on lower branchlets and in the shade, becoming a broad "V" on the upper ascending branches, and radial on true orthotropic leaders. Winter buds globular.

This clon is not represented in the Secret Arboretum. In addition to the specimen in Figure 15, there is a fair plant in the shade of taller trees at Highland Park, Rochester, New York. According to Steffek (83), it is still offered in the trade. Winter hardiness of this clon is not known.

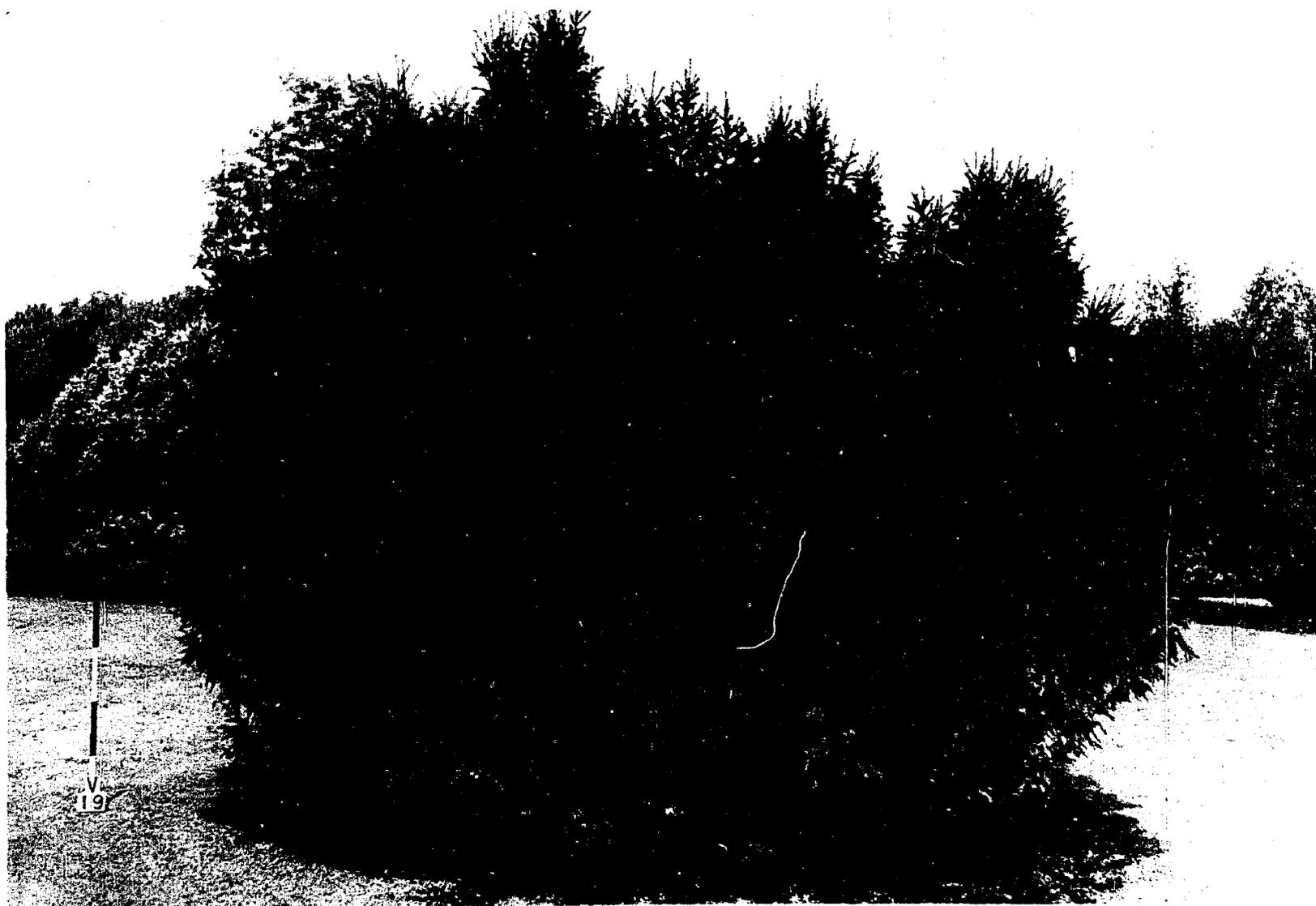


Figure 15. Specimen of CHESHUNT ENGLISH YEW 12 feet high by 15 feet spread in the Tyler Arboretum, Lima, Pennsylvania.

Clon COMPACT ENGLISH YEW Taxus baccata compacta Beissner

This clon originated in the Den Ouden Nursery, Holland, about 1910, according to Krüssmann (49), who states that Beissner's description is inaccurate because it was of a young plant about eighteen inches high. The plant is not dwarf, and like most Yews, grows more rapidly after it attains some size.

It is a dense, fastigate, compact, male clon of broad oval or conical form. The branchlets ascending or somewhat appressed, abundant on previous seasons' and older growth, two to three inches long.

The leaves are radially arranged on the branches and upper branchlets. The leaves are short, not over five-eighths of an inch, narrow and somewhat curved, dark glossy green above, lighter below with a narrow dark green midrib.

Not as winter hardy as the clon BROOM ENGLISH YEW, it has shown some winterburn on the south side almost every year. The specimens in group 21, Figure 16, in the Secret Aboretum were propagated from plants imported from Blauw Nurseries, Boskoop, Holland, about 1917.

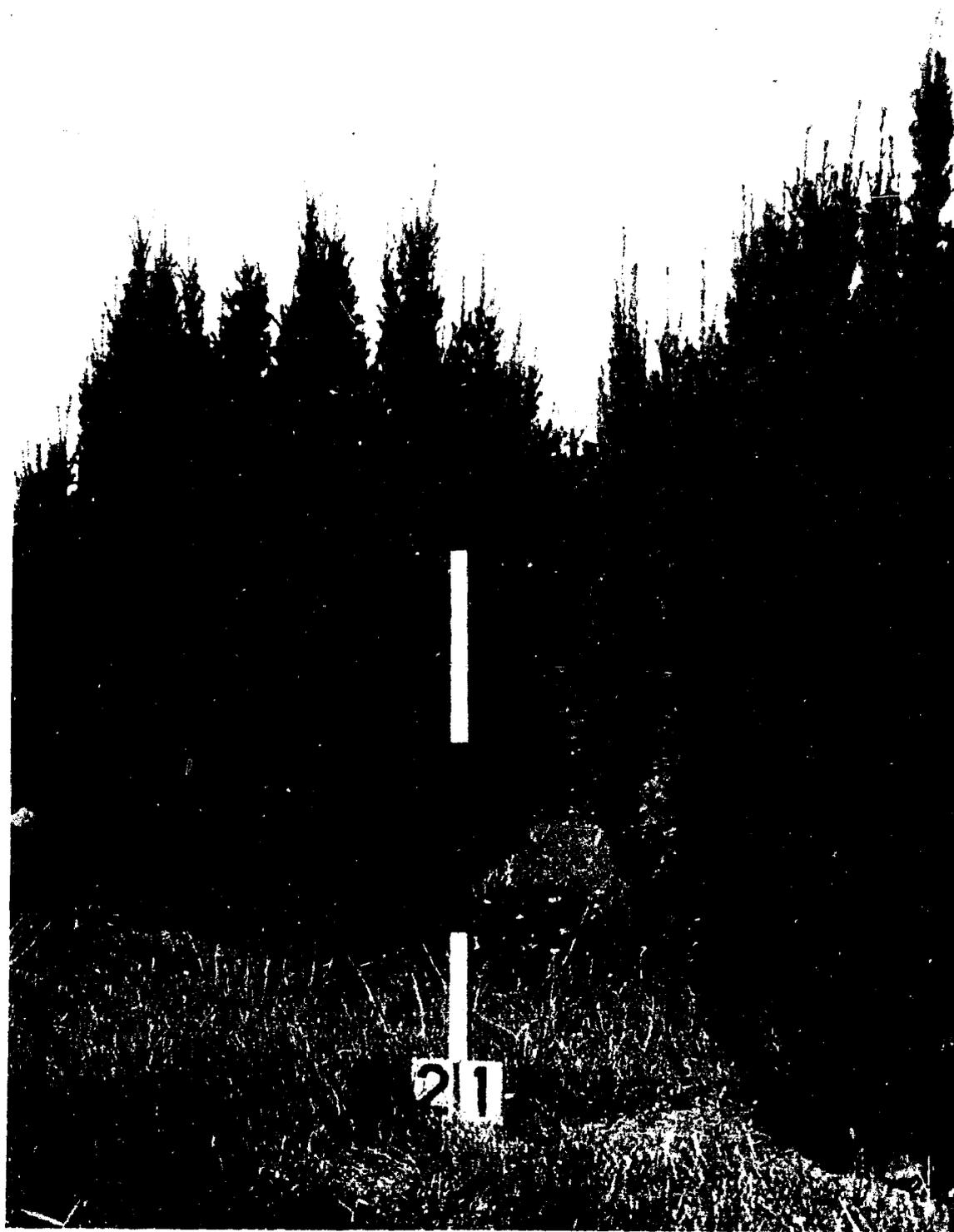


Figure 16. Clon COMPACT ENGLISH YEW in group 21 of the Secret Arboretum.

Cultivar DOVASTON ENGLISH YEW

Taxus baccata dovastoniana Leighton

T. baccata dovastonii Lawson

T. baccata dovastoni Loudon

T. imperialis Hort. ex Hoopes

T. baccata horizontalis Hort.

T. baccata pendula Hort.

Rehder (72) corrected the spelling of the name of this old clon, which was first described in 1838 by Loudon (53) as "Westfelton Yew." The original tree was planted about 1777 at Westfelton, England. It is monoecious, having one female branch. Elwes and Henry (28) discuss the results of attempting to grow seedlings from this tree. When self-pollinated, the seedlings come true to type; however, when pollinated by other trees, the seedlings are common English Yew.

The cultivar differs from the English Yew only in that the branchlets are pendulous from horizontal and terminally ascending branches in much the same habit of an old Norway Spruce, Figure 17. Krüssmann (49) considers this clon "one of the most decorative of all conifers."

It was once quite popular in the trade, and many large specimens can be found from Newport, Rhode Island, Figure 17, southward. The large specimen on Long Island, mentioned by Wilson (91), is now neglected and declining, but one in Dosoris Cemetery, Glencove, Long Island, is still in

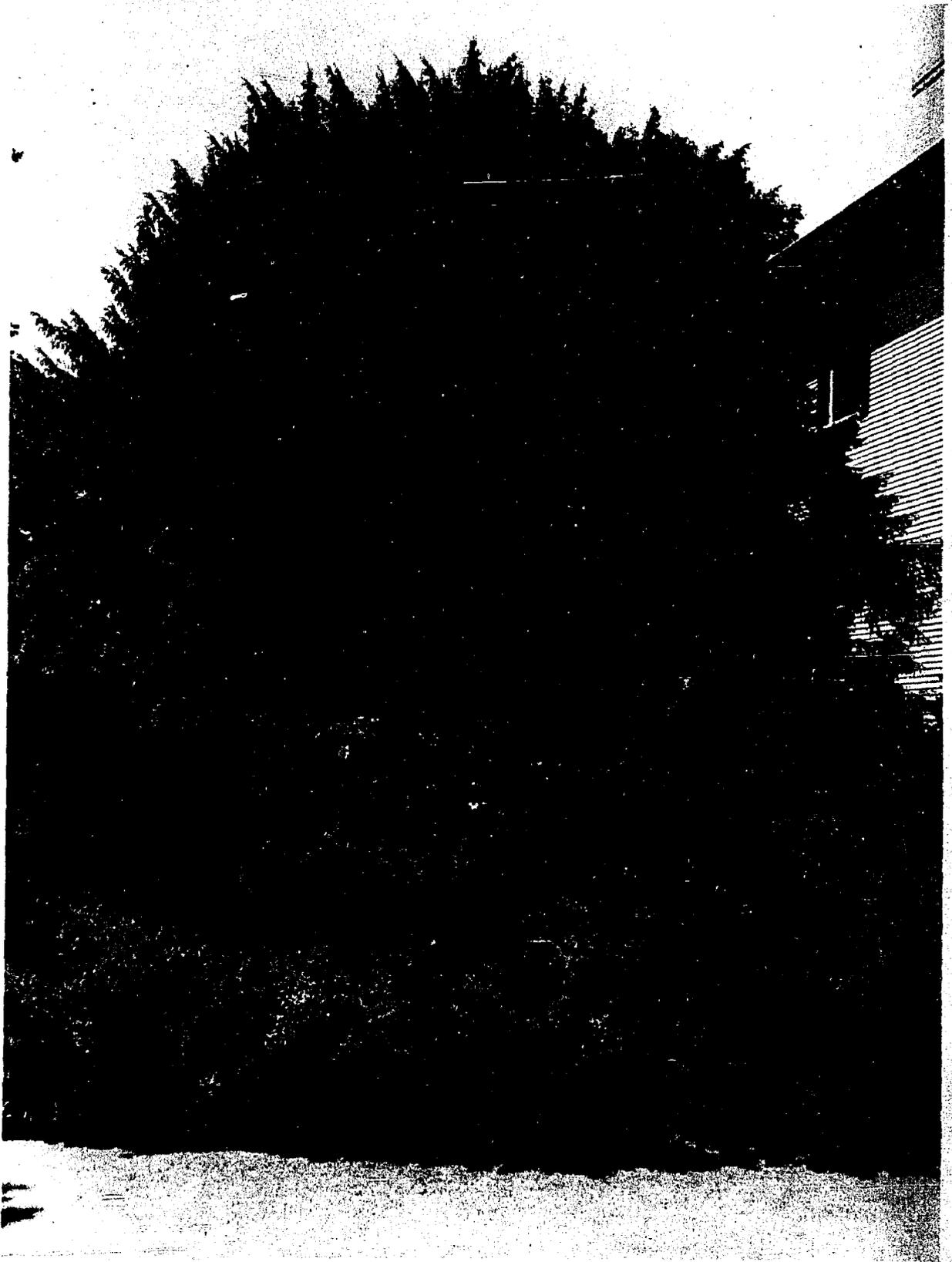


Figure 17. DOVASTON ENGLISH YEW in Newport, Rhode Island. This tree was planted in 1852, according to Dunn (24). The pendulous branchlets can best be seen against the white house.

excellent condition. The specimen in the Secrest Arboretum, group 20-C, is a small leaderless shrub, the last survivor of five. It is damaged most winters, and has not developed enough to show typical growth characteristics.

Clon GLAUCOUS ENGLISH YEW Taxus baccata glauca Carriere

T. baccata var. glauca Hoopes (42)

T. baccata pyramidalis glauca Hort.

T. baccata nigra Paul

T. baccata "Blue Jack" Hort. ex Gibbs

T. baccata "Blue John" Hort.

The plants in group 19, Figure 18, which represent this clon in the Secrest Arboretum are quite hardy at Wooster, Ohio. The parent plants were imported from England before 1914 to the Caulby estate, now the City Hall of Wicliffe, Ohio, and are still in good condition. Several importations of this clon were made from Scotland by Hicks Nurseries and planted on Long Island estates because of their reputed hardiness. Mr. Henry Hicks (38) believed it to be the *baccata* parent of the clon HICKS ANGLOJAP YEW.

This male clon is well described by Gordon (32) as "a very vigorous kind, with leaves dark green above, and bluish or glaucous gray on the under part, and with the bark on the young shoots of a rusty brown color." The habit of young plants is strongly ascending, almost fastigiata and easily trained columnar. With age they become more spreading and



Figure 18. The GLAUCOUS ENGLISH YEW in the Secrest Arboretum.

ovate. The terminal buds of the vigorous branchlets are exceptionally large as are the abundant pollen cones in April.

Cultivar GOLDEN ENGLISH YEW Taxus baccata aurea Carriere

T. baccata var. aurea Bailey

T. baccata var. elvastonensis Beissner

T. baccata aurescens Hort.

T. baccata elegantissima Hort. not Beissner

The Golden English Yews are not a clon, having been widely grown from seed to avoid the "one-sided" growth of vegetatively propagated plants. Therefore considerable latitude is allowed in growth habit and leaf characteristics as long as the undersides and margins of the leaves are bright golden yellow, Figure 33. This color is fugitive, fading to yellowish white by late autumn; the leaves are green the second season.

The popular type with American nurserymen is quite compact and erect while young, making dense pyramids or globes in the field, becoming broad conical or hemispherical, and less dense with age, Figure 19. The leaves are straight, arranged spirally or pectinate in a narrow "v" and somewhat appressed, showing the bright yellow undersides to good advantage. Both sexes are offered in this form. The presence of the seed is practically hidden by the thick foliage. The aril is long ovate or elliptical, exceeding



Figure 19. GOLDEN ENGLISH YEW in the Tyler Arboretum, Lima, Pennsylvania. This specimen is 14 feet high by 19 feet spread.

the seed by half.

This cultivar is more hardy than the species, but frequently shows some winter damage on the sunny side of the plants at Wooster, Ohio. It is represented in the Se-crest Arboretum by groups 1, 2, 13, 28, 38 and 55. These were furnished from commercial sources under the following names: T. baccata aurea, aurescens, washingtoni, linearis, aurea, and elegantissima, respectively, yet they are all alike and female, except two plants in group 2, which are male.

There are a considerable number of golden clons described in Europe which are wanting in America. However, seedlings from T. cuspidata and T. media, which had probably been pollinated by the GOLDEN ENGLISH YEW, were observed at the Hiti Nurseries at Pomfret, Connecticut, and Fairview Nurseries, Fairview, Pennsylvania, Figure 20, which contained a wide selection of varied golden forms. Some were tiny golden globes about 8 inches high. Others were more erect and loose, or less colored, and 24 to 30 inches high. They were six years from the seed bed when observed. These would be T. media clons if named.

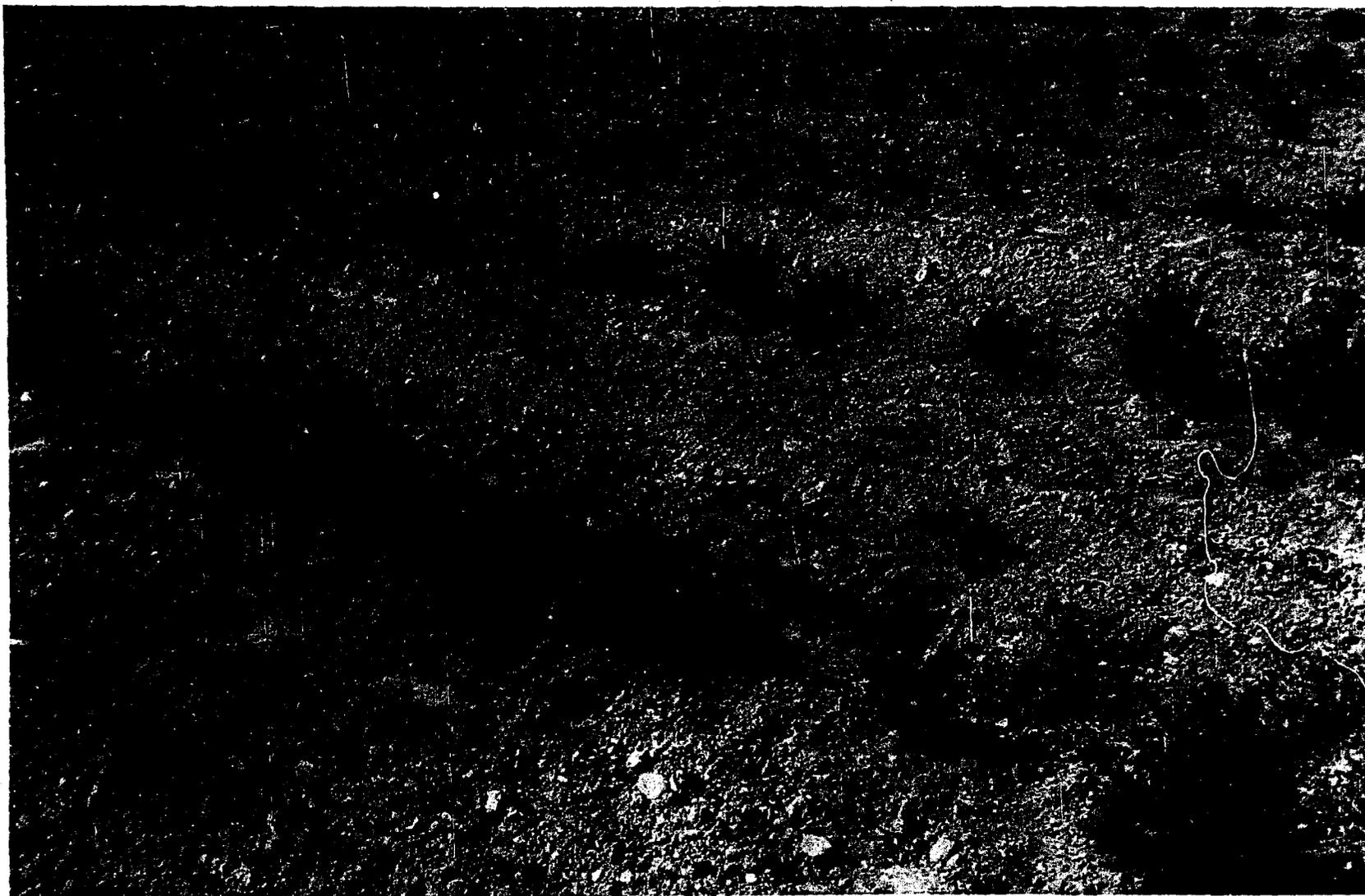


Figure 20. Variation in seedling yews, Fairview Nursery, Fairview, Pennsylvania, August 1954. Seed collected from a mixed planting.

Clon GRACEFUL ENGLISH YEW

Taxus baccata gracillis pendula Lauche

T. baccata pendula Kent

"Ramshorn Yew" Hort.

Rehder (71) (73) considered this clon synonymous with the clon WEEPING ENGLISH Yew (T. baccata pendula Jaeg.), but all European writers distinguish between the two clons, stating that the latter is less vigorous and more loose.

A striking plant when grown as an excurrent tree with a central leader, Figure 21. Without the leader, it forms a broad open shrub of little mass but interesting character, especially when planted at the top of a retaining wall, as it is at Dumbarton Oaks, Washington, D. C.

The branch pattern is much like that of the Pin Oak, drooping below, horizontal midway and ascending in the upper part of the tree. The branchlets and twigs are all pendulous, drooping below the branches, Figure 22, which also illustrates the unique growth of the branch terminal in a series of sinuous curves. The bark on the young twigs is thick and leathery.

The leaves are large, over one inch long, tapering, falcate or sickle shaped, midrib prominent above, arranged on the upper side of the twig. The color is a deep glossy green, the lighter stomate bands below somewhat glaucous, appearing almost esculent. A female clon with glaucous, scarlet, large arils. The nutlet is broad ovoid, above



Figure 21. Clon GRACEFUL ENGLISH YEW at Longwood Gardens, Kennett Square, Pennsylvania. In 1954 the larger tree measured 23 feet high by 39 feet spread.



Figure 22. Pendulous branchlets and sinuate terminal growth of the clon GRACEFUL ENGLISH YEW.

average size, mostly three-angled.

This clon is apparently quite tender, as no specimens were observed north of Tyler Arboretum, Lima, Pennsylvania. It is not represented in the Secrest Aboretum.

Clon HEATH ENGLISH YEW Taxus baccata ericoides Carriere

T. baccata var. ericoides Carriere

T. Mitchelli Hort.

T. Michelii Hort.

T. Mitschelli de Vos

T. b. microphylla Hort.

This dwarf clon originated in France before 1855, and like most old clons has too many synonyms to list here. The plant is erect, very slow growing, and heath-like in appearance, with many fastigate slender branchlets scattered on the previous season's and older growth, Figure 23.

The leaves are small, narrow, pointed and radially arranged on the twig. They are a dark, dull green, turning bronzy or purplish in winter, according to Dallimore (20), and quite uniform in length. The plant observed is male. Though generally described as small and less than thirty inches high, Hornibrook (43) states that the Kew specimen was 7 feet 6 inches high by 21 feet wide. It was over fifty years old when measured in 1926. This clon is not represented in the Living Herbarium of Taxus, and its hardiness

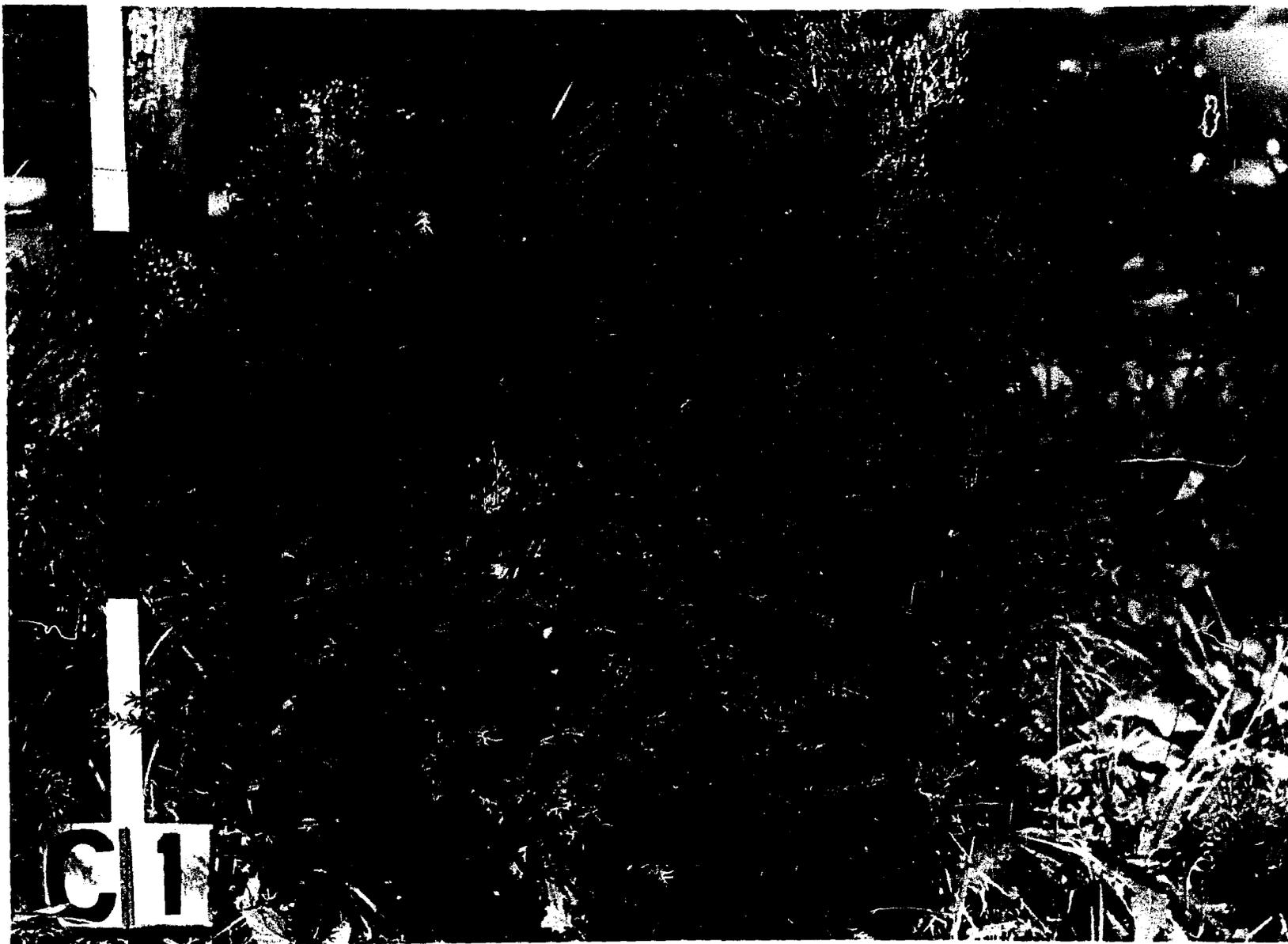


Figure 23. HEATH ENGLISH YEW near the pavilion in Highland Park, Rochester, N. Y.

is not determined.

Bailey (3) evidently described the plant which is in the trade in America under this name using the terms low and spreading. His plant is probably identical to the clon MICHELL ENGLISH YEW.

Clon IRISH ENGLISH YEW Taxus baccata fastigiata Loudon

T. baccata stricta Lawson

T. baccata hibernica Loudon

T. fastigiata Lindley

This clon was discovered as a seedling on the mountains above Florence Court, County of Fermanagh, Ireland, before 1760, according to Dallimore (20). It is no more hardy than the species, and has not survived in the Secret Arboretum. In addition to the plant in Figure 24, large trees are at White Marsh, Virginia; Dumbarton Oaks and the National Cathedral in Washington, D. C.; Longwood Gardens, Kennett Square, Pennsylvania; and the cemetery at Newport, Rhode Island.

A truly fastigiate tree, to 25 feet, narrow columnar when young, becoming ovate with age, Figure 24. The branchlets are short, slow-growing and appressed, with radial leaves, giving the uppermost branches a spire or pinnacle effect. The leaves are larger and more cuspid than in the species, dark green and somewhat glaucous, Figure 33. Lowe (55) considers the spirally radiating leaves and fastigiate



Figure 24. IRISH ENGLISH YEW 20 feet high by 12 feet wide, in Shockoe Cemetery, Richmond, Virginia.

habit "juvenile or seedbed characteristics which have become persistent."

This clon is female with larger, more ovate arils and seeds than the species. The seeds are mostly 3-4 angled in the specimens observed. It is the seed parent of the clons BROOM ENGLISH YEW and HATFIELD ANGLOJAP YEW.

The clon GOLDEN IRISH ENGLISH YEW (T. baccata fastigiata aurea Standish) is of much slower growth and more winter hardy. Fine specimens are present in the old Taxus Section of Secret Arboretum, and Tyler Arboretum, Lima, Pennsylvania, Figures 25 and 33.

Clon MICHELL ENGLISH YEW Taxus baccata michelli Slavina

T. baccata mitchelli Hort.

T. baccata micheli Hort.

T. baccata ericoides Hort. not Pilger

This clon is reported to be synonymous with the HEATH ENGLISH YEW by Rehder (73) and European writers; however, there is no resemblance between the clons as grown in America. The American source of MICHELL ENGLISH YEW has been the Barbier Nursery of Orleans, France, in two importations, the first to the Rochester Park Department in 1911, the second to F. & F. Nurseries in Princeton, New Jersey, about five to seven years later.

This clon forms a low, dense, globular or spreading shrub like a miniature SPREADING ENGLISH YEW, Figure 26.

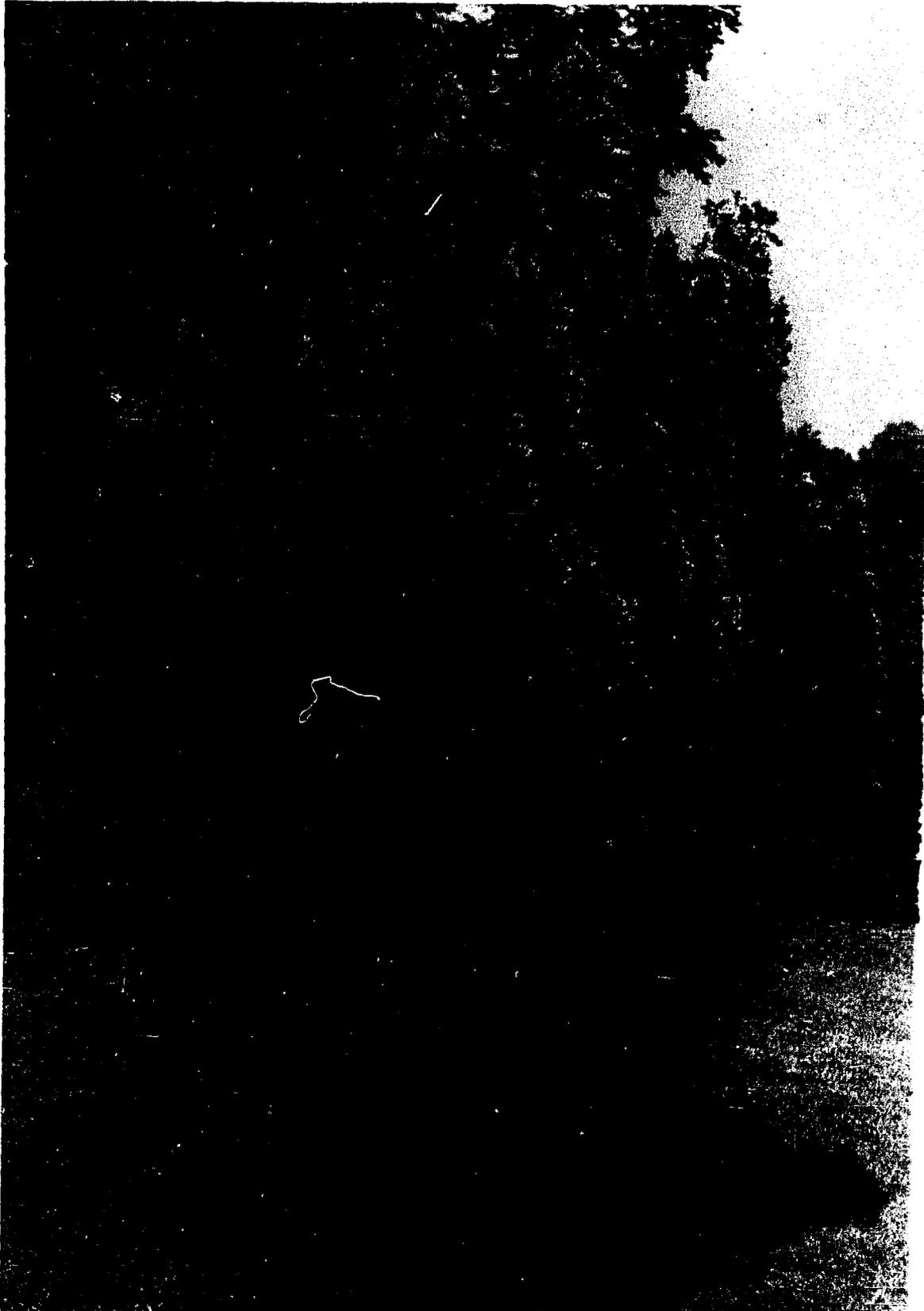


Figure 25. Clon GOLDEN IRISH ENGLISH YEW. This specimen is in the Tyler Arboretum, Lima, Pennsylvania.

Branches ascending or arching with decurved apex. Twigs very slender, olive green and slow-growing, one to three inches annually, to six inches annually on vigorous main shoots, winter buds ovate and prominent. Leaves strongly falcate and recurved, exposing under sides; slender, tapering to an acute apex; bright green above turning bronze in winter when exposed to sun, olive green or yellowish below, with midrib and margins mere lines; arranged in a broad "v" on upper side of twig, close set, and pointing forward at an angle of 45° from the twig, never two-ranked in a horizontal plane. Sex unknown, the large old plants at Rochester, New York, and Arnold Arboretum had no indication of flowers or seed.

In the Secrest Arboretum, group 12, it has been somewhat less hardy than SPREADING ENGLISH YEW and about half as vigorous.

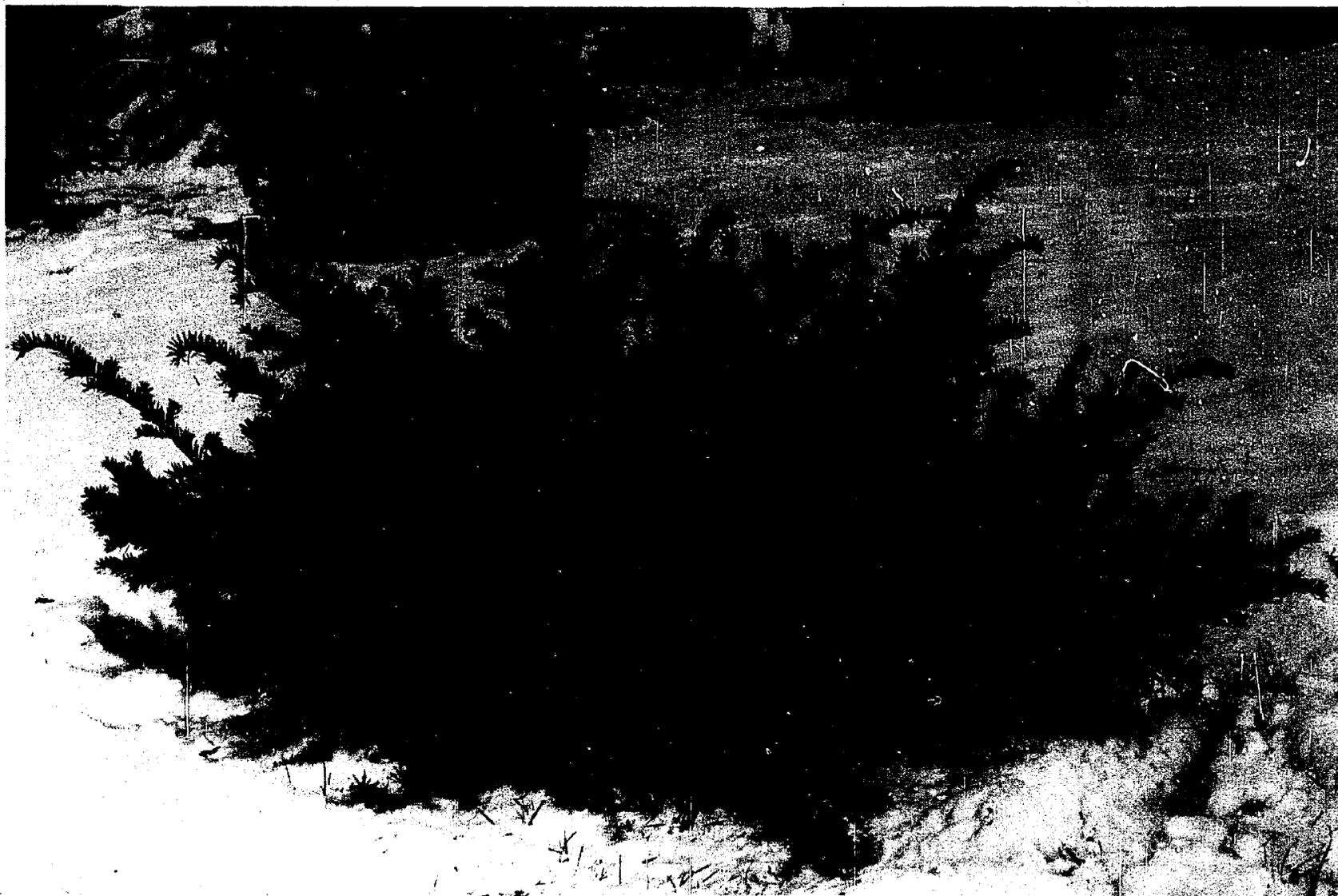


Figure 25. MICHELL ENGLISH YEW in the Secrest Arboretum. Growth rate is about one-half that of SPREADING ENGLISH YEW which it resembles.

Clon OVEREYNDER ENGLISH YEW

Taxus baccata overeynderi Krüssmann

T. baccata erecta overeynderi Den Ouden

T. baccata overeynderi Hort.

This male clon was grown from seed of the IRISH ENGLISH YEW about 1860, by C. G. Overeynder in Boskoop, Holland. It is commonly compared with the BROOM ENGLISH YEW, which it resembles very much, but is smaller in twig size and growth. The leaves are shorter and finer in texture, more likely to be damaged in winter. The growth is more narrow and erect than COMPACT ENGLISH YEW.

This clon is represented in the Secret Arboretum by group 58, Figure 27.

Clon ROUNDTOP ENGLISH YEW Taxus baccata expansa Carriere

T. baccata var. procumbens Kent

T. baccata var. expansa Bailey

T. baccata dovastioni Hort, not Leighton

The plants in both Arnold and Secret Arboretums were obtained under the name T. baccata dovastioni (Hort.) from different sources: The Arnold plant from a private estate at Cos Cob, Connecticut. The specimens at Secret Arboretum were received from the abandoned Jackson Nursery in west Cincinnati via the city forester and Spring Grove Cemetery. Winter hardiness equals that of clon GLAUOUS ENGLISH YEW.

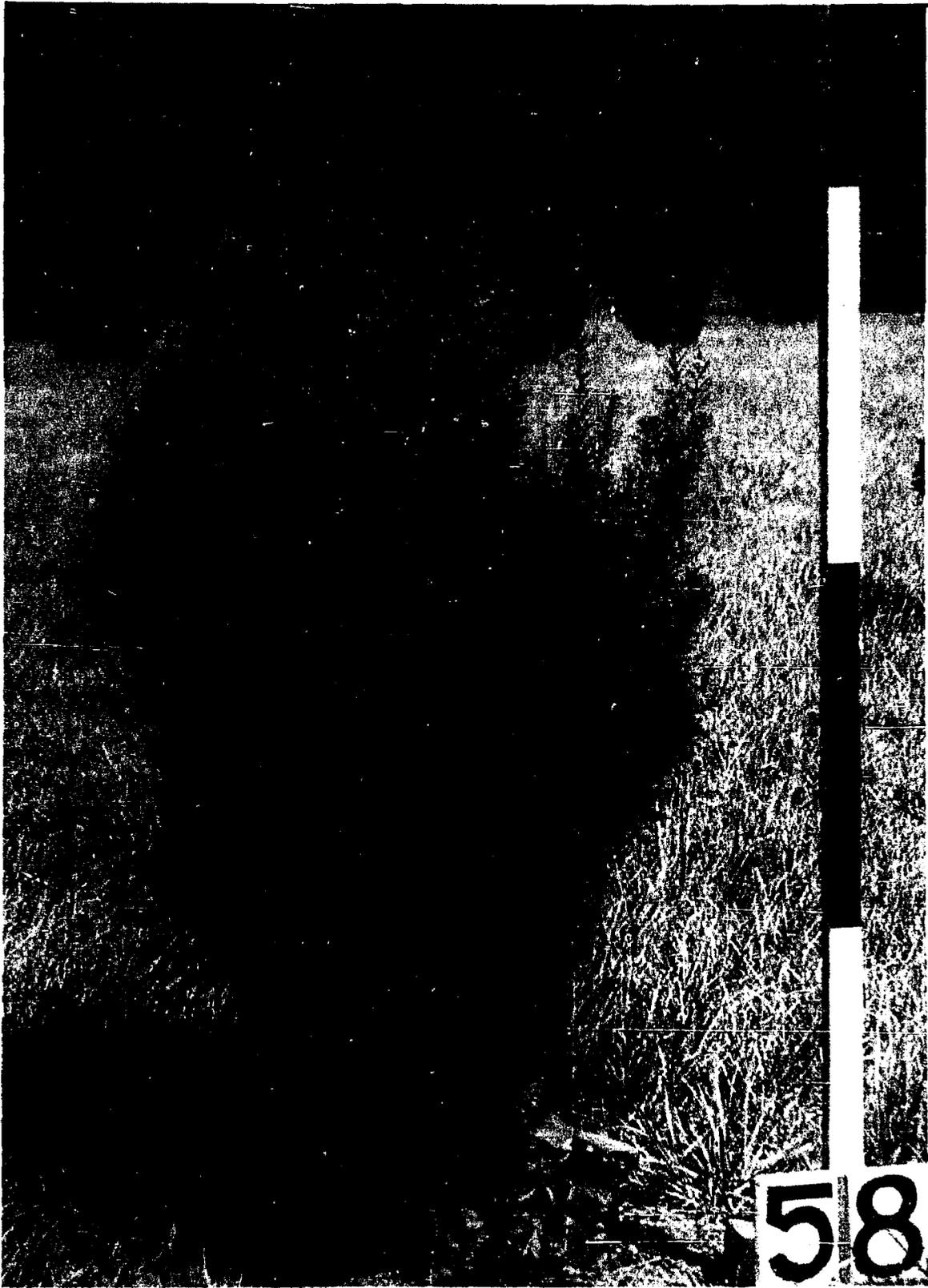


Figure 27. Clon OVEREYNDER ENGLISH YEW, young plant in group 58 of the Secrest Arboretum.

There is considerable difference in the descriptions of this clon by various authors, due, perhaps, to variations in propagation, training and age. All agree that the clon is quite distinct with large dark green falcate leaves 1 to $1\frac{1}{2}$ inches long arranged pectinately in a deep "V" exposing the contrasting light green undersides rather conspicuously.

The clon is female with light crops of early maturing seed. Aril crimson, subglobose, large, 11 mm. wide by 9 mm. long only slightly exceeding the seed; the opening large, elliptical or round, the interior angled; base of aril creased. Nutlet easily extracted, red chestnut brown, broad ovate, obtuse, two-angled, large, 5 mm. by 7 mm., glossy; hilum large, ovate, margin slightly puckered, center somewhat raised.

The specimens in group 39A-C in the Secret Arboretum were trained as globes when small. The branches were horizontal or somewhat pendulous, little divided, and somewhat in layers or sprays. Growth was moderately vigorous. As the plants approached four feet in height, Figure 28, growth became vigorous and more ascending. In this respect they resemble the plants in the Arnold Arboretum, which have grown with less restraint.

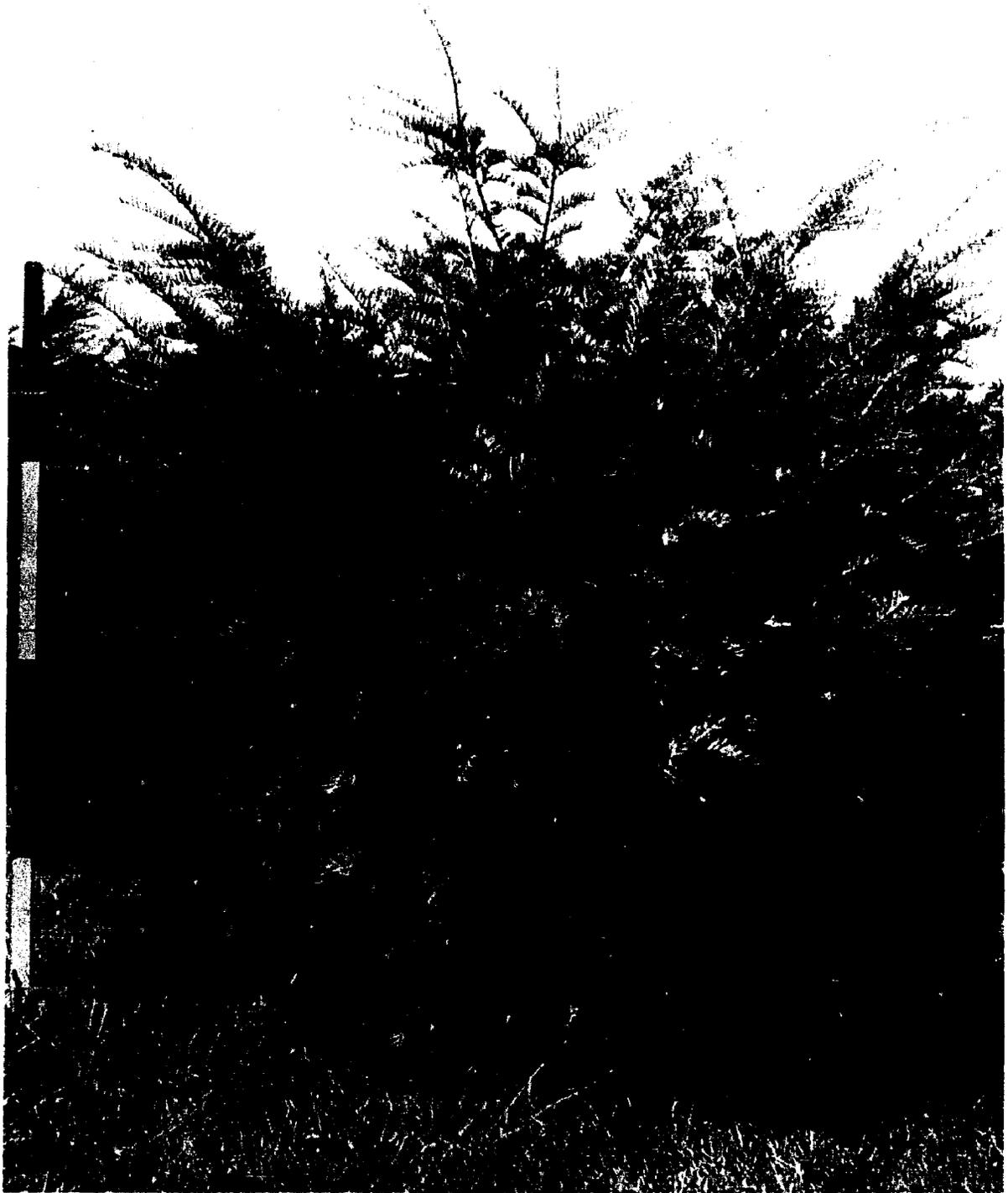


Figure 28. Clon ROUNDTOP ENGLISH YEW in the Secrest Arboretum. This plant is about eighteen years old, from a cutting.

Clon SHORTLEAF ENGLISH YEW Taxus baccata adpressa Carriere

T. adpressa Gordon

T. tardiva Lawson

T. brevifolia Hort. not Nuttall

T. baccata var. adpressa Carriere

According to Wilson (89), this clon is a seedling of T. baccata, first grown in the Dickson Nursery at Chester, England, about 1828. He states that Endlicher started the much copied error that this clon was of Japanese origin. The author has yet to locate or observe any of the variegated kinds.

The dark green, abruptly pointed or mucronulate short leaves, less than one-half inch long, make this female clon unique and impossible to confuse with any other. The leaves are broad ovate to oblong, two-ranked in one plane and so uniform in length the sprays appear ribbonlike.

The twigs are bright to olive green and moderately slow in growth, often somewhat pendulous. According to Dalimore (20), this shrub "never affects a central leader," but the young newly planted specimens in group 30 in the Secret Arboretum and in the Arnold Arboretum labeled T. b. adpressa stricta appear to differ only in having a central leader and excurrent growth. The lateral branches are not fastigate. If they were sheared columnar and allowed to become multileader plants, the effect would be that of fastigate plants. The problem of propagating two "forms" from a

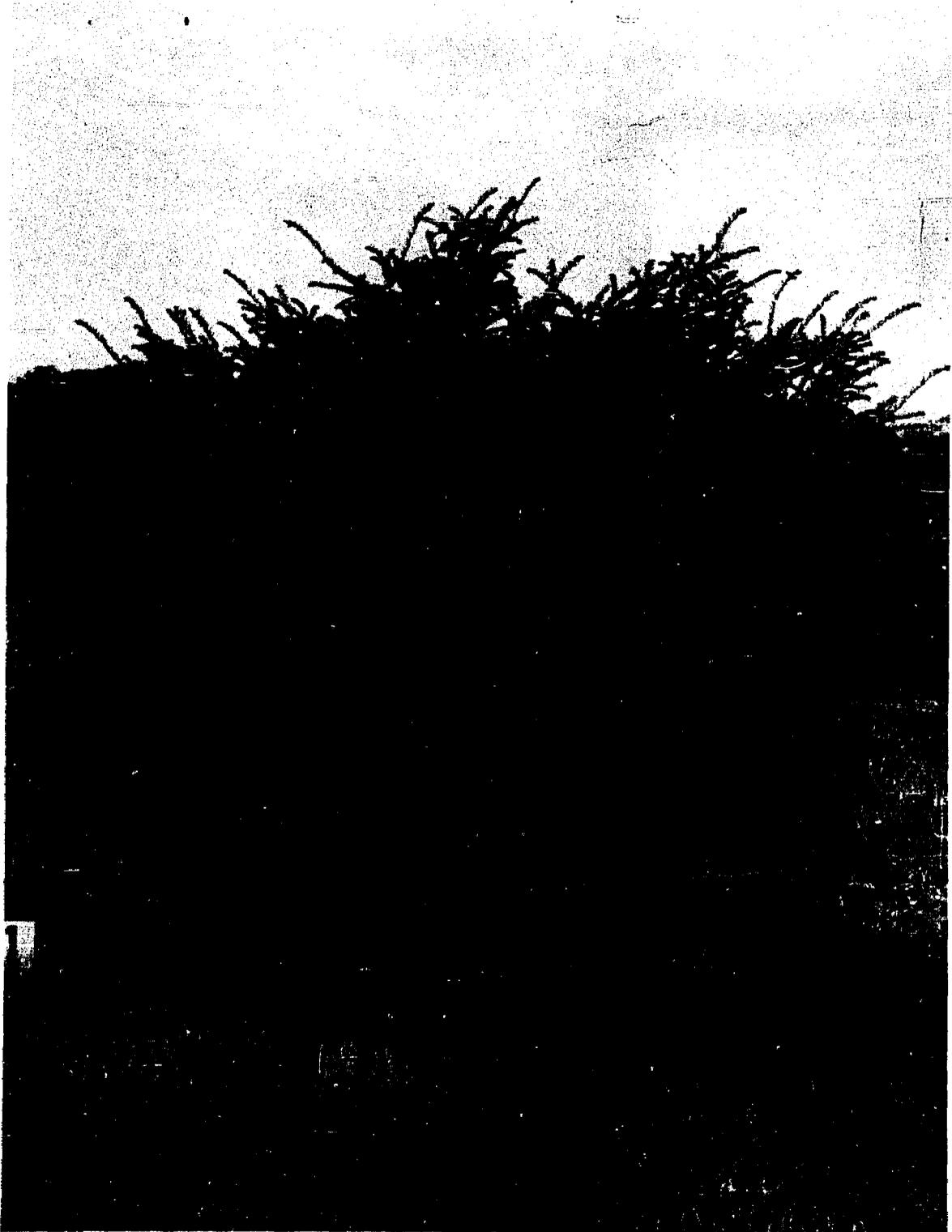


Figure 29. Clon SHORTLEAF ENGLISH YEW. Young plant in the Secret Arboretum, Wooster, Ohio.



Figure 30. Clon SHORTLEAF ENGLISH YEW 15 feet high by 21 feet spread, in the Tyler Arboretum, Lima, Pennsylvania.

single plant has been discussed previously.

The winter buds are globose with thin obtuse scales. The aril is light red, about 9 mm. wide by 7 mm. long, the cup enclosing only two-thirds to three-fourths of the seed; the large opening is angled to fit those of the seed. The nutlet is short and globular, mostly 3 - 4 angled, very dark brown when mature, the hilum depressed and deltoid or squarish in outline.

The SHORTLEAF ENGLISH YEW is represented in the Secret Arboretum by group 11, Figure 29, and group 30. This clon is as hardy as BROOM ENGLISH YEW.

Clon SPREADING ENGLISH YEW Taxus baccata repandens Parsons

T. baccata var. repandens Parsons ex Bailey

T. baccata repanda Hort.

T. baccata imperialis Hort. not Beissner

The origin of this clon is unknown other than in America. It is represented in the Secret Arboretum by group 3. A large old specimen is in the old Taxus Section of the Secret Arboretum.

This hardiest English Yew is a wide-spreading shrub to 10 feet high by 30 feet wide, Figure 31, but usually a low wide radially-spreading plant two to three times as broad as high, Figure 32. Branchlets green to olive green and horizontal; or, if ascending, with decurved tips and becoming horizontal the following season. In the shade it

grows almost creeping or procumbent. The leaves are slender, long tapering, or acuminate and somewhat falcate; arranged in a narrow "V" or pectinate on upper half of the twig, exposing the light green underside of the leaf, which is mostly stomate bands, the midrib and margins very narrow. Upper surface of the leaves dark green to bluish green with a prominent midrib. Winter buds broad ovate to globose, with ridged or keeled bud scales.

A female clon with slightly flattened two-angled globose seeds. The aril exceeding the seed by one-third. Seed scattered and scarce, often wanting, even when an abundance of female flowers mature.

A specimen at the Arnold Arboretum developed a central leader with excurrent growth which reached a height of five feet before it was removed. Plants imported from Barbier in France to Highland Park, Rochester, New York, about 1911, under the name T. b. imperialis, appear to be identical. However, these plants and the specimens propagated from them at the Arnold Arboretum are growing in deep shade, and all have assumed the dark glossy green color and prostrate habit characteristic of SPREADING ENGLISH YEW under such conditions.



Figure 31. Clon SPREADING ENGLISH YEW, 11 feet by 27 feet, at Dosoris Cemetery, Glen Cove, Long Island. The raised center portion is typical of old unpruned plants.

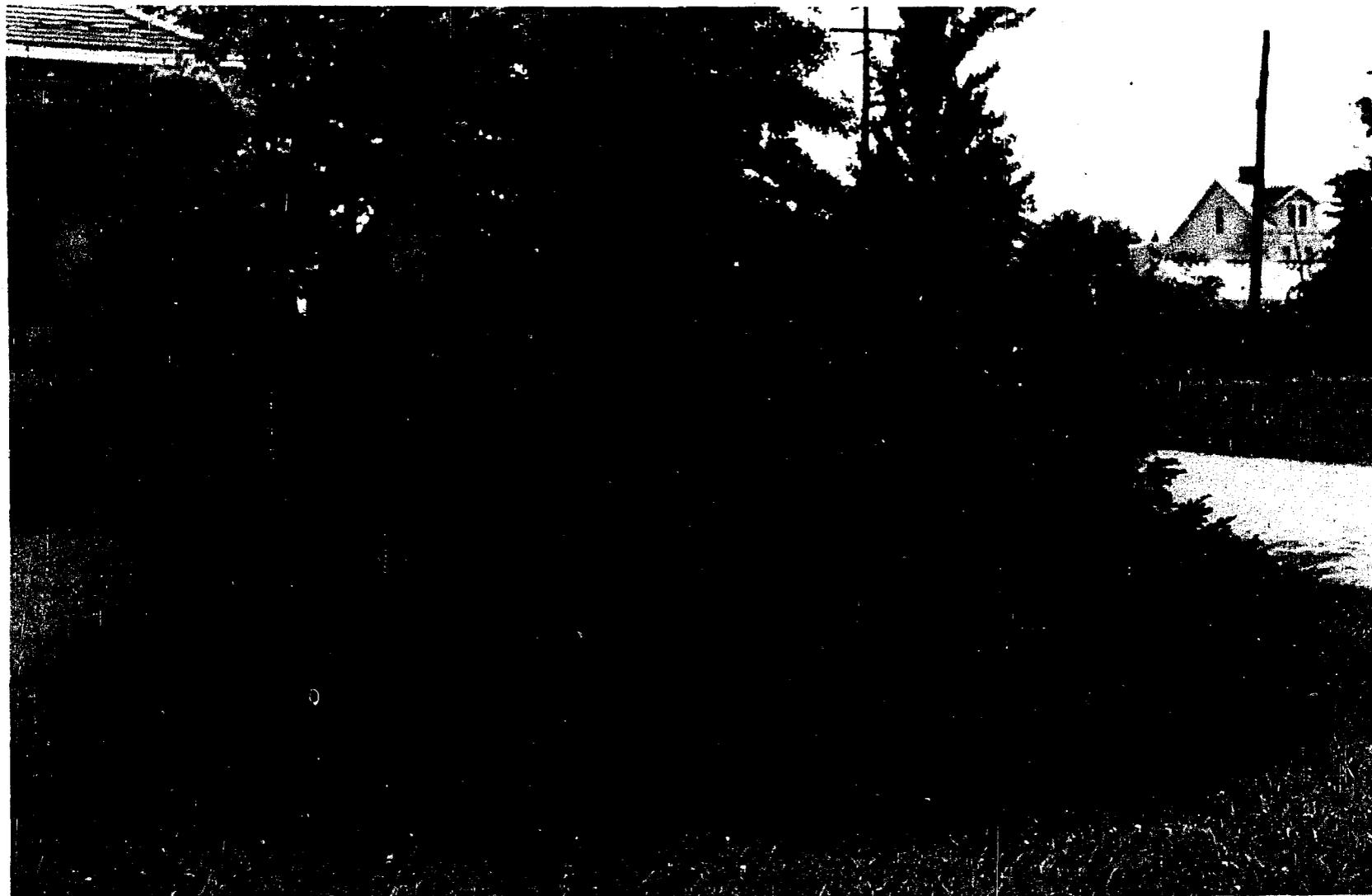


Figure 32. Clon SPREADING ENGLISH YEW, 5 feet by 16 feet, in Spring Grove Cemetery, Cincinnati, Ohio.

This name has been applied by various authors to several different variegated plants. In America it is not in the trade generally, nor listed by Steffek (83). The author has observed only two plants, unmistakably from the same ultimate source, bearing this name. The large old plant at the Arnold Arboretum was from a Mr. Palmer of Stamford, Connecticut, in 1907. The other smaller plant, about 8 feet high by 15 feet wide, was on the grounds of the South Wilton (Connecticut) Nursery, where it has been propagated from a plant on a private estate in Port Chester.

These female plants were wide, horizontally spreading in the manner of a Pfitzer Chinese Juniper. The needles are pectinately arranged on the upper third of the twig in a broad "V" and strongly falcate or recurved. The yellowish variegation followed no particular pattern, but like a mericlinal chimera, might include whole twigs, entire leaves along one side, or a portion of a few leaves along one side of the shoot. The color, or absence of chlorophyll, is confined to the current season's growth; the previous summer's needles being all deep green.



Figure 33. Foliage characteristics of some *Taxus* species and clons. Clockwise, beginning at upper left: JAPANESE YEW; DWARF JAPANESE YEW; ENGLISH YEW; GOLDEN ENGLISH YEW; YELLOW BROOM ENGLISH YEW; GOLDEN IRISH ENGLISH YEW; IRISH ENGLISH YEW; CHESHUNT ENGLISH YEW; WASHINGTON ENGLISH YEW.

Clon WASHINGTON ENGLISH YEW

Taxus baccata washingtoni Beissner

T. canadensis washingtoni Hort.

According to Krüssman (49), this clon is female in Europe. However, in America, most of the old arboretum specimens are male. Female plants were observed in the stock block at Fairview Nurseries, Fairview, Pennsylvania, and the old Taxus Section of Secrest Arboretum, Ohio Agricultural Experiment Station, Wooster, Ohio.

This yellow clon is less showy than GOLDEN ENGLISH YEW, the leaves being more green, with the yellow confined to the tips and narrow margins of the strongly falcate leaves. The texture of the leaves is somewhat finer, accented by their falcate shape and pectinate arrangement in a broad "V", Figure 33. The yellow color disappears the second season from both twigs and leaves; those in the shade develop little yellow color. The growth habit is generally described as spreading and rounded. Older plants observed have the centers well filled with ascending branches, Figure 34.

This clon is not in the Living Herbarium of Taxus. First described in 1890, the origin is unknown.



Figure 34. WASHINGTON ENGLISH YEW on the ground of Tyler Arboretum, Lima, Pennsylvania, 11 feet tall, 22 feet spread.

Clon YELLOW BROOM ENGLISH YEW

Taxus baccata erecta aureo-variegata Beissner

This clon differs from BROOM ENGLISH YEW in being somewhat more loose in character, Figure 35, with larger leaves having yellow margins above and all yellow below, at least on the tip growth, Figure 33. From other yellow clons it differs in having straight broader needles.

Clon YELLOW DOVASTON YEW

Taxus baccata dovastoniana aureo-variegata Beissner

This is a wide-spreading drooping female clon, Figure 36. Leaves falcate with the under side and margins of the upper side of the current season's growth a bright yellow. Plant 39D in the Secret Arboretum appears to be this clon, but is a favored browse for rabbits and makes little new growth.



Figure 35. Clon YELLOW BROOM ENGLISH YEW, 13 feet high by 15 feet wide, in the Tyler Arboretum, Lima, Pennsylvania.

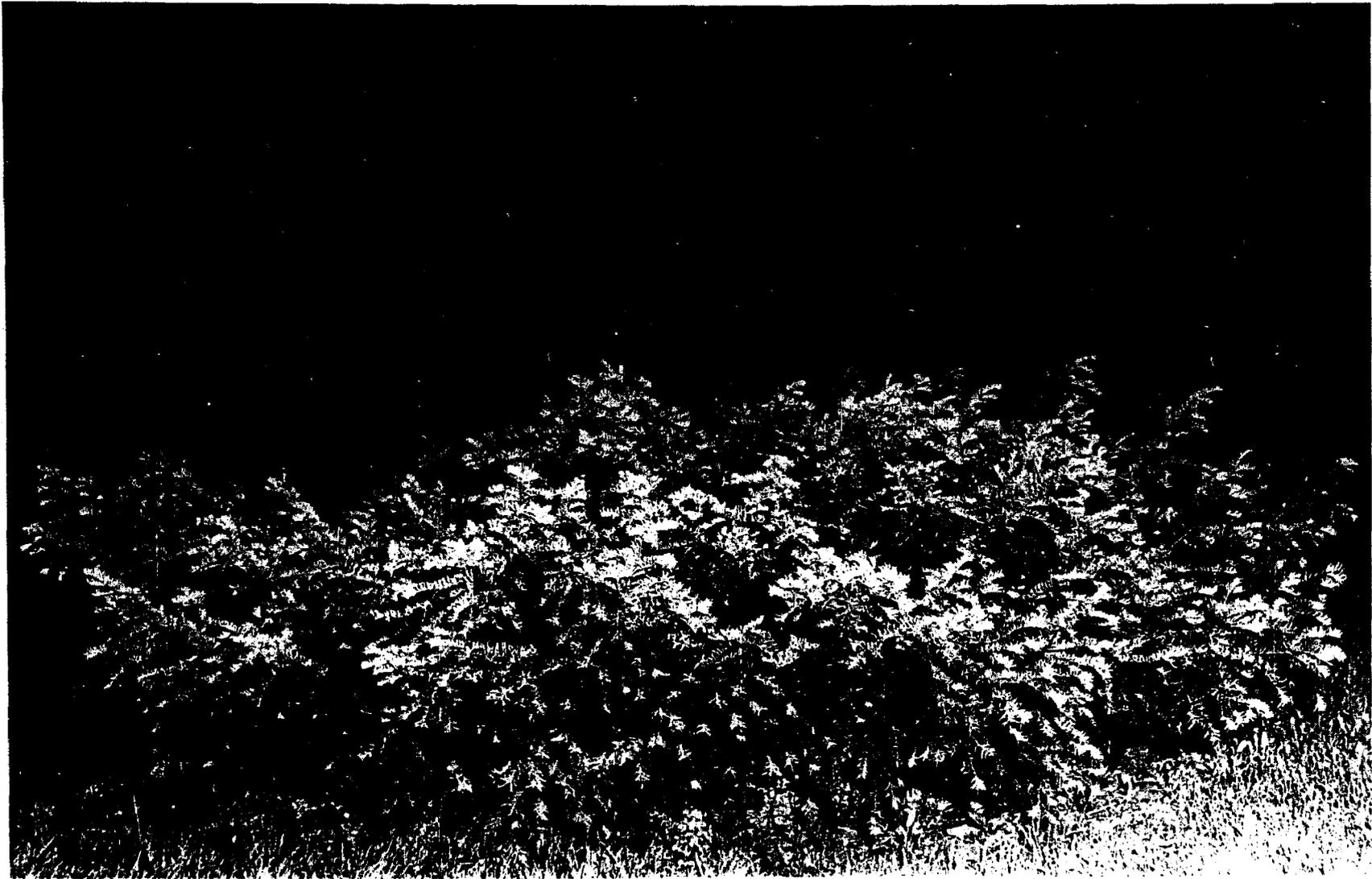


Figure 36. YELLOW DOVASTON YEW on the grounds of Masonic Homes, Elizabethtown, Pa.

Taxus brevifolia Nuttall

PACIFIC YEW

T. bourcierii Carriere

T. lindeyana Lawson

T. baccata var. brevifolia Koehne

T. baccata subsp. brevifolia Pilger

Sargent (75) (77) gives the range of T. brevifolia as being along the Pacific Coast of North America, from the southern tip of Alaska south in the Coast Range to the Bay of Monterey, and inland to the Selkirk and west slope of the Rocky Mountains.

Along the Pacific Coast a tree to 80 feet with a broad conical crown, becoming a shrub inland in the mountains of Montana and Idaho. Branches with reddish brown shredding bark, horizontal or somewhat drooping, branchlets yellowish green and quite slender and often pendulous.

Leaves short, uniform, less than three-fourths of an inch, bluntly cuspid or mucronate, according to Nuttall (61), flatly two-ranked and horizontally spreading, lighter green than T. baccata, and fine-textured like T. canadensis. Stomate bands, described as light yellow-green by McMinn and Maino (58), and pale glaucous green by others, are broader than the green margins, which are somewhat revolute.

Flowers dioecious, small, resemble those of T. canadensis as do the winter buds. Seed ovoid, 2-4 angled, longer than wide, in a fleshy red aril, which is eaten by birds, the natural agents of Yew seed dispersal, according

to Davidson (22).

This species is not represented in the Secret Arboretum. It is considered quite tender by Dallimore (20); however, propagation material from Idaho was recently introduced into cultivation. An earlier attempt to establish a hardy form from Montana in the Arnold Arboretum, reported by Bailey (5), ended in failure. The plant listed as T. brevifolia in the nursery trade is the DWARF JAPANESE YEW. The Yew in Christ Church Cemetery, Greenwich, Connecticut, Figure 37, which Moldenke identified as T. brevifolia, according to Mix (60), is a fine specimen of T. baccata with rather cuspid leaves.



Figure 37. Taxus baccata in Christ Church Cemetery, Greenwich, Connecticut. Height 36 feet, branch spread 42 feet. Circumference 6 feet 10½ inches, 2 feet above ground line.

T. baccata var. procumbens Loudon

T. baccata var. canadensis Gray

T. baccata var. minor Michaux

T. minor Britton

T. baccata subsp. canadensis Pilger

T. canadensis wilsoni Hort.

The range of Taxus canadensis is from Newfoundland to Virginia, according to Small and Vail (81), and west to Iowa and Manitoba. In its southern limits it is a relict in deep sheltered coves and ravines or on mountain tops. It is probably the hardiest of all Yews, but discolors severely and may even be killed when exposed to winter sun. Useful for low hedges and ground cover in deep shade, and in natural plantings for wild life cover. Though poisonous to livestock, it is recorded as a preferred browse for deer and moose in winter by Van Dersal (87).

A straggling evergreen shrub to five feet with many ascending branches, Figure 38. Main stems prostrate and rooting, or ascending, forming thickets beneath hemlock and other forest trees. Mature branchlets olive green to reddish brown, changing to brown the second season.

Leaves to three-fourths of an inch, shorter near tips of twigs, abruptly and sharply pointed, margins slightly revolute, midrib prominent on both surfaces. Leaf color is dark glossy green above, changing to brick red to purple

when exposed to winter sun. Stomate bands lighter, about twice as wide as the green margins, petiole very short. Leaves arranged pectinately in flat plane on horizontal branches and in the shade, to a deep "v" and falcate on ascending branchlets.

Winter buds small, ovate or pyramidal, with keeled persistent scales, Figure 3C. Lateral vegetative buds appear square in cross section or from an end view.

Flowers monoecious, with female below on each twig, somewhat smaller than other species. The seed ripens irregularly in August and September, somewhat ahead of other species; aril orange to scarlet, subglobose, small, 8 mm. wide by 6 mm. long, slightly exceeding the nutlet. The nutlet is small broad ovate, 4 mm. by 5 mm., with blunt or mucronate apex, mostly two-angled, hilum small, ovate, depressed with puckered margin or fluted neck. The surface dull brown and finely reticulate.

Hatfield (35) states that this species loses its straggling habit under cultivation and becomes dense and compact. Hoopes (42) remarks that it can be pruned to any desired form, but considers globular most appropriate. This species is represented in groups 79, 96 and 97 in the Secret Arboretum.

The yellow or golden clons have not been observed by the author. WASHINGTON ENGLISH YEW is listed as a clon of T. canadensis by some writers, but the plants observed by

the author confirm Slavin's (80) and Gibbs' (31) observations that it is a clon of T. baccata. It may possibly be a hybrid of GOLDEN ENGLISH YEW and T. canadensis, based on the bronze winter color of this clon.

Clon DWARF HEDGE CANADA YEW Taxus canadensis stricta Bailey

T. canadensis densa Hort.

T. canadensis var. stricta

This clon is no longer listed in the trade, even by Wyman's Framingham Nurseries, Framingham, Massachusetts, who originated and introduced the clon about 1915, according to Wyman (94). Bailey (3) describes this as a "dwarf stiffish form," and Rehder (71), as having "stiff upright branches." The plants in group 87 of the Living Herbarium of *Taxus* are more erect and compact than the species, the ascending twigs almost vertical with nodding ends. The growth rate is less and the secondary twigs more abundant; otherwise, it is like the species. Best used as a small sheared hedge in deep shade.

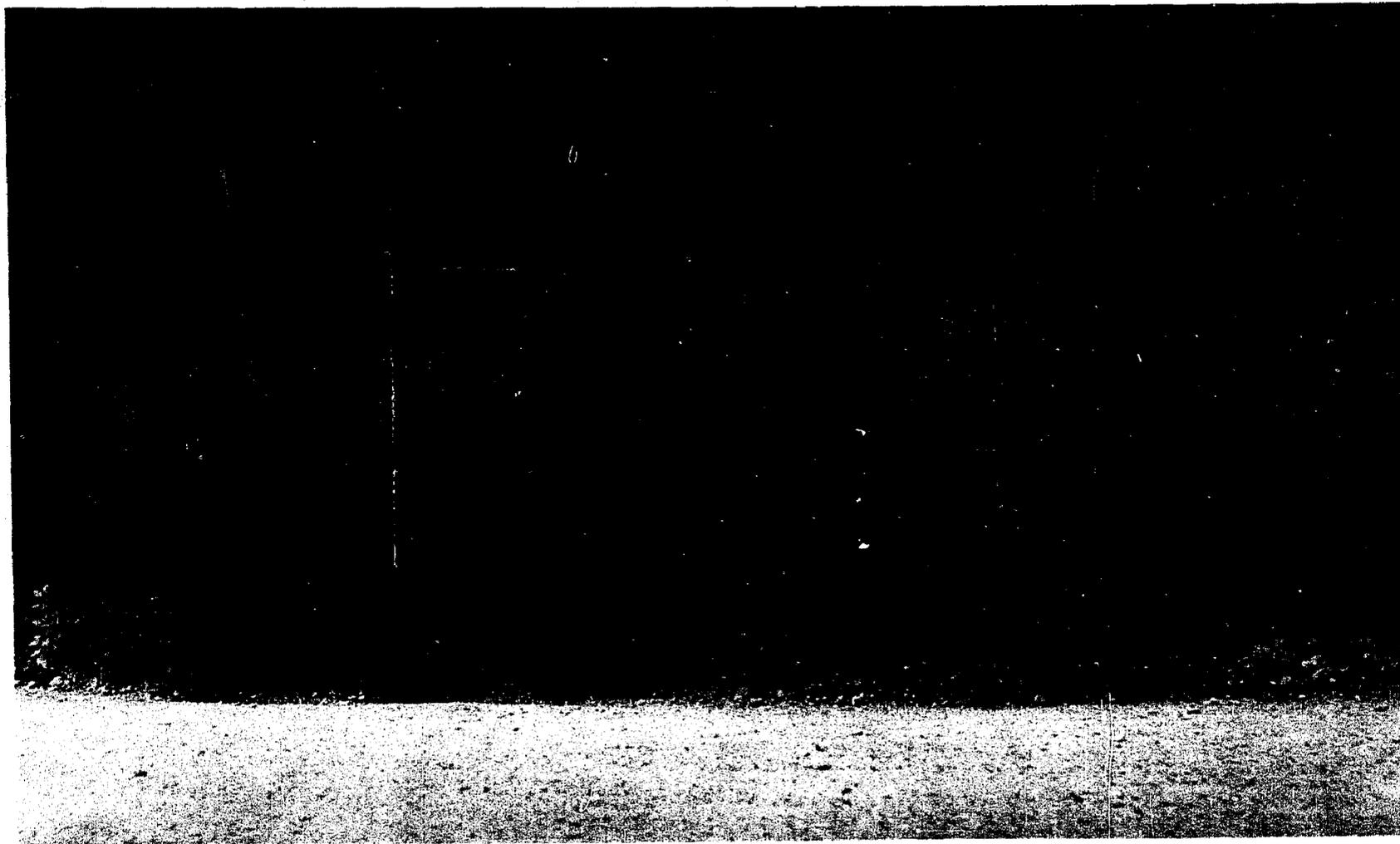


Figure 38. Taxus canadensis in the Arnold Arboretum.

Taxus chinensis Rehder

CHINESE YEW

T. baccata var. chinensis Pilger

T. cuspidata var. chinensis Rehder and Wilson

T. baccata var. sinensis Henry

This species from the interior of China was represented in the Secret Arboretum in group 22, but the plants succumbed to poor soil drainage. An old plant, rather severely pruned, exists in the old Taxus Section of Secret Arboretum. In addition to the plants mentioned, there are specimens at the Arnold Arboretum and the Masonic Homes, Elizabethtown, Pennsylvania.

A tree to 50 feet, or shrubby, with fissured, scaly, grayish or reddish bark. Mature twigs slender and yellowish green, becoming brown the second or third season; mostly horizontal or slightly drooping, Figure 39. Leaves large, to one and three-fourths inch long, usually falcate, midrib prominent below, raised for half to three-fourths of leaf above. The leaf is not tapered but abruptly cuspid or mucronate at the apex, the petiole short and yellowish; arranged pectinately two-ranked in one plane and rather distant, giving a loose airy appearance or lack of density, Figure 40. Leaf color above, a distinct glossy green, turning olive green or yellowish in winter, the two broad stomate bands below light grayish green.

Winter buds smaller than in T. baccata, with thin obtuse, deciduous scales. Seed matures much later than

other species observed, often failing to mature at Wooster, Ohio, and Boston, Massachusetts. Seed broad ovoid, slightly flattened and two-angled, hilum ovate.



Figure 39. Taxus chinensis, on the Hunnewell estate, Wellesley, Massachusetts, 12 feet high by 24 feet spread. This plant was grown from seed collected in China by Wilson (76).

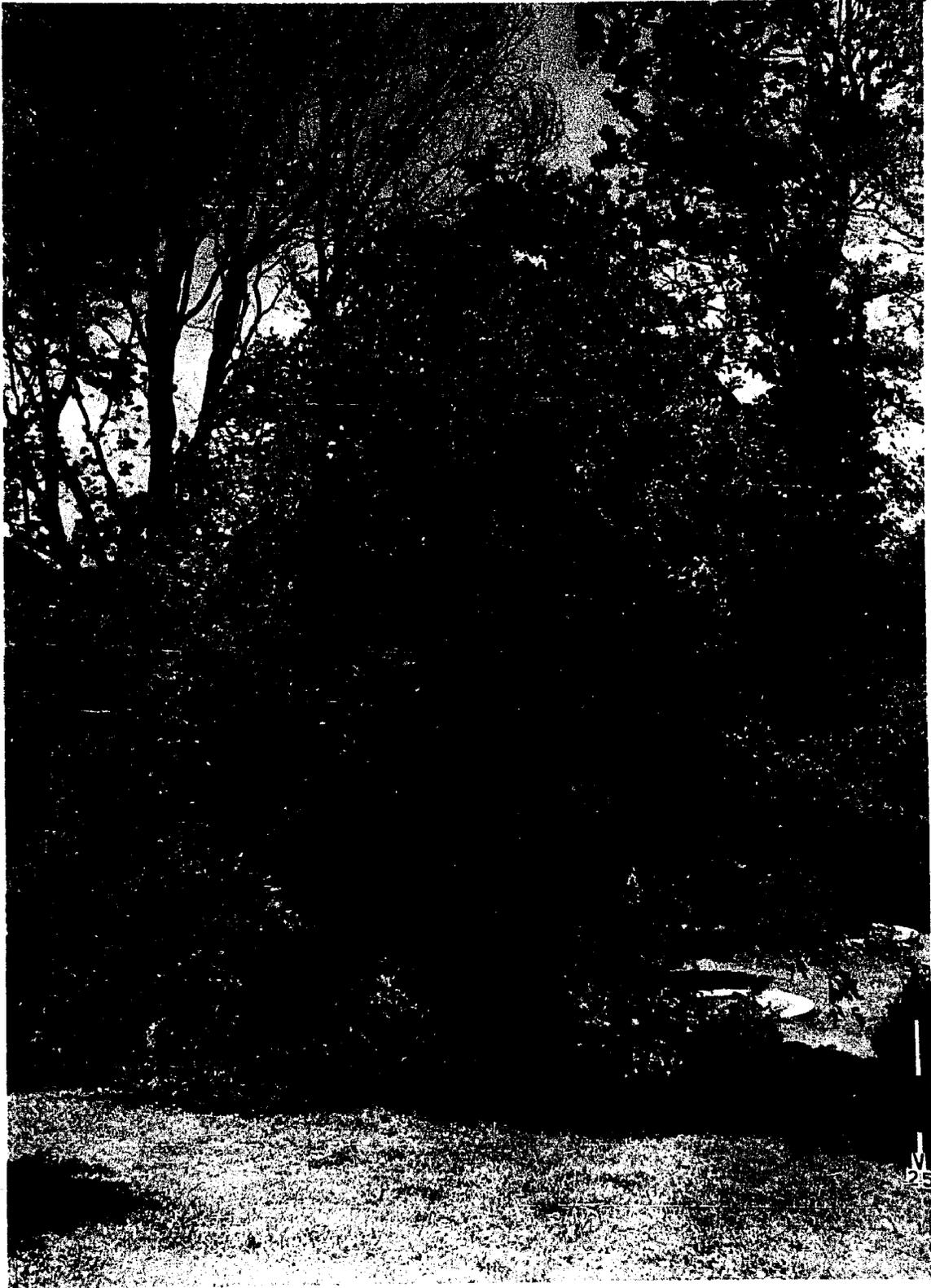


Figure 40. Chinese Yew on grounds of Morris Arboretum, Philadelphia, Pennsylvania, 17 feet high by 16 feet wide.

T. baccata Thunburg

T. baccata cuspidata Carriere

T. baccata sieboldi Hatfield

T. baccata subsp. cuspidata Pilger

T. cuspidata sieboldi Hort.

T. cuspidata expansa Rehder

T. cuspidata capitata Hort.

According to Wilson (89), this species was brought to America from Japan in 1862 by Dr. George R. Hall, who released it to the nursery trade through Parsons and Co., Flushing, Long Island, New York. Parsons and Co. later imported it direct from Japan, as did several other companies. Large quantities of seed are imported direct from Japan today by some firms who consider the imported seed superior to mixed domestic seed. The resultant plants show considerable variation.

A tree to 50 feet, with spreading or ascending branches, Figure 42, or a spreading, rounded to vase-shaped shrub, Figure 41, when propagated from lateral or plagiotropic branches. Bark reddish to dark brown scaling from trunk and larger branches, or falling in long strips from older trees.

Twigs slender, yellowish green, or reddish in winter when exposed to the sun, turning brown the second season. Winter buds ovate with persistent, ovate, keeled scales;

the basal scales are triangular ovate, Figure 3B.

Leaves dull dark green above, about one inch long, linear and abruptly cuspid, not tapering and acute as in T. baccata. Midrib prominent above, a narrow line or almost invisible below. The stomate bands yellowish green, turning almost yellow when exposed to winter sun, about twice as wide as green margins of leaf. Petiole short but distinct, yellowish.

The plants are dioecious with a propensity for bearing heavy crops of seed which mature somewhat later than the other species, except T. chinensis. The aril is usually globular, about 10 mm. in diameter, and exceeding the nutlet. The opening circular and as large as the seed, the interior often 3-4 angled. Nutlet brown, broad ovate, 5 mm. by 6 mm., with obtuse apex mostly 3-4 angled. Hilum tan, slightly depressed, usually deltoid or squarish with margin fluted or puckered.

The original plant on the Hall estate died from neglect about 1920, but large plants still survive, Figure 41. Some of the finest specimens of Japanese Yew in America are in the Arnold Arboretum, and on the Hunnewell estate, which grew from seed collected by C. S. Sargent in 1892. Wilson (89) also states that the Japanese Yew was introduced into England by Robert Fortune, between 1854 and 1856, but considered its lack of popularity there due to the hardiness and abundance of varieties of the English Yew.



-100-

Figure 41. Japanese Yew, T. cuspidata, 28 feet high by 52 feet wide, in the fore-court of the C. A. McBride estate, a portion of the old Hall estate, Bristol, Rhode Island, where the Japanese Yew was first brought to America. This leaderless plant is not one of the original importations, the last of which died in 1920.

However, Guillaumin (33) states that Siebold, a German botanist working at Leyde University in Holland, was the first to bring plants from Japan. This may explain the "Taxus baccata sieboldi" of "Chinese" origin imported by Hatfield (35), which he later (36) observed was as hardy at Boston as T. cuspidata. This has almost become a clon in the trade in America, variously known as T. sieboldi, T. baccata sieboldi and T. cuspidata sieboldi. The plant is a dense, bluegreen, vigorous, female form, Figure 42. However, Hatfield (35) and others considered it as "coming true from seed," which would negate the clonal status of this plant.

Seedling Number 74, grown from the same lot which produced T. cuspidata minima, by Mr. B. Slavin of the Rochester, New York, Park Department, is a pendulous male specimen on Yew Hill in Durand Eastman Park. In appearance it is much like the clon GRACEFUL ENGLISH YEW, and should be propagated.

Excurrent specimens of Japanese Yew are represented in group 15 in the Secret Arboretum. Spreading shrubs propagated from side branches are in groups 6, 7, 9 and 32, and mixed in several others.



Figure 42. T. cuspidata Siebold and Zuccarini sold as SIEBOLD JAPANESE YEW. This fine specimen 16 feet high by 18 feet spread is on the grounds of the South Wilton (Connecticut) Nursery. The low golden plant to the left is the Clon GOLD TIP JAPANESE YEW, T. cuspidata aurescens Rehder. Both plants are about the same age.



Figure 43. A nursery block of large sheared specimen plants of T. cuspidata Sieb. and Zucc. near Cincinnati, Ohio. Grown from seed, these plants will be marketed as "Taxus cuspidata capitata."

Clon ADAMS JAPANESE YEW

Taxus cuspidata adamsi Hort.

T. cuspidata columnaris Hort.

T. media columnaris Hort.

T. columnaris adamsi Hort.

T. cuspidata "Adams spreaders" Hort.

The origin of this vigorous male clon is unknown, but it has been widely sold by the Adams Nursery of Springfield, Massachusetts. It is a favorite with many nurserymen, because it makes up a salable columnar plant rather quickly when sheared heavily. The habit is excurrent with a propensity for developing several to many leaders which furnish abundant propagation material and make the columnar form easy to attain in small plants. Lateral branches ascending at about 45°. The exposed twigs turning orange to red in winter and brown the second season.

Leaves spirally scattered on leaders and well spaced in deep pectinate "V" on strong lateral twigs, exposing the broad yellow-green stomate bands; close set in a broad "V" on secondary branchlets. The dark green color becomes a characteristic dark olive green in winter. The abundant large yellow pollen cones add to the yellow appearance of the plant from August to April.

The plants in groups 36 and 73 in the Secret Arboretum were received as narrow columns, and were so pruned for five years until 1947. Left unsheared until 1954, the plants were soon more broad than high, Figure 44. With the



Figure 44. Clon ADAMS JAPANESE YEW, Secrest Arboretum. This plant was kept sheared as a narrow column until over 6 feet high. Left unpruned it spread to one and one-half times the height in seven years.

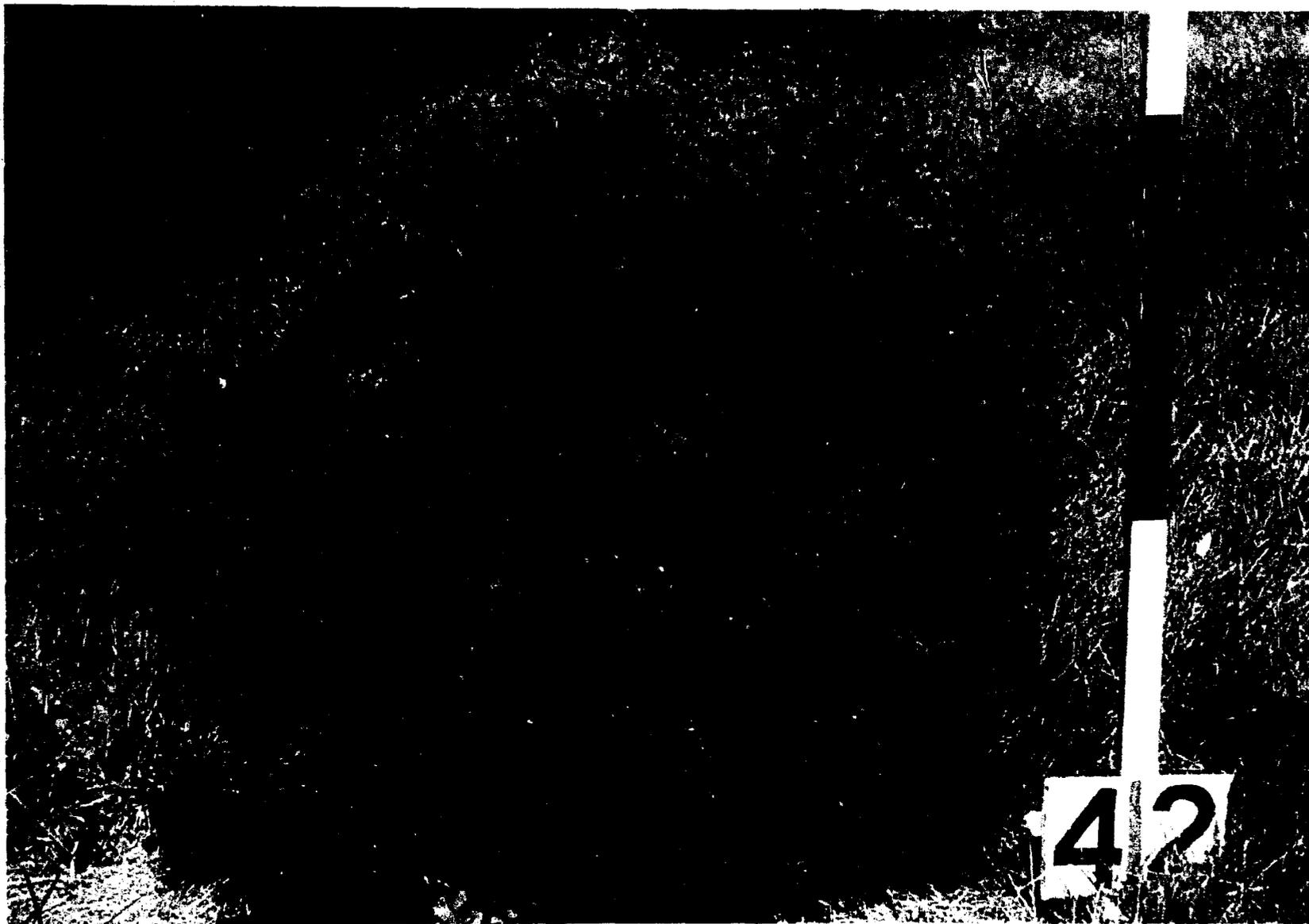
several good fastigiate Yews on the market, this clon should not be used where a columnar plant is needed in the landscape.

Clon BOBBINK JAPANESE YEW Taxus cuspidata tsugifolia

This dwarf female clon was discovered among the T. cuspidata plants in the Bobbink and Atkins Nursery, East Rutherford, New Jersey. The rate of growth is only slightly faster than that of the clon PYGMY JAPANESE YEW. Four to six inch one-year rooted cuttings in 1942 were twenty-six inch globes by 1954 in group 42 in the Secret Arboretum, Figure 45.

Branchlets green in shade to bright red-orange in sun, turning brown the second season. Winter buds and bud scales as in the species, but much smaller, as are all parts of the plant. Leaves short, less than one-half inch, linear cuspidate to acicular, close-set and spirally radiating to almost opposite or paired. Bright green and glossy in summer, becoming reddish in winter sun.

The aril is orange red, a shallow cap or torsus 9 mm. by 5 mm., covering one-half of the seed, opening clasping the nutlet; the base deeply depressed; somewhat late in maturing. Nutlet small 3 mm. by 4 mm., subglobose, acute, weakly two-angled, light brown, glaucous where exposed and wrinkled. Hilum small, depressed, and ovate.



-107-

Figure 45. Clon BOBBINK JAPANESE YEW in the Secrest Arboretum.

While young, these plants are irregular and somewhat loose, but become quite ornamental with age. It is strictly a high priced novelty item if offered in the trade. Winter hardy at Wooster, Ohio.

Clon CUSHION JAPANESE YEW Taxus cuspidata densa Rehder

T. baccata subsp. globosa, f. tardiva Matsumura

This clon was imported from Japan by Parsons Nursery, Flushing, Long Island, according to Wyman (95). Plants were sent to the Arnold Arboretum about 1900 under the name T. cuspidata "Dwarf Form." Rehder (2) described this clon in 1916. The plants in group 18 in the Secret Arboretum were propagated from the plants at the Arnold Arboretum. This clon is considered unprofitable by most nurserymen, due to its slow growth and liability to damage by careless help.

This low, compact, slow-growing clon is irregularly globular in form as a young plant, becoming hemispherical with age, Figure 46. Annual growth under the best conditions rarely exceeds eight inches and is usually much less, with many secondary branchlets on previous season's and older wood. The bark on the twigs is thick, soft and leathery.

Leaves thick, broad, leathery and dark green above, with cuspid to mucronate apex. Stomate bands below very broad, the margins and midvein mere lines. The leaves are

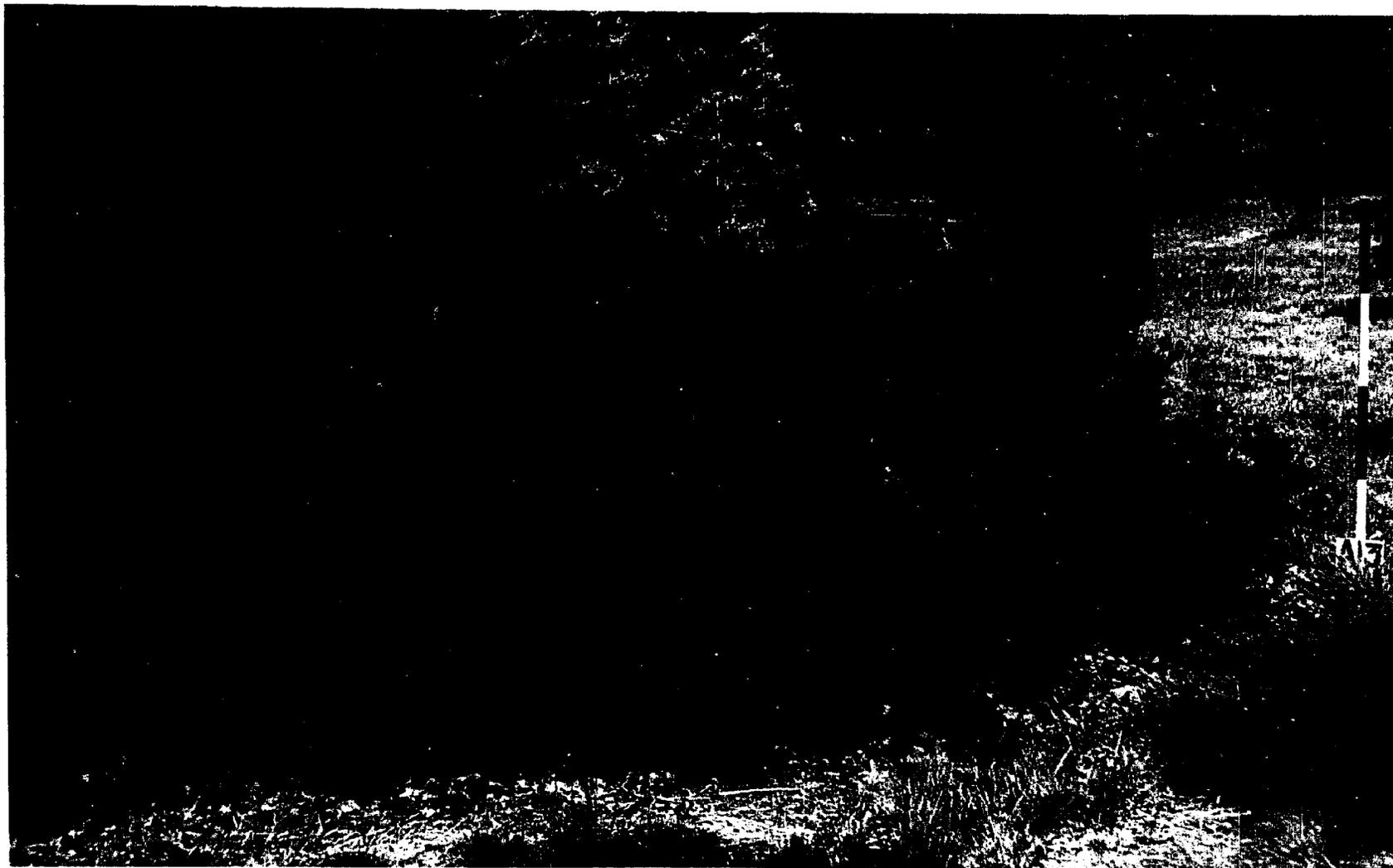


Figure 46. Clon CUSHION JAPANESE YEW, 4 feet high by 12 feet wide. This is Rehder's type plant in the Arnold Arboretum, planted in 1900.

thick-set, mostly radial or semiradial on the short branch-lets, to a broad "V" on ascending vigorous twigs. The general appearance is that of DWARF JAPANESE YEW except that the internodes and total growth are shorter.

The aril flattened to subglobose, 9 mm. by 7 mm., scarcely exceeding the nutlet. Opening elliptical, as large as nutlet with long axis at right angle to ridge of nutlet. Nutlet dark brown, wrinkled, globose, 5 mm. by 5 mm., slightly compressed and weakly two-angled. Hilum small, elliptical, not depressed.

DWARF JAPANESE YEW

Taxus cuspidata nana Rehder

T. brevifolia Hort. not Nuttall

T. cuspidata brevifolia Hort.

T. cuspidata var. compacta Bean

T. cuspidata f. nana Rehder

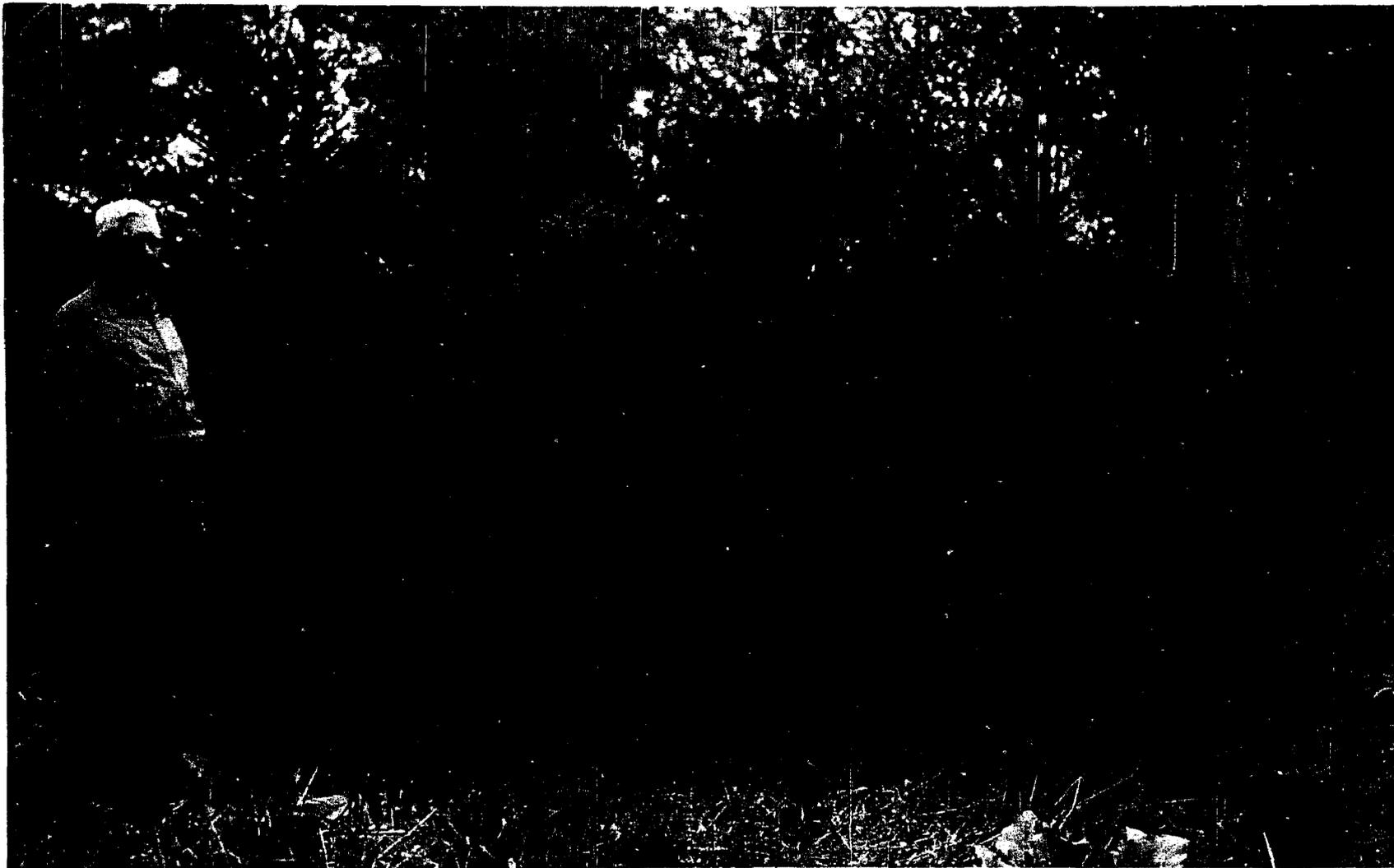
This cultivar is one of the oldest of the Japanese Yews, originating in Japan, according to Wilson (90). Two general types are in the trade; one, faster growing with lighter leaves forms a loose, hemispherical plant with age, Figure 48. The second is more dense with broader darker green leathery leaves and more ascending branches, Figure 49. This cultivar should not be considered to include some of the fast growing media forms which have been grown from its seed by Hatfield (35) and others. (See "Hatfield Yews," page 144.)

Excurrent plants are rare; the usual form is a dense wide-spreading shrub with spreading ascending branches covered with short branchlets, Figure 47. The twigs are stouter than the type, with a soft, leathery, or coriaceous, wrinkled bark. Growth slower than T. cuspidata, especially on young plants.

Leaves a dull dark green, broader and thicker than the species, Figure 33, arranged radially on the secondary branchlets and in a deep "V" on the upper side of ascending branches.

Plants of either sex are in the trade. The male plants make better specimen plants with age. Plants with one or more branches of the opposite sex are not rare, according to Keen and Chadwick (47).

T. cuspidata nana Rehder is represented in the Se-crest Arboretum by groups 8, 24, 26A, 31 and 53.



-112-

Figure 47. DWARF JAPANESE YEW, 5 feet high by 14 feet wide. This plant in Youngstown, Ohio, is about thirty-five years old.



-113-

Figure 48. DWARF JAPANESE YEW on the Hunnewell estate, Wellesley, Massachusetts.
Loose type of plant 10 feet high by 45 feet spread.



Figure 49. Dense type of DWARF JAPANESE YEW, 5 feet high by 38 feet apread. This plant, on the Hunnewell estate, was 5 feet high by 50 feet in circumference in 1899 (44).

Clon BLUE JAPANESE YEW

Taxus cuspidata glauca Hort.

This female clon was grown and introduced by Mr. R. Baker of the Hiti Nursery, Pomfret, Connecticut. The parent tree is a compact excurrent cone, as broad as high, Figure 50. The branches are almost horizontal, the current season's twigs slightly ascending, often with decurved tips. The appearance is much like that of a fir or spruce.

The leaves are glaucous blue-green above on new growth, turning dark green the second season, broad, falcate and bluntly cuspid to mucronate. Arranged in a deep "V" which exposes the broad contrasting stomate bands, especially on the tips of strong laterals, or when the wind turns the foliage. Growth rate medium.

Only low spreading plants from lateral growth have been propagated and offered to the trade, but these should be a welcome addition to the plants suitable for planting the low rambling type of home architecture currently in style.

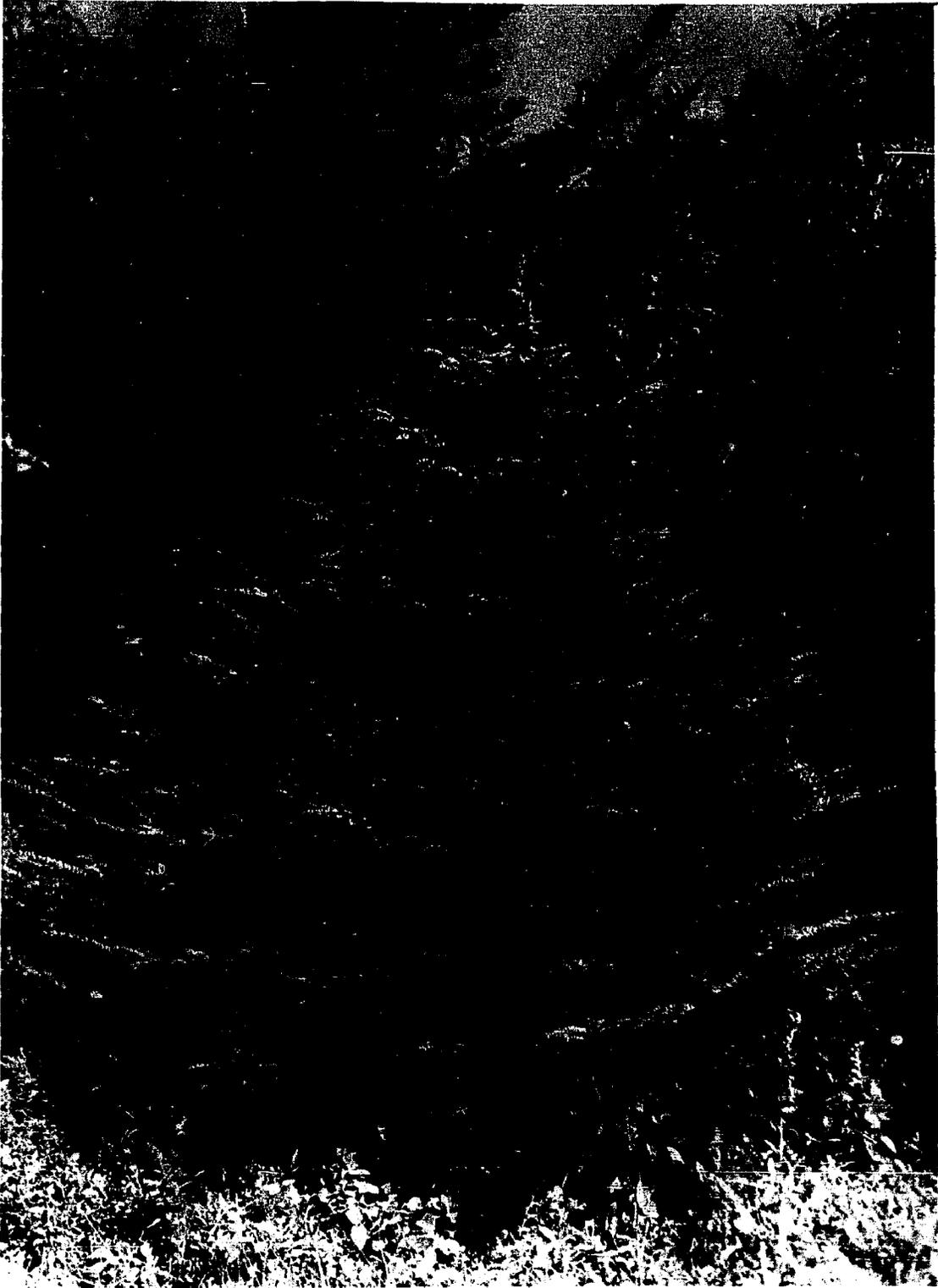


Figure 50. BLUE JAPANESE YEW, type plant at Hiti Nursery, Pomfret, Connecticut.

Clon GOLDTIP JAPANESE YEW Taxus cuspidata aurescens Rehder

T. tardiva aurea Hort.

T. cuspidata tardiva aurea Hort.

T. cuspidata var. aurescens Rehder

T. cuspidata nana aurea Hort. ex Wyman (95)

Rehder (65) gives as a source "... Japanese dealers who offer it as 'Taxus tardiva yellow-variegated.'" The nursery that donated the plants in group 62 in the Secrest Arboretum received them as T. cuspidata tardiva aurea, indicating that the Japanese regarded this clon as a golden form of the CUSHION JAPANESE YEW.

According to Rehder (65), this clon is the first variegated form of the Japanese Yew in cultivation. It is a low, compact, very slow-growing shrub, Figure 42, with the young terminal leaves bright golden yellow changing to green with age; those on the tips may remain yellow all winter. Leaves thick, leathery and radiating from twig much like those of CUSHION JAPANESE YEW but not so wide.

Twigs are orange red, turning olive green with the leaves and brown the second year. Twig growth very short on all-yellow plants, only one or two inches per year. Plants are severely damaged by rabbits.

Wyman (95) considers this clon identical with the "T. cuspidata nana aurea," Figure 51, at the G. R. Hall estate, Bristol, Rhode Island. The author reserves judgment until cuttings of both plants can be grown together. The very

old Hall plant is much coarser and faster growing, which may be due to age and site. However, Rehder collected a herbarium specimen from the Hall plant in October 1923, four years after he had described the clon T. c. aurescens Rehder, and labeled the Hall specimen "Taxus cuspidata var. nana fol. varieg." The Rehder collection is identical in growth rate and appearance to a collection by the author in August 1954. This plant is identical to the low, dark green type of DWARF JAPANESE YEW, except for the golden color of the younger leaves, Figure 51.

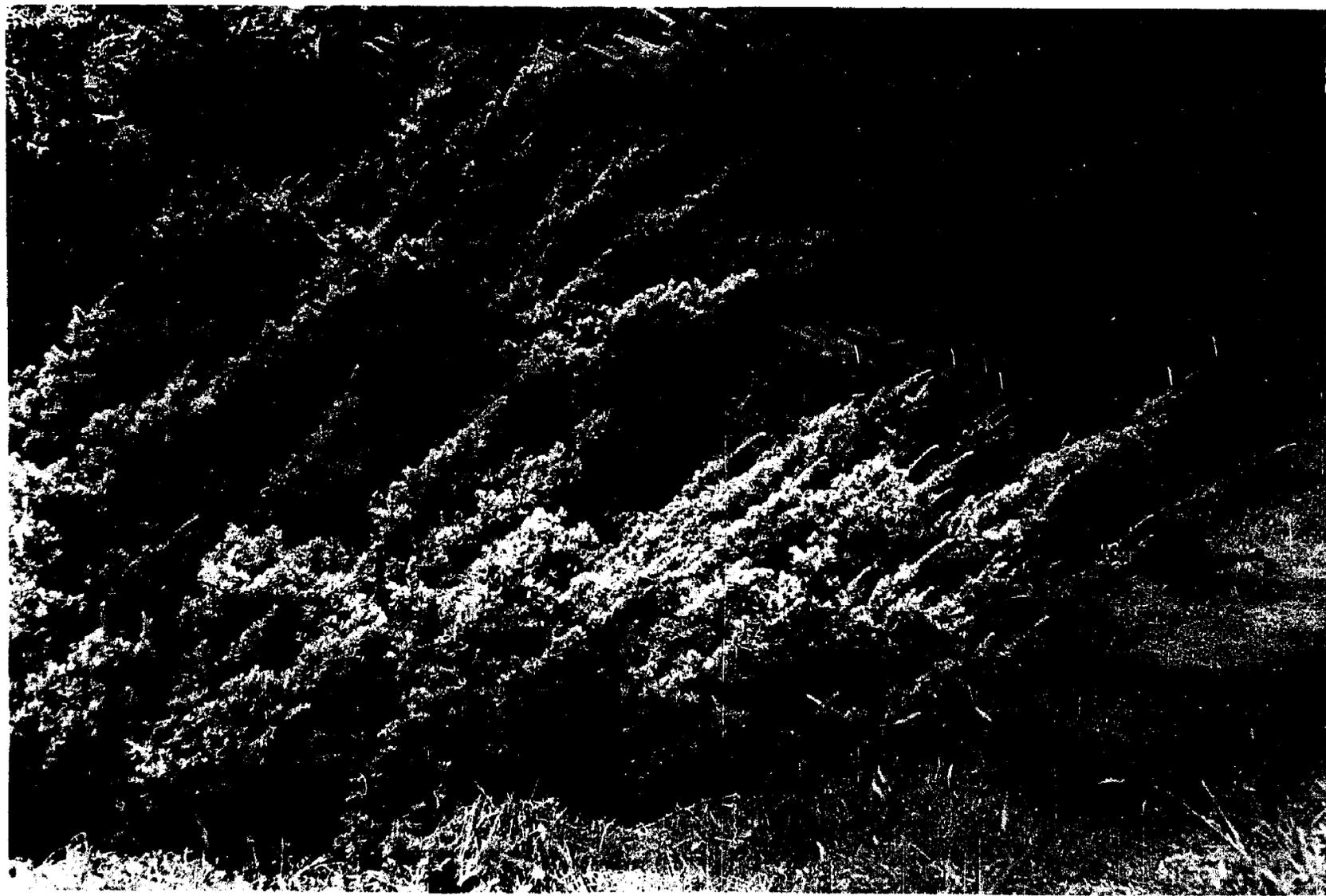


Figure 51. GOLDTIP JAPANESE YEW, $6\frac{1}{2}$ feet high by 27 feet spread. On a portion of the G. R. Hall estate, Bristol, Rhode Island.

Clon HITI JAPANESE YEW

Taxus cuspidata hiti Hort.

This old clon has not had general acceptance in the trade. It was selected from a block of T. cuspidata seedlings at the Hiti (pronounced Hī'tē) Nursery, Pomfret, Connecticut, about 1925. In the Secrest Arboretum it is represented by group 61, which were narrow columns when received but are now dense vasiform plants.

This male clon is a pyramidal to broad columnar shrub or small tree of moderately rapid growth. Branches strongly ascending, almost fastigate, with a characteristic whorl of strong secondary branches at the apex of the previous season's growth, Figure 52. Winter buds large, ovate, sometimes stalked, clustered near apex of twig. Pollen cones large, sparsely scattered. Leaves dark green above, in a broad "V" on horizontal twigs, to a deep narrow "v" on ascending branches, exposing the lighter yellowish green stomate bands below; mostly exceeding one inch, broad linear, cuspid, thick-set on secondary twigs.

This clon is quite distinct from the T. "Hiti", Accession No. 814-37-A of the Arnold Arboretum, mentioned by Wyman (95). The Arnold plant is a strongly fastigate, narrow columnar, media form, Figure 53. Colonel R. H. Montgomery, Cos Cob, Connecticut, was the source of the Arnold Arboretum plants.

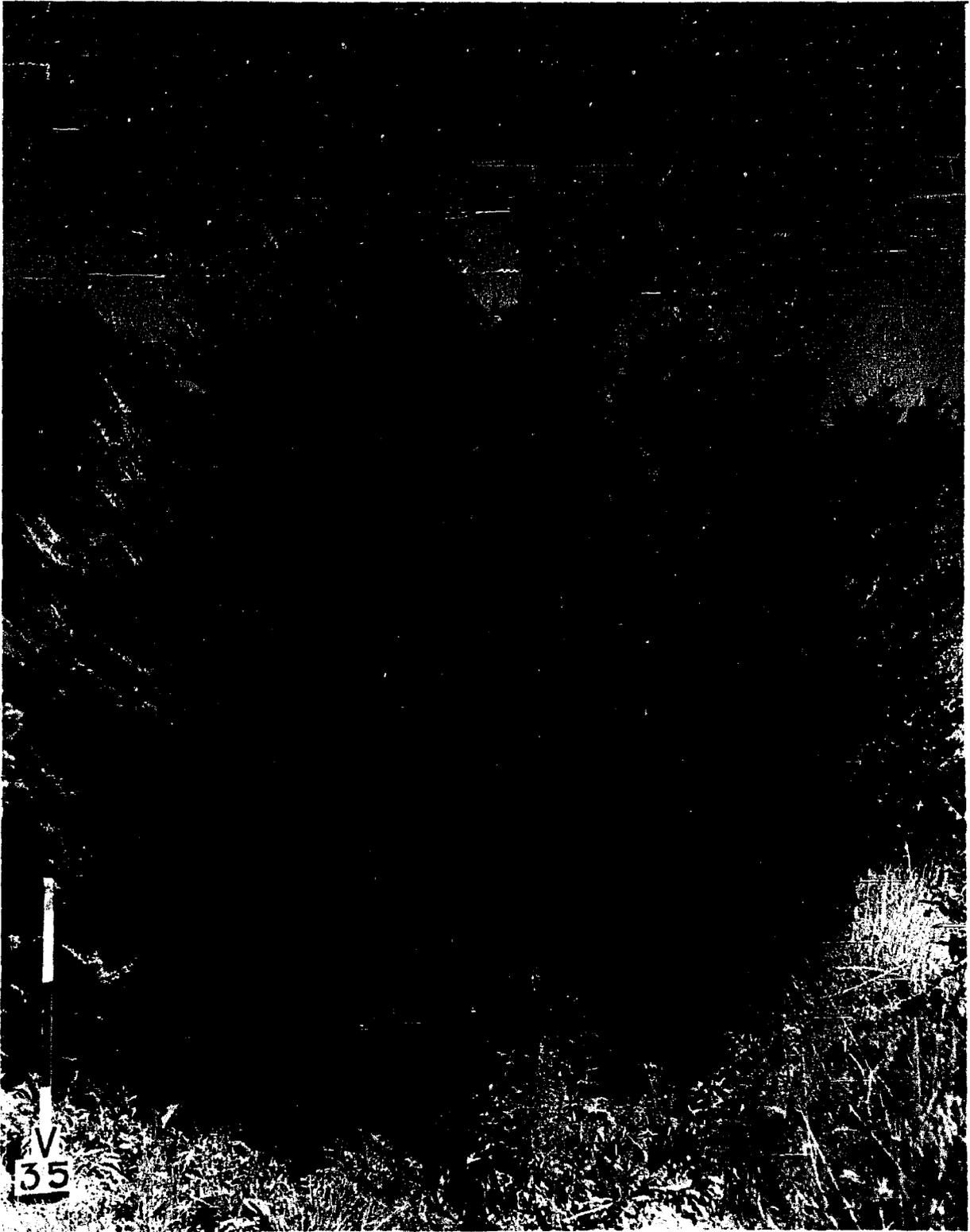


Figure 52. HITI JAPANESE YEW in an old field of the Hiti Nursery, Pomfret, Connecticut. Excurrent plants with true central leaders are called "Hiti erecta" at the nursery.

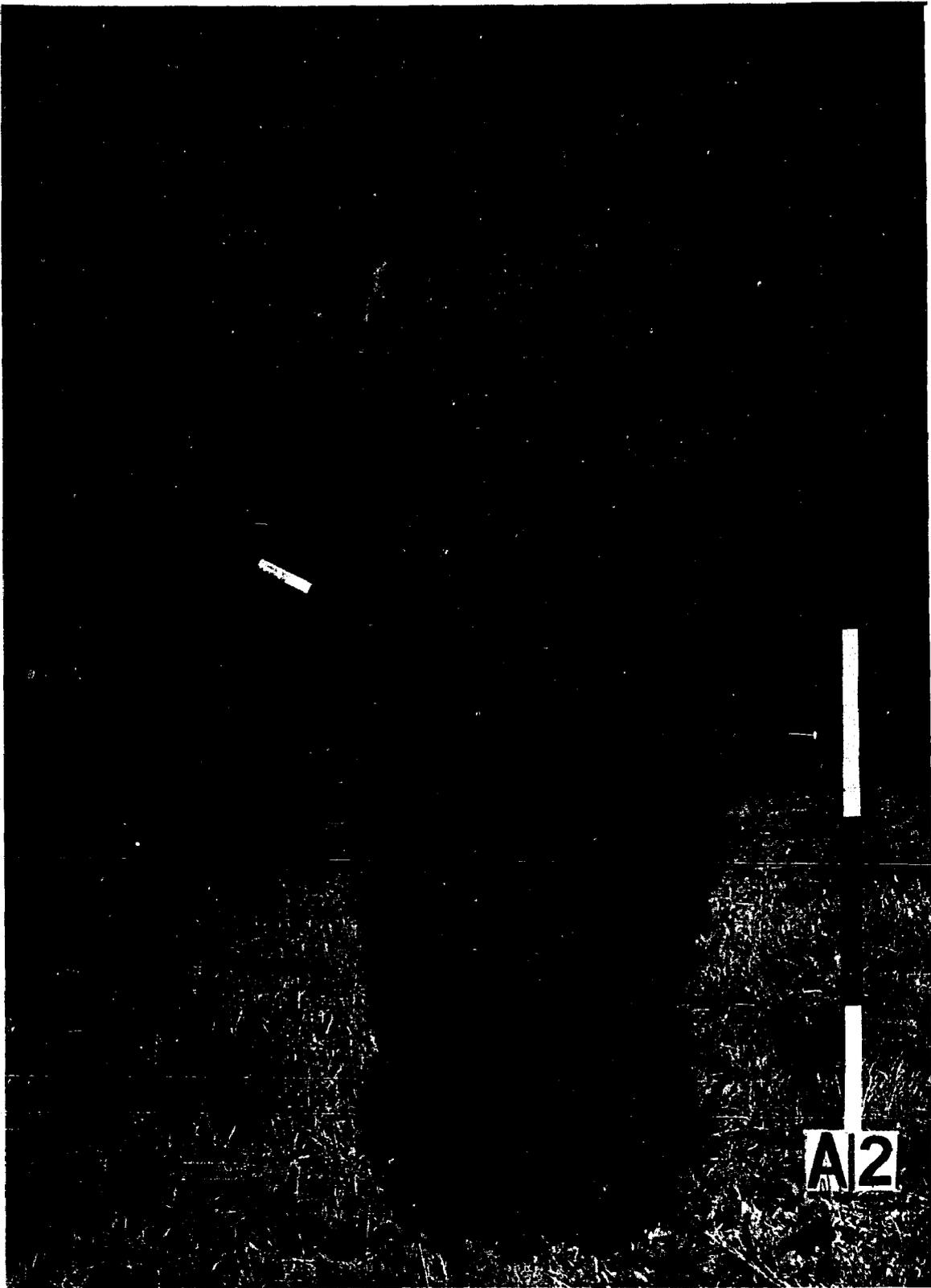


Figure 53. Taxus "Hiti" Accession No. 814-37 at the Arnold Arboretum.

Clon INTERMEDIATE JAPANESE YEW

Taxus cuspidata intermedia Kumlien

Taxus intermedia Hort.

T. cuspidata intermedia upright Hort.

T. cuspidata intermedia capitata Hort.

The INTERMEDIATE JAPANESE YEW was selected and named by Mr. Robert Brown of Cottage Gardens, Queens, Long Island, according to Kumlien (50) (51), who predicted, "Its growth is so much more rapid than the old Dwarf Japanese Yew that it will likely go far to replace this latter variety." The name was intended to convey the habit of growth intermediate between a shrubby T. cuspidata and the DWARF JAPANESE YEW. It is one of the "brevifolia" seedlings grown by T. D. Hatfield.

This clon forms a dense, low-growing, globular shrub while young, almost identical with its parent, the DWARF JAPANESE YEW. With increasing age and size, the growth-rate increases until it is more than twice as rapid as that of DWARF JAPANESE YEW, but the form remains globular, Figure 54, except in those plants that have a true central leader, which are excurrent and conical. Growth begins a week to ten days ahead of DWARF JAPANESE YEW.

Twigs slender and turning brown the second season as in the Japanese Yew. Leaves dark glossy green, broad, thick and leathery as in the DWARF JAPANESE YEW, mostly radiating around the twig, especially on young plants and

secondary branchlets of older plants, or in a deep pectinate "v" on vigorous horizontal or ascending twigs, with the older needles at the base of the mature twig often more than twice as long as the apical leaves, the intervening leaves graduated to give a tapered effect.

A female clon with medium crops of rather late-maturing seed. Aril globose to subglobose, 10 mm. by 8 mm., slightly exceeding the nutlet; opening elliptical, as large as the seed or a thin slit. Nutlet dark brown, small, 4 mm. by 5 mm., very broad ovate, apex obtuse, 2-4 angled, but mostly 2-angled. Hilum small, depressed with slightly raised center, margin slightly puckered.

This clon was in the first planting of the Living Herbarium of Taxus in Secrest Arboretum, in group 35. It is quite winter-hardy, but is often damaged by spring frosts because it begins growth so much ahead of other Yews.

There are a number of T. media clons and many of the "upright brevifolias" of an earlier day which resemble this plant while young. As a result there are several different "Intermedias" in the trade. Some, such as Sebian's, are distinct enough and superior enough to be named. Others should be discarded since they are inferior.



Figure 54. INTERMEDIATE JAPANESE YEW in the Secrest Arboretum. Younger plants resemble the DWARF JAPANESE YEW.

Clon PROSTRATE JAPANESE YEW

Taxus cuspidata prostrata Chadwick

T. cuspidata "Flat Type" Hort.

This clon originated as a seedling at the Evergreen Nursery Company, South Wilton, Connecticut, before 1937. It should be more widely grown, because its horizontal lines are ideal for use with contemporary architecture.

A very vigorous, wide-spreading and somewhat open-centered shrub, $3\frac{1}{2}$ feet high by 10 feet wide and making about eighteen inches of new growth annually, Figure 55. The branches are horizontal to slightly ascending with de-curved tips. Considerable lateral branchlet growth occurs on the more vigorous twigs which continue to grow until stopped by cold weather.

Leaves dark green above, yellow green or light olive green below; arranged pectinately flat in one plane on horizontal and shaded branchlets, and in a narrow "V" on ascending branches, which exposes the broad stomate bands, imparting a yellowish color to the plants in winter. The yellowish winter color is increased by the abundant crops of large, prominent pollen cones.

The plants in group 14 of the Secret Arboretum are quite winter hardy, showing only slight leaf damage in the most severe winters. The ultimate size is not known.



Figure 55. Clon PROSTRATE JAPANESE YEW in group 14 of the Secret Arboretum. These plants, $3\frac{1}{2}$ feet tall by 9 feet spread in 1954, were ten to twelve inch transplants in 1942.

Clon PYGMY JAPANESE YEW

Taxus cuspidata minima Slavin

This clon originated from a seedling plant discovered in 1918 by Mr. Bernard Slavin (80), Superintendent of Parks, Rochester, New York, according to Hornibrook (43).

It is an extremely dwarf, picturesque clon, reaching a height of fifteen inches in twelve years, Figure 56. Plants globular, strongly erect, making one to two inches of twig growth annually. Bark of exposed twigs bright cinnamon brown to red. Leaves dark glossy green above, turning red where exposed to sun in winter, thin, mostly less than one-half inch long; characteristically longest at beginning of season, giving the twig with its close-set radiating leaves a tapered appearance which is repeated each season.

This type of plant appears to recur rather rarely; though, if common, it would tend to be lost in commercial practice. A similar plant is described by Hornibrook (43) under T. cuspidata var. pygmaea Hornibr. Another similar female clon was presented to the Living Herbarium of Taxus by the Bobbink & Atkins Company under the name "T. cuspidata capitata with Carolina Hemlock Foliage." The name BOBBINK JAPANESE YEW is proposed for this clon. Needless to say, these plants are even less popular with American nurserymen than the clon CUSHION JAPANESE YEW.



-129-

Figure 56. Clon PYGMY JAPANESE YEW, fifteen inch plant in nursery row, Highland Park, Rochester, New York.

Cultivar THAYER JAPANESE YEW

Taxus cuspidata thayerae Wilson

T. cuspidata form Thayerae Wilson

T. media thayeri Hort.

T. media andersoni Hort.

T. cuspidata andersoni Kumlein

This cultivar was grown from the seed of a single plant of T. cuspidata by Mr. William Anderson, Superintendent of the Bayard Thayer estate of South Lancaster, Massachusetts, according to Rehder (70). Wyman (95) claims that the parent plant was intermediate between T. cuspidata and T. cuspidata nana, and adds that the seedlings were planted in 1916 or 1917. Wilson (91) and Rehder (70) considered the "seedling plants," selected and sent to the Arnold Arboretum by Mr. Anderson in 1924, to be a dwarf form. In 1941, Wyman (95) gave the dimensions of these plants as approximately 8 feet tall by 16 feet spread. In 1954, these plants were observed to be about 11 feet tall with a diameter or spread of 26 feet, Figure 57.

It is a wide-spreading, fast-growing shrub with the center well-filled, giving a salable plant one year or more ahead of the species. The branches strongly ascending on small plants, becoming more horizontal with age, the lower branches drooping. Younger salable plants in the nursery often presenting a wide vase or globular shape, according to training, becoming rectangular in profile with age,

Figure 57. The terminal growth of vigorous branches often showing a sinuate ascending curve with nodding apex, forming a shallow "S". Secondary branches often variously curved, and not rarely, inverted.

The leaves are rather narrow, somewhat tapering, acute and somewhat falcate; close-set in two-ranked flat planes at almost 90° to the twigs on horizontal or drooping branchlets, or on ascending terminals, wide spaced in a deep pectinate "V", exposing the contrasting olive green of the broad stomate bands, which become almost yellow in winter sun. The leaf margin and midrib below a very narrow line.

All plants examined have been female with medium to heavy crops of somewhat late maturing seed; twin seeds are common. The aril scarlet, large, globose, 10 mm. broad by 11 mm. long, exceeding the nutlet by one-third; opening as large as seed, elliptical or squarish. Nutlet broad ovate 4 mm. by 6 mm., brown with glaucous apex when fresh, apex obtuse and 2-angled. Hilum elliptical with a raised center, the margin or neck ribbed or puckered.

Since the original plants were a group of seedlings, there is some variation in this cultivar, and differences can be seen in the "Andersoni" and "Thayeri" plants offered by some nurseries. Other nurseries fill orders for both names from a single block of plants, rightly regarding the name Andersoni as a synonym. Kumlien (50) reported that a

few plants of "andersoni" were sold as "Taxus cuspidata thayeri," but the latter name was later applied to a different plant. The author has been unable to confirm this statement; however, the plants figured as Anderson Yew by Kumlien are T. cuspidata thayerae. Mr. Anderson released this Yew commercially through the Cottage Gardens, Queens, Long Island. In the Secret Arboretum the plants in group 77 received as "T. media andersoni," and group 74 received as "T. media thayeri," were propagated from stock plants purchased by their respective donors from Cottage Gardens. The plants in group 17 were propagated by their donor from the plants in the Arnold Arboretum.

Wyman (95) points out that this Yew will not likely come true from seed and should be propagated vegetatively. In the author's opinion this cultivar could easily become a clon because a majority of the plants in the trade are of a single kind, the inferior sorts having been discarded, and the "seedlings" at Arnold Arboretum show a remarkable uniformity and lack of central leaders to be true seedlings.



Figure 57. THAYER JAPANESE YEW in the Arnold Arboretum. The rectangular outline is characteristic of old plants.

Taxus floradale Hort.

This large evergreen shrub or small tree to 25 feet occurs only along a short section of the eastern bank of the Apalachicola River in Gadsden County in northwestern Florida, between the towns of Bristol and Aspalaga, according to Sargent (75). The bark is purplish brown, scaling from the trunk and larger branches. The purplish brown color extends to the slender third season branchlets. Twigs very slender, green two years, ascending on young plants, but somewhat drooping in flat sprays on older trees, usually making two flushes of growth annually on young plants.

Leaves quite slender, falcate, three-fourths to one inch long, thin, bright glossy green above, linear or very slightly tapered, the apex cuspid to acute with a sharp cartilaginous point. Petiole very short, leaf almost sessile. The stomate bands below gray green, broad with very narrow somewhat revolute or cupped margins and narrow midrib. The midrib raised about one-half the length of the leaf above. Leaves usually pectinate in flat sprays, but may be in a broad irregular "V" on upper side of ascending twigs.

Both Sargent (75) and Harrar (34) show the scarlet aril only partly enclosing the yellowish brown nutlet. Winter buds smaller than T. baccata, ovate, bud scales

persistent, thin, not keeled.

Timber is too scarce to have commercial importance for lumber, according to van Dersal (87). However, large specimens of this tree have become extremely rare because of the local demand for the wood for fence posts, the wood being unusually durable in low, wet areas.

Hoopes (42), in 1868, speculated that the northern limit for growing T. floridana would be Philadelphia, Pennsylvania, as it is for Torreya taxifolia. The Upper Bank Nursery, Media, Pennsylvania, lists this species commercially under the name Taxus floradale. Small plants 24 to 30 inches spread were the only size in stock. The problem of winter hardiness is complicated by the long and late growing habit of this species.

T. canadensis stricta Hort. not Bailey

T. canadensis compacta Hort.

T. media hunnewelliana Kumlien

This chance hybrid between T. canadensis X cuspidata was raised from seed of T. canadensis about 1900 by Mr. T. D. Hatfield, gardener on the Hunnewell estate, Wellesley, Massachusetts, according to Rehder (68). At first regarded as T. canadensis; the excurrent plants were being distributed as "T. canadensis stricta" as late as 1936, Figure 58. The hybrid nature of these seedlings was recognized in 1923. The formal description was published by Rehder (68) in 1925. Since this name was proposed for all plants of this parentage, as wide a variation of characteristics must be expected as in the case of T. media with all of its clons. Some of these differences can be seen on close examination of the seedling plants in the hedge around the tennis courts on the Hunnewell estate, Figure 59.

One of the type plants described by Rehder (68) in 1925 is an excurrent tree estimated to be 23 feet high by 28 feet spread with a trunk diameter of 12 inches in 1954.

The plants in the trade are leaderless vasiform spreading shrubs propagated from side branches and mostly of two sorts. One, a short-leafed, low, dense shrub with strongly ascending branches probably from the Arnold

Arboretum plant. The second seems to stem from specimen No. 9 in T. D. Hatfield's specimen tree block on the Hunnewell estate. These plants favor the T. cuspidata parent, having longer, darker green leaves not so closely set, and the branches more vigorous and less ascending than the former kind.

The Hunnewell Yew is intermediate between its parents. It is more vigorous than T. canadensis with stouter branchlets which turn brown the second season. The leaf bases are more swollen and the winter buds are not squarish in cross section; the scales are broader and thicker than in T. canadensis. The leaves are generally larger in all dimensions. The green margins below are much narrower than the stomate bands; they are equal or only slightly narrower in T. canadensis. The larger branches are not prostrate and rooting but ascending. T. hunnewelliana differs also in being excurrent, unless propagated from lateral branchlets, and dioecious, with seed ripening irregularly and later.

The branchlets are more slender and less lustrous than those of T. cuspidata, and usually greenish the first winter. The winter bud scales are narrower than in T. cuspidata, and the ridge or keel less pronounced. The leaves are proportionately narrower and thinner than those of T. cuspidata and less cuspid, almost acute. The undersides of the leaves have less yellowish color.

T. hunnewelliana is represented in the Secret Arboretum by groups 88 and 78, and a severely pruned specimen in the old Taxus Section.



Figure 58. Taxus X hunnewelliana received at the Arnold Arboretum as "T. canadensis stricta" in 1936. Leaderless plants resemble the lower half of the plants.

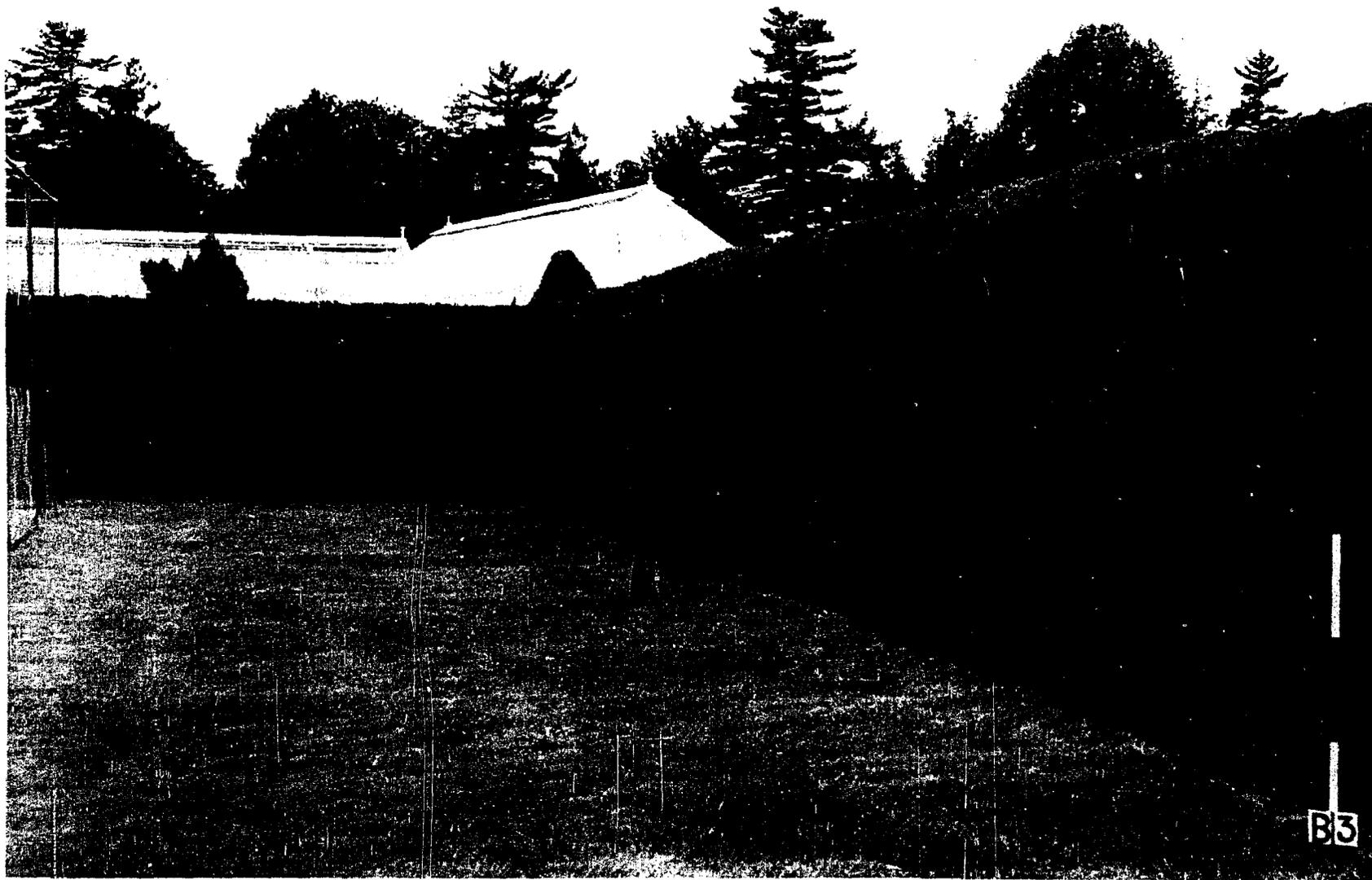


Figure 59. Formal hedge of seedling T. hunnewelliana on Hunnewell estate. These plants show minor differences in color, sex, foliage and growth characteristics.

Rehder (67) proposed this name for the hybrids between T. baccata X cuspidata, recognizing that a wide variation of forms were possible "... between different varieties of the parent species which combine the characters of the parents in various degrees." For his type plant he chose a plant figured and described by Hatfield (35) as "ENGLISH YEW AT WELLESLEY. Raised from mixed hybrid seed, and quite indistinguishable from T. cuspidata type in general appearance. It has withstood the severe winters." This discrepancy in name and description is explained in the discussion under "Hatfield Yews." Rehder (67) took cognizance of the difficulty of identification in the statement, "As the two parent species cannot be separated by strong morphological characters it is even more difficult to point out good characters to distinguish the hybrid; the differences become really apparent only by comparison with living plants of the two parent species." Rehder's type plant (67), No. 11270, is no longer in the Arnold Arboretum, but other plants, Figure 60, of Hatfield origin are present.

Hatfield's (36) descriptive names of some of his numbered specimens, Figure 62, give an indication of the range of variation in these hybrids.

In addition to the named clons which are described below, Taxus media is represented by the following groups in the Secret Arboretum: 27, 46, 59, 79, 76, 80, 81 and



Figure 60. T. media in the Arnold Arboretum, No. 10762-B, is a Hatfield seedling. It has grown to one side because of the shade trees on the south.

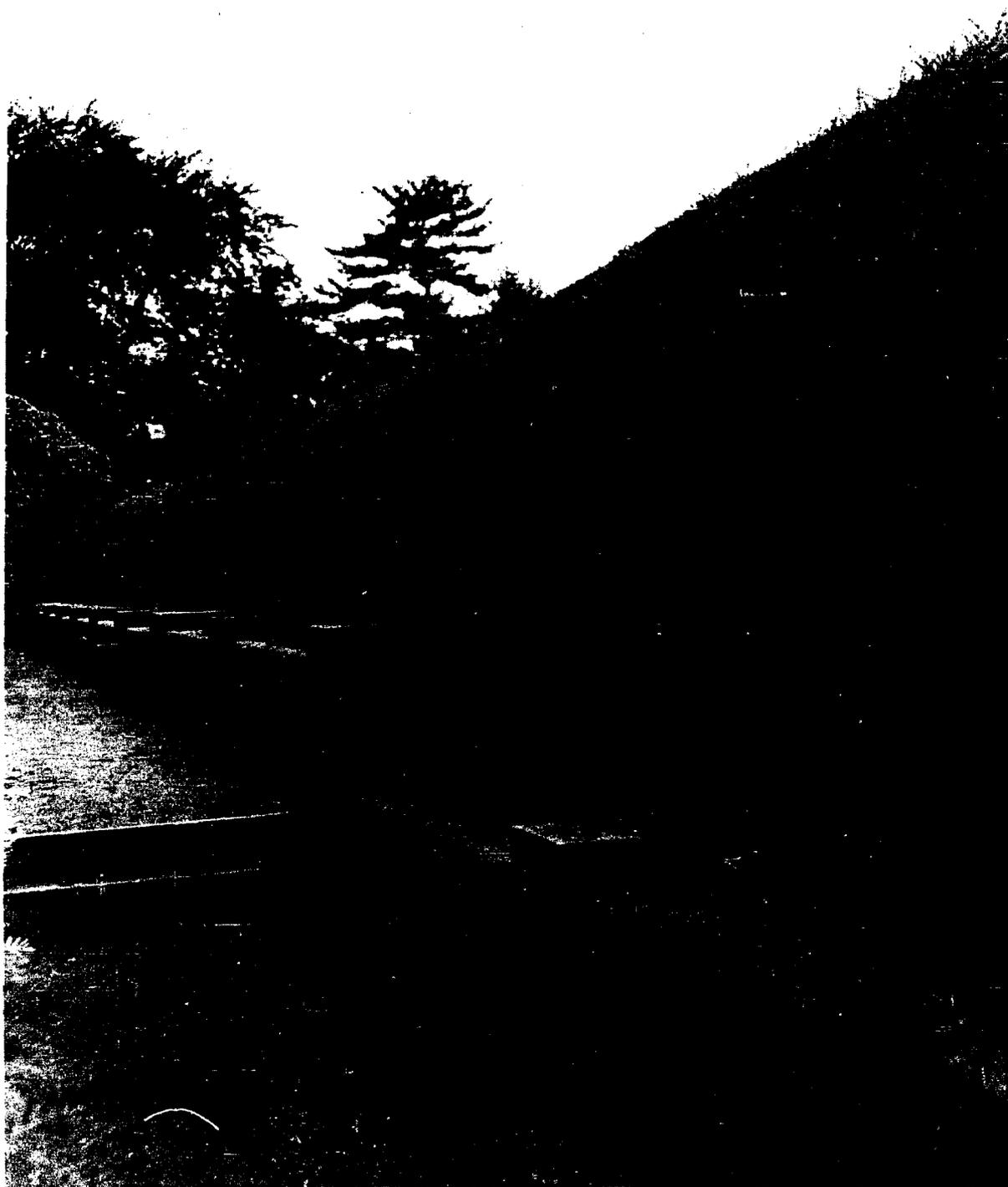


Figure 61. Seedling Taxus media hedge on the Hunnewell estate, Wellesley, Massachusetts, planted by T. D. Hatfield about 1920. It has been a source of both seed and cuttings.

92. Included are the T. media numbers that T. D. Hatfield did not name, which are discussed under "Hatfield Yews," on the following pages.

The Hatfield Yews

Much of the popularity of Yews is due, at least in the early years, to the work of T. D. Hatfield, head gardener at the Hunnewell estate, Wellesley, Massachusetts. In addition to raising the first recognized hybrids and distributing them widely, he wrote popular articles (35) and lectured on their merits (36). As early as 1866, the Hunnewell estate received some of the first T. cuspidata and T. cuspidata nana plants (called "T. brevifolia" at that time) released by the Parsons Nursery from Dr. Hall and also imported direct from Japan. Additional plants were received from the Arnold Arboretum from seed collected by Professor C. S. Sargent in Japan before Mr. Hatfield came to America. Hatfield found a "T. baccata sieboldii" at Waterer's Nursery in England, which he imported to the Hunnewell estate. This was reported to be from China, but he recognized that it definitely was not T. chinensis, but probably T. cuspidata, from its winter hardiness. He considered the twigs thinner and the color more olive than the type. His statement that "It comes true from seed in so far as the color and general character goes, but many of the seedlings develop a leader, which the original does

not,..." indicates that he was unaware of the effect on growth habit of orthotropic and plagiotropic propagation wood. His remark that "T. b. Dovastoni was disposed to spread rather than get up,..." further confirms this, because otherwise the DOVASTON YEW is excurrent, Figure 17.

Professor C. S. Sargent had observed that Mr. Hatfield "seemed to have a nurseryman's instinct for propagating plants" because he was always propagating the rare and unusual plants on the estate. These young plants were often presented to friends of his employer, both here and abroad. Surplus plants and seed were also sold to nurseries. Seed of T. cuspidata was sold at one dollar per thousand seeds, while seed of T. media brought a fifty cent premium in the seed lists published by Hatfield (36). The F. & F. Nursery, Springfield, New Jersey, raised a seedling from seed purchased from Hatfield which has had wide acceptance as "T. cuspidata compacta." The name compacta is a homonym and cannot be applied to this plant which is probably a T. media clon. The excellent plants in group 27 of the Secret Arboretum are of both sexes and have other small differences which must be resolved before the clon can be named and described.

Mr. Hatfield's names (35), indicate that he did not recognize the hybrid character of his early seedlings of the Irish, Dovaston and Canadian Yews. His "Second Irish," "English," "Dovastoni upright," "canadensis stricta,"

- Years
1. 1. a 2. 3 Hatfieldii late media
acc. 9-10
- 4 Brownii
- 5 " No 2
6. 7. 8 second Irish
9. 10 Hummelliana Canadensis
x cuspidata
11. 12. Seiboldii
13. English near road pyramidal
- 14 " Flat leaved, fruiting
- 15 Dovastoni, upright
- 16 17. 18. pyramidal. (Cusp x lacinate)
19. orbicular
- 20 dark leaved, media-medium
21. 22. media medium
23. 24 upright brevifolia
25. Chinensis
- 27 ~~No~~ nondescript
- 28 Irregular brevifolia (up)
- 26 seedling upright 1928.

(pencil note)
 late media
 acc. 9-10
 iron hand

Figure 62. Photograph of T. D. Hatfield's list of numbered plants in his trial block in 1928. The penciled note in the upper righthand corner is by his son, Mr. William H. Hatfield.

"upright brevifolia," and "Irregular brevifolia" were as descriptive as they were apt, Figure 62, and continue with us today.

These seedlings were put in a test plot in an exposed area where only the more tender of the "plants of English and Irish blood" were injured during ten winters, "...but finally there came a winter which made between the English and Japanese types a distinction more decided than any botanist could." About ten percent were uninjured; "the other ninety percent were sent to Mr. T. A. Havemeyer of Long Island where they enjoy a more salubrious climate,..." from whence some found their way into the nursery trade. Of those retained, one of the best "English" plants was selected as the type plant for the hybrid genus T. media by Rehder (67), and the best of the "Irish" he named T. media hatfieldii after Mr. Hatfield. Others in this group were assigned names by Mr. Hatfield in honor of his friends: Browni for Mr. R. T. Brown, Sewelli after the family physician, and Wellesleyana after the village. One of his "Upright brevifolia" seedlings of T. cuspidata nana with a propensity for twin fruits furnished Mr. Brown of Cottage Gardens, Queens, Long Island, with Wardi, in honor of Mr. Brown's employer. Its merits were likewise recognized in material furnished Mr. Harry Deverman, who called it "Cliftoni" after the New Jersey location of his nursery. Another "Intermediate form" seedling of T. cuspidata nana

was the T. cusp. intermedia introduced by Mr. Brown.

Other plants were used for specimens and hedges on the estate, Figure 61. A few of the best were planted in a nursery near his home and assigned numbers, Figure 62, from whence they were introduced into the trade by purchase, gift and theft. These "Hatfield Numbers" are to be found in the stock blocks of some of the older nurseries and occasionally appear in the trade. The original plants are still standing on the Hunnewell estate where they are good sized excurrent trees. Most of the labels are lost, and some of the better plants have been removed to other locations on the estate. Some of these plants are hardly worthy of a name, being excelled in growth rate and habit by superior clons which are in the trade. Numbers 6, 7 and 8, Hatfield's "Second Irish," are in the trade as "T. m. irish." Number 8 is male with bright green radial leaves and dense compact habit. It is reported quite heat- and drought-resistant, by the late Mr. C. R. Runyan, Superintendent of Spring Grove Cemetery, Cincinnati, Ohio. Numbers 6 and 7 are female with the latter bearing heavier crops of later maturing seed. After Mr. Hatfield's death, Mr. Richard Wyman purchased the surplus stock, from which he selected T. media wymani, and named material propagated from the seedling hedge, Figure 61, "T. m. brevicata."

Mr. Hatfield must have been fortunate enough to find a male-sterile Taxus canadensis from which he picked the

seed that produced the excurrent "Taxus canadensis stricta" that was later named Taxus hunnewelliana by Rehder (68). He considered T. canadensis to be dioecious; however, all plants examined by the author, including those on the Hunnewell estate have been monoecious. Hatfield stated that this plant was isolated at least one hundred feet from other T. canadensis, with several T. cuspidata near by. The seedlings raised by Mr. Hatfield are definitely hybrids and remarkably uniform in habit, even for F₁ hybrids, Figure 59.

These Yews, along with some of the better Japanese clons, were early sent to Holland by Dutch-American nurserymen who had their propagation done abroad prior to the passing of Quarantine Law 37. From such imported hybrid material were selected the clons HILL ANGLOJAP YEW, COLE ANGLOJAP YEW and others. Thus the total contribution of new Yews by Mr. Hatfield is far larger than generally realized.

Clon ANDORRA ANGLOJAP YEW

Taxus media andorra

T. cuspidata fastigiata Hort.

T. cuspidata erecta Hort.

T. baccata erecta Hort. not Loudon

This excellent clon originated as a fastigiata sport in the center of a spreading "cuspidata type" plant in the Andorra Nurseries, Philadelphia, in 1916. The possibility of a "stray" grafted plant should not be overlooked.

A conical or ovate shrub with a central leader and appressed fastigiata branches densely set with short branchlets, Figure 63. Leading shoots rather stout with soft leathery bark like that of DWARF JAPANESE YEW but less pronounced. Leaves mostly radial, glossy green with prominent midrib above, light olive green stomate bands below with narrow margins and midvein; mostly straight, about one inch long, slightly tapered to an acute apex. Compared with the clon MOON the leaves are larger and longer; they are lighter green than those of COLE which they otherwise resemble; they are smaller and more dense than those of the clon HICKS.

Seed crops heavy; aril subglobose, scarlet, 9 mm. broad by 8 mm. long, hardly exceeding the nutlet, opening elliptical to squarish, or circular with angular interior if exceeding the nutlet; nutlet brown, broad ovate, acutely 2-4 angled, 4-5 mm. broad by 6-7 mm. long, hilum ellipsoid to squarish, depressed angles with raised center, margin



Figure 63. ANDORRA ANGLOJAP YEW in the Living Herbarium of Taxus.

fluted and slightly necked. In the Secret Arboretum, group 16, this clon has never shown any winter damage.

Clon BLACK ANGLOJAP YEW

Taxus media nigra Chadwick

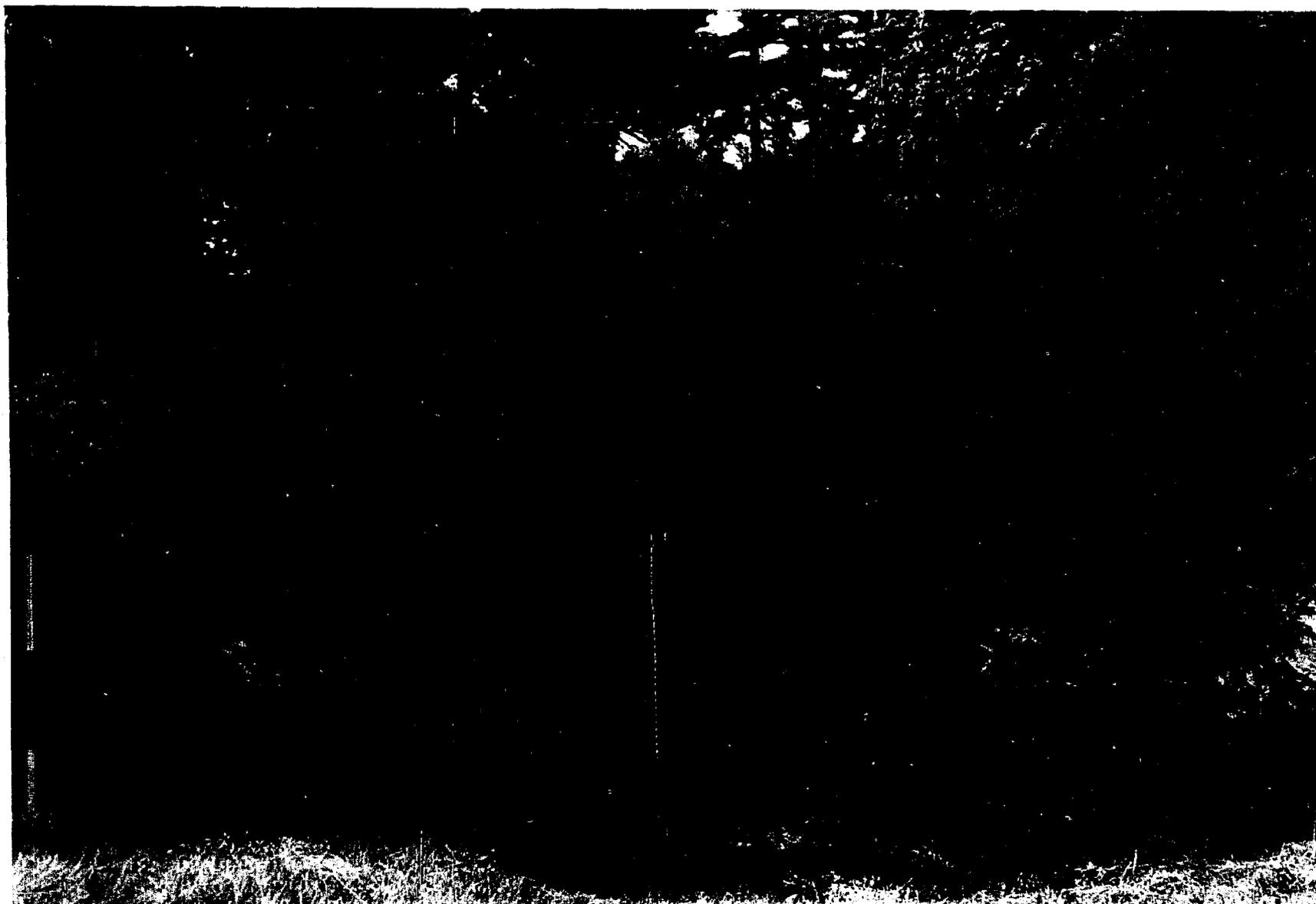
T. cuspidata nigra Hort.

T. media nigra Hort.

The origin of this clon is unknown, but it was introduced by Mr. Robert T. Brown of Cottage Gardens, Queens, Long Island, before 1928. This early date and its tenderness would point toward the tender hybrids which Hatfield (35) sent to Long Island about ten years earlier. Other "nigras" have been introduced later by various nurseries.

This male clon is a globose or spreading shrub with erect or ascending branches of moderate growth, Figure 64. Twigs slender, olive green, turning reddish in winter sun. Tips of vigorous twigs decurved. Leaves slender, to $1\frac{1}{4}$ inches, tapering and acuminate, dark glossy green with prominent midrib above, becoming reddish or purplish in winter sun. Under side of leaves yellowish green with midrib and green margins mere lines, arranged pectinate or scattered on upper side of twigs but irregularly curved, arched and twisted to give a distinct "curly" effect.

Pollen cones abundant, large, and the first to reach anthesis. The plants in the Secret Arboretum, groups 25 and 66, are heavily worked by bees as a source of early pollen. The foliage is somewhat tender and subject to some



-153-

Figure 64. BLACK ANGLOJAP YEW in the Arnold Arboretum, 7 feet high by 14 feet wide.
It was planted in 1928.

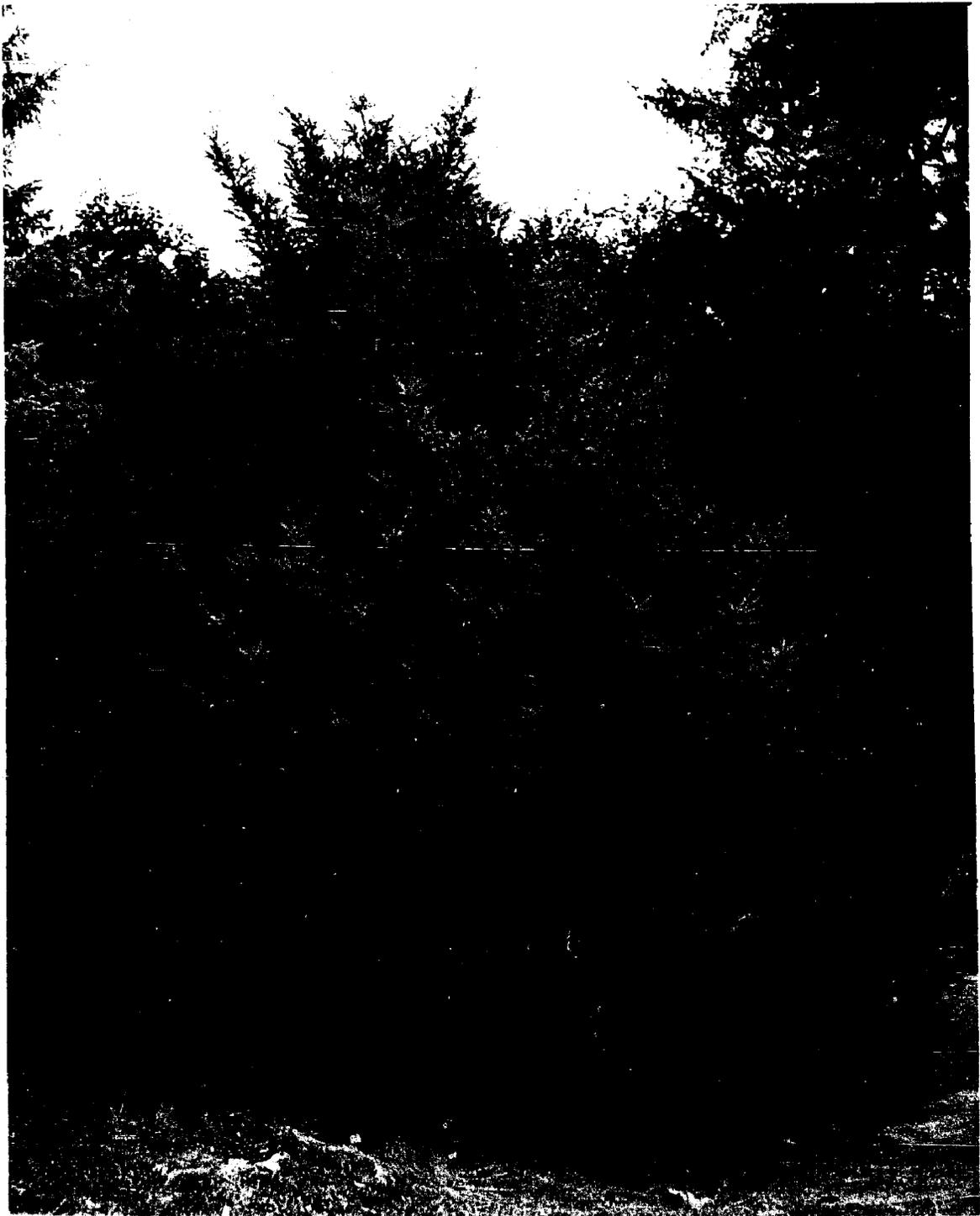


Figure 65. BROWN ANGLOJAP YEW. This excurrent seedling plant is in T. D. Hatfield's original trial block on the Hunnewell estate, Wellesley, Massachusetts. It measured 17 feet high by 18 feet spread in August 1954.

pollen cones in winter and early spring make this clon easily recognized by the practiced eye.

One of the hardiest Yews, it is grown in shade as far west as Kansas and Iowa with little winter damage. This clon is represented in the Secret Arboretum by group 94 and odd plants received in mixture with other clons.

Clon COLE ANGLOJAP YEW

Taxus media coleana

T. baccata erecta Hort. not Pilger

T. erecta Hort.

T. cuspidata erecta Chadwick

The Cole Nursery Company of Painesville, Ohio, discovered this clon in a lot of imported HICKS ANGLOJAP YEW. It was introduced because it is more dense and hardier than HICKS, showing only slight bronzing of the leaves on the southwest side of the plant in winter, which disappears in early spring.

This clon forms a broad columnar fastigiata shrub, Figure 66. Twigs stouter than clon MOON but thinner than clons ANDORRA and HICKS, with leaves more close-set and growth shorter than clon HICKS, which it resembles when small. Leaves dark glossy green with prominent midrib above, grey green stomate bands, or yellow green in sun, with margins and midvein as in the clon HICKS; rather plump and leathery, often exceeding one inch, broad at the base and tapering to a somewhat cuspid apex. Hardier and less

winter leaf damage than HICKS. Seed crops medium to heavy, and late maturing, aril light red, oblate, 10 mm. broad by 7 mm. long, not equaling the seed, opening large, elliptical to circular, or adnate to nutlet and angular. Nutlet large, broad ellipsoid and blocky, 5 mm. broad by 7 mm. long, 2-4 angled but mostly 3-angled, brown with glaucous bloom. Hilum deltoid or squarish, depressed in angles with raised center and puckered or fluted margin.

This clon is represented as T. baccata erecta in the Arnold Arboretum, under Accession No. 682-33; in the Se-crest Arboretum by group 16, where growth has been only 4 feet in twelve years, because of the annual theft of terminal growth for cuttings.



Figure 66. COLE ANGLOJAP YEW in the Secrest Arboretum.

Clon COSTICH ANGLOJAP YEW

Taxus media costichi

T. cuspidata hicksii No. 2 Hort.

T. media hicksii No. 2 Hort.

T. hicksii No. 2 Hort.

This male plant was selected from the same lot of seedlings as HICKS ANGLOJAP YEW by Professor Sargent, who considered it a superior hedge plant. Growth and appearance are much like that of HICKS. However, COSTICH ANGLOJAP YEW is more rapid growing and more narrow and erect if left unpruned. The original plant was adjacent to that of the Clon HICKS, and the plants have often been mixed in the trade. COSTICH ANGLOJAP YEW is somewhat less damaged by winter burn than is HICKS. Pollen cones are abundant, and conspicuous when shedding their pollen in March.

This clon is found mixed with other plants in the Secret Arboretum in group 48, plants A and E, Figure 67, and plants A, D and E in group 67.

Clon DUTWEILER ANGLOJAP YEW

Taxus media dutweileri

T. media dutweileri Hort.

T. media dutweileri Chadwick

This clon was selected by Mr. Dutweiler, foreman at the Hicks Nurseries, Westbury, Long Island. One of the original plants is in the Friends Cemetery, Westbury, where it is closely sheared into a hemisphere 5 feet high by 7 feet wide. Plants were sent to Cornell University where

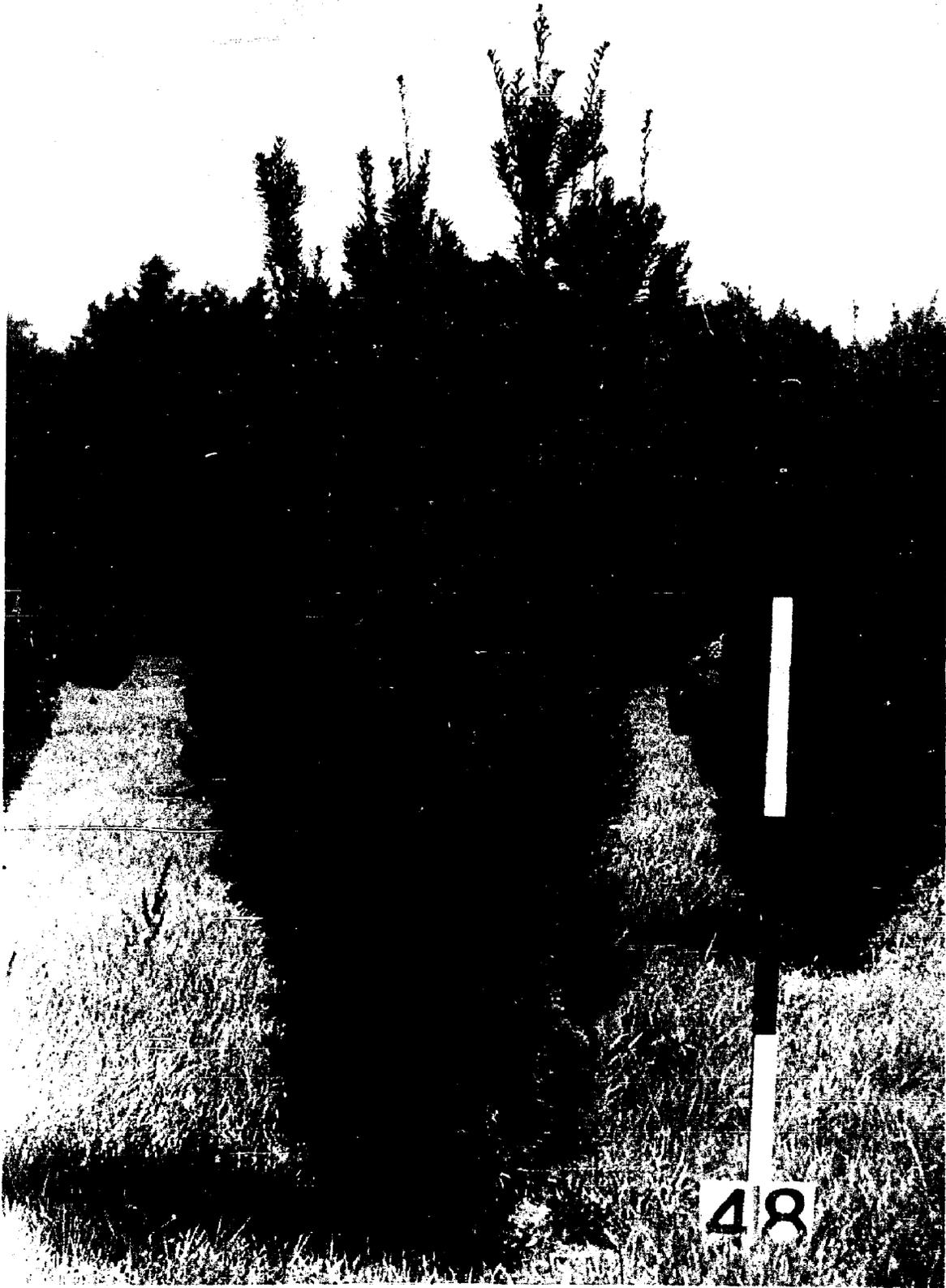


Figure 67. Clon COSTICH ANGLOJAP YEW in the Secret Arboretum. This male clon is often found mixed with the clon HICKS ANGLOJAP YEW, but is more rapid and less spreading in growth habit.



-161-

Figure 68. DUTWEILER ANGLOJAP YEW in the Secrest Arboretum.

they were catalogued as T. cuspidata dutweeleri, Item 131-31. They were catalogued as Item 40-17 and planted in area 2-12 on May 22, 1940. Cuttings sent from Cornell to the donor of group 75 in the Secret Arboretum were grown and are sold as dutuilerdi, thus furnishing the classic example of a name changing each time the plant changed hands! Only two plants, D and E in group 75, have survived; plants A, B and C are the clon VERMEULEN ANGLOJAP YEW which were planted as replacements.

This rather indistinct male clon forms a dense vase-form or spreading shrub with ascending branches, Figure 68. Twigs yellow green becoming olive green the second year or reddish where exposed to the sun. Terminal buds large. Leaves thin, tapering, less than one inch long, nearly straight, bright glossy green above, olive green to orange below. Arranged pectinately, flat in one plane or in a broad "V" on ascending leaders. Pollen cones large and prominent in winter, but not very abundant. Growth moderate, 6 to 12 inches per year, but branching freely without shearing to make dense well-formed plants in a short time. It was probably for this characteristic that this clon was selected. It is, therefore, the forerunner of many more popular clons in the trade today. DUTWEILER ANGLOJAP YEW is handled by very few nurseries.

Clon HATFIELD ANGLOJAP YEW Taxus media hatfieldi Rehder

T. hatfieldii Hort.

T. media hatfield No. 2 Hort.

T. hatfield upright Hort.

This male clon was named after T. D. Hatfield by Rehder (67). It was the best of the seedling "Irish Yews" produced at the Hunnewell estate; see "Hatfield Yews," page 144. This clon is represented in the Secret Arboretum by group 86 except plant B, and plants B and C in group 95. A few additional plants have been included by accident in other groups.

Plants columnar or pyramidal while young, as grown by most nurseries, with appressed fastigiate branches, Figure 69. Left unpruned the plants are more spreading and loose, Figure 70. Hatfield's original seedling, reportedly dense and conical without shearing in the true sense of the word, had a crop of cuttings removed annually. In addition to this, his son William told the author that his father was wont to "nip all yews back a little with a knife to keep them in shape." Secondary branchlets appressed and abundant.

Leaves straight mostly spirally radiating and close-set, especially on the secondary branchlets, dark waxy green above with prominent midrib. Rather broad and leathery with very slight taper and cuspid apex. Stomate bands below very broad, bright gray-green with very narrow

margins and midrib below. More winter hardy at Wooster, Ohio, than the clon HICKS ANGLOJAP YEW.

"Hatfield Spreader" is not propagated from this clon but from one of the numbered plants in Hatfield's specimen block. It greatly resembles T. cuspidata, but is reported to produce plants with the centers better filled; however, this occurs only with considerable shearing.

The various "Hatfieldi" numbers are discussed under "The Hatfield Yews," page 144. Most of these are no longer in the nursery trade, because they lack the general excellence of HATFIELD and BROWN.

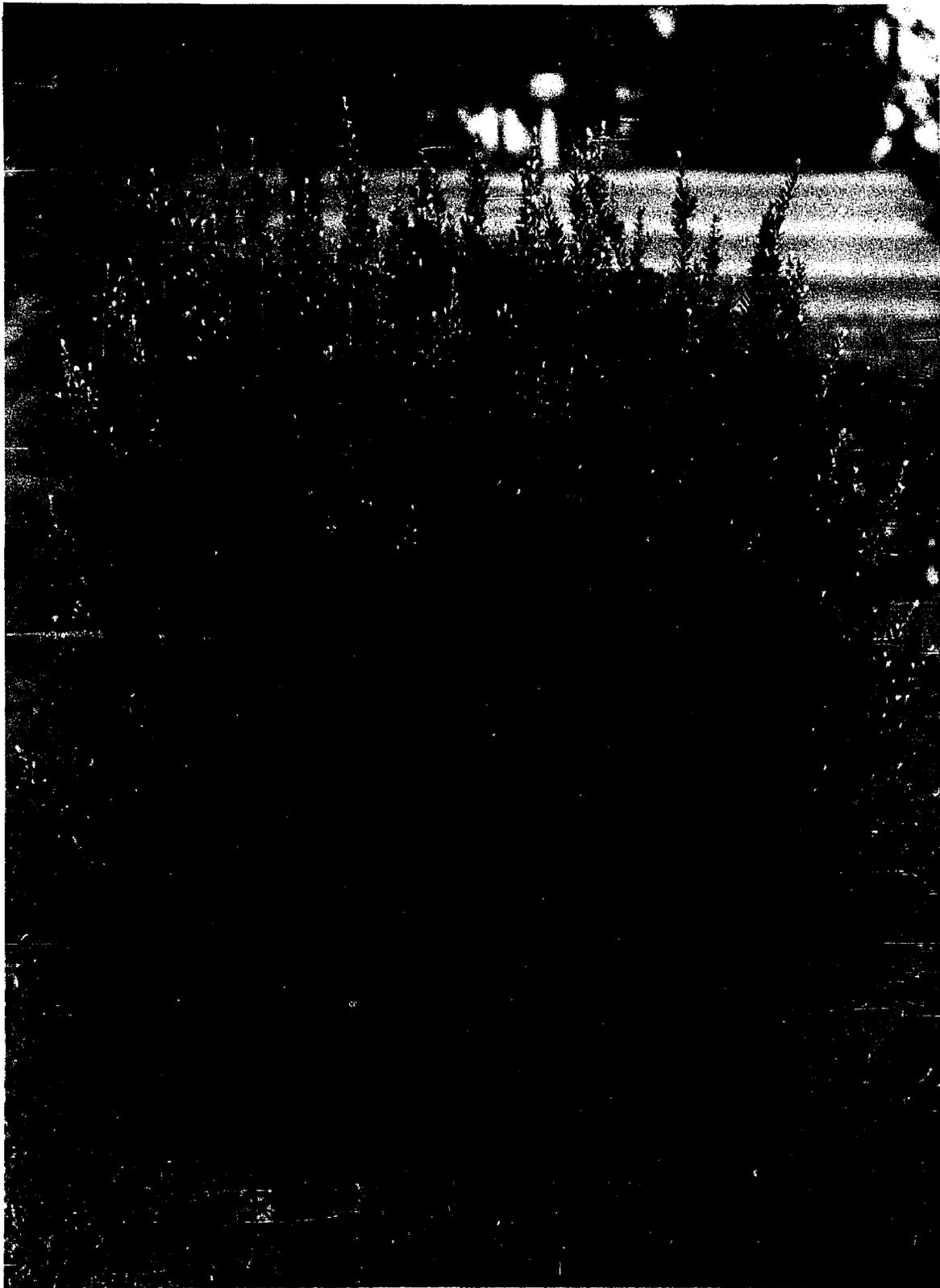


Figure 69. HATFIELD ANGLOJAP YEW on grounds of Natorp Nursery, Cincinnati, Ohio.



-166-

Figure 70. HATFIELD ANGLOJAP YEW in the Arnold Arboretum. This specimen is over thirty years old and measures 12 feet high by 15 feet wide.

Clon HENRY ANGLOJAP YEW

Taxus media henryi

This clon was selected and introduced by Mr. Henry Verkade of the Henry Verkade Nursery, New London, Connecticut.

A wide-spreading shrub of rapid growth, Figure 71, branching freely in a second flush of growth on current season's twigs without being sheared, especially on vigorous plants in the field. Twigs slender, slightly ascending and arching, or with decurved apex if strongly ascending.

Leaves bright green, slender, tapering and quite long, to one and one-half inches, with prominent midrib above and distinct slender petiole. Arranged in broad "V" on upper side of twig or pseudo two-ranked but irregularly falcate and twisted to produce a "curly" effect similar to that of BLACK ANGLOJAP YEW.

This clon is not in the Secest Arboretum, thus its hardiness and ultimate size are not known. It will probably be a very large shrub judging from the vigor, which makes it a favorite with nurserymen because it makes up a salable plant rapidly with very little loss by shearing. Roots readily from cuttings.



Figure 71. Clon HENRY ANGLOJAP YEW. Specimen and type plant on home grounds of Mr. Henry Verkade, New London, Connecticut.

Clon HICKS ANGLOJAP YEW

Taxus media hicksi Rehder

T. cuspidata hicksii Hort.

T. hicksii Hort.

The clon HICKS ANGLOJAP YEW was selected from some fifty upright seedlings chosen from the seed block by Mr. Dutweiler, foreman at the Hicks Nursery. A second plant, often called "Hicks No. 2," was selected from this lot by Professor C. S. Sargent and Mr. Havermeyer for hedging purposes. The name COSTICH ANGLOJAP YEW is proposed for this male clon.

HICKS ANGLOJAP YEW is an erect growing fastigiate plant with ascending branches. Young plants narrow columnar, becoming broader with age and additional leaders. Old plants ovate or globose, Figure 72, and susceptible to snow and ice damage.

Leaves long, more than one inch, radial spreading and tapering on vertical twigs, scattered on upper side of horizontal twigs or pectinate with cuspid apex. Dark glossy green with prominent midrib above, gray green or slightly glaucous below.

Seed often abundant, aril large, 9 mm. in diameter, scarlet with white bloom, globular, exceeding the nutlet by one-fourth, opening large as seed, interior squarish, Figure 5. Nutlet large, dark brown, 5 mm. broad by 7 mm. long, broad ovate, plump, obtusely 2- to mostly 4-angled, hilum small, not depressed, mostly deltoid or squarish, margin

smooth.

According to Rehder (67), this hybrid clon "... was raised by Mr. H. Hicks from seed of T. cuspidata f. nana Rehd. collected in Mr. C. A. Dana's garden at Dosoris, Long Island, ..." Mr. Henry Hicks (38) confirmed the seed parent of this plant and thought that the pollen parent might have been the "Blue John Yew" (see GLAUCOUS ENGLISH YEW), which was planted near the seed parent. However, Mr. Hicks was persuaded to accept Mr. John Dunbar's opinion that the "Blue John Yew" was not the pollen parent. Others have considered the IRISH ENGLISH YEW as the pollen parent, but the latter clon is female. Since the seed parent is known, and the clon HICKS is a media or hybrid type, it seems obvious to the author that the pollen parent must be the "Blue John Yew" or the large specimen of DOVASTON ENGLISH YEW on the estate, as these are the only English Yews recorded as present at that time. In view of its growth habit and color, the author is inclined to accept the former as the more likely parent.

This clon is represented in the Secret Arboretum by groups 37, 50, plants B and C in group 67, and plants B, C and D in group 48. This Yew, more than any other, takes the place of the tender IRISH ENGLISH YEW in northern gardens.

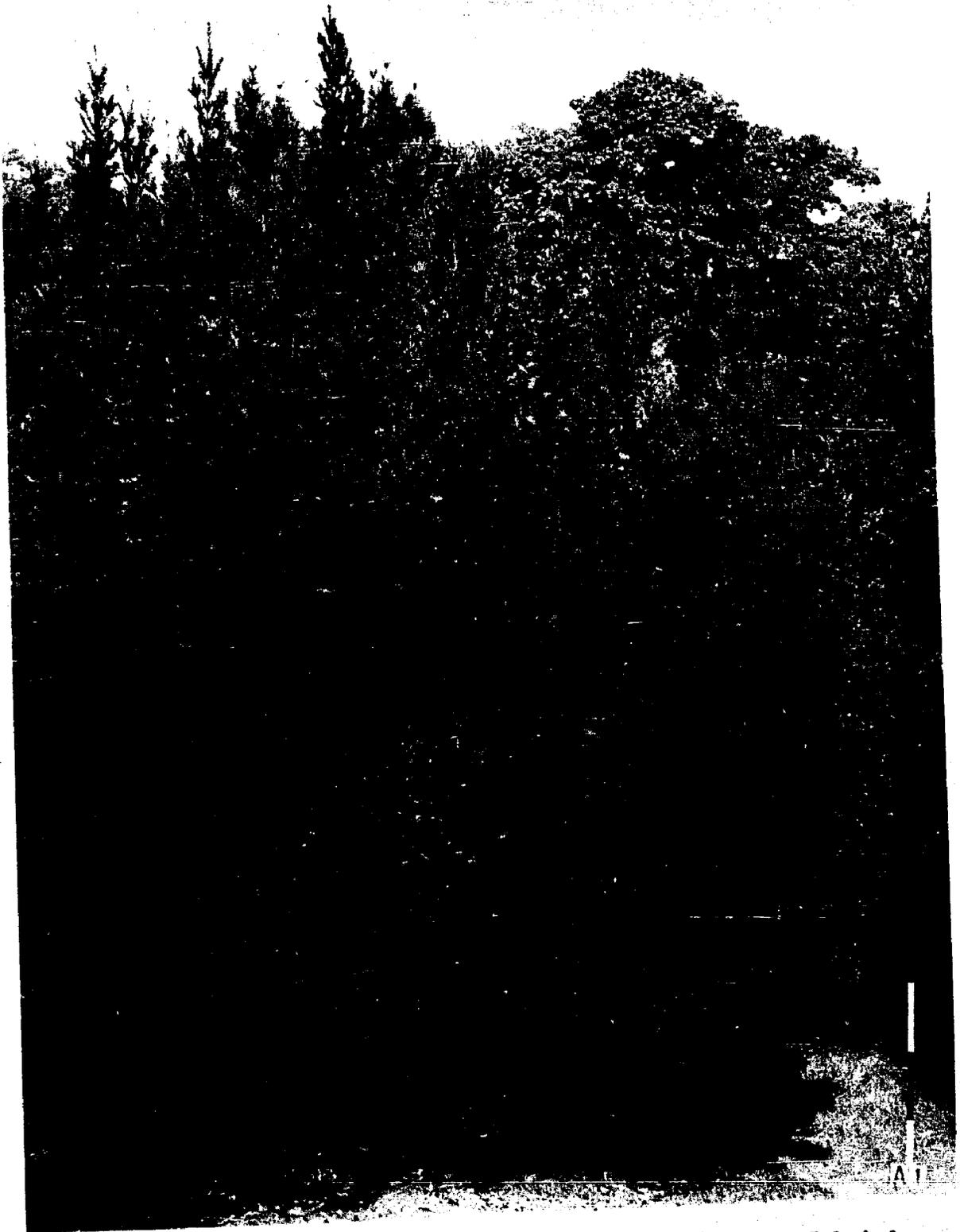


Figure 72. Clon HICKS ANGLOJAP YEW at the Arnold Arboretum. This is Dr. Rehder's type plant. The original plant at the Hicks Nursery was destroyed when the nursery was subdivided.

Clon HILL ANGLOJAP YEW

Taxus media hilli

T. cuspidata columnaris (Hill) Hort.

T. cuspidata pyramidalis (hilli) Hort.

T. nana pyramidalis hilli Hort.

"Hill Pyramidal Yew" Kumlien

This clon was selected for superior hardiness and introduced by the D. Hill Nursery Company, Dundee, Illinois, from material imported as "Taxus Hybrids" from Koster and Company, Boskoop, Holland, prior to 1917. This is probably of American origin, since most of the hybrids in Holland were sent there by Dutch-American nurserymen for propagation. See "Hatfield Yews," page 144.

A dense columnar or pyramidal shrub of slow growth while small, Figure 73. Twigs dark olive green, main leaders medium stout with rather thick leathery bark.

Leaves mostly radial, very dark glossy green above, dull olive green below; slightly tapered, with a cuspid apex on dense, close set leaves of lateral branchlets; on main shoots tapered with acute apex, and more scattered. A male clon with light scattered crops of pollen cones.



Figure 73. HILL ANGLOJAP YEW in the Secret Arboretum has grown two feet in twelve years. Present growth about twelve inches per year.

T. media "vase shape" Hort.

T. media jeffreyi pyramidalis Hort.

This clon was propagated from plants on a small estate in Locust Valley, Long Island, by Mr. John Vermeulen. The plant may have come from Hatfield by way of Havermeyer's Cedar Hill estate or from the Hicks Nursery. Its good winter hardiness favors the latter source. Vermeulen's Nursery introduced the clon in 1928 under the name "Vase Shape," later changing it to T. media kelseyi in honor of Mr. F. W. Kelsey of New York City. It is fairly common in the trade.

An erect, or strongly ascending to fastigate vasiform shrub of medium growth rate, Figure 74. Twigs and buds as in T. media. Leaves very dark glossy green, tapered, acute, straight, about one inch long, close set in a deep "v" or scattered on upper side of twigs exposing the abundant crop of late maturing seed for which this clon is noted. The seed may persist all winter if not collected by birds or rodents. Little if any winter damage at Wooster, Ohio.

Aril scarlet with whitish bloom, subglobose, 9 mm. broad by 7 mm. long, scarcely equaling the nutlet, opening circular with squarish or angular interior. Nutlet broad ovate to blocky 4 mm. broad by 6 mm. long, mostly 3-4 angled, obtuse. Hilum small, slightly depressed with



Figure 74. KELSEY ANGLOJAP YEW in the Secret Arboretum. This clon produces heavy crops of seed, even when small.

raised center, margin wrinkled or fluted. This clon is represented by groups 65 and 67 in the Secest Arboretum.

Clon MOON ANGLOJAP YEW

Taxus media mooni

The origin of the clon is unknown, but the William H. Moon Nursery introduced it to the trade before 1925. Growth is rapid enough that nurserymen still find it profitable. It is represented in the Secest Arboretum by group 89, Figure 75, where it grows about six inches per year.

This old clon is a dark green, columnar, fastigate shrub, Figure 75. The twigs are erect, appressed and quite slender, often with considerable secondary growth the first season on vigorous leaders. Leaves very dark green with prominent midrib on basal half above, light green with midrib and margin mere lines below; usually less than one inch long, slender tapering and acute, arranged radially, rather close set and dense.

Seed matures late, aril crimson with white bloom, subglobose, 9 mm. broad by 8 mm. long, slightly exceeding the nutlet; opening as large as nutlet, elliptical or angular. Nutlet dull chestnut brown, broad ovate with obtuse or "mucronate" apex, compressed and 2-angled. Hilum very small, depressed with raised center, margin wrinkled.

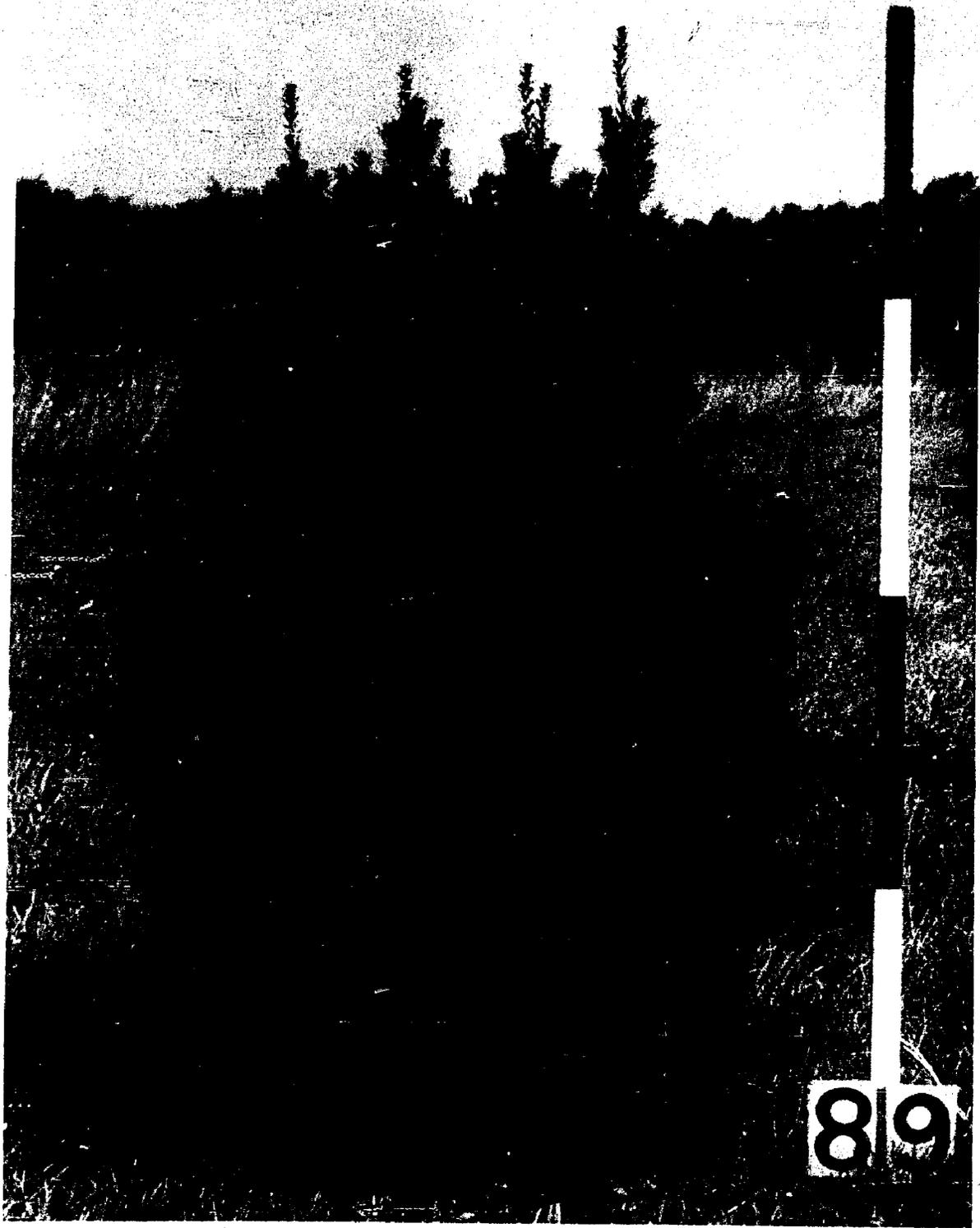


Figure 75. MOON ANGLOJAP YEW in the Secrest Arboretum.

Clon ROBUST ANGLOJAP YEW

Taxus media robusta

T. cuspidata robusta Chadwick

T. cuspidata columnaris Hort.

T. "Globe Shape" Hort.

This clon has been in the nursery trade for many years. It was probably introduced by the Parsons Nursery, Flushing Long Island, which sold sheared specimens as "T. cuspidata columnaris." The Evergreen Nursery Company of South Wilton, Connecticut, sold the erect growing plants under the same name, Figure 76. Spreading plants were sheared and sold as T. "globe shape". The plants in the Secret Arboretum, group 5, were propagated from plants from the latter group. Plants "C" and "E" are spreading and almost globular.

A vigorous female clon growing as much as two feet per year on the stronger branches. Habit of two sorts: either erect and almost fastigate, when propagated from the near vertical ascending leaders, Figure 76; or spreading plants with well-filled centers, when propagated from slightly ascending lateral branches. The latter easily sheared to globular form.

The leaves are dark green, mostly falcate, arranged in a "V". No true vertical leaders with radiating leaves have been observed, even on erect "multileader" plants.

The seed crops vary from light to medium heavy, the aril crimson, subglobose to oblate, 9 mm. broad by 7 mm.



Figure 76. Clon ROBUST ANGLOJAP YEW. This specimen on the grounds of the South Wilton (Connecticut) Nursery is 15 feet high by 12 feet wide.

long, equal to or slightly exceeding the nutlet. The opening squarish. Nutlet dark brown, smooth, 4 mm. broad by 5 mm. long, mostly strongly 4-angled and blocky; hilum squarish, not depressed.

Clon SEBIAN ANGLOJAP YEW

Taxus media sebiani

T. cuspidata intermedia Hort.

T. cuspidata intermedia Sebiani Hort.

This male clon originated in the nursery of Mr. Mike Sebian, Painesville, Ohio, as a seedling of the clon INTERMEDIATE JAPANESE YEW. Small plants resemble the parent clon from Cottage Gardens Nursery or the DWARF JAPANESE YEW, except that the needles are lighter green and more narrow than the latter. Growth begins even earlier in the spring than INTERMEDIATE JAPANESE YEW, and is often damaged by late frost and freezes at Wooster, Ohio. It makes up a salable plant quicker, because of its more rapid growth, up to twenty-four inches annually, and is becoming a favorite plant with some nurseries because it roots readily from cuttings. Older plants lose the low, compact resemblance to the DWARF JAPANESE YEW and become more informal and wide spreading with age, Figure 77. Secondary branching occurs abundantly, without shearing, to keep the plant well filled and dense.

Leaves mostly straight, only slightly falcate, slightly tapered and acute or acuminate, not cuspidate, bright green



Figure 77. Clon SEBIAN ANGLOJAP YEW in group 43 of the Secrest Arboretum.

with a tinge of red in newly opened buds. Mostly radial on secondary branchlets and on young plants. On older plants the leaves are on the upper side of the twig or in a broad pectinate "V" on arching branches.

Clon STOVEKEN ANGLOJAP YEW

Taxus media stovekeni

T. stovekeni Hort.

T. cuspidata stovekeni Hort.

The original plant was selected about 1932 from a block of seedling T. cuspidata by Mr. Stoveken, foreman of the A. N. Pierson Nursery, Cromwell, Connecticut, who moved it to his home garden for observation. Propagation was begun in 1939. The top of this plant was removed in 1953.

This fastigate clon is vigorous, growing twelve to eighteen inches annually. The habit is broad columnar, Figure 78. The branches are erect, fastigate and appressed, with some secondary twigs or branchlets growing on the current season's growth of vigorous leaders. Bark of leaders thick and leathery, green, becoming bright red orange where exposed to winter sun and red brown the second summer except for the adnate leaf bases which are green.

Leaves dark green, glossy, mostly radially spreading, about one inch long, slightly tapered with acute apex. No winter damage has been observed on the leaves of this clon at Wooster, Ohio. The pollen cones are large and showy in late winter and spring, equaled in size only by those of



Figure 78. STOVEKEN ANGLOJAP YEW. This plant, in Secrest Arboretum is 6 feet high by 3 feet wide, and is unpruned except for the removal of a few cuttings.

the clon PROSTRATE JAPANESE YEW.

In the Secret Arboretum the plants in group 33 are unique. The only plant approaching this clon in habit and growth rate is T. media costichi, which is more tender and slower in growth.

Clon TOTEM ANJOJAP YEW

Taxus media totemi

T. media hicksi pyramidalis Hort.

This clon, represented by group 70 in the Secret Arboretum, is not currently available in the trade. It was distributed by the Wilton (Connecticut) Nurseries, which no longer exist. The donor states that there is no demand for this plant, yet thousands of wide-spreading ADAMS JAPANESE YEW are sheared to this narrow columnar form for sale each year. It is as hardy as HICKS ANGLOJAP YEW.

An extremely narrow columnar shrub with appressed short branchlets and a single leader, Figure 79. Leaders stout, olive green, turning orange to brown in the sun, with numerous short branchlets the same season. Secondary branchlets short, slender, olive green, densely scattered and appressed. Leaves dark glossy green with prominent midrib above, light gray-green stomate bands about twice as wide as margins or midrib beneath; long tapering, to $1\frac{1}{4}$ inches with acute apex, close set and densely radiating on branchlets; more scattered spiral on leader and more tapering; much like those of the clon HICKS ANGLOJAP YEW.



Figure 79. TOTEM ANGLOJAP YEW in the Secrest Arboretum, a perfect vertical accent.

A female clon with medium to heavy crops of seed, maturing late and irregularly. Aril crimson with white bloom, subglobose, 9 mm. broad by 8 mm. long, slightly exceeding the seed. Opening very large, squarish or circular with angular interior. Nutlet variable, globose and blocky to broad ovate, obtuse 2-5 angled, 4 mm. broad by 5 mm. long to 5 mm. broad by 7 mm. long. Hilum small to very large, elliptical to pentagonal, angles depressed, center raised or domed.

Clon VERMEULEN ANGLOJAP YEW

Taxus media vermeuleni

T. cuspidata "Upright brevifolia" Hort.

T. cuspidata vermeuleni Hort.

T. media hicksi, improved Hort.

This clon, like KELSEY ANGLOJAP YEW, was propagated from a plant on a Locust Valley, Long Island, estate by Mr. John Vermeulen, who introduced it into the trade in the late 1920's as T. cuspidata "upright brevifolia." Whether the original plant was planted by the Hicks Nursery, which had several "upright brevifolias," or from one of Hatfield's "upright brevifolias" by way of Havermeyer or Cottage Gardens is a moot question. The name vermeuleni was applied by retail customers of the Vermeulen Nursery, according to Mr. John Vermeulen.



-187-

Figure 80. VERMEULEN ANGLOJAP YEW in the Secrest Arboretum.

This female clon makes a dense, columnar, vasiform or globose shrub with vertical fastigate branches, Figure 80. Leaves mostly radial, close set, deep glossy green above, light gray to yellowish green below, mostly straight, slightly tapered with acute apex, rather wide, less than DWARF JAPANESE YEW, but wider than clons MOON, HATFIELD and ANDORRA ANGLOJAP YEW.

Seed crops often heavy and late to mature. Aril crimson with whitish bloom, subglobose, 10 mm. broad by 9 mm. long, exceeding the nutlet by one-third; opening large, elliptical to squarish or round with angular interior. Nutlet very broad ovoid, obtusely 2-4 angled, mostly 3-angled, 5 mm. broad by 6 mm. long, brown, with glaucous apex, smooth and plump. Hilum large, ovate, deltoid or squarish, slightly depressed in angles, margin finely fluted or puckered.

In the Secret Arboretum this clon is represented by group 84 and scattered plants included in several other groups where it was received under such names as "hicksi improved," "hatfield upright," "ovata," etc. At Wooster it is readily recognized in late winter by the white sun-scalded needles on the lower part of the southwest side of the plants.

Clon WARD ANGLOJAP YEW

Taxus media wardi Chadwick

T. cuspidata cliftoni Hort.

T. cuspidata wardi Hort.

This clon was selected and named by Mr. R. T. Brown of Cottage Gardens, Queens, Long Island, after one of his employers. It originated from one of T. D. Hatfield's seedling "upright brevifolias." Identical material was included with some *T. media* plants he sent to Mr. Harry Deverman of Clifton, New Jersey, who recognized the merits of this plant and named it cliftoni. Mr. Brown and the Arnold Arboretum usually had "first chance" at any material from the Hunnewell estate, according to Mr. William H. Hatfield.

This wide, irregular, spreading shrub is of moderately rapid growth, the branches ascending with decurved or nodding tips. Considerable branchlet development occurs on strong, current season's growth, Figure 81. The twigs are rather stout with thick soft leathery bark as in DWARF JAPANESE YEW, olive green or turning reddish where exposed to the sun, especially in winter. Growth starts early.

Leaves dark lustrous green with prominent midrib above, of the nana type, quite broad and leathery, bluntly cuspid, mostly less than one inch long, shorter at the beginning and end of each season's growth on lateral twigs giving a distinct oval segmented appearance to older twigs. Stomate bands light green to olive green, very broad, the



-190-

Figure 81. Clon WARD ANGLOJAP YEW in the Secret Arboretum, group 41. This plant was received from Mr. Deverman, Clifton, New Jersey, as T. cuspidata cliftoni.

leaf margins and midrib a mere line below.

A female clon with heavy crops of late maturing seed and many twin flowers and seeds. Aril bright red with whitish bloom, a broad, oblate, fleshy cup 11 mm. wide by 7 mm. long, scarcely equaling the nutlet. Opening large, circular, with squarish or angled interior. Nutlet globose, dark glossy brown with dull bloom, 4 mm. broad by 5 mm. long, obtusely 2-4 angled. Hilum very large, ovate, deltoid or squarish, scarcely depressed.

This clon includes groups 41 and 93 and plants A and B in group 51 in the Living Herbarium of Taxus. No winter damage has been observed on these plants.

Clon WELLESLEY ANGLOJAP YEW

Taxus media wellesleyana

This male clon is one of the hardy seedlings of the IRISH ENGLISH YEW produced by T. D. Hatfield (see "Hatfield Yews"). It is a columnar to vasiform shrub with vertical fastigate branches, Figure 82. Twigs coarser than the clon HATFIELD ANGLOJAP YEW, which it greatly resembles, as is the entire plant. Leaves bright green, spirally radiating or scattered on upper side of branchlets.

Growth is more rapid and loose than HATFIELD ANGLOJAP YEW and more liable to damage from snow and ice in winter. It is very hardy in the Secest Arboretum, group 82.

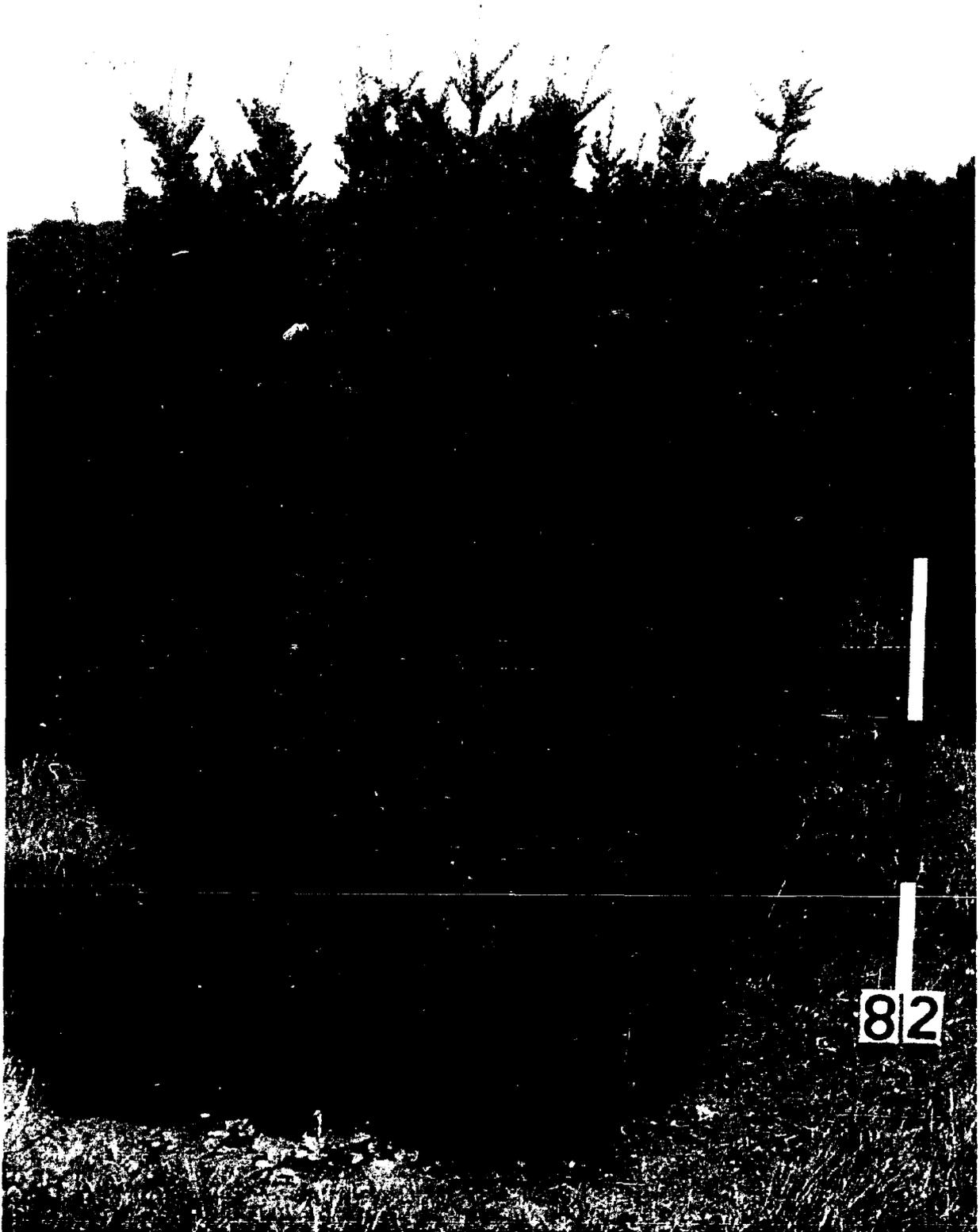


Figure 82. Clon WELLESLEY ANGLOJAP YEW in the Secret Arboretum. A coarse-textured "Hatfield" of more rapid growth.

Summary

1. The Yews are the most useful low evergreens for landscape gardening in the Northeastern United States. The newer clons provide the distinct vertical and low horizontal lines so complementary to contemporary architecture. The Yews are tolerant of shade and smoke.

2. The taxonomy of the genus Taxus is controversial; the family may not belong to the class Coniferales; the recognized species are more geographic than morphologic; many of the cultivars and clons in America have not been described nor named by horticulturists in accord with recognized taxonomic rules. The confusion of names at the species and cultivar levels is a distinct handicap to the nursery trade.

3. This study of the Yews in cultivation in America is the second of a continuing series based on the extensive collection in the Secrest Arboretum, Ohio Agricultural Experiment Station, Wooster, Ohio. The present study includes the important arboretums and many individual specimens from Virginia to Massachusetts and west to Ohio. The Yews of Hatfield origin received particular attention because original source material was made available by Mr. Wm. H. Hatfield from his father's records and correspondence.

4. The chromosomes do not vary enough between species to be of taxonomic value. Haploid somatic chromosomes were studied in acetocarmine smears of the female gametophytes collected in early July. Pollen mother cells (microspore mother cells) reach meiosis in October at Wooster, Ohio. The haploid number of chromosomes is twelve.

5. It is proposed that the Secret Arboretum be made the basis of a National Register of Taxus. The National Register would function in accordance with section C of the International Code of Nomenclature for Cultivated Plants. A Yew Society, after the manner of other plant societies, would be a valuable adjunct to the Register.

6. Fifty-eight species, cultivars and clons of Taxus, which are in cultivation in America, are described and illustrated with photographs of mature specimens as far as possible. New and small, recently acquired plants at the Secret Arboretum have not been included in the present study. Many new clons in the trade remain to be evaluated and described.

Bibliography

1. Anonymous. 1900. The Dovaston Yew. The Gardeners Chronicle 27: 146-147.
2. Bailey, L. H. (Ed.) 1916. The Standard Cyclopedia of Horticulture. The Macmillan Co., New York, N. Y.
3. _____. (Ed.) 1925. The Cultivated Evergreens. The Macmillan Co., New York, N. Y.
4. _____. 1933. The Cultivated Conifers in North America. The Macmillan Co., New York, N. Y.
5. _____. (Ed.) 1949. Manual of Cultivated Plants. The Macmillan Co., New York, N. Y.
6. Baldwin, J. T., Jr. 1935. Chromosomes from Leaves. Stain Technology 10: 101-103.
7. Baltet, C. 1910. The Art of Grafting and Budding, 6th Ed. Translated from the French. Crosby Lockwood and Son, London.
8. Bean, W. J. 1914. Trees and Shrubs Hardy in the British Isles. John Murray, London.
9. Beissner, L. 1909. Handbuch der Nadelholzkunde, 2nd Ed. Berlin.
10. Brown, R. G. and F. E. Hull. 1951. Taxus (Yew) Poisoning of Cattle. Jour. Am. Vet. Med. Assn. 118: 398-9.
11. Camp, W. H. 1945. The North American Blueberries. Brittonia 5: 203-275.

12. Campbell, D. H. 1940. The Evolution of the Land Plants (Embryophyta). Stanford Univ. Press, California.
13. Carriere, E. A. 1867. Traite General des Coniferes, 2nd Ed. Paris.
14. Chadwick, L. C. 1940. Selection of Narrow-Leaved Coniferous Evergreens. American Nurseryman, Chicago.
15. _____ . 1942. Ornamental Evergreens, Ohio State Univ. Agr. Ext. Serv. Bull. 113, Revised.
16. _____ . 1951. The Best in Taxus. American Nurseryman 93(6): 13-82.
17. Chamberlain, C. J. 1937. Gymnosperms, Structure and Evolution. Univ. of Chicago Press, Chicago.
18. Chang, Y. 1954. Bark Structure of North American Conifers. U. S. D. A. Technical Bull. No. 1095, Washington, D. C.
19. Coltman-Rogers, C. 1920. Conifers and their Characteristics. John Murray, London.
20. Dallimore, W. 1908. Holly Yew and Box with Notes on Other Evergreens. John Lane, London.
21. Dark, S. O. S. 1932. Chromosomes of Taxus, Sequoia, Cryptomeria and Thuja. Annals of Botany 46: 965-977.

22. Davidson, J. 1927. Conifers, Junipers and Yews: Gymnosperms of British Columbia. T. Fisher Unwin Ltd., London.
23. Den Ouden, P. 1949. Coniferen, Ephedra en Ginkgo. Veenman and Zonen, Wageningen, Netherlands.
24. Dunn, R. 1950. Giant Taxus. Horticulture 28: 453.
25. Dupler, A. W. 1917. The Gametophytes of Taxus Canadensis, Marsh. Botanical Gazette 64: 115-136.
26. _____. 1920. Ovuliferous Structures of Taxus Canadensis. Botanical Gazette 69: 492-520.
27. Eames, A. J. and L. H. MacDaniels. 1925. An Introduction to Plant Anatomy. McGraw-Hill Book Co., New York, N. Y.
28. Elwes, H. J. and A. Henry. 1906. Trees of Great Britain and Ireland. Edinburgh, Scotland.
29. Emsweller, S. L. and R. N. Stewart. 1951. Cytological Identification of An Interspecific Hybrid in Liliium. Proc. Amer. Soc. for Hort. Sci. 57: 411-414.
30. Fritsch, F. E. and E. J. Salisbury. 1938. Plant Form and Function. G. Bell and Sons Ltd., London.
31. Gibbs, V. 1926. Taxaceae at Aldenham and Kew. Jour. Royal Hort. Soc. 51: 189-224.
32. Gordon, G. 1880. The Pinetum, 2nd Ed. Henry G. Bohn, London.

33. Guillaumin, A. 1946. Les Plantes Cultivees. Payot, Paris.
34. Harrar, E. S. and J. G. Harrar. 1946. Guide to Southern Trees. Whittlesey House, McGraw-Hill Book Co. Inc., New York.
35. Hatfield, T. D. 1921. Raising Yews from Seed at Wellesley. The Garden Magazine 33: 23-26.
36. _____ . Undated. Unpublished Records, Correspondence, and Lectures. Courtesy W. H. Hatfield, Silver Spring, Md.
37. Hawker, L. 1930. Microsporogenesis in Taxus. Annals of Botany 44: 535-539.
38. Hicks, H. 1923. Personal communication to C. S. Sargent, May 18, 1923.
39. Hill, T. G. and E. de Fraine. 1906. On the Seedling Structure of Gymnosperms. Annals of Botany 20: 471-473.
40. Hofmeister, W. 1862. Translated by F. Curry. On the Germination, Development and Fructification of the Higher Cryptogamia and on the Fructification of the Coniferae. London.
41. Hooker, W. J. 1840. Flora Boreali-Americana. Henry G. Bohn, London.
42. Hoopes, J. 1868. The Book of Evergreens. Orange Judd & Co., New York.

43. Hornibrook, M. 1938. Dwarf and Slow-Growing Conifers, 2nd Ed. Country Life Ltd., London.
44. Hunnewell, H. H. 1906. Life, Letters, and Diary of Horatio Hollis Hunnewell. Boston.
45. Jeffrey, E. C. 1917. The Anatomy of Woody Plants. Chicago.
46. Keen, R. A. 1947. A Study of the Genus Taxus. Ohio State University Masters Thesis. Unpublished.
47. _____ and L. C. Chadwick. 1955. Sex Reversal in Taxus. American Nurseryman 100(6): 13-14.
48. Kelsey, H. P. and W. A. Dayton (Eds.) 1942. Standardized Plant Names. J. Horace McFarland Co., Harrisburg, Pa.
49. Krüssmann, G. 1955. Die Nadelgehölze. Paul Parey, Berlin.
50. Kumlien, L. L. 1938. The Japanese Yews. D. Hill Nursery Co., Dundee, Ill.
51. _____. 1946. The Friendly Evergreens. D. Hill Nursery Co., Dundee, Ill.
52. Linnaeus, C. 1764. Species Plantarum, 3rd Ed.
53. Loudon, J. C. 1844. Arboretum et Fruticetum Britannicum. London.
54. _____. 1875. Trees and Shrubs. Frederick Warne & Co., London.
55. Lowe, J. 1897. The Yew-Trees of Great Britain and Ireland. Macmillan & Co. Ltd., London.

56. Lubbock, Sir J., Bart. 1892. A Contribution to Our Knowledge of Seedlings. D. Appleton & Co., New York, N. Y.
57. Matsuura, H. and T. Suto. 1935. Contribution to the Idiogram Study in Phanerogamous Plants I. Jour. Faculty of Sci. Hokkaido Imp. Univ. Series V. Botany 5(1): 33-75.
58. McMinn, H. E. and E. Maino. 1937. An Illustrated Manual of Pacific Coast Trees. Univ. Calif. Press, Berkeley, Calif.
59. Mendes, J. E. T. 1950. Multiplicacao do Cafeeiro poi Estacas com Uma Folha. Bragantia 10(7): 209-211.
60. Mix, W. B. 1949. Largest Taxus Tree. Horticulture 27: 419.
61. Nuttall, T. 1871. The North American Sylva. Wm. Rutter & Co., Philadelphia, Pa.
62. Paul, W. 1861. Varieties of the Common Yew (*Taxus Baccata*). The Florist 14: 201-203.
63. Raffill, C. P. 1935. In Bailey, L. H., The Standard Cyclopedia of Horticulture. The Macmillan Co., New York, N. Y.
64. Rehder, A. 1919. The Ligneous Plants of Northern China. Jour. Arnold Arboretum 1: 51-52.
65. _____. 1919. Taxaceae: Taxus cuspidata Sieb. & Zucc. f. aurescens. Jour. Arnold Arboretum 1: 191.

66. Rehder, A. 1923. Some of the Trees in Dr. Hall's
Plantation on His Farm in Bristol, Rhode Island.
Jour. Arnold Arboretum 4: 98.
67. _____. 1923. Taxus media hybr. nov. Jour.
Arnold Arboretum 4: 106-109.
68. _____. 1925. Taxus Hunnewelliana hybr. nov.
Jour. Arnold Arboretum 6: 201-202.
69. _____. 1927. Manual of Cultivated Trees and
Shrubs. The Macmillan Co., New York, N. Y.
70. _____. 1931. Taxus cuspidata Sieb. & Zucc. f.
Thayerae Wilson. Jour. Arnold Arboretum 12: 59.
71. _____. 1940. Manual of Cultivated Trees and
Shrubs Hardy in North America, 2nd Ed. The
Macmillan Co., New York, N. Y.
72. _____. 1945. Notes on Some Cultivated Trees and
Shrubs. Jour. Arnold Arboretum 26: 67.
73. _____. 1949. Bibliography of Cultivated Trees
and Shrubs. Arnold Arboretum, Jamaica Plain,
Mass.
74. Robertson, A. 1907. The Taxoideae; a Phylogenetic
Study. New Phytologist 6: 92-102.
75. Sargent, C. S. 1896. The Silva of North America.
Houghton, Mifflin & Co., New York, N. Y.
76. _____. (Ed.) 1914. Plantae Wilsoninae, Part
4. Publications of Arnold Arboretum No. 4,
Jamaica Plain, Mass.

77. Sargent, C. S. 1933. Manual of the Trees of North America. Houghton, Mifflin Co., Boston.
78. Sax, K. and H. J. Sax. 1933. Chromosome Number and Morphology in the Conifers. Jour. Arnold Arboretum 14: 356-374.
79. Schaffner, J. H. 1937. Stability and Instability of Sexual Conditions in Morus Alba. Jour. Heredity 28: 426-427.
80. Slavin, B. 1932. In Chittenden, F. J., Conifers in Cultivation: Report of the Conifer Conference. Royal Hort. Soc., London.
81. Small, J. K. and A. Vail. 1893. Report of the Botanical Exploration of Southwestern Virginia During the Season 1892. Memoirs of the Torrey Botanical Club 4(2): 167.
82. Stearn, W. T. (Ed.) 1953. International Code of Nomenclature for Cultivated Plants. The Royal Hort. Soc., London.
83. Steffel, E. F. (Ed.) 1949. Plant Buyers Guide. Mass. Hort. Soc., Boston.
84. Sterling, C. 1948. Gametophyte Development in Taxus Cuspidata. Bull. Torrey Bot. Club 75: 147-165.
85. _____ . 1948. Proembryo and Early Embryo in Taxus Cuspidata. Bull. Torrey Bot. Club 75: 469-485.

86. Sterling, C. 1949. Embryonic Differentiation in *Taxus cuspidata*. Bull. Torrey Bot. Club 76: 116-133.
87. Van Dersal, W. R. 1938. Native Woody Plants of the U. S. U. S. D. A. Misc. Pub. 303.
88. Van Melle, P. J. 1946. The Upright and Spreading Japanese Yews. Gard. Chron. of America 50(3): 81.
89. Wilson, E. H. 1916. The Conifers and Taxads of Japan. Publications of Arnold Arboretum, No. 8, Cambridge Univ. Press, Cambridge, Mass.
90. _____. 1920. The Romance of Our Trees, IV The Yew. Garden Mag. 32: 213-217.
91. _____. 1926. Some Yews and Low-Growing Conifers. House and Garden 49: 82-83, 150, 154.
92. _____. 1929. *Taxus Cuspidata*. Arnold Arboretum Bull. of Popular Information Series 3 3: 38, 40.
93. Worsdell, W. C. 1899. Observations on the Vascular System of the Female 'Flowers' of Conifereae. Annals of Botany 13: 527-548.
94. Wyman, D. W. 1938. Hedges, Screens and Windbreaks. Whittlesey House, New York, N. Y.
95. _____. 1941. Various Forms of the Japanese Yew. Horticulture 19: 51-52.

96. Wyman, D. W. 1948. Sturdy and Serviceable Yews;
Little Care Required. Horticulture 26: 379,
397.

AUTOBIOGRAPHY

I, Ray Albert Keen, was born in Jefferson County, Kansas, October 9, 1915. I received my secondary education in the public schools of Topeka, Kansas. My undergraduate training was obtained at Kansas State College of Agriculture and Applied Science, from which I received the degree Bachelor of Science in Agriculture in 1942. I entered the Naval Reserve Midshipmen's School, Notre Dame, Indiana, from which I was commissioned Ensign, U.S.N.R., in January, 1943. I received a certificate in Marine Diesel Engineering from North Carolina State College in May, 1943. Upon release from active duty in June, 1946, I entered The Ohio State University, where I specialized in the Department of Horticulture. I received the degree Master of Science in June, 1947, and accepted a position as Assistant Professor of Horticulture at Kansas State College of Agriculture and Applied Science, and Assistant Ornamental Horticulturist with the Kansas Agricultural Experiment Station. I attended The Ohio State University during the summer quarter 1951 and while on sabbatical leave from September, 1953 to August, 1954.

I married Dorothy May Ericsson on May 25, 1943. We have four children: Robert, eleven; Margaret, ten; Kenneth, seven; and Catharine, two.