

1927

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Recommended Citation

Taylor, Mrs. H. J. (1927) "The History and Distribution of Yellow Nelumbo, Water Chinquapin, or American Lotus," *Proceedings of the Iowa Academy of Science*, 34(1), 119-132.

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THE HISTORY AND DISTRIBUTION OF YELLOW
NELUMBO, WATER CHINQUAPIN, OR
AMERICAN LOTUS

Nelumbo lutea (Willd) Pers

MRS. H. J. TAYLOR¹

Much interest has been manifested in recent years in the American lotus, not only because of the economic value but its value for ornamental purpose and its beauty in its native habitat.

Description. Aquatic plants with yellowish, tuberous root-stock; leaves orbicular, usually raised several feet out of the water from the rootstock, 3-5 dm. in diameter, depressed towards the center, upper surface dark green, shining, lower surface paler in color. Leaf stalk rough, brownish, spotted. Flower, pale yellow, 1, 2-2, 5 dm. in diameter, from the rootstock, sepals and petals similar in color, free from the ovary hypogynous. Stamens numerous, hypogynous, long, anthers tipped with slender hooked appendage. Pistils several, 1 ovuled, separately immersed in the receptacle, stigma umbilical, fruit, nut-like in an enlarged receptacle. Seeds without endosperm, embryo large.

Distribution. Robinson & Fernald in Gray's Manual. Revised 7th Edition. Gray's New Manual of Botany² gives the distribution.

Concord and Osterville, Massachusetts, South Connecticut (probably introduced) to Lake Ontario, Lake Erie, Michigan, Minnesota, Eastern Nebraska and Southward; rare in the middle states.

Dr. John K. Small,³ in Flora of Southern States, gives the distribution, Ontario to Michigan, Florida and Texas.

N. L. Britton, in his Manual,⁴ gives in general the same distribution as in the Illustrated Flora,⁵ Grand River, Ontario, Sandusky Bay, Lake Ontario, Connecticut River near Lynn, Northern and Southern New Jersey, locally south to Florida, west to Michigan, Oklahoma and Louisiana.

¹ Presented by L. H. Pammel. The writer of this note became considerably interested in the American Lotus. I studied the pollination, the fruit, tuber, and its distribution. I asked Mrs. Taylor to use this material, so far as applicable, for her paper. There are wonderful economic possibilities in this plant. — L. H. PAMMEL.

² P. 392.

³ P. 455.

⁴ P. 408.

⁵ 1st Edition 47; 2nd Edition 77.

The species is represented in the Iowa State College herbarium from the following localities, furnished by Mr. R. I. Cratty, Curator of the herbarium:

<i>Nelumbo lutea</i> (Willd.) Pers. In Herbarium.		
Near mouth of Yellow River, Allamakee Co.,	8/10/22,	L. H. Pammel
In Iowa near Nebraska City, Neb.	7/14/23,	L. H. Pammel
Onawa, Iowa,	7/24/22,	L. H. Pammel
Onawa, Iowa,	7/17/22,	Blanche Gossard
McGregor, Iowa,	7/15/25,	L. H. Pammel
McGregor, Iowa,	8/—/23,	L. H. Pammel
McGregor, Iowa,	9/—/19,	Ada Hayden
Farmington, Iowa,	7/18/19,	L. H. Pammel
Lake Wabonsie, Fremont County,	8/18/05,	J. P. Anderson
Burlington, Iowa,	8/20/95,	Paul Bartsch
"Iowa" (probably opposite Oquawka, Ill.,		H. N. Patterson

Specimens of seeds and capsules in museum from McGregor, collected by L. H. Pammel.

Dr. L. H. Pammel has furnished me with the following localities where he has observed it: near LaCrescent near mouth of Root River, Reno, near Winona, Minnesota, French Island, near Warner's Landing, Stoddard, near mouth of Mormon Coulé Creek, Lynxville, near Trempealeau, Wisconsin, American Bottom, near East St. Louis, Illinois, Dubuque, Turkey River Junction, Guttenberg, Gard Lake, Fremont county, near Hamburg, Marquette, Lansing, New Albin, Amana, Iowa River, near Centerville, Appanoose County, Iowa, Payne's Prairie near Gainesville, Florida, and many other lakes in that vicinity; near Biloxi and Gulfport, Mississippi.

The term "lotus" has been and still is used quite indiscriminately. It meant various things to the ancients. The Greek "lotus" was a leguminous plant, a kind of clover on which horses fed, probably *Lotus corniculata*, or bird's-foot trefoil. Tennyson's poem *The Lotus Eaters* describes a shrub or small tree producing honey sweet fruit, the *Ceratonia Siliqua*. Homer also speaks of lotus eaters. The fruit is probably of the same plant.

To describe and give the history of the American lotus it is necessary to have some history of the lotus in the Orient and especially of the Egyptian lotus or Sacred Lily of the Nile with which the American lotus is quite generally confused. I will confine myself to two scientific names. First, American or Yellow lotus, is *Nelumbo lutea*. Second, Egyptian lotus or Sacred Lily of the Nile is *Nymphaea caerulea*. The former belongs to the *Nelumbo* group; the latter, to the water lily group. Both the blue and the

white lotus are native in Egypt. The pink lotus is native in India. It is found carved on cave temples, showing its veneration in India. It was introduced into Egypt about 800 B.C., was extensively cultivated along the Nile, probably for food; and died out about 1000 A.D. There is also a sacred Chinese and Hindu lotus called Pythagorean Bean. Pythagoras believed that men's souls dwelt in the lotus. Prof. Asa Gray⁶ reviews Dr. Buist's notes on this lotus. He says it is sacred throughout the East and deities are almost invariably represented as sitting or standing on a lotus throne or holding a scepter formed of the flowers. The red lotus of southern India is said to have sprung from the blood of Siva when wounded by Cupid. The Buddhists probably took this lotus to Japan and China as it is indigenous to neither of these countries. It is natural to suppose that the worship of the lotus in Japan came with the worship of Buddha.

To the Orientals the lotus makes an imaginative appeal which expresses itself in Eastern Art. Japanese use it almost as much as they do their sacred mountain, Fuji. It is seen in temple floors and carved on altars. Made of gold and silver paper it is carried in funeral processions as the symbol of the immortality of the soul. In Egypt the lotus design was wrought into ornaments. It was also used on pillars, columns and tombs. The London Illustrated News⁷ published a picture taken in the Museum at Cairo of lotus blossoms taken from the tomb of Rameses II, 1225 B.C. It is of the water lily group, undoubtedly the sacred lotus which was the floral offering to a dead Pharaoh. The buckles on Tutankhamen's sandals, pictured in the same article, have a lotus flower of exquisite inlaid gold. This is also a water lily.

Samuel Henshaw made the first successful attempt in bringing the tuber of the pink flowered lotus, *Nelumbo nucifera*, described by Gaertn 1788, from Japan and growing them in an artificial pond at New Brighton, Staten Island. About the same time, E. D. Sturdevant introduced the pink lotus in Bordentown, New Jersey, growing it in a mill pond. From here it was disseminated to various parts of the United States. Although the name Egyptian lotus may forever cling to this plant it is not the true Egyptian lotus. In 1877, the attempt was made to introduce the Japanese lotus in Central Park, New York City. It was carefully housed, not knowing that the plant is very hardy and lives even in Siberian climate. It is also a very prolific plant. In ten years there were over 5000 plants in Central Park, New York.

⁶ See American Journal Science series 2, vol. 26, p. 118.

⁷ February, 1923.

The ancients cultivated lotus, lilies and other aquatic plants. There is, however, no record of a yellow lotus prior to the discovery of America by the white man. The Indians knew and cultivated the American lotus as an article of food. It was first described by Willdenow in 1799 and later by Persoon in 1805. Britton and Brown⁸ state that the American lotus is found from Grand River near Dunnville, Ontario, on Lake Ontario; on the Connecticut River near Lynn; Swartswood Lake, New Jersey, Woodstown and Sharpstown, New Jersey, and formerly in the Delaware River below Philadelphia. Locally it extends south to Florida, west to Michigan, Indian Territory and Louisiana. Perhaps Britton and Brown were not familiar with the Mississippi River region or it may be that the lotus at that time had not been carried farther west and north than indicated. The American or yellow lotus is found in at least 26 states. Wisconsin has 19 lotus beds. Iowa has at least 12 beds. I have no record of lotus in either North or South Dakota. With these exceptions it is found in a double row of states on either side of the Mississippi River. The most northern record is Lake Pipin. The New York Herbarium has a specimen of American lotus secured in 1832 from South Carolina. Gray's Herbarium, Harvard University, has a specimen secured in 1834 from Texas.

The lotus is the most beautiful of wild flowers and the most revered of all flowers. It is the flower of eternal calm living only in quiet waters. There is a stately majesty about the lotus. It rises on a single stem out of 10 or 14 inches of mud, through several feet of water until it stands three to five feet above the surface. The bud tightly closed by green sepals, grows four to six inches long before opening. As the 14 to 20 pale yellow, waxy petals open they reveal a heart of gold and shed a rare and delicate fragrance. In full bloom the flower measures 10 to 14 inches in diameter. On bright sunny days the flowers close at high noon. I have read that the lotus opens but a single day then sheds its petals. I observed this plant three seasons and found that it opens and closes three to six days depending on the weather, before the petals fall. The leaves, rolled up from opposite sides like a scroll, also rise singly on a perforated stem until they stand three to five feet above water. They are deep saucer shaped and dark green in color. With buds, flowers, leaves and seed pods, properly the receptacle, a lotus bed is worth going many miles to see. There are two lotus beds in Monona County, Iowa, about 40 miles southeast

⁸ Illustrated Flora ed. 1, vol. 2, p. 45.

of Sioux City. Few people knew of these until Dr. L. H. Pammel visited them in July, 1922. The beds are in Gard Lake and Blue Lake, about three miles southeast of Onawa. The question arises as to how the lotus came to these out of the way places. According to a letter from Miss Helen Myers, whose father settled on the banks of Gard Lake in 1856, there were no lotus plants or yellow chinquapin lilies as they called them, in the lake at that time. In 1863 or 1864 the United States Government moved part of the Winnebago Indians from the reservation in Wisconsin to Monona County, Iowa, and put them on Gard Lake, just west of the Myers' home. It was at this time that the flowers made their appearance and it was generally understood that the Indians brought them and planted them as they used both the seeds and tubers for food.⁹ Dr. Melvin R. Gilmore in an article on "Plants used by the Indians of the Missouri River Region," states that the tubers and seeds of American lotus were used by Winnebago, Dakota, Omaha and Pawnee tribes, cooked with meat and hominy. The tuber is the shape and size of a small banana. In August and September, when the water is low, they harvest the tubers by wading in the shallow water, finding the tubers with their toes and bringing them up with a hooked stick. Some are dried for winter use. The Indians say that when one is digging tubers he must refrain from sneezing or the pores of the tuber will fill with mud, thus spoiling it for food. They also believe that tubers gathered by a tall man will be long; if gathered by a short man, they will be small. Dr. Gilmore concludes by saying that the lotus seeds and tubers are delicious food and worthy of cultivation. The so-called seed pod, more properly the receptacle, of the lotus with its 25 to 50 carpels, each in a separate depression on the receptacle, made a fine rattle for the Indian papoose.

The lotus seed has great vitality. De Candolle¹⁰ speaks of the germination of lotus seed that had been buried in clay 150 years. L. H. Pammel,¹¹ who made a study of the microscopic structure of the seed, with reference to the light line, notes that many seeds in which there is prolonged vitality, have Malpighian cells with a light line.

In December, 1923, I made experiments in germinating lotus seeds. I placed them in a two-quart jar of water. After three weeks there were no signs of germination. I took other seeds,

⁹ 33 Annual Report of United States Ethnological Survey.

¹⁰ Geographic Botanique, p. 542.

¹¹ Trans. Acad. of Science, St. Louis.

filed an opening through the thick, horny covering and put these into a two-quart jar of water with a little soil. In ten days to two weeks all had germinated. In eight weeks one plant sent a leaf up and over the side of the jar. It was about the size of a silver dollar. Mr. W. F. Bickel, of McGregor, Iowa, on whose land are large lotus beds, which I have visited, writes me that he has started many lotus beds, both by tubers and by seed. Tubers are the quicker and easier way. In the fall roll the tubers in two or three inches of soil, wrapping each in an old cloth or straw, tying loosely with a string to which a weight is fastened and drop in the pond or lake below frost line. In case of very shallow water, dig a hole in the mud 12 to 14 inches deep and put the tuber in.

Much attention is being given to the lotus, not only for its beauty but also for its food value. In Des Moines, Iowa, a Chinese restaurant serves the Chinese lotus tuber. It is not unlike our sweet potato in taste. They also serve the seeds roasted, which are similar to chestnuts in taste. The lotus is extensively raised in China for its commercial value. The large leaves are used instead of paper to wrap packages. The winter boquets of painted weeds created a great demand for the lotus pod a few years ago. The La Crosse, Wisconsin, *Tribune-Leader*¹² had the following: "Harvesting lotus lily pods with a car on the ice of the Mississippi River is a new winter job in this vicinity. Many tons of pods have been gathered from the sloughs and ponds of the river about McGregor and Prairie du Chien this winter, and shipped to eastern firms for use in making winter boquets and wreaths for cemeteries. The big brown cone-shaped pods of lotus with their cup-like seed receptacles lead all other dead weeds in adaptability to preservation with paraffin and painting with colors. They are not only the largest and choicest of weeds but the lightest, toughest and most durable. W. F. Bickel of McGregor has found unlimited demand for pods. With his force of men and boys he has spent much of the winter gathering and bringing in the pods. They are found on the banks where they fall in the autumn after shedding their seeds."

"Cast thy bread upon the waters, for thou shalt find it after many days" referred to the custom of throwing the lotus seed into the water to produce future plantations from which seed was gathered to make bread for the people. The lotus adapts itself to colonization and I wish that every state had a bed of *Nelumbo lutea*, the queen of the wild flowers.

¹² February 2, 1923.

PRELIMINARY LIST OF IOWA MOSSES

BETTY BLAGG

Mosses have been collected for three years in various parts of the state. Specimens have been taken in Henry, Washington, Muscatine, Fayette, Emmett, Dickinson, Tama, and Poweshiek counties with special efforts made in Henry county during the spring of 1927.

The specimens have been mounted in as near their natural condition as possible on 3 x 5 index cards placed in slits in the upper left-hand corner of regular herbarium paper. The herbarium labels have been placed in the lower right-hand corner and an envelope containing extra material in the center of the page. In the upper right-hand corner, small amounts (Pleurocarpous mosses) have been separated out and mounted on 2 x 3 cards to show detail. With the Acrocarpous mosses, single plants have been placed on the same card with the rest. Glycerin jelly mounts (sealed) have been made of leaf and peristome and placed in small envelopes which have been glued to the sheets. This method of mounting involves considerable time, but once completed makes a most convenient moss herbarium. (See diagram.)

In classification Grout's¹ key has been used almost entirely. Barnes's² key has not seemed so satisfactory, though this may be due to the fact that this key has not been given so thorough a trial. Classification of mosses seems almost insurmountable to the beginner, but once he sets his mind to fine dissecting needles and tweezers, a binocular and compound microscope both, and practices removing the leaves and dissecting the peristome, the task is not so hopeless. An illustrated key to our most common families (with figures from Grout) has been prepared with the view to using it with the general botany class. There are perhaps one or two families that should have been included, but representatives have not been found and quite probably would not be found by the ordinary beginning student.

¹ Grout, A. J. Mosses with hand lens and microscope. Published by the author, 360 Lenox Road, Flatbush, Borough of Brooklyn, New York city. 1903.

² Barnes, C. R. Analytic keys to the genera and species of North American Mosses. Bull. Univ. Wisc., Science Series Vol. I, No. 5, pp. 157-368. Madison, Wisc., Jan., 1897.

Verification of most of the Pleurocarpus mosses has been made through the courtesy of Dr. H. S. Conard of Grinnell college who offered the use of his Grout collection for comparison.

Grateful acknowledgment is also due Mr. Grout for assistance with synonymy and verification of species not hitherto reported from Iowa. Above all is the writer indebted to Professor H. E. Jaques of Iowa Wesleyan for help and inspiration.

There has not been a great deal of work done on Iowa mosses. T. E. Savage published a preliminary list (seventy-eight species) of the mosses of Iowa in 1899.³ In 1919 B. O. Wolden published "The Moss and Lichen Flora of Western Emmett County."⁴ He reports thirty-three species and since then has added ten species. The collection at Iowa Wesleyan contains forty-two named specimens with quite a number as yet unidentified. In order to make a usable list of Iowa mosses, the writer has combined the three lists and indicated by initials which species appear in the Savage, Wolden, and Blagg lists. They have been rearranged according to Grout. There are a few species not included in Grout which have been indicated by *. The six species not heretofore reported for Iowa are followed by brief notes.

The mosses prove a most fascinating study, especially since the work for the state has been so incomplete that there are always possibilities of new species. The following are the combined lists of the 103 species and varieties named for Iowa to date:

Polytrichaceae

Catharina undulata (L.) W. & M.....	S. W. B.
Catharina angustata Brid.....	S. W. B.
Polytrichum commune L.....	S.
Polytrichum juniperinum Willd.....	S. W. B.
Polytrichum piliferum Schreb.....	S.
Pogonotum brevicaula (Brid.) Beauv.....	S.

Fissidentaceae

Fissidens incurvus var. minutulus Austin.....	S.
Fissidens adiantoides (L.) Hedw.....	W.
Fissidens taxifolius (L.) Hedw.....	S.
Fissidens subbasilaris Hedw.....	W.

Dicranaceae

Ditrichum pallidum (Schreb.) Hampe.....	S.
Ditrichum tortile (Schreb.) Hampe.....	S. B.
Ceratodon purpureus (L.) Brid.....	S. W. B.
*Ceratodon purpureus aristatus Aust.....	S.

³ Savage, T. E. A preliminary list of the mosses of Iowa. Proc. Ia. Acad. Sci., vol. 6, pp. 154-164. 1899.

⁴ Wolden, B. O. Moss and lichen flora of western Emmet county. Proc. Ia. Acad. Sci., vol. 26, pp. 259-267. 1919.

Dicranella heteromalla (L.) Schimp.....	S.	W. B.
Dicranella varia (Hedw.) Schimp.....	S.	
Dicranum scoparium (L.) Hedw.....	S.	W.
Dicranum flagellare Hedw.....	S.	
Leucobryum glaucum (L.) Schimp.....	S.	
<i>Grimmiaceae</i>		
Grimmia apocarpa (L.) Hedw.....	S.	B.
<i>Tortulaceae</i>		
Phascum cuspidatum Schreb.....	S.	
Astomum nitidulum Schimp.....	S.	
Weisia viridula (L.) Hedw.....	S.	B.
Barbula unguiculata (Huds.) Hedw.....	S.	B.
*Barbula rigida Schultz.....	S.	
Desmatadon arenaceus S. & L.....	S.	
<i>Orthotrichaceae</i>		
Orthotrichum Porteri Aust.....	S.	
Orthotrichum obtusifolium Schrad.....	S.	
Orthotrichum strangulatum Sulliv.....	S.	
<i>Funariaceae</i>		
*Pyramidula tetragona Brid.....	S.	
Physcomitrium turbinatum (Mx) Brid.....		B.
Henry county, May 19, 1927. Very common; growing on ground everywhere, old fields, pastures, gardens, lawns.		
*Physcomitrium Hookeri Hemp.....		W.
*Physcomitrium acuminatum Bruch & Schimp.....	S.	
*Physcomitrium Drummondii E. G. Britton.....		B.
Henry county, Ia., May 2, 1927. Rocky ground. Down "K-line."		
Funaria hygrometrica (L.) Sibth.....	S.	W. B.
<i>Timmiaceae</i>		
Timmia megapolitana Hedw.....	S.	B.
<i>Aulacommiaceae</i>		
Aulacomnium hererostichum (Hedw.) B. & S.....	S.	B.
<i>Bartramiaceae</i>		
Bartramia pomiformis (L.) Hedw.....	S.	B.
<i>Bryaceae</i>		
Leptobryum pyriforme (L.) Wils.....	S.	
Pohlia nutans (Schreb.) Lindb.....	S.	
Mniobryum albicans (Wahlenb.) Limpr.....		W.
Bryum inclinatum (Sw.) Bland.....		W.
Bryum caespiticium L.....		W. B.
Bryum intermedium Brid.....	S.	B.
Bryum capillare L.....		W.
Bryum argenteum L.....	S.	W. B.
*Bryum argenteum lanatum Bruch & Schimp.....	S.	
Rhodobryum roseum (Weis.) Limpr.....	S.	W. B.
Mnium cuspidatum (L.) Leyss.....	S.	W. B.
Mnium affine rugicum B. & S.....		W.
Mnium affine Bland.....	S.	

Mnium stellare Reich..... B.
 Henry county, deep woods near Salem, May 15, 1927.
 Growing on ground.

Leskeaceae

Thuidium delicatulum (L.) Mitt..... W. B.
 Thuidium recognitum (Hedw.) Lindb..... S.
 Thuidium abietinum (L.) B. & S..... S.
 Thuidium scitum (Beauv.) Aust..... S.
 Thuidium Virginianum (Brid.) Lindb..... S.
 Leskea polycarpa Ehrh..... S.
 Leskea gracilescens Hedw..... W.
 Leskea obscura Hedw..... S. B.
 Anomodon minor (P. Beauv.) Fuern..... S. W. B.
 Anomodon viticulosus (L.) Hook & Taylor..... B.
 Henry county, State park, Oakland Mills, March 16, 1927.
 Growing on rocks.
 Anomodon attenuatus (Schreb.) Hueben..... S. W. B.
 Anomodon rostratus (Hedw.) Schimp..... S. W. B.
 Thelia aspirella (Schimp) Sulliv..... S. B.

Hypnaceae

Hylocomium triquetrum (L.) B. & S..... S.
 Brachythecium oxycladon (Brid.) J. & S..... S. W. B.
 Brachythecium acutum (Mitt.) Sulliv..... W.
 Brachythecium campestre B. & S..... W.
 Brachythecium rivulare B. & S..... W.
 Brachythecium plumosum (Sw.) B. & S..... S. W.
 Brachythecium acuminatum (Hedw.) Lindb..... S. W.
 *Brachythecium acuminatum setosum Sulliv. & Lesq..... S.
 Eurynchium hians (Hedw.) J. & S..... S. B.
 Eurynchium strigosum (Hoffm.) B. & S..... W.
 Eurynchium serrulatum (Hedw.) Lindb..... S. W. B.
 Climacium Americanum Brid..... S. W. B.
 Climacium Kindbergii (R. & C.) Grout..... B.
 Fayette county, Ia., July, 1924. Base of limestone cliffs.
 Drepanocladus adunctus (Hedw.) Warnst..... S.
 Drepanocladus adunctus var. gracilescens (Sch.)..... W.
 Cratoneuron filicinum (L.) Roth..... S.
 Calligeron Schreberi (Willd.)..... S.
 Campylium hispidulum (Brid.) M. H..... S.
 Campylium chrysophyllum (Brid.) Bruhn..... W.
 Campylium stellatum (Schreb.) Bruhn..... W.
 Amblystegium serpens (L.) B. & S..... S. W. B.
 Amblystegium Kochii B. & S..... W. B.
 Amblystegium varium (Hedw.) Lindb..... W. B.
 Amblystegium irriguum (Wils.) B. & S..... S. B.
 Amblystegium orthocladon (P. B.) Kindb..... B.
 Henry county, May, 1924.
 Amblystegium riparium B. & S..... S. W. B.
 Amblystegium riparium var. fluitans (L. & J.) R. & C..... S.
 Hypnum imponens Hedw..... S.

Hypnum curviflorum Hedw.....	S.
Hypnum Haldanianum Grev.....	S.
Plagiothecium sylvaticum (Hedw.) B. & S.....	S.
Amblystegiella adnata (Hedw.) Nichols.....	S.
Entodon seductrix (Hedw.) C. M.....	S. W. B.
Entodon cladorrhizans (Hedw.) C. M.....	S. W. B.
Entodon compressus (Hedw.) C. M.....	S. B.
Platygyrum repens (Brid.) B. & S.....	W.
Pylaisia intricata (Hedw.) R. & C.....	S.

Fontinalaceae

Fontinalis Lescurii Sulliv.....	W.
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IOWA MOSSES — KEY TO FAMILIES

1. Plants whitish or light gray, scarcely appearing green.....
Leucobryeae in *Dicranaceae*
1. Plants green, yellow green, or dark green to almost black..... 2
2. Leaves in two rows with edges apparently towards the stem; leaves
 apparently split on the inner edge and sheathing each other and the
 stem. Fig. 1.....*Fissidentaceae*
2. Leaves in more than two rows, or if apparently two ranked the
 edges of the leaves not toward the stem..... 3
3. Acrocarpous. Fig. 2..... 4
3. Pleurocarpous. Fig. 3..... 16



Fig. 1.



Fig. 2.

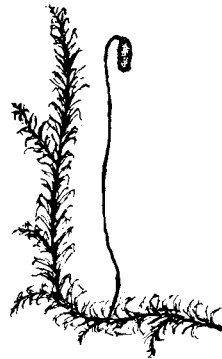
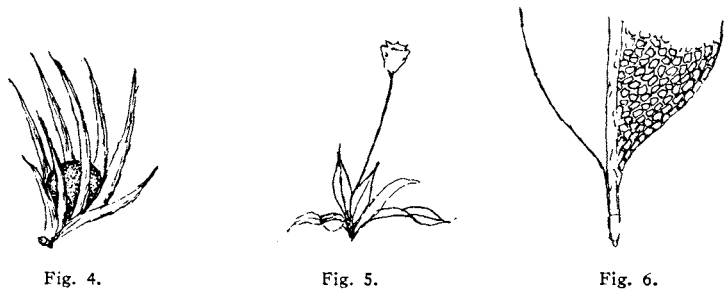


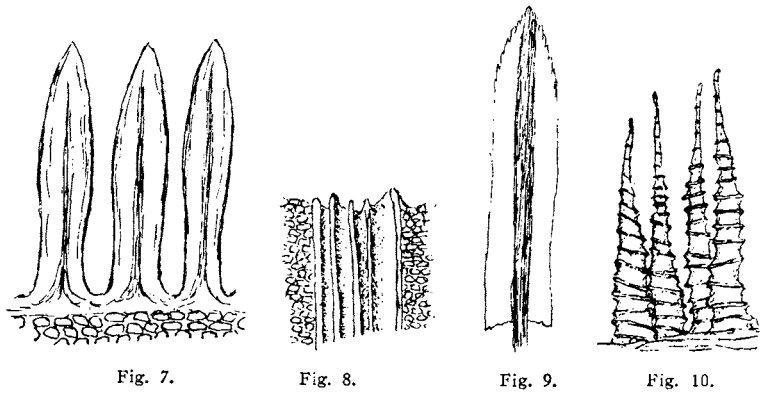
Fig. 3.

4. Plants black or blackish green; leaves with very thick cell walls;
 growing on trees or rocks..... 5
4. Plants green to light yellow-green, or, if blackish, growing on soil 6
5. Plants often hoary with colorless leaf apices, nearly all growing on
 rocks*Grimmiaceae*
5. Plants very rarely hoary, mostly tree-growing.....*Orthotrichaceae*
6. Without peristome..... 7
6. With peristome..... 9
7. Capsules immersed. Fig. 4.....*Astomum* in *Tortulaceae*
7. Capsules not immersed..... 8

- 8. Plants larger 3-12 mm. in height; costa not excurrent. Fig. 5.....
*Physcomitrium* in *Funariaceae*
- 8. Plants only about half as large; costa excurrent. Fig. 6.....
*Pottia* in *Tortulaceae*



- 9. Peristome of 32-64 non-articulate teeth. Fig. 7. Leaves with numerous vertical lamellae on the upper surface of the costa. Figs. 8 & 9. Plants large and very often dark colored; growing on soil.....
 *Polytrichaceae*
- 9. Peristome of 16-32 plainly articulate teeth. Figs. 10 & 11..... 10



- 10. Peristome single. Fig. 10..... 11
- 10. Peristome double. Fig. 11..... 12
- 11. Leaves papillose. Fig. 12.....*Tortulaceae*
- 11. Leaves not papillose.....*Dicranaceae*
- 12. Leaves papillose; capsules strongly plicate or furrowed when dry.. 13
- 12. Leaves not papillose..... 14
- 13. Capsules nearly as broad as long; inner peristome without cilia. Fig. 13.....*Bartramaceae*
- 13. Capsules longer than broad; cilia of inner peristome well developed. Fig. 14.....*Aulacomniaceae*

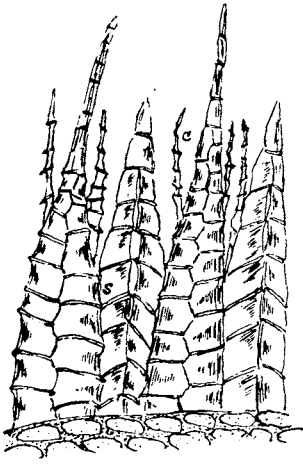


Fig. 11.



Fig. 12.



Fig. 13.



Fig. 14.

- 14. Inner peristome of cilia only. Fig. 15.....*Timmiaceae*
- 14. Inner peristome of keeled segments; intermediate cilia often present. Fig. 11s & Fig. 11c..... 15
- 15. Segments opposite teeth; capsules very strongly unsymmetric with mouth one-sided. Fig. 16.....*Funariaceae*
- 15. Segments alternate with the teeth; capsules usually symmetric, often pendent. Fig. 17. Well developed cilia; leaves often bordered by a margin of narrow elongated cells. Fig. 18.....*Bryaceae*

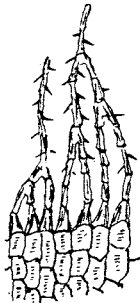


Fig. 15.

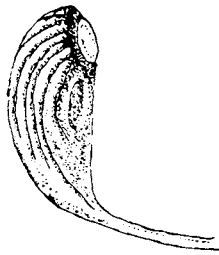


Fig. 16.

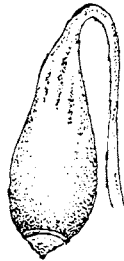


Fig. 17.

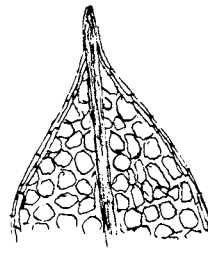
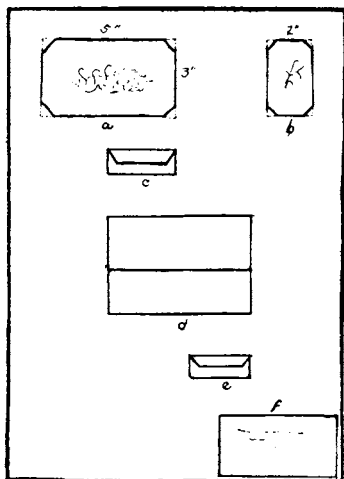


Fig. 18.

- 16. Aquatic, long, and floating, capsules immersed or emergent, never exerted on long setae.....*Fontinalaceae*
- 16. Terrestrial; a few aquatic, but with capsules exerted on long setae 17
- 17. Leaves papillose; leaf cells short, rhomboidal, or subcircular. *Leskeaceae*
- 17. Leaves not papillose; leaf cells elongated, sometimes rhomboidal, but never in the main portion of the leaf.....*Hypnaceae*

METHOD OF MOUNTING



- a. Habitat structure.
- b. Detail.
- c. Envelope containing glycerin jelly mount of peristome.
- d. Envelope containing extra material.
- e. Envelope containing leaf slide.
- f. Regular herbarium label.

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