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PHORESY BY NORTH AND CENTRAL AMERICAN PSEUDOSCORPIONS

William B. Muchmore[1]

ABSTRACT. It is widely known that some pseudoscorpions attach themselves to other, larger animals and are thereby transported from place to place. Reviews of the subject by Vachon (1940) and Beier (1948) have dealt mainly with European pseudoscorpions and with African, Asian and South American material in European collections. The present paper summarizes the records of pseudoscorpion phoresy in Central and North America as presented by Beier and as published since 1948. Additional records are presented, based upon material seen by the author. The utility of phoretic behavior in pseudoscorpions is discussed, with special reference to certain cave-dwelling forms.

INTRODUCTION

Pseudoscorpions of various kinds have long been known to occur on the bodies of other, larger animals. They have often been found clinging to the legs of insects, especially Diptera, Coleoptera and Hymenoptera, and of harvestmen (Opiliones). Also, particularly in tropical areas, they are frequently encountered under the elytra of large beetles, especially Cerambycidae. And a few have been found on the legs or bodies of Orthoptera and Lepidoptera. Further, they have been reported occasionally from the bodies of birds and mammals.

Because there is no direct evidence that pseudoscorpions are capable of feeding upon their hosts, the associations are usually not considered to be parasitic in nature. It has been suggested, variously, that pseudoscorpions contact their hosts by accident, grasping the leg or other part because of some reflex action; that they "purposely" attach to the hosts in order to be carried to a new location, to find new food sources or to disperse the species; and that they climb onto the hosts to search for food in the form of smaller, parasitic or commensal mites, also harbored by the hosts. "The non-parasitic association of one kind of animal with another in order to obtain transportation" is called *phoresy* (Websters Third New International Dictionary).

Phoresy by pseudoscorpions has been the subject of extensive reviews by Vachon (1940) and Beier (1948). Subsequently, other notes and records have been published by these and other authors. The great majority of the records have referred to European pseudoscorpions or to

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Asian, African or South American material in European collections, rather few dealing with Central or North American forms. In this paper, I shall review the published references to phoretic behavior of North and Central American pseudoscorpions and cite additional records based upon my own investigations of these animals.

Many of the specimens mentioned here have been borrowed from the collections of other institutions. I am indebted to the several curators of these collections for their cooperation in lending the material. Much of this work was supported by research grants from the National Science Foundation.

RECORDS

In his review, Beier recognized six different categories of relationships of pseudoscorpions with other, larger animals.

A. Species found attached to the appendages of other arthropods.
B. Species found settled on the bodies of larger insects.
C. Species found in the nests of social insects.
D. Species found in birds' nests.
E. Species found in the nests of small mammals or on such mammals.
F. Species found in human habitations.

It seems appropriate to follow the same plan here.

A. Species found attached to the appendages of other arthropods.

The records cited by Beier (1948) for North America are as follows:

?"*Obisium*" sp. On *Tipula* sp.: Hagen 1879, p. 400[2] (North America). This is likely *Syarinus obscurus* (see below).

Lamprochernes oblongus (Say). On *Dysdercus andreae:* Myers, 1927, p. 291 (Cuba).

It is doubtful that this was actually *L. oblongus,* which has not otherwise been recorded from Cuba and which is usually found under the bark of fallen logs and not on living trees. More likely it was another, larger lamprochernetine belonging to *Lustrochernes* or *Mesochernes,* or else an atemnid, which might to the untrained eye resemble *Lamprochernes.* In any event, the pseudoscorpions reported by Myers were not carried about by the bugs, but rather held the bugs fast to the tree trunk until they died or were cannibalized by others of their own kind. Thus, this is not a record of phoresy.

Lamprochernes (?) *loewi* (Hagen). On dipteran: Hagen 1879, p. 400. (Panama)

It appears that there has never been a formal description of this species

2. See Beier (1948) for complete references.

which was mentioned by Hagen as *Ch. Loewii*. Therefore, the name is invalid and the actual creature which was observed is unknown. There is no good reason for assigning it to *Lamprochernes*.

Neochernes sanborni (Hagen). On dipterans: Hagen, 1867, p. 323; 1868, p. 48; 1879, p. 400 (North America), etc.

This species has been reassigned by Hoff (1946) to the genus *Hesperochernes*. It is probable that this is a valid record, since Hagen described the species within a year after first reporting its occurrence on a fly. However, the records cited by Beier of observations by Leidy, Knob and Webster are unacceptable, because none of these authors made any attempt to identify the pseudoscorpions involved, and Beier's assignment to this species could at best have been based on an educated guess.

Neochernes (?) *pallipes* (Bank) [sic]. On dexiid: Banks, 1895, p. 115 (North America).

This species (*Chelanops pallipes*) has also been reassigned by Hoff (1947) to the genus *Hesperochernes*. Although the species was originally described from California (in 1893), Banks was possibly familiar enough with it to make an accurate determination of the phoretic specimen from Colorado (in 1895).

Incachernes mexicanus Beier. On *Staphylinus fulvomaculatus:* Beier, 1933, p. 95 (Mexico).

And in 1952 Chamberlin recorded the following case.

Dinocheirus sicarius Chamberlin. "Clinging to trochanter of third leg of Muscidae fly." (Monterey County, California).

Thus, to the present, there are only five known pseudoscorpion species in North America which engage in phoresy by clinging to the legs of flies or other arthropods, namely:

Syarinus obscurus
Hesperochernes sanborni
Hesperochernes pallipes
Incachernes mexicanus
Dinocheirus sicarius

Additional cases which have come to my attention may be summarized as follows:

Lechytia sp., 1 ♂ and 1 ♀, "clinging to hind tarsus of small beetle". *Prostomis mandibularis* (Fab.). [det. S. B. Peck] at Big Basin, Santa Cruz County, California, collected by C. D. Duncan. (JC)[3]

3. These specimens are from the J. C. Chamberlin collection. Others are from the collections of the Academy of Natural Sciences of Philadelphia (ANSP), the American Museum of Natural History (AMNH), Cornell University (CU), the Museum of Comparative Zoology at Harvard University (MCZ), the United States National Museum (USNM), and W. B. Muchmore (WM).

Syarinus obscurus (Banks), 1 ♀ on cranefly, *Tipula* (Lunatipula) *unicincta* Doane [det. C. B. Alexander] in the Olympic National Park, Jefferson County, Washington, collected by B. Malkin (AMNH).

Paratemnus nidificator (Balzan), 2 ♂, 3 ♀, 1 nymph "from adult honey bees" in Costa Rica. (CU)

Pycnochernes sp., 1 ♀ on fly, *Musca domestica* L. [det. H. C. Huckett] in Washington [presumably, Washington, D.C.], collected by B. P. Mann. (MCZ)

Pycnochernes sp., 1 ♀ "from body of wild bee" at Beach, Golden Valley County, North Dakota, collected by C. N. Ainslie. (USNM)

Pycnochernes sp., 1 ♀ "found in cyanide bottle with insects" at Seattle, King County, Washington by T. Kincaid. (WM)

Pselaphochernes scorpioides (Hermann), 1 ♀ attached to leg of fly, *Pegomya affinis* Stein [det. H. C. Huckett] at Holliston, Middlesex County, Massachusetts. (MCZ)

Pselaphochernes sp., 4 ♀ attached to legs of a fly (*Musca*?) at Byron, Peach County, Georgia, collected by J. A. Payne. (WM)

Hesperochernes tamiae Beier, 2 ♀ attached to legs of a fly, *Amoebalaria* sp. [det. L. Knutson] [no locality data, but presumably from New England]. (MCZ)

Hesperochernes sp., 1 ♂, 8 ♀ from flies taken in a Malaise trap at Pullman, Whitman County, Washington by R. D. Akre and R. W. Dawson. One ♂ and one ♀ were attached to the legs of a single fly, *Pegomya apicalis* Stein [det. R. D. Akre]: two ♀ were each attached to a separate fly; the remaining four ♀ were found in the bottom of the trap. (WM)

Pseudozaona sp., 1 ♀ found clinging to leg of fly, *Amoebalaria defessa* (Osten-Sacken) [det. G. D. Gill] about 100 feet from entrance in Wright's Cave, near Clinton, Anderson County, Tennessee, by J. A. Payne. (WM)

Dendrochernes sp., 1 ♀, from a horntail, *Tremex columba* (L.), at Youngstown, Niagara County, New York, by L. L. Pechuman. (CU)

Dendrochernes sp., 1 ♀, "attached to leg of longicorn beetle" at Grand Canyon, Arizona. (WM)

Parachelifer longipalpus Hoff, 1 ♀, "loosely attached to hindquarters" of tiger beetle, *Cicendela hirticollis*, at Goose Island, Memphis, Shelby County, Tennessee, collected by R. D. Ward. (WM)

It is of great interest to note that the *Lechytia* mentioned above are the first chthoniid pseudoscorpions reported to be involved in phoresy, though Beier (1948) recorded two tridenchthoniid species having been found on the bodies of beetles. It is likely, as Beier has suggested, that most chthoniids, living in moist ground litter and soil, do not often come into close contact with other arthropods which could serve as hosts. On the other hand, species of *Lechytia*, living in somewhat more open and drier habitats (dry leaves and litter, under stones and wood), may frequently attach to more mobile creatures.

In Europe, a number of pseudoscorpions have been found attached to the legs of harvestmen (Opiliones). On the other hand, there are no records at all of such an association in America. It is difficult to understand why this is so, since we have plentiful numbers of both pseudoscorpions and harvestmen. Perhaps it is just that our fauna has not been studied as intensively as that of Europe and the association, occurring sporadically, has not yet been observed by an interested person.

Also, it is notable that there is no valid record of a *Lamprochernes* attaching to the leg of an insect in this country, while in Europe, the majority of records of phoresy involve *Lamprochernes nodosus*. This is probably correlated with the fact, pointed out by Jones (1970), that *L. nodosus* and the housefly, *Musca domestica,* occupy much the same habitats, namely vegetable detritus, manure heaps, and lawn cuttings. Thus, they could frequently come into close proximity, allowing the pseudoscorpion to grasp the leg of the fly. In America, the species of *Lamprochernes* usually inhabit drier niches, especially under the loose bark of fallen logs, where flies are infrequent and the opportunities to grasp a leg are thus few.

Most of the species which have been found attached to flies in America are in fact, litter-dwelling forms, which obviously do have good opportunities to contact their hosts. But in no case are any details of the relationship between the animals known.

Two of the species mentioned above, namely *Dendrochernes* sp. and *Parachelifer longipalpus* are typically found under the loose bark of living trees. It is reasonable to find the *Dendrochernes* sp. on a horntail or a longicorn beetle, which would normally rest on tree trunks. However, the attachment of *P. longipalpus* to a tiger beetle is puzzling, because tiger beetles are usually encountered on mud banks or sandy surfaces and not on trees. In this case, in order for the animals to have made contact, either the beetle did land on a tree trunk or else the pseudoscorpion was down on the ground, perhaps on a detached piece of bark.

B. Species found settled on larger insects.

The cases recorded by Beier in this category for North and Central America were as follows:

Lamprochernes oblongus (Say). On *Alaus maculatus:* Hagen, 1879, p. 400 (North America). On *Alaus oculatus:* Haldeman, 1848, p. 148; Mann, 1868, p. 325; Leidy, 1877, p. 261 (as *Chelifer alius*); Banks, 1895, p. 115 (North America).

The mention of *Ch. alius* on *Alaus maculatus* by Hagen (1879) appears not to pertain to a new observation; it is likely that he simply erred in reporting the name of the beetle upon which Leidy had found the pseudoscorpions (six on one beetle, in fact). It was Banks (1895) who first suggested that *Ch. alius* Leidy is a synonym of *Ch. oblongus* Say, but without, apparently, seeing any new specimens. Thus there are three separate records of pseudoscorpions, probably *L. oblongus,* on *Alaus oculatus,* one from Pennsylvania (Leidy), one from Ohio (Mann) and one from a locality unspecified (Haldeman).

Cordylochernes scorpioides (L.). On *Acrocinus longimanus:* Ellingsen, 1913, p. 453 (Trinidad); Beier, det. 1947 (Costa Rica and Panama).

Cordylochernes costaricensis Beier. On *Acrocinus longimanus:* Beier, det. 1947 (Mexico).

Cordylochernes nigermanus Hoff. On "large beetle": Hoff, 1944, p. 7 (Panama).

Cordylochernes panamensis Hoff. On "large beetle": Hoff, 1944, p. 10 (Panama).

Parachernes nigrimanus Beier. On *Chalcolepidius rugatus:* Beier, det. 1946 (Costa Rica).

Parachernes setosus Beier. On *Chalcolepidius rugatus:* Beier, det. 1946 (Costa Rica).

Pachycheirus instabilis Chamberlin. On a cerambycid beetle: Chamberlin, 1934, p. 126 (Montana).

This species has been reassigned to the genus *Dendrochernes* by Hoff (1958).

Parachelifer hubbardi (Banks). On *Acrocinus longimanus:* Beier, det. 1946 (Mexico).

To my knowledge, no further records appear in the literature.

Additional cases which have come to my attention are:

Lustrochernes sp., 2♂, 3♀ "from cerambycid at light" [in Florida?] by Jennings. (WM)

Lustrochernes grossus (Banks), 9 ♂, 10 ♀ on cerambycids, *Ergates spiculatus*, at Walnut Canyon, Coconino County, Arizona, collected by J. G. Franclemont. (WM)

Lustrochernes sp. many ♂ and ♀ "under elytra of harlequin beetles" at Barro Colorado Island, Panama Canal Zone, by R. D. Akre. (WM)

Lustrochernes sp., 1 ♀, and *Cordylochernes* sp., 8 ♂, found together "under elytra of a harlequin beetle" at Barro Colorado Island, Panama Canal Zone by R. D. Akre. (WM)

Cordylochernes sp., 2 ♂, 4 ♀ and 4 ♂, 6 ♀ found under the elytra of two separate harlequin beetles at Barro Colorado Island, Panama Canal Zone by R. D. Akre. (WM)

Cordylochernes sp., 2 ♂, on *Acrocinus longimanus* at Juan Viñas, Costa Rica. (ANSP)

Parachelifer persimilis (Banks), 5 ♂, 7 ♀, on cerambycids, *Ergates spiculatus,* at Walnut Canyon, Coconino County, Arizona, collected by J. G. Franclemont. (WM)

These specimens were in a vial together with the *Lustrochernes grossus* listed above, all having come from three adult beetles. While this is not certain, it seems likely that the two species may occur together on a single beetle.

Parachelifer persimilis (Banks), 2 ♂, 2 ♀ (one with eggs) "under elytra of prionine cerambycid (*Tragosoma depsarius*) under bark of *Pinus ponderosa* log" at rim of Jamez Coldera, Sandoval County, New Mexico, collected by R. C. Graves. (WM)

B2. Species found on the bodies of moths.

Beier listed a few occurrences of pseudoscorpions on moths, none of them, however, from America.

Treat (1956) noted the discovery of two small pseudoscorpions on the bodies of pinned specimens of noctuid moths, *Acronycta g. grisea* and *A. ovata,* in the American Museum of Natural History. These were identified by C. C. Hoff as males of an undescribed species of *Apocheiridium*. Because the history of the host specimens was poorly known, Treat admitted the possibility that the pseudoscorpions became associated with them in the cabinet rather than in the field. However, for a number of reasons, he believed that this represented "true phoresy rather than predation upon scavengers." (p. 88).

Recently, Dr. Treat has sent me several specimens of *Apocheiridium* sp. which he recovered from moths taken in the field at Tyringham, Berkshire County, Massachusetts. They proved to be:

1 ♀, "found alive on mesosternum of *Acronycta morula* G. & R. ♂."
1 ♂, "behind fore coxae of *Catocala neogama* A. & S. 70–49 ♀."
1 ♂, "in killing jar after seen on *Catocala neogama* A. & S. 70–50 ♂."
1 ♂, "in killing jar after *Catocala neogama* A. & S. 70–49 ♂, 50 ♀."

It is now clear that at least one species of *Apocheiridium* may get onto the bodies of moths and be carried about by their hosts. It is by no means clear what the pseudoscorpions are doing in this situation. It should be easy for *Apocheiridium* to board the moths as they rest on tree bark, beneath which the pseudoscorpions live; but whether they do this accidentally, or in pursuit of prey (mites), or for some other reason, is quite unknown.

B3. Mention should also be made here of some captures of pseudoscorpions in light traps.

Hoff (1956) reported in his paper that one female *Dactylochelifer silvestris* Hoff was "taken with beetles in a light trap" at Mt. Taylor, Valencia County, New Mexico. And Frost (1966) lists *Dendrochernes* sp. and *Parachernes* sp. among the insects found in light traps at the Archbold Biological Station, Highlands County, Florida.

Recently Dr. Frost has sent me some additional pseudoscorpions from his light traps at the Archbold Biological Station.

Lamprochernes sp., 1 ♂
Parachernes latimanus (Banks), 1 ♂, 1 ♀
Dendrochernes sp., 1 ♂
Ocalachelifer cribratus Chamberlin, 1 ♀, 1 tritonymph
Parachelifer superbus Hoff, 1 ♀

Since it is difficult to imagine how pseudoscorpions could get into the light traps by themselves, it seems reasonable to conclude that they were carried in by flying insects. But it is, of course, impossible to determine which particular insect, or kind of insect, provided the transportation.

It is not hard to see how pseudoscorpions might get onto the bodies of large insects such as cerambycid beetles and noctuid moths. Both of these kinds of insects habitually rest upon the tree trunks and so may place themselves in close proximity to pseudoscorpions which may be on or under the bark. On the other hand, it is by no means clear why the pseudoscorpions should move from the tree to the insect. Perhaps the pseudoscorpions can discern no difference between bark and insect, the body of the latter being just another surface upon which to walk, the space beneath the elytra being just another crevice in which to hide. But, also, other creatures, such as parasitic and commensal mites, are often found on large insects; these could form an attractive source of food for pseudoscorpions actively searching for prey. In either case, the pseudoscorpions would board the insect more or less by accident, that is, not for the purpose of being transported to another place. Whether they are in fact transported would depend upon the length of time spent upon the insect and the activities of the insect during this interval. It is tempting to believe that pseudoscorpions could spend their entire lives upon one of the large cerambycid beetles, such as *Acrocinus longimanus,* living in safety under the elytra and feeding upon the smaller fauna of the insect. Gravid females are occasionally encountered, but it appears that no nymphs have ever been found upon beetles; Beier mentions only males and females and I, myself, have seen no nymphs in the material I have studied. If nymphs are hatched upon the beetles, it may be that in the limited space on the host they readily fall prey to their hungry elders.

C. Species found in the nests of social insects.

Beier listed a number of pseudoscorpions which had been found in the nests of ants or, in one case, of a ground-nesting wasp:

Microcreagris rufula (Banks). With *Camponotus sansabeanus:* Banks, 1908, p. 42 (Texas).

This species is certainly not *M. rufula*, which is otherwise recorded only from Washington, D. C., Virginia, and Kentucky. It likely belongs to an undescribed species, of which there are several from Texas.

Pachyolpium (?) *minutum* (Banks). With *Eciton coecum:* Banks, 1908, p. 42 (Texas).

I have recently reexamined the holotype of this species (MCZ) and found it to belong to the genus *Serianus.*

Paratemnus perpusillus Beier. With *Camponotus* sp.: Beier, 1935, p. 487 (Windward Islands).

Neochernes dorsalis (Banks). With *Formica subpolita* and *Aphaenogaster subterranea:* Wheeler, 1911, p. 168 (California).

This species has been reassigned to the genus *Dinocheirus* by Hoff (1947).

Hesperochernes laurae Chamberlin. With *Vespa occidentalis:* Chamberlin, 1924, p. 89 (California).

Hesperochernes unicolor (Banks). With *Eciton coecum* and *Pachycondyla harpax:* Banks, 1908, p. 40 (Texas).

Incachernes mexicanus Beier. With *Atta* sp.: Beier, 1933, p. 95 (Mexico).

Beier either overlooked or ignored the record by Chamberlin (1932) of *Ellingsenius sculpturatus* (Lewis) from Claremont, California, possibly because Chamberlin himself expressed some doubt about the validity of the record. It is possible, however, that this African species has been introduced into this country along with honeybees, with which it is usually commensal.

Chamberlin (1949, p. 8) has also noted the occurrence of two species of pseudoscorpions in a "nest of *Bombus americanorum* in flying squirrel nest in black oak stub twenty feet above the ground" at Vienna, Virginia, namely:

Phoberocheirus cribellus Chamberlin.

Mirochernes dentatus (Banks).

I know of only three other specimens, which fit into this category, all having been taken by R. D. Akre at Barro Colorado Island, Panama Canal Zone.

Pachyolpium sp., 1 ♂ with *Labidus coecus.*

Lustrochernes sp., 1 ♂ with *Eciton hamatum,* and 1 ♀ with *Eciton burchelli.*

The status of the pseudoscorpions found in the nests of ground-living social insects is difficult to ascertain. None of the genera, with the exception of *Ellingsenius*, is restricted to associations with insects. Because most of the pseudoscorpion collections consist of only one or two specimens, there are no data on the frequency with which particular species associate with insects. And there is no information about what pseudoscorpions actually do in ants' nests. It has been suggested that they may live there as commensals feeding on ant larvae or on small mites or commensal insects also present. On the other hand, it appears possible that they may only wander into the nests by chance, or that they were accidentally mixed with the ants, along with surface litter, when the nests were dug up, particularly as they are encountered so infrequently.

The pseudoscorpions reported by Chamberlin to have been found in the bumblebee nest in a tree hole were undoubtedly there only by chance. *Mirochernes dentatus* has often been reported from tree holes, and *Phoberocheirus* is the same as, or closely related to, *Acuminochernes,* representatives of which are often found in stumps or tree holes.

D. Species found in birds' nests.

Beier lists two species of pseudoscorpions which had been found in the nests of birds:

Hesperochernes montanus Chamberlin. In bird's nest: Chamberlin, 1935, p. 37 (Montana).

Chelifer cancroides (L.). In nest of a phoebe, *Sayornis phoebe:* Beier, det. 1946 (North America).

Other cases have been reported by Hoff, as follows:

Parachernes squarrosus Hoff in a "nest in a bluebird box": Hoff, 1949, p. 460 (Quincy, Adams County, Illinois).

Tejachernes stercoreus (Turk) in "swallow nests constructed from mud at cave entrance": Hoff, 1957, p. 88 (Frio Cave, Uvalde County, Texas).

Acuminochernes tacitus Hoff "from debris in the nest of a flicker, *Colaptes cafer*": Hoff, 1961, p. 455 (Fort Collins, Larimer County, Colorado).

Additional specimens, which I have seen, are:

Chthonius tetrachelatus (Preyssler), 1 ♂, 1 ♀ in a catbird nest in a lilac bush, near Rensselaerville, Albany County, New York. (WM)

Pseudogarypus sp., 1 ♂ in a swallow nest, near Woodruff, Rich County, Utah; collected by G. F. Knowlton and T. Whitworth. (WM)

Dinocheirus sp., 1 ♂, 2 nymphs from starling nests at Mantua, Box Elder County, Utah; and 1 ♀ from a marsh wren's nest at Benson, Cache County, Utah; collected by G. F. Knowlton and T. Whitworth, (WM)

Dactylochelifer silvestris Hoff, numerous ♂, ♀ and nymphs in nests of yellow-headed blackbirds near Benson and Wellesville, Cache County, Utah, and 2 nymphs from nest of yellow warbler at Logan, Cache County, Utah; collected by G. F. Knowlton and T. Whitworth. (WM)

Chelifer cancroides (L.), 1 ♂, 1 nymph from robin's nest in barn, and 1 nymph from robin's nest in hemlock tree, near Rensselaerville, Albany County, New York. (WM)

The occurrence of pseudoscorpions in birds' nests is certainly fortuitous, because most nests are quite temporary in nature. It is usually only while the birds are actively using the nest that mites and lice, which could serve as food for pseudoscorpions, would be present. It is likely that the pseudoscorpions are carried into the nests on building materials such as mud, dried grass and straw, or perhaps on the feet of the adult birds. Ressl (1963) has presented data which suggest that certain European pseudoscorpions may actually be dispersed by birds, though no direct evidence is cited.

E. Species found in the nests of small mammals, or on such mammals.

Beier listed only a single species from America:

Hesperochernes tamiae Beier. With *Tamias striatus:* Beier, 1930, p. 216 (North America).

More recently a number of other records have appeared in the literature.

Lechytia pacifica (Banks), in *Neotoma* nest: Hoff and Clawson, 1952, p. 2 (Utah).
This species is presently without a valid name (see Schuster, 1968).

Microcreagris nigrescens Chamberlin, in *Neotoma* nest: Chamberlin, 1952, p. 265 (California).

Aglaochitra rex Chamberlin, in *Neotoma* nest: Chamberlin, 1952, p. 269 (California).

Larca granulata (Banks), in *Neotoma* nest: Hoff and Bolsterli, 1956, p. 164 (Tennessee).

Archeolarca rotunda Hoff and Clawson, in nests of *Neotoma* and *Erethizon:* Hoff and Clawson, 1952, p. 8 (Utah).

Cheiridium insperatum Hoff and Clawson, in *Neotoma* nest: Hoff and Clawson, 1952, p. 13 (Utah).

Pselaphochernes parvus Hoff, in "nests of small mammals": Hoff, 1949, p. 464 (Illinois).

Pselaphochernes becki Hoff and Clawson, in nests of *Rattus* and *Microtus:* Hoff and Clawson, 1952, p. 27 (Utah).

Dinocheirus astutus Hoff, in *Neotoma* nest: Hoff, 1956, p. 48 (New Mexico).

Dinocheirus sicarius Chamberlin, in *Neotoma* nest: Chamberlin, 1952, p. 279 (California).

Dinocheirus texanus Hoff and Clawson, in *Neotoma* nest: Hoff and Clawson, 1952, p. 30 (Texas).

Dinocheirus venustus Hoff and Clawson, in *Neotoma* nest: Hoff and Clawson, 1952, p. 35 (Kansas).

Mirochernes dentatus (Banks), in mouse nest in hollow snag; Hoff, 1949, p. 481 (Illinois).

Hesperochernes minulus Chamberlin, in *Citellus* nest: Chamberlin, 1952 p. 292 (California).

Hesperochernes molestus Hoff, in nests of *Neotoma, Dipodomys* and *Perognathus:* Hoff, 1956a, p. 38 (New Mexico).

Hesperochernes riograndensis Hoff and Clawson, in food storage of *Dipodomys:* Hoff and Clawson, 1952, p. 23 (New Mexico).

Hesperochernes thomomysi Hoff, in nest of *Thomomys:* Hoff, 1948, p. 345 (California).

Hesperochernes unicolor (Banks), in *Neotoma* nest: Hoff and Clawson, 1952, p. 23 (Texas).

Hesperochernes utahensis Hoff and Clawson, in *Neotoma* nests: Hoff and Clawson 1952, p. 19 (Utah).

Tychochernes inflatus Hoff, in *Neotoma* nest: Hoff, 1956a, p. 25 (New Mexico).

Chelifer cancroides (L.), in nest of *Mus musculus:* Hoff and Clawson, 1952, p. 35 (Utah).

Levichelifer fulvopalpus (Hoff), in *Neotoma* nest: Hoff, 1956b, p. 9 (New Mexico).

Phorochelifer mundus Hoff, in *Neotoma* nest: Hoff, 1956b, p. 22 (New Mexico).

Juxtachelifer fructuosus Hoff, in nests of *Neotoma:* Hoff, 1956b, p. 28 (New Mexico).

Additional specimens, which I have seen, are:

Chthonius tetrachelatus (Preyssler), 3 ♂, 4 ♀, 1 nymph in mouse nest at Barnstable, Barnstable County, Massachusetts, collected by S. Peck; many specimens from mouse nests at Rochester, Monroe County, New York. (WM)

Mundochthonius sp., 3 ♂, 3 ♀ and nymphs in old mouse nest at Mountain Lake, Giles County, Virginia. (WM)

Kleptochthonius sp., 1 ♂ in old mouse nest at Mountain Lake, Giles County, Virginia. (WM)

Microbisium brunneum (Banks), many specimens from beaver houses in Gatineau Park, Quebec, Canada, collected by S. Peck. (WM)

Microbisium confusum Hoff, 1 ♀ in *Neotoma* nest in Mill Hollow Head Cave, Franklin County, Tennessee, collected by S. Peck; many specimens from mouse nests at Rochester, Monroe County, New York. (WM)

Microcreagris sp., 1 ♂ from *Neotoma* nest at Berkeley, Alameda County, California (USNM)

Pseudogarypinus marianae (Chamberlin), 1 ♂ in *Neotoma* nest at Blacksmith Fork Canyon, Cache County, Utah, collected by G. F. Knowlton. (WM)

Larca granulata (Banks), many specimens from entrance to chipmunk burrow at the E. N. Huyck Preserve, Albany County, New York. (WM)

Archeolarca rotunda Hoff and Clawson, 2 ♂, 3 ♀, 3 nymphs in *Neotoma* nests in Blacksmith Fork Canyon, Cache County, Utah, collected by G. F. Knowlton and W. J. Hanson. (WM)

Atemnidae gen. and sp., 1 ♀, 2 nymphs from *Neotoma* nest near Portal, Cochise County, Arizona, collected by H. Howden. (AMNH)

Pseudozaona sp., 1 ♀, 3 nymphs from *Neotoma* nest in Lester Collins #2 Cave, Jackson County, Kentucky, collected by T. G. Marsh; 1 ♂ from *Neotoma* nest in Catfish Cave, Blount County, Alabama, collected by S. Peck. (WM)

Dinocheirus sicarius Chamberlin, 1 ♂, 3 ♀ in *Neotoma* nest at Berkeley, Alameda County, California (AMNH).

Beier lists only a few pseudoscorpions which were known to have been on the bodies of mammals, none of them from America. More recently, two species of *Hesperochernes* have been reported from small mammals in the southwestern United States.

Hesperochernes mimulus Chamberlin, female, collected on *Citellus beecheyi:* Chamberlin, 1952, p. 292 (California).

Hesperochernes molestus Hoff, two females taken from the hair of separate specimens of *Onychomys leucogaster:* Hoff, 1956a, p. 38 (New Mexico).

In addition, I have a few specimens belonging to the Field Museum of Natural History, from mammals collected by Luis de la Torre in Guatemala.

Dinocheirus (?) sp., 1 ♀ from *Heteromys* sp., 1 ♀ from *Liomys* sp., and 2 nymphs from *Liomys* sp.

Cheliferidae, gen. and sp. indet., 1 nymph from *Natalus* sp.

In the same collection there are several other specimens, of different species, taken from mammals in Colombia. It seems likely, therefore, that such associations may occur rather frequently in tropical South and Central America.

Because all of the species listed above belong to genera whose members typically inhabit soil and ground litter, it is reasonable to believe that their associations with mammals have come about by chance. The nests of small, ground-dwelling mammals, especially the woodrat or packrat, *Neotoma,* are usually also inhabited by a variety of mites and insects, some of which are parasitic upon the mammals while others are only commensals. These small creatures would provide a good source of food for such predators as pseudoscorpions. Whether our pseudoscorpions go onto the bodies of the mammals by chance, or in search of food, or for some other reason is not known. But, whatever the reason for their boarding the hosts, they are undoubtedly carried from place to place, thus helping to disperse the species.

It is interesting to note here that some pseudoscorpions, such as *Megachernes* species in east Asia and *Lasiochernes pilosus* in Europe, seem to be specifically adapted to living with certain small mammals (rats and moles, respectively). Weygoldt (1969) points out that in captivity *L. pilosus* reacts positively toward a warm finger or glass rod and toward a soft brush, thus indicating that it would probably be attracted to the warm, furry body of a mole. Further study may reveal similar reactions on the part of some of our species.

F. Species found in human habitations.

Beier lists seven species which are regularly found associated with man. Four of these, *Cheiridium museorum* (Leach), *Lamprochernes nodosus* (Schrank), *Withius subruber* (Simon) and *Chelifer cancroides* (L.), are said to be especially frequent coinhabitants of human habitations, easily spread by man, and consequently nearly cosmopolitan in distribution. In view of this opinion of Beier in 1948, it is interesting to note that while the latter two species, *Withius subruber* and *Chelifer cancroides,* have often been found in North America, the first two have never been identified from collections here. On the other hand, several other European species have been collected in the United States, evidently having been introduced by human enterprise. They are not usually found in houses, but always in or near sites of long-standing human activities.

Chthonius ischnocheles (Hermann) has been recorded from several places along the eastern seaboard (Hoff, 1958; unpublished records of the author).

Chthonius tetrachelatus (Preyssler) has been found in most states east of the Mississippi River. It is usually found in human settlements and often in greenhouses (Hoff, 1958; unpublished records of the author).

Roncus lubricus L. Koch has been recorded only from a greenhouse and one outdoor location in Rochester, New York. (Muchmore, 1969).

Lamprochernes godfreyi (Kew) has been identified by Hoff and Bolsterli (1956) from localities in Indiana and Kansas. These specimens were found in stable sweepings and compost, respectively.

Pselaphochernes scorpioides (Hermann) was reported by Hoff and

Bolsterli (1956) from Lexington, Kentucky; and I have specimens apparently belonging to this species from the leg of a fly taken at Holliston, Middlesex County, Massachusetts (MCZ), from a decaying grass pile at New Haven, Connecticut (Yale), from under old railroad ties near the site of an abandoned botanical nursery at Rochester, Monroe County, New York (WM), and from straw in an old barn at Kendall, Ontario County, New York (WM).

All of these forms were probably introduced accidentally into this country many years ago, along with household belongings, farm animals and feed, or botanical nursery stock. There are probably other species which also occur locally, but which have not yet been discovered or recognized.

The two most common pseudoscorpions associated with man in this country are *Chelifer cancroides* and *Withius subruber*. The former may be found, often in large numbers in the older human communities, in barns, stables, poultry houses and homes, where it evidently feeds on the numerous mites and small insects also found in these places. It has been found in nearly every state and in Canada. *Withius subruber* is not so widely known, but has been found in several southern states in stored grain products, where it evidently feeds on the larvae of small grain insects. Hoff (1964) has recorded it from Florida, Cuba and Arizona and I have received from J. A. Payne a number of specimens from stored corn at Tifton, Tift County, Georgia, and from stored peanuts at Douglas, Coffee County, Georgia, and at O'Brien, Lafayette County, Florida. Also at hand are 1 ♂ and 2 ♀ from a wheat mill in Saucillo, Chihuahua, Mexico (USNM).

GENERAL DISCUSSION

The records given above certainly demonstrate that pseudoscorpions do get onto the bodies of larger animals and strongly suggest that they may then be transported by the hosts. Why they go onto the other animals is not certainly known in any case, though Beck (1968) has shown that *Cordylochernes scorpioides* is actively attracted to the harlequin beetle, *Acrocinus longimanus,* in Brazil. In this case, the pseudoscorpion could detect a beetle, apparently by a sense of smell, at a distance of 4–6 cm. and would move directly toward the beetle and climb upon its abdomen. The source of the odor was not determined by Beck, but might possibly be the parasitic mites which usually live on the beetles. Since very little is known of the sensory capabilities of pseudoscorpions, it is difficult to determine what stimuli affect them in any situation.

Altogether, it seems to me the bulk of evidence agrees with the conclusion of Vachon (1940, p. 9):

"En résumé, le transport de Pseudoscorpions par d'autres animaux (phorésie) est accidentel et motivé par la faim. Dans certains cas le Chelifer est transporté par le proie qu'il vient de saisir et qui, trop forte, l'enléve (Diptéres, etc.). Dans d'autres cas, la proie dont se nourrit le Pseudoscorpion est déja transportée par un autre animal (Acariens logés sous les élytres de Coléoptêres . . . .) donc phorétique et c'est en recherchant cette proie que le Chelifer est à son tour transporté. Les ♀ qui, avant la ponte et en vue de constituer des réserves, recherchent activement leur nourriture, manifestent une tendance très nette à l'état phorétique."

Phoresy should then be defined as a *nonparasitic association of one kind of animal with another which results in transportation of the smaller by the larger.* This definition does not require us to know the reasons why pseudoscorpions get onto other animals nor does it imply any purpose to the act of transportation. It does away with the necessity for Beier's distinction between phoresy and phagophily and it leaves open the question whether dispersal of the species does actually result from the association in any given case.

It appears clear to me that attachment of pseudoscorpions to the legs of flies or other arthropods is simply a result of the predacious nature of the former. Their normal habit when they are hungry is to lie in wait for, or move slowly about seeking, prey animals. It is doubtful that they are very discriminating at a distance and they probably grasp with the palpal chelae anything that moves within reach. If this should be the leg of a fly, which immediately took wing, the pseudoscorpion might be carried aloft before it could relinquish its grasp. Further, the pressure against the chela might reflexly cause the fingers to tighten on the fly's leg, as though the latter were prey, attempting to escape. Very instructive in respect to this is the account of Myers (1927, p. 291) who reported the capture of pyrrhocorid bugs by pseudoscorpions in Cuba. The pseudoscorpions, hiding under loose bark of a tree, were found to have grasped with their chelae the antennae or legs of many of the bugs, which were mating on the tree trunk. The bugs were held fast to the tree for long intervals, in many cases even after they were cannibalized by others of their own kind. It was not determined whether the pseudoscorpions actually fed upon the bugs. In any event, if the pseudoscorpions had not been securely wedged into the crevices beneath the bark, they might easily have been carried away by the insect. This would likely be the case with pseudoscorpions, e.g. *Lamprochernes nodosus,* living in such insubstantial shelters as manure heaps, piles of grass clippings, or other vegetable debris, and could explain their frequent occurrence on flies (see Jones, 1970).

While it would not seem necessary that dispersal of the species be the result of phoresy, it is likely that it does, in fact, occur. There are, for example, some pseudoscorpions which are common in caves regularly occupied by bats. These pseudoscorpions, *Pseudozaona* species in eastern United States and *Tejachernes* species in western United States, Mexico and Central America, live upon mites and small insects which abound on the guano under the bats' roosts. Such pseudoscorpions have never been found upon living bats (though a cheliferid nymph has been recovered from a *Natalus* bat) and yet they appear to be restricted to bat caves, that is, have not been collected from epigean situations or from caves not having bat colonies. That they are carried to these specific caves is strongly suggested by two recent collections of *Tejachernes* sp., one from bat guano in an abandoned railroad tunnel in Val Verde County, Texas (collected by J. Reddell) and the other from bat dung in a mine tunnel in Pichacho Peak, Pinal County, Arizona (collected by Philip and Pechuman). Because the railroad tunnel and mine tunnel are very recent human constructions, it is obvious that the bat colonies and the pseudoscorpion populations must have been founded within the last few decades. The pseudoscorpions may have been carried in by the bats themselves, though we have no direct evidence of this and it is difficult to understand how a bat would pick up a pseudoscorpion from the guano on the floor of the cave. On the other hand, it is possible that the pseudoscorpions may be carried from cave to cave by some other agents, perhaps by flies. There is one record of a *Pseudozaona* on a fly (see above); but since little is known about the flight ranges of flies, it is impossible to decide whether this might be a likely mode of dispersal. Until more is learned about the lives of pseudoscorpions and the other creatures with which they associate, this problem must remain unsolved.

BECK, L. (1968). Aus den Regenwäldern am Amazonas I. Natur und Museum. 98:24–32

BEIER, M. (1948). Phoresie und Phagophilie bei Pseudoscorpionen. öst zool. Zeitschr. 1:441–497

CHAMBERLIN, J. C. (1949). New and little-known false scorpions from various parts of the world (Arachnida, Chelonethida), with notes on structural abnormalities in two species. Amer. Mus. Novitates, No. 1430:1–57

CHAMBERLIN, J. C. (1952). New and little-known false scorpions (Arachnida, Chelonethida) from Monterey County, California. Bull. Amer. Mus. Nat. Hist. 99:259–312

CHAMBERLIN, J. C. (1932). A synoptic revision of the generic classification of the chelonethid family Cheliferidae Simon. Canadian Ent. 64:35–39

FROST, S. W. (1966). Additions to Florida insects taken in light traps. Florida Entomologist. 49:243–251

HOFF, C. C. (1948). *Hesperochernes thomomysi*, a new species of chernetid pseudoscorpion from California. J. Wash. Acad. Sci. 38: 340–345

HOFF, C. C. (1949). The Pseudoscorpions of Illinois. Bull. Ill. Nat. Hist. Surv. 24:413–498

HOFF, C. C. (1956a). Pseudoscorpions of the family Chernetidae from New Mexico. Amer. Mus. Novitates, No. 1800:1–66

HOFF, C. C. (1956b). Pseudoscorpions of the family Cheliferidae from New Mexico. Amer. Mus. Novitates, No. 1804:1–36

HOFF, C. C. (1957). *Tejachernes* (Arachnida, Chelonethida, Chernetidae, Chernetinae), a new genus of pseudoscorpion based on *Dinocheirus stercoreus*. Southwestern Nat. 2:83–88

HOFF, C. C. (1959). The ecology and distribution of the pseudoscorpions of north-central New Mexico. Univ. N. Mex. Publ. Biol. No. 8:1–68

HOFF, C. C. (1961). Pseudoscorpions from Colorado. Bull. Amer. Mus. Nat. Hist. 122:409–464

HOFF, C. C. (1963). Pseudoscorpions from the Black Hills of South Dakota. Amer. Mus. Novitates, No. 2134:1–10

HOFF, C. C. and BOLSTERLI, J. (1956). Pseudoscorpions of the Mississippi River drainage basin area. Trans. Amer. Microsc. Soc. 75:155–179

HOFF, C. C. and CLAWSON, D. L. (1952). Pseudoscorpions from rodent nests. Amer. Mus. Novitates, No. 1585:1–38

JONES, P. E. (1970). *Lamprochernes nodosus* (Schrank)—an example of phoresy in pseudoscorpions. Bull. Brit. Arach. Soc. 1:118–119

MUCHMORE, W. B. (1969). A population of a European pseudoscorpion established in New York. Ent. News. 80:66

MYERS, J. G. (1927). Ethological observations on some Pyrrhocoridae of Cuba. Ann. Ent. Soc. Amer. 20:279–300

RESSL, F. (1963). Können Vögel als passive Verbreiter von Pseudoscorpioniden betrachtet Werden? Vogelwelt. 84:114–119

SCHUSTER, R. O. (1968). The identity of *Roncus pacificus* Banks. Pan-Pacific Ent. 44:137–139

TREAT, A. E. (1956). A pseudoscorpion on moths. Lepidopterists' News. 10:87–89

VACHON, M. (1940). Remarques sur la phorésie des Pseudoscorpions. Ann. Soc. Ent. France. 109:1–18

WEYGOLDT, P. (1970). The biology of pseudoscorpions. Cambridge, Mass.: Harvard University Press, pp. 1–145

PLANT COMMUNITY DEVELOPMENT IN BERGEN SWAMP*

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ABSTRACT. A pollen analysis of a core from Bergen Swamp is presented in order to trace the development of selected plant communities presently extant. Core evidence, and the radiocarbon date of an adjacent mastodon site are cited as evidence for tundra conditions during the Valders ice readvance following the warmer Two Creeks interval of 11,000 years ago. A warming trend led to the development of oak forests around the swamp during the warm and dry hypsithermal period, followed by somewhat cooler and moister climate in the immediate past centuries. Present plant communities are shown to represent a composite of the effects of changes over this postglacial period.

INTRODUCTION

The hills and valleys of eastern North America, clothed with vegetation, are regarded by many as symbols of permanence. The rapid changes of the past decades are often seen as something new that has been introduced by man and his technology. While man accelerates change, and often determines its direction, the hills are by no means permanent, much less the vegetation which adapts to the changing conditions. Were one's life span much longer, we could see the change in vegetation as a battle in a diorama where, as conditions change, first one and then the other army gains dominance, only to give way in time to others. Coming on this scene at a much later date, the historian and archeologist must pick up the clues, the artifacts, which enable him to reconstruct the original events. This is what we attempt to do as we construct the picture of past communities that have left their artifacts in the form of microfossil pollen grains preserved in the peat of bogs. Cores taken from the marl and peat of Bergen Swamp show a complex interbedding of the layers that suggests violent changes in the topography of the basin. While the changes that produced the interbedded layers of peat and marl were taking place, the pollen of neighboring plant communities was settling down and being deposited along with the peat and marl. Thus, in spite of a complex sequence of layers, we can extract the microfossils in a sequential manner to record the history of past development and change, and hypothesize on future changes.

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* [Now more commonly called Bergen-Byron Swamp, Ed.]

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PREVIOUS STUDIES

Much of the previous work in New York state and the history of pollen analysis is covered elsewhere (Davis 1963, 1965; Cox 1959). The only other study in the vicinity is the one of Kennedy's Bog in Mendon Ponds Park (Yeager, 1969). The same volume has a description of the geology and weather of the area (Coleman, B. B. and E. B. Ehrle, 1969). Stewart and Merrell (1937) discuss the possible geological origin of Bergen Swamp and more recently Calkin (1966) has compiled the studies of recent geological events in western New York. The plants of Bergen Swamp have been discussed in various publications, chiefly Vol. 9 of the Proceedings of the Rochester Academy of Science (1948–1951). The most complete study of the vegetation of the area is by Shanks (1966). Except for the study on Kennedy's Bog noted previously, very little work has been done on the bogs west of the Syracuse area in New York state, yet such studies provide a means for analyzing the growth and development of the vegetation over the past centuries and up to the present time. The nature of the migration of plants from the south as the ice melted and the land became available for plant growth, poses some interesting problems. Recent discoveries along the moraine to the south of Dansville and the Finger Lakes are shedding new light on our knowledge and will be discussed in future publications. Eventually the account of the spread of the vegetation from the highland refugia, and other unglaciated areas to the south, should provide an account of plant adaptation to changing conditions as the ice receded from western New York state. The present paper is limited to the development of selected communities of Bergen Swamp. It is a summary of the work of the author and his students. Coring and slide preparation was done by several graduate students, the major effort being that by Cave (1967).

SAMPLING AND PREPARATION

Cores for pollen studies must be obtained from the deepest part of the basin in order to provide as complete a history as possible. For an area as large as Bergen Swamp, a major task—done by probing through marl and peat until one reaches the unyielding glacial clay. Such probing reveals a major basin in the central area, with its deepest part on the south edge, with minor basins in the east and west areas (Cave, 1967). Present location of this presumed basin bottom is in the open marl area to the west of Hemlock Knoll. This deep basin area was the source of the 205″ depth core of the present study. Sampling was done with a Davis-type sampler which cuts a core one inch in diameter, ten inches long.

To avoid contamination at the ends, alternate holes are used for successive samples. Further treatment involves removal of marl with hydrochloric acid, removal of peat with potassium hydroxide, and removal of clay with hydrofluoric acid. Acetylosis treatment provides controlled oxidation for contrast and visibility under the microscope. Standard procedure involves counting a minimum of 150 pollen at each level, with identification. Bromoform flotation is used for additional concentration on the lower layers.

THE GROSS STRUCTURE OF THE CORE

The open marl area in which the core was taken presents an interesting pattern of white marl parts, which are covered with open water in the spring, other areas where plants have gained a foothold and provide ground cover, and a third type, the hummocks. The hummocks are shrubby mounds that maintain a good organic base in which other plants can grow. Sphagnum moss maintains the moisture and an acid medium for the heaths (Ericaceae), pitcher plants, sundews, and others. Here also one finds the bayberry, reminiscent of seaside dunes. Root penetration from this surface vegetation extends roughly to thirty inches in depth. Below the surface vegetation, except for the roots, there is mostly white marl. From thirty to fifty-five inches below the surface the marl becomes increasingly grayer from clay, and one finds the dead roots of old plant material. From fifty-five to ninety-five inches one finds coarse brown peat, with rather large amounts of undecomposed wood, bark, and twigs present. From ninety-five inches down to 145 inches the peat becomes somewhat finer. At 145 to 160 inches one finds a layer of gray glacial clay that is normally found on the bottom of lakes and bogs. Then one descends into another layer of finely decomposed brown peat from 160 to 190 inches, below which one again finds the typical gray, glacial clay of the bottom. Thus, while the original basin may have been somewhat hemispheric in form, the subsequent layering, and especially the double layer of glacial clay, gives some indication of past events. It is evident that the subsurface layers are not homogeneous, and many more core studies are needed. In a recent study (Mack, 1971) of marl pits and diggings to the south of Bergen Swamp, but in the same valley to the north of the Onondaga escarpment, the same pattern of interbedded layers of peat and marl is found. In this study the concluding hypothesis was that a relatively dry period immediately following deglaciation permitted the development of the peat under swamp conditions, after which a lake formed in which the marl was deposited. Lake drainage again led to the development of a swamp with peat formation, with marl overlaid in recent times in more local ponds and lakes. In any case, the marl-peat alternation appears to

TABLE I. GROSS CORE STRUCTURE (Depth in inches below surface)

Depth	
0 – 5	Plants, coarse organic material, some exposed marl.
5 – 10 10– 15 15– 20 20– 25 25– 30	Marl, with penetrating roots.
30– 35 35– 40 40– 45 45– 50 50– 55	Marl, becoming grayer with increasing amounts of clay. Root material present.
55– 60 60– 65 65– 70 70– 75 75– 80 80– 85 85– 90 90– 95	Coarse brown peat. Wood, twigs, and bark present.
95– 100 100–105 105–110 110–115 115–120 120–125 125–130 130–135 135–140 140–145	Medium coarse brown peat with larger pieces of roots, bark and wood.
145–150 150–155 155–160	Coarse to fine gray, glacial clay.
160–165 165–170 170–175	Fine brown peat, with some roots and coarser material in upper layers.
175–180 180–185 185–190	Fine decomposed brown peat changing to mixture with small stones and clay.
190–195 195–200 200–205	Gray glacial clay.

be more than a local phenomenon, and is undoubtedly related to the whole pattern of postglacial climate and lake alteration (Hough, 1963).

THE POLLEN PROFILES

The pollen profiles (Fig. 1a, 1b) are based on Cave's work (Cave, 1967). Although additional profiles are needed for definitive interpreta-

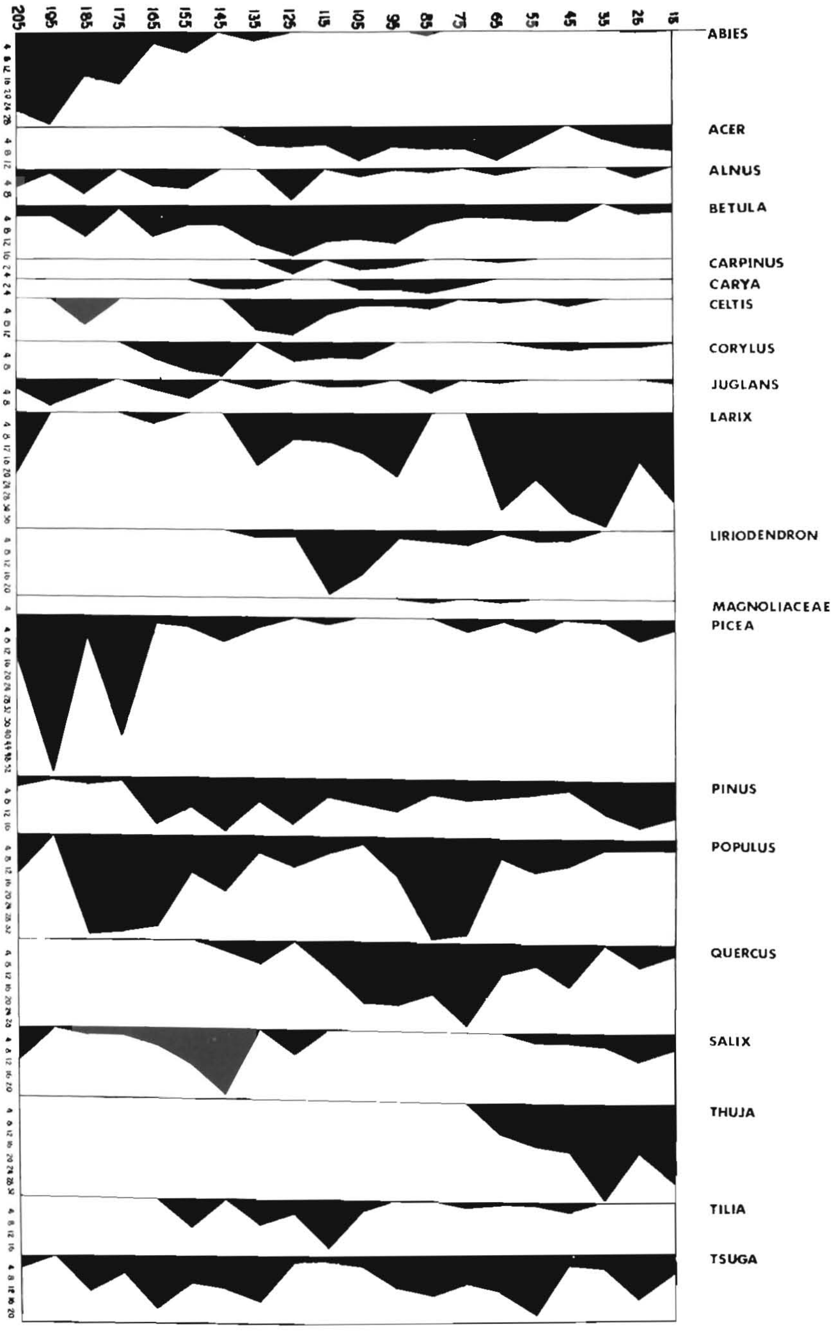

FIGURE 1a. Arboreal Pollen Profiles.

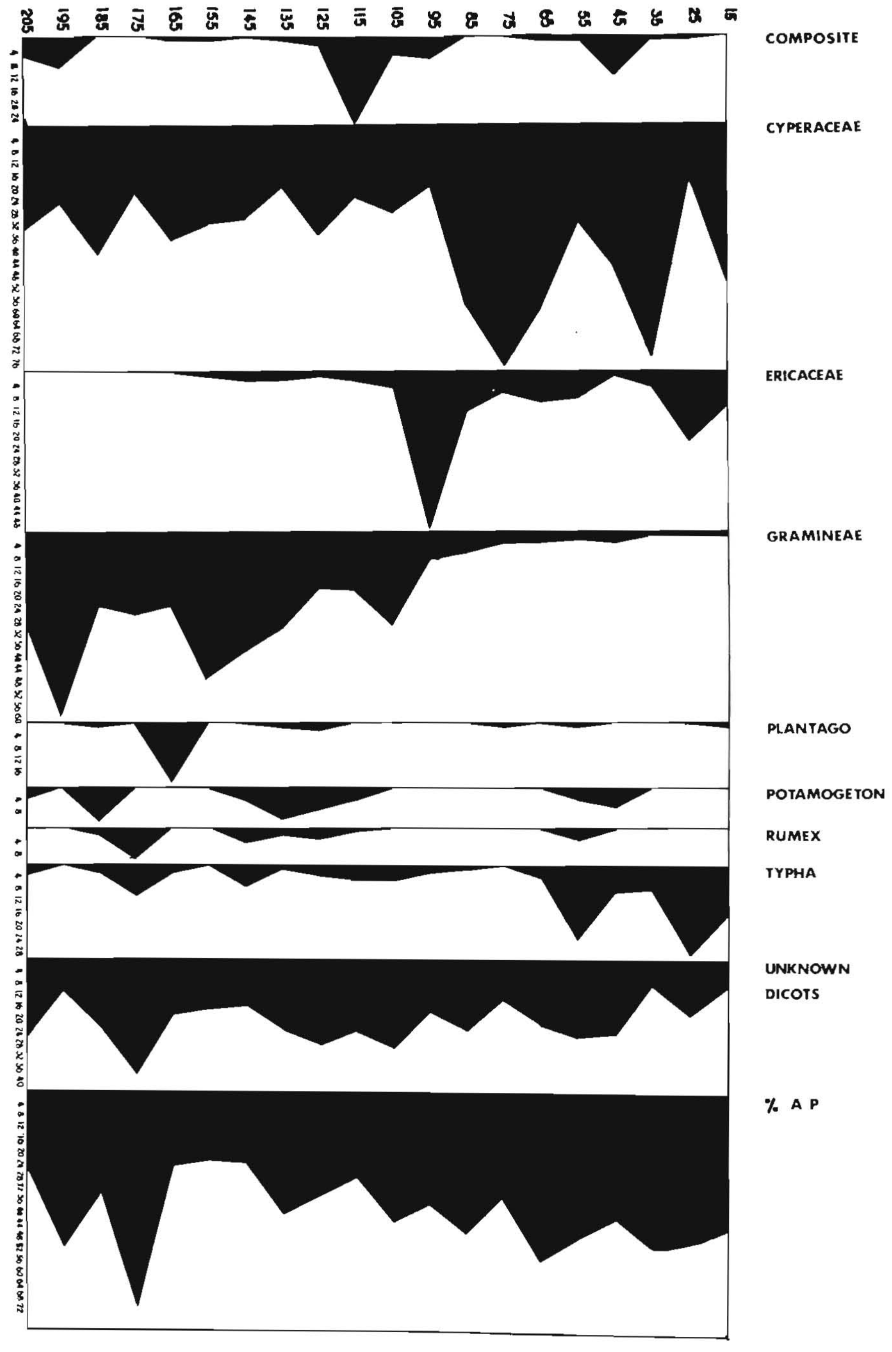

FIGURE 1b. Non-arboreal Pollen Profiles.

tion, the broad outlines and many local variations can be traced. Both the arboreal and non-arboreal profiles are based upon the percentage of arboreal pollen only, according to standard practice, since the arboreal dominants determine the nature of the plant community. The bottom 205 inch level contains only 24% arboreal pollen with high percentages of fir (Abies) and spruce (Picea). Grasses (Gramineae) and sedges (Cyperaceae) share equally in the non-arboreal percentages. At the 195 inch level grasses occupy more than 50% of the total, while spruce increases to a maximum. The 185 inch level is marked by a precipitous decrease in grasses and spruce, coupled with a corresponding increase in poplar (Populus), a genus not recorded in most New York bogs, but found by Davis (1967) in New England and Great Lakes bogs, and also by Wright (Cushing and Wright, 1967) in Minnesota and other midwestern locations. In the light of these findings by leading workers, and especially Wright's similar large percentages, it is rather anomolous that poplar was not found in other New York studies. We must conclude that the topography and chemistry of the deposits favored the preservation of the genus in this case. At 175 inches a sharp rise in spruce causes a maximum arboreal percentage. Above 175 inches we find a decrease in fir and spruce coupled with a rise in hemlock (Tsuga) and larch (Larix). The hardwood dominance reaches a maximum with oak (Quercus) at the 75 inch level, coupled with a decrease in larch. Tulip poplar (Liriodendron) reached a maximum earlier in this period at 115 inches, accompanied by an increase in grasses and composites. A subsequent rise in the heaths precedes a rise in the sedges at the same 115 inch level as oaks. The upper levels, with a rise in larch, arborvitae (Thuja) and cattails (Typha) and willow (Salix) indicate the generally cooler climate of the centuries between the oak maximum to the present.

THE SPRUCE-FIR ZONE

The postglacial history of plant invasion begins with a cold and wet periglacial environment, similar to the present arctic tundra. There is no absolute or direct evidence in our profiles to indicate an extensive tundra plant community. Another problem is the difference between prairie and tundra which can not be resolved in most pollen profiles (Davis, 1967). With the recession of the ice from the Niagara escarpment and the lowering of the periglacial lakes there were extensive open areas on the well-drained higher sites, with numerous small lakes, kettle holes, and swampy areas. The profiles show a spruce-fir forest in the higher areas, with willow, alder (Alnus), birch (Betula), and poplar around the lower edges. Extensive meadow areas of grasses and sedges, subject to periodic flooding occupied the lower areas around the watercourses. This picture is confirmed by the study of a mastodon site at Byron, very close to Bergen

Swamp. Studies at this site were begun around 1960 by the Buffalo Museum of Science. They were abandoned when the landowner refused to release the mastodon bones for museum display. The deposition site was radiocarbon dated at 10,450 ± 400 years B.P., before present. (Note 1). Pollen associated with the site is chiefly non-arboreal pollen typical of tundra or park-tundra communities. (Note 2). The two spruce peaks of our profiles plus the mastodon site data are ample evidence for tundra-type vegetation communities existing during the Two Creeks time, at least in the basin of the swamp area. (Note 3). Geologists generally believe that the ice of the Valders readvance, following the Two Creeks interval, came no farther than the Niagara escarpment to the north of Bergen Swamp. This advance, placed at 11,000 years B.P. (Hough, 1963), caused the cold, wet climate conducive to the conditions at the mastodon site. With this evidence, it is therefore reasonable to assume that the decline in fir and spruce at the 185 inch level, with the increase in hemlock, represents the warming trend of the Two Creeks interstadial, while the rise of fir and spruce at the 175 inch level and decrease of hemlock indicates the cooling climate of the Valders readvance. The rise of herbaceous dicots and decline of grass and sedge pollen also tends to confirm these changes. It is noted that many workers find a spruce-hardwoods assembly at the lower layer of this zone where it rests in contact with the herbaceous zones. The Bergen Swamp profile gives no indication of this, and thus is similar to other New York state profiles in this respect. However, a spruce-hardwood assemblage has been discovered in a buried peat deposit near South Dansville, N. Y., including spruce cones and oak logs. Studies of this material are to be published shortly. The spruce-oak combination would tend to confirm the relative nearness of the more temperate forest of the Allegheny highland refuge, although the presence of actual logs eliminates the necessity for hypothesizing long, wind-blown deposition of oak pollen as has been done in New England (Davis, 1967).

THE PINE-BIRCH ZONE

A pine-birch zone, with other hardwoods, is identified in many New England and mid-western studies as following the spruce-fir zone. Our present profile shows an increase in pine and hemlock, as well as birch, with a mixture of other hardwoods. While perhaps not as distinctly marked as in other regions, there is a definite indication of the warming trend of the period. This is the warming period between the cool climate of the Valders ice readvance and the warming hypsithermal period following. It has been called the C zone in New England, or the Atlantic substage of warm, moist climate.

THE HYPSITHERMAL PERIOD

Various names have been applied to this period of warmth and dryness, such as climatic optimum, xerothermic, or hypsithermal. Preference for the latter is explained by Deevey and Flint (1957). It is clearly defined in Bergen Swamp by an oak maximum, a disappearance of larch, and a minor rise in hickory (Carya). A sudden drop in grasses, with a consequent rise in heaths indicates a rapid change in vegetation, possibly abetted by fire. The high percentages of sedge and poplar would indicate the continued existence of wet depressions in the area. It is known that the dry, warm climate of this period caused extensive destruction of the forests, and extension of the prairie eastward. A prairie peninsula extended across Ohio, and into west-central New York. The effects of this period remain visible today as the "oak openings" on the Onondaga escarpment. The best example is found near the village of Five Points, between routes 15 and 15A, although records indicate its presence all along the escarpment to the south of the swamp (Shanks, 1966).

THE RECENT PAST

From the hypsithermal period to the present, a period of approximately 5000 years, the climate cooled a bit, with only minor fluctuations, such as the slight cooling of the nineteenth century and its moderation in the first half of the twentieth century. Over the time, as the profile and other records indicate, the forest communities were able to stabilize themselves with climatic and soil factors to bring about mature communities and zonation which the white man found when first usurping the area. The basin topography of the swamp area, with its narrow zonation of drainage conditions created the narrow bands of vegetation which exist today, either as distinct communities or as relict species. Several problems are presented by the profiles. There is a slight rise in maple following the hypsithermal period, but beech is absent. Since a fine beech-maple stand now exists approximately two miles southeast on a drumlin hill of the Pocock farm, the absence of a significant beech record must be regarded as tentative pending further studies. It is possible that prevailing winds failed to carry the pollen to the central area of the swamp. Beech was not a major component of the swamp community, and beech-maple is not mentioned as a swamp community by Muenscher (1946). There is a significant rise of arborvitae (Thuja) and larch at the 35 inch level, followed by a rise in pine, hemlock, and heaths at the 25 inch level. This would appear to indicate another rapid change in the communities. There is no continuous layer of charcoal that could be attributed to fire, nor has there been any major climatic change in this recent period; therefore the changes may be associated with human activity in the area. A wider intensive study is needed to delineate these recent changes.

THE STATUS OF THE PRESENT PLANT COMMUNITIES

Of the ten communities listed by Muenscher (1946), the marl and sphagnum bog, the arborvitae swamp, pine-hemlock, and birch-maple communities will be noted. Lakes, swamps, and bogs are only temporary stages in the geological history of an area. Many farms with black soil give evidence that bog communities are replaced in normal succession by mesophytic forest communities. As shown in Table I, peat from sphagnum and other sources filled the major portion of the basin, indicating the typical centripetal progression of aquatic, emergent, shrub, and forest communities. The marl deposition was not an important factor until water depth was shallow enough for emergent plant growth. Succession could then proceed rapidly through the sedge meadow and shrub stages to forest community as is taking place today in some of the inner marl areas.

As the profiles indicate, the evergreen trees with winged seeds were best able to occupy the land freed by the receding ice. These included fir, which died out with the warming climate, and spruce. Recent macrofossil finds of whole spruce cones in the Valley Heads moraine are all of the small black spruce variety. Since the profiles show spruce disappearing in the hypsithermal period, it was the black spruce which disappeared as a component of the bog vegetation, to be replaced in recent times by white spruce. Larch was present from the beginning, but with the availability of the inner marl areas, shows a rise that parallels that of arborvitae. White pine (Pinus Strobus L.) is present but does not compete as well in the inner marl as around the edges where some organic soil cover is present. The shrub that is most common as a mound builder of the inner marl is Labrador Tea (Ledum groenlandicum Oeder). A possible indicator of the original wider extent of inner bog conditions is the goldthread (Coptis trifolia (L.) Salis.). This relict of arctic conditions is widely distributed in the hemlock-white pine zones surrounding the inner marl. Until extensive core studies are available, it is the best indicator of the centripetal progression in space and time of the communities.

The present pine-hemlock zone is shown by the profiles to be a rather recent dominant association. It is probably a temporary, passing community. Hemlock is assumed to be an indicator of a climate with a moderate amount of rainfall. It prefers a well-drained situation as shown by its dominance on the knolls. Thus, except for isolated hummock situations, it seems to give way to white pine. Both the pine and the hemlock decreased with the hypsithermal period, expanding again with the increased rainfall of the recent past.

As previously noted, the hypsithermal period of warmth and dryness was one in which the forests on the thin soils of the escarpments died out, giving rise to open parklands and prairie type vegetation. Where adequate soil was available, the oak forests became dominant. The profiles show this change, indicating an oak forest with maple and hickory. The dry conditions are shown by the disappearance of willow (Salix) and the decrease of birch. A more detailed discussion of the oak forest distribution in Monroe County can be found in Shanks (1966). The present beech-maple forest, at least in this area, is a composite of beech, which originated in the southeast and migrated by way of the Susquehanna drainage (Braun, 1967), and the oak forests of the Appalachian highlands.

Thus the zonation and present vegetation of Bergen Swamp can be seen as a composite of changes over the past 10,000 years and more. As the ice receded, and the belts of vegetation moved northward, some plants were able to compete and survive in the conditions provided by the swamp. With the warm hypsithermal period, the dominants of the oak forests to the south moved into the area, although the low-lying, wet areas provided conditions in which many of the previous species were able to survive. The competition continues, and the zones are not static. Additional studies and data are revealing more details of these changes and the acceleration that man is causing.

BIBLIOGRAPHY

Calkin, Parker E. (1966). Late Pleistocene History of Northwestern New York. In Buehler, E. J. Ed. Guidebook for New York State Geological Association annual meeting. Department of Geological Sciences, State University of New York at Buffalo.

Cave, John (1967). A Pollen Analysis of Bergen Swamp. Thesis for M.Ed. State University College, Brockport, N. Y. Unpublished.

Coleman, B. B. & E. B. Ehrle (1969). Studies on the Plants of the Genesee Country (Western New York State). 2. A Description of the Genesee Country. Proceedings of the Rochester Academy of Science 12:13–23.

Cox, Donald D. (1959). Some Postglacial Forests in Central and Eastern New York as Determined by the Method of Pollen Analysis. New York State Museum & Science Service. Bulletin #377. Albany, N. Y.

Cushing, E. J. & H. E. Wright, Jr. (1967). Quaternary Paleoecology, Yale University Press. New Haven, Conn.

Davis, Margaret Bryan (1963). On the Theory of Pollen Analysis. American Jour. Science 261:897–912.

———— (1965). Phytogeography and Palynology of Northeastern United States. In Wright, H. E. Jr. & D. G. Frey, Eds., The Quaternary of the United States. Princeton University Press. Princeton, N. J.

———— (1967). Late-Glacial Climate in Northern United States: A Comparison of New England and the Great Lakes Region. In Cushing, E. J. & H. E. Wright, Jr. Eds., Quaternary Paleoecology. Yale University Press, New Haven, Conn.

DEEVEY, E. S. & R. F. FLINT (1957). The Hypsithermal Period. Science 125:182.

HOUGH, J. L. (1963). The Prehistoric Great Lakes of North America. American Scientist 51:84–109.

KUCHLER, A. W. (1964). Potential Natural Vegetation of the Conterminous United States. Special Publication #36. American Geographical Society, New York, N. Y.

MACK, JAMES W. (1971). A Study of Marl Pits in the Caledonia Quadrangle. Unpublished study for Dr. Victor Schmidt's class in Pleistocene Geology, Department of Geology and Earth Sciences. State University College, Brockport, N. Y.

MUENSCHER, W. C. (1946). The Vegetation of Bergen Swamp. I. The Vascular Plants. Proceedings of the Rochester Academy of Science. 9:77.

SEARS, PAUL B. (1948). Forest Sequence and Climatic Change in Northeastern North America since Early Wisconsin Time. Ecology 29: 326–333.

SHANKS, ROYAL E. (1966). An Ecological Survey of the Vegetation of Monroe County, New York. Proceedings of the Rochester Academy of Science 11:108–252.

STEWART, P. A. & W. D. MERRELL (1937). The Bergen Swamp: An Ecological Study. Proceedings of the Rochester Academy of Science. 7:209–262.

TERASMAE, J. (1967). Postglacial Chronology and Forest History in the Northern Lake Huron and Lake Superior Regions. In Cushing, E. J. & H. E. Wright, Jr. eds. Quaternary Paleoecology. Yale University Press, New Haven, Conn.

YEAGER, DONALD (1969). Studies on the Plants of the Genesee Country (Western New York State). 3. A Pollen Profile from Kennedy's Bog in Mendon Ponds Park. Proceedings of the Rochester Academy of Science. 12:24–45.

1. Radiocarbon date of 10,450 ±400 years B.P. was determined by Meyer Rubin of the U.S. Geological Survey (U.S.G.S. # W–1038). The sample was submitted by Dr. Ernest H. Mueller of Syracuse University.

2. In a letter to Miss Carol Heubusch, then curator of geology at the Buffalo Museum, Dr. Ernest H. Mueller of Syracuse University expressed his opinion that any date earlier than 9000 years B.P., such as this one, is evidence that New York was not glaciated after the Two Creeks interval.

3. Data on the Byron mastodon site are unpublished, and the file of material was made available to the author in 1966 through the courtesy of Dr. Harvey J. Hambleton, Curator of Geology of the Buffalo Museum of Science. Pollen at the site was identified by Donald M. Lewis of the State Museum in Albany, N.Y.

STUDIES ON THE PLANTS OF THE GENESEE COUNTRY (WESTERN NEW YORK STATE)

6. The Aquatic Flora of Conesus Lake*

Part I — *THE ENVIRONMENT OF CONESUS LAKE*

By H. S. Forest and E. L. Mills,[1] and others as noted

ABSTRACT. Included in the ecological consideration of the lake are: 1) a study of the sewage increase and its relationship to coliform counts and the pollution of the environment and 2) an analysis of the pattern of phosphorus content and distribution in the lake. Preliminary distribution data and quantitative community analysis of the flora, including 26 genera and 43 species of angiosperms, are presented and discussed.

Conesus Lake is located almost in the middle of Livingston County. On the United States Geological Survey maps (7.5 minute series, topographic) it lies mostly in the Livonia Quadrangle. The Conesus Quadrangle includes the lake from Cottonwood Point southward and the complete watershed of the principal inlet stream. The lake bottom has been mapped in careful detail to a scale of 1 inch to 400 feet with a two-foot contour interval, the work having been done under the direction of Kenneth B. Donnell for the Conesus Lake Sportsman's Club. The original map is present at the State Conservation Department Region I Headquarters, Scottsville, New York. Although the map bears no date, personal communication with Mr. Donnell and with Mr. Robert F. Perry of the Conservation Department has fixed the time of the survey as the winter of 1939–40. An article by Perry (1948) mentions the survey, and gives a popular account of the Conesus environment.

The surface geology of the lake basin is included within the Finger Lakes Sheet of the Geologic Map of New York (1961). The bedrock is of Devonian age. Underlying the southern end of the lake are the Java and West Falls Groups of sandstones and shales, the Sonyea Group of shales and siltstones extend from slightly south of the neck formed by Long Point and McPherson's Point almost to the northern end; the Genesee Group of shale and limestones underly approximately the northern 15% of the lake; and the Hamilton Group touches the lake in the Lakeville area at the outlet, but is well covered with recent deposits. The soils of the lake basin are described in the Soil Survey, Livingston County

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New York (1956). Berg (1963) generalized that the Finger Lakes lie in the east-west limestone belt of the state, but that their character is associated with the Allegheny highland belt which lies along their southern tips, particularly since the principal inlet stream of the lakes is at their southern end, and the basin of the stream lies in the Allegheny belt. A consideration of topographic, geologic, and edaphic documents suggests that considerable qualification should be made to Berg's generalization in respect to Conesus, and probably others of the western Finger Lakes. If land form is considered, the high southern hills continue well up the sides of Conesus, with the 1000 foot contour less than a mile south of the outlet on both east and west sides. The bedrock is rather typical of the variety found in the Allegheny region. On the other hand, the drainage basin of the main inlet stream as well as the smaller feeder streams on both sides of the lake drain several soils which are classified as having a high lime content . . . a reasonably expected result of glacial activity. The total effect of its basin is to make Conesus a hard water lake.

A beginning of limnological studies was made by Birge and Juday in the Finger Lakes (1914, 1921), and Conesus received slight attention by them. Almost nothing has been recorded since with the exception of the hydrologic data given by Berg (1963) which lists elevation 818 feet, surface area 5.2 mi^2, drainage area 89 mi^2, maximum depth 59 feet, and Secchi disc reading of 21 feet. Our calculation of the area of the lake, using the large scale map of Donnell is 4.97 mi^2. A slight discrepancy in elevation can be noted with the Livonia Quadrangle (817 feet) and current studies give a slightly greater depth, while the Secchi disc readings are variable, of course, and may reach 30 feet. Berg also lists: pH 7.7, conductivity 309 micromhos, total alkalinity 108.2 ppm, and nitrate .9 ppm. Gilbert and Kammerer (1965) give the 15 year average outflow of the lake (1921–1934) as 48.3 cfs. Serious limnological studies on the lake were undertaken recently by Dr. K. M. Stewart, and these will be reported elsewhere. A letter from Dr. Stewart (Aug. 26, 1968) provides this information on a few characteristics of the lake. Conesus has a higher concentration of several salts than many regional lakes; its chemistry may be compared with that of Lake Erie. In comparison with Lakes Canadice or Canandaigua, the dissolved oxygen level declines more rapidly in lower waters. The lake stratifies inversely in winter and directly in summer. The winter range from top to bottom is typically 0°-3° or 4° C (32°-39° F). In mid-August a temperature profile was: surface 23.5° C (74° F) 8 m (27 ft.), 22.6° C (72.5° F), 11 m (40 ft.), 16.4° C (63.5° F), and 18 m (60 ft.) 52° F. Stewart and Forest obtained and completed data (Figure 1) consolidating records of water level, water consumption, and annual precipitation for the lake 1930–1966. Since no precipitation record is kept at the lake itself, the records utilized are those from Hemlock Lake, about 5 miles east, and Mt. Morris, about 10 miles west (since 1952). In addition to the villages of Geneseo and Avon, the Lakeville Water District has been a consumer of much lesser quantities of water for about ten years but it has not provided data for study. The amount of water in the lake has also been affected from time to time by a weir across the inlet stream in Lakeville, about 75 yards from the lake outlet, but the regulation has been both sporadic and infrequent, so that no effect can be detected on a background of long range data.

The inevitable conclusion obtained from the combined data is that no simple correlation is obtainable at all among lake level, rainfall, and water withdrawal. The high level peaks which formerly occurred at least once every five years have indeed not been reached in recent years, when rainfall has been low and withdrawals high, although subsequent to the preparation of the figure, a high level was reached briefly in the fall of 1967. During the next few years the effect of withdrawal and rainfall may become manifest in the lake level. Finally, in a permit issued August 4, 1967 by the State Conservation Department, the Conesus Lake Association was authorized to maintain the level of the lake at 819 feet elevation. The permission had not been implemented at this writing.

HUMAN ELEMENTS IN THE ECOLOGY

By almost any standards, the present human use of Lake Conesus is extremely high. Demonstrable effects on the lake have begun to accumulate in recent years, and in the near future critical changes may occur.

Landfills

Modification of the shore line on a minor scale undoubtedly began when owners of summer cottages built docks or built sea walls to satisfy aesthetic tastes and provide level lawns. The prevention of erosion in most cases was not a rational justification. Later the number of shore residences increased enormously both the amount of time spent in residence and the availability of machinery and resources for modification increased disproportionately, with the cumulative result that perhaps a third of the shoreline is physically modified. Building occurred principally in the generation from 1920 to 1950, when over 1100 residences were counted. At the present the number has reached almost 1600, and building still takes place, although the lake shore is past saturation by the standards of regulation customary in many parts of the country, such as Wisconsin.

Major modification of the lake shore near the outlet began in the late 19th century. A map prepared for the New York State Canal Board by Henry Tracy in 1849 showed a pier extending from the north end of the lake just west of the outlet southward along what is now Pebble

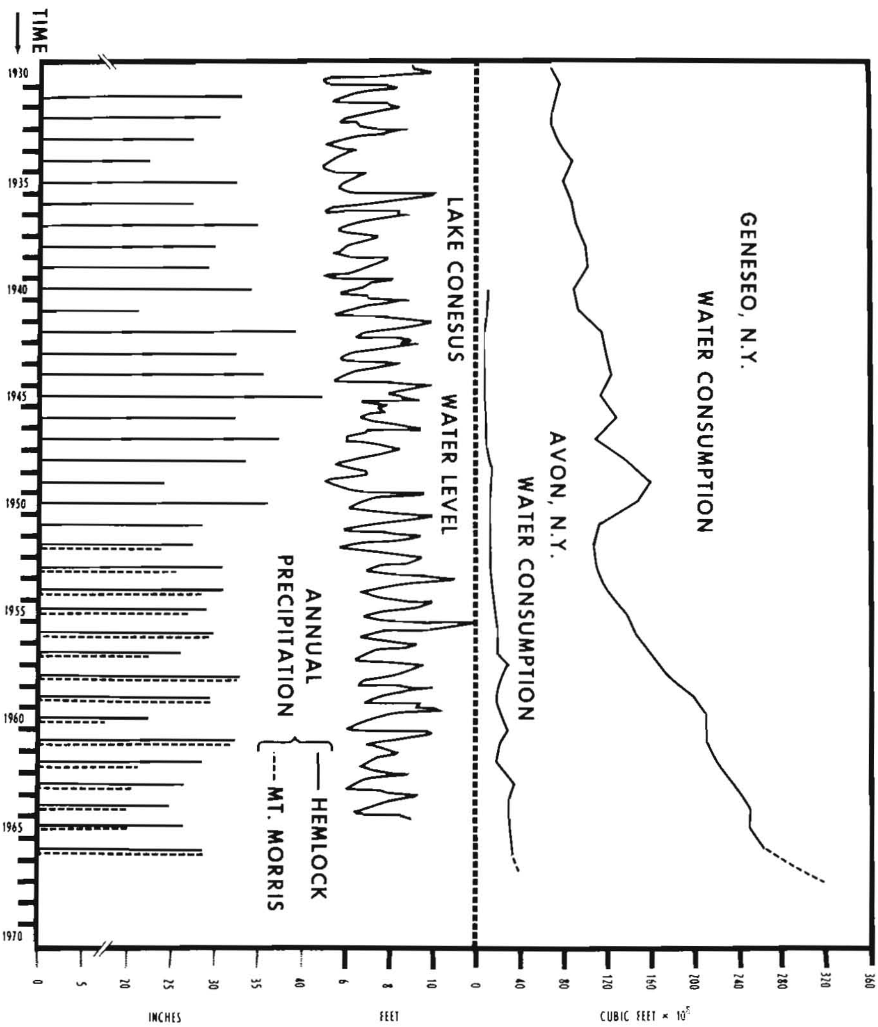

TIME
GENESEO, N.Y.
WATER CONSUMPTION
AVON, N.Y.
WATER CONSUMPTION
LAKE CONESUS WATER LEVEL
ANNUAL PRECIPITATION
HEMLOCK
MT. MORRIS
1930
1935
1940
1945
1950
1955
1960
1965
1970
INCHES
FEET
CUBIC FEET × 10^5

FIGURE 1.

Beach. The outlet itself contained a small island. This island had been obliterated by the time the first phase of modification was completed: the construction of a peninsula southward into the lake from a point .1 mile east of the outlet. The shore line before modification formed a convex curve to the north of the present driveway which runs from the outlet to the east side of the present peninsula. A railroad spur was constructed on the peninsula, a small hotel and ferry landing constructed at the southern point, and the name "Fisherman's Point" applied to the new feature. However, the name "Sand Point" appears instead on the Livonia Quadrangle Map. Although the rails and ferry disappeared, the old hotel stands in 1968 and the original filled area is lined with cottages.

Two further encroachments increased the size of the peninsula. At low water, it became customary to drive wagons directly from the outlet to the point, forming a second side to an isosceles triangle (with the driveway as base). Willow trees were planted along the route in 1925, and these stabilized the line with the accumulation of sand and the reduction of circulation in the interior of the peninsula. Meanwhile dumping of fill from the shore line reduced the area of the swamp forming inside the peninsula and created a hump near its base, just to the southeast of the outlet. A study of photographs made by the U. S. Department of Agricultural Stabilization Service in 1938 and 1963 verified that the shore line still extended almost to the driveway; two trees, an ash to the south and a cottonwood to the north still stand in the area and serve as markers. Since that time extensive filling was undertaken, and suspended in January 1966 after about half of the interior had been filled. In the opinion of the Conservation Department, this filling destroyed the breeding areas of northern pike, which had become established in the lake. The unfilled portion of the peninsula consists of an interior portion where *Typha angustifolia* is conspicuous as an emergent and *Utricularia vulgaris* and *Potamogeton* species are submergent plants. *Lemna minor* and *L. trisulca* may cover the surface on occasion, with intermingled *Spirodella polyrhiza*, especially toward the outer edge. The outer portion of the marsh is open to the lake, connected with it almost continuously at a level of approximately 817 feet or 6′10″ on the Geneseo pumping station interior gauge. This portion is indistinguishable from shallow lake waters, containing emergents such as *Peltandra virginica*, *Sagittaria latifolia* and *Polygonum amphibium*, and submerged *Myriophyllum exalbescens*, and species of *Potamogeton*, and *Elodea canadensis*. Preliminary examination indicates an unusually rich diversity of aquatic plants in the interior of the peninsula, and it must be noted with deep regret that, at this writing, a permit has been granted (Memorandum of Determination, Application 1-1-66, March 23, 1967) for the filling and obliteration of the entire habitat.

Since the sides of the lake have a relatively narrow shelf of shallow water, major filling operations have been less tempting than at the ends, but in one case the earth removed for the erection of a bowling alley near Long Point on the west side of the lake was placed in the lake and created sufficient new property to contain a large house and its yard.

The shallow water adjacent to the inlet, at the southern extremity of the lake was relatively undisturbed until the Spring of 1967. An application was made for filling of the area adjacent to the inlet but denied by the State Water Resources Commission (Memorandum of Determination, Application 1–95–66, March 23, 1967). Nevertheless, before the Determination was prepared, the forest and herbaceous cover had been removed from the inlet area, and bulldozing operations filled shallow water areas. The filling was halted by court order and the removal of fill up to the elevation of 818.6 feet was required. Subsequent operations completely destroyed both the natural vegetation and the land form, since new channels were constructed perpendicular to the inlet stream. Considerable silt has continued to enter the lake since the beginning of the operation.

Sewage

A vast increase in sewage draining into Lake Conesus has resulted not only from the high density of dwellings on the lake shore and in nearby areas, but also in the change of character of their use. Many are not summer cottages, but year-round residences. Even trailers are installed permanently in great density, particularly in the area adjacent to and just west of the outlet. Most of the dwellings have septic tanks, and sealed tanks (which must be pumped at intervals, and the contents presumably emptied away from the lake) are required where the water table is very high. Inspection of over one thousand tanks is quite beyond the capacities of the sanitary inspectors of the four towns (Geneseo, Conesus, Livonia, Groveland) which bound the lake, and there is little doubt as to the inadequacy of much of the equipment. At this writing, a sewer district to encompass the lake perimeter is being organized. Concentrated sources of sewage input to the lake include Lakeville, where Muenscher (1927) identified the milk processing plant as a polluter, and the Village of Livonia discharging into Wilkins Creek. Other densely inhabited areas are drained by the inlet stream, and by an unnamed stream located between the outlet and Wilkins Creek, at the north-east corner of the lake.

The most accepted index for untreated fecal content is the presence of coliform bacteria. Precise determination of *Escherichia coli* is a fairly involved laboratory procedure which is frequently not accomplished in routine testing. The Millipore membrane filter technique (Standard Methods for the Examination of Water and Wastewater, 1965) is, however, rather meaningful when performed by a skilled technician. This technique was employed for the culture and counting of specimens collected in Conesus Lake during 1967 and 1968. The work was done by Mrs. Dudley Stewart, technician for the Rochester Committee for Scientific Information. In a few cases, data from secondary sources is discussed. The outlet stream, the lake proper and South McMillan Creek (a principal tributary of the inlet stream) were surveyed by the State Health Department in 1959 (Genesee River Basin Survey No. 2, 1961). As in 1926, Lakeville still lacked treatment facilities and its discharge into the outlet of the lake had a bad odor and visible oil content. Coliform counts were listed without information as to the method of sampling, culture, or counting.

For perspective, it may be noted that the New York Standard for swimming waters is not more than $2.4 \times 10^3/100$ ml, at present (1967 revision, Key 1205 iii) based on a median of five counts. The New York Standard is somewhat less strict than those applied in the Mid-west, where the limit is $1 \times 10^3/100$ ml. Counts of a few hundred are common in waters draining land under intense use for animal husbandry, and suburban drainage commonly contains a few hundred coli in the standard 100 ml. portion.

On August 19th, a count of 2.4×10^4 was obtained for Conesus Lake Outlet stream. Wilkins Creek delivers the effluent from the sewage treatment plant of the village of Livonia into the lake about one mile southeast of the outlet. Counts made in August 1959 were from 930 to 9.3×10^3 and September counts ranged from 2.4×10^4 to 1.1×10^5. The obvious explanation for erratic counts from Wilkins Creek is that there is sometimes a failure to chlorinate the effluent of the treatment plant. Counts of water in the open lake at the same time (August) were quite low, from 9.1 to 43.

More recently, samples were collected and examined by Fact Technical Service of Rochester, N. Y. under contract for the Conesus Lake Association. Their report (letter to J. Frederick Colson, June 20, 1967) does not meet current scientific standards since the qualifications of the technician are dubious, there are unexplained gaps in the sequence of sample numbers, and an unjustified extrapolation of numbers was noted among the counts. The report is discussed here chiefly for completeness of record, and to observe that the results do indeed conform to the pattern of other studies.

sample	*location*	*count/100 ml.*
361	"upstream at treatment plant"	2.75×10^4
365	"downstream at treatment plant"	1.1×10^3
	note: it may be speculated that the two samples were confused	

sample	*location*	*count/100 ml.*
369	"middle of lake, west of creek"	60
366	"middle of lake, 4½ miles out"	120
362	"mouth of inlet"	350

The landfill application for Sand Point (previously discussed) spurred special attention to it, since an argument in support of the fill was the elimination of pollution in Sand Point swamp. While the merits of the application are beyond the scope of this report, the sequence which developed is quite instructive both in regard to the human ecology of the lake and in both the natural history of coliform bacteria and the critique of coliform data.

Fact Technical Service examined water samples by using the membrane filter technique, but without reporting dilutions used, or use of duplicates (letter to Mr. Joseph Vitale, July 13, 1967). A number of sites were sampled on July 11, 1967 within the marsh but reports were given for only five numbers in an eleven number sequence. The accompanying map showed a distribution around the entire periphery of the marsh, although the map was inadequate to locate such gross features as the opening to the lake. The counts were reported as precise to ten colonies out of over 18,000! The numbers were remarkably uniform, from a low of 10,250 to a high of 26,900. As presented, the data were not credible. Moreover, an elementary knowledge of the habitat would predict a strong gradient in numbers (a sharp decline) from the source of the fecal material through the unpolluted lake water with which it is mixed at the side and end of the swamp. The source of pollution was alleged to be the cottages on the east side of Sand Point, but the testimony was discounted and evidence presented which established the presence of a sewer pipe from Lakeville at the north-eastern edge of the swamp. Evidence presented from a study made by E. Grant Pike included data which followed the predictable ecological pattern. A gradient was confirmed starting at a count in the millions near the pipe opening and declining to a few hundred near the swamp opening. The swamp, in fact, is a rather effective sewage treatment lagoon, a natural model of the artificial ponds constructed by sanitary engineers!

Table I presents a consolidation of data obtained during the Fall of 1967 and the Summer of 1968, and Figure 2 shows collecting sites at the northern end of the lake. The sterility of collecting equipment, the collecting procedure, and the culturing were under my control (Forest). The technician received duplicate collections identified by numbers only. Collecting sites were located mostly at the perimeter of the north end of the lake—the vicinity of the outlet. The objectives of the study were to establish the probable sources of untreated fecal contamination, and to discover patterns of distribution of material in the lake.

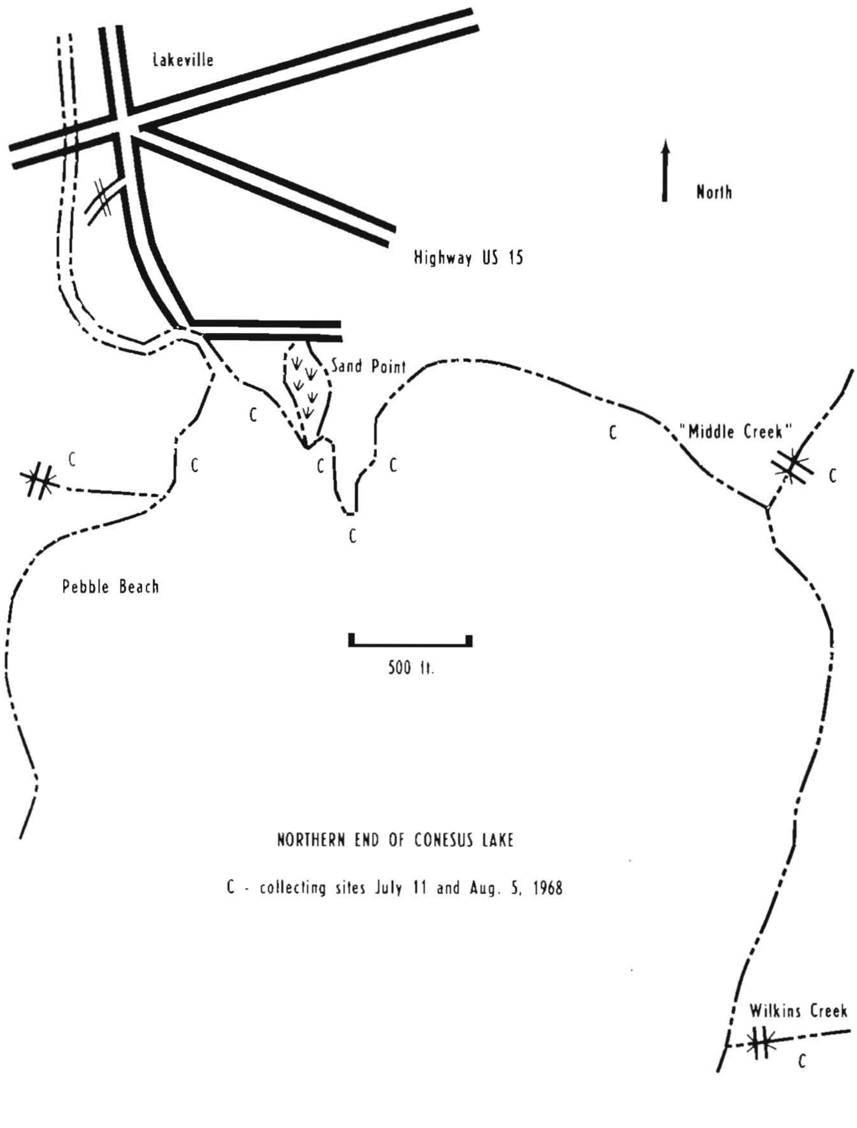


FIGURE 2. Sites of Duplicate Collections of Water for Culture of *E. coli* North End of Conesus Lake.

Determinations of *E. coli* frequency in water of Conesus Lake
Fall 1967, Summer 1968

Table I

Part 1. Long Point Beach

Date	*Vol. filtered*	*Colony* Count converted to 100 ml.
9/17/67	.1	—
	1.0	600
	10.0	90
9/17/67	.1	1000
	1.0	1000
	10.0	140
9/24/67	1.0	500
	10.0	370
9/24/67	1.0	100
	10.0	190
10/1/67	1.0	—
	10.0	—
10/1/67	1.0	1000
	10.0	—

Part 2. Lake Inlet (at lake)

10/1/67	1.0	6×10^3
	10.0	overcrowded
10/1/67	1.0	3.4×10^3
	10.0	7.8×10^2

Part 3. Lake Outlet (at bridge)

9/17/67	.01	—
	.1	—
	1.0	400
9/17/67	.01	—
	.1	—
	1.0	600
10/1/67	1.0	1.5×10^3
	10.0	(crowded) $\pm$1000
10/1/67	1.0	1.2×10^3
	10.0	630

Part 4. Sand Point Swamp near outlet into lake.

9/24/67	1.0	100
	10.0	60
9/24/67	1.0	—
	10.0	190
6/20/67	.001	6×10^4
	.01	4.5×10^4
6/20/67	.001	1×10^4
	.01	3×10^4

Date	Vol. filtered	Colony
6/27/67	.001	2.5×10^4
	.01	3×10^4
6/27/67	.001	—
	.01	7×10^3
7/4/67	.01	—
	.1	—
7/4/67	.01	—
	.1	1000

Part 5. Creek at Pebble Beach 100 yards southwest of outlet.

9/17/67	.1	1000
	1.0	100
	10.0	100
9/17/67	.1	1000
	1.0	—
	10.0	20
9/24/67	1.0	600
	10.0	70
9/24/67	1.0	700
	10.0	overgrown
10/1/67	1.0	4.6×10^3
	10.0	1.7×10^3
10/1/67	1.0	3.7×10^3
	10.0	1.7×10^3

note: creek was running freely only on 10/1 in the fall of 1967, but continued to run all summer in 1968.

Date	Vol. filtered	Colony Count converted to 100 ml.
6/6/68	.001	1×10^5
	.01	2×10^4
duplicate lost		
6/13/68	.001	4×10^5
	.01	—
6/13/68	.001	—
	.01	—
6/20/68	.001	—
	.01	5×10^4
6/20/68	.001	1×10^5
	.01	6×10^4
6/27/68	.01	3×10^4
	.1	2.7×10^4
6/27/68	.01	2×10^4
	.1	8×10^3
7/4/68	.01	—
	.1	1×10^4
7/4/68	.01	—
	.1	5×10^3

Part 6. Creek entering lake, .3 miles east of outlet.

Date	*Vol. filtered*	*Colony* Count converted to 100 ml.
6/6/68	.001	7×10^5
	.01	1.2×10^5
6/6/68	.001	6×10^5
	.01	1.6×10^5
6/13/68	.001	10.8×10^5
	.01	2.07×10^5
6/13/68	.001	11.5×10^6
	.01	1.85×10^5
6/20/68	.001	5×10^5
	.01	2.6×10^5
	.1	2.25×10^4
6/20/68	.001	7×10^5
	.01	2.2×10^5
	.1	1.94×10^4
6/27/68	.01	—
	.1	1×10^3
6/27/68	.01	—
	.1	2×10^3
7/4/68	.01	3.1×10^5
	.1	2.07×10^5
7/4/68	.01	3.2×10^5
	.1	1.52×10^5
7/11/68	.01	8.3×10^5
	.01	8.6×10^5

Part 7. Wilkins Creek.

9/17/67	.01	2×10^4
	.1	1000
	1.0	2.4×10^3
9/17/67	.01	—
	.1	—
	1.0	1.2×10^3
9/24/67	.1	7×10^3
	1.0	3.8×10^3
	10.0	1.7×10^3
9/24/67	.1	4×10^3
	1.0	3.2×10^3
	10.0	930
10/1/67	1.0	2.5×10^3
	10.0	overgrown
10/1/67	1.0	4.2×10^3
	10.0	overgrown
6/6/68	.001	—
	.01	—
6/6/68	.001	—
	.01	1×10^4

Date	*Vol. filtered*	*Colony* Count converted to 100 ml.
6/13/68	.001	1×10^5
	.01	5×10^3
6/13/68	.001	—
	.01	3×10^3
6/20/68	.01	1×10^5
	.1	5×10^3
6/20/68	.01	—
	.1	3×10^3
6/27/68	.01	3×10^4
	.1	9×10^3
6/27/68	.01	—
	.1	8×10^3
7/4/68	.01	—
	.1	1000
7/4/68	.01	—
	.1	2×10^3

Part 8. Selected collecting stations near outlet of lake sampled on July 11 and August 5, 1968.

		July 11	*August 5*
Pebble Beach Creek	.1		3.8×10^4
(see part 5)	1.0	not sampled	1.2×10^4 (overgrown)
	.1		1.9×10^4
	1.0	not sampled	1.6×10^4 (overgrown)
Trailer Park, about 50 yards	.1	8×10^3	8×10^3
west of outlet	1.0	6.6×10^3	6.5×10^3
	.1	7×10^3	8×10^3
	1.0	5.7×10^3	1.4×10^3
West side of Sand Point, about	.1	5×10^3	2×10^3
20 yards from outlet	1.0	2.4×10^3	900
	.1	5×10^3	3×10^3
	1.0	1.1×10^3	700
Sand Point swamp near outlet	.1		—
(see part 4)	1.0	not sampled	900
	.1		3×10^3
	1.0	not sampled	800
Open lake at extreme southern	.1	—	2×10^3
tip of Sand Point	1.0	—	400
	.1	2×10^3	—
	1.0	500	200
East side of Sand Point, about	.1	1000	
half-way to tip	1.0	100	not sampled
Beach at 3496 East Lake Road,	.1	—	
about .2 mile east of Sand	1.0	100	not sampled
Point and .1 mile west of	.1	—	
mouth of "middle" creek	1.0	200	not sampled
	.1	—	not sampled
	1.0	omitted	

Date	*Vol. filtered*	*Colony* Count converted to 100 ml.	
"Middle" creek at highway US 15	.01	8.3×10^5	3.6×10^5 overgrowth
	.1	overgrowth	
	.01	8.6×10^5	2.5×10^5 overgrowth
	.1	overgrowth	

Conclusions which have been derived from the study may be stated briefly:

1. Even with the best available, rapid methods performed by a competent technician, the derived count of coliform colonies (based on 100 ml) is variable and capricious. A blind (if objective) computation and averaging of counts is quite likely to produce results with less relationship to the natural condition than critical subjective judgment of the data. For example, one chance colony in a very small volume can greatly exaggerate an average. Generally speaking, counts are most consistent when the volume cultured is fairly large, but too many colonies prevent counting altogether.

2. Rough numbers furnish the most utilitarian guide in indexing the content of untreated fecal sewage by use of coliform colony counting.

Slight pollution . . .	a few hundred/100 ml.
Moderate pollution . . .	from one to several thousand, quite arbitrarily a line could be drawn somewhere between ten and thirty thousand.
Heavy pollution .	from several thousand to millions.

3. Data on the natural history of the environment is a necessary adjunct to laboratory data in any meaningful interpretation of the coliform index. It may be noted that moderate and heavy rainfall completely changed the pattern of counts obtained. Current patterns affect the distribution of the untreated fecal material: on July 11 there were no countable coli only .1 mile away from a discharge of millions. The capacity of a given receiving water varies in respect to rate of destruction of the index bacteria (not necessarily in direct proportion to the destruction of either pathogenic organisms or non-living organic matter). Destruction may be much more rapid in open sunlit waters than near the shore in turbid waters with organic deposition. A natural area, such as the Sand Point swamp may be overloaded by heavy run-off just as municipal treatments may be overloaded from increased water usage.

4. Heavy pollution enters the lake from "middle" creek and from the sewer pipe discharging into Sand Point swamp (other sewers discharge into the outlet stream). In times of low to moderate rainfall

the effluent in Sand Point swamp is treated to a surprisingly effective degree, but the treatment fails when rainfall is heavy.* The pollution entering the lake from "middle" creek is distributed in an unknown pattern in the north-eastern portion of the lake. The sources of moderate pollution around the lake are probably numerous. The sources identified at one time or another include the inlet stream, the creek at Pebble Beach (when it runs), the congested trailer and cottage area straddling the outlet principally to the west, and (periodically) Wilkins Creek. Although the counts obtained in the open lake are rather remarkably low, almost any area on the perimeter of the lake may be considered hazardous for swimming on unpredictable occasions. Particularly the beaches adjacent to the outlet are most unsuitable for swimming when judged even by the decidedly moderate standards of New York State.

Phosphate

In recent years the perspective on the spectrum of human pollution has increased enormously, with different facets coming into focus as they become too serious to ignore. The fertilization, or "over"-fertilization, of waters has received considerable attention because of its association with heavy growths of planktonic and attached algae and of rooted aquatic angiosperms. The result of numerous inquiries has been to select phosphorus as the critical nutrient which might be controlled. Since sewage treatment plants are the best places for extracting a large amount of the phosphorus going into waters, technology for removal has been developed and laws requiring removal are scheduled for application in the central Great Lakes area (Wisconsin, Michigan, Illinois, Indiana). Regulations for New York are in the drafting stage by the State Health Department. The particularly critical problem of the City of Rochester (Forest, 1968) has stimulated its concrete planning for phosphate removal of its sewage in new treatment facilities which will be constructed, and the need for similar treatment is acknowledged by the planning group for sewage facilities in Monroe County.

A general belief is manifest among the residents of the shores of Conesus Lake that the amount of aquatic angiosperms ("water weeds") has greatly increased in recent years. While the reports are reasonable they are unsupported by any systematically recorded observations. There is every reason to *expect* that an increase in human sewage input to the lake would have increased the phosphorus input greatly during the last 30–40 years. Ordinary treatment of sewage, whether on residential or municipal scale removes very little phosphorus. An additional source to be

* Overloading is indicated for June 20 and June 27 when a period of heavy rain was recorded. At other times the lagoon was quite effective.

considered for Conesus is the run-off from adjoining land, particularly from fertilized fields.

In the summer of 1968 a limited study was designed for the purpose of probing the current summer phosphorus budget of Lake Conesus. Dr. Bruce Ristow, Chemistry Department, State University College at Geneseo, provided phosphorus-free collecting vessels and performed the analysis by the colorometric molybdenum method. The data are presented in Table II, with collecting sites at the south end of the lake indicated on Figure 3.

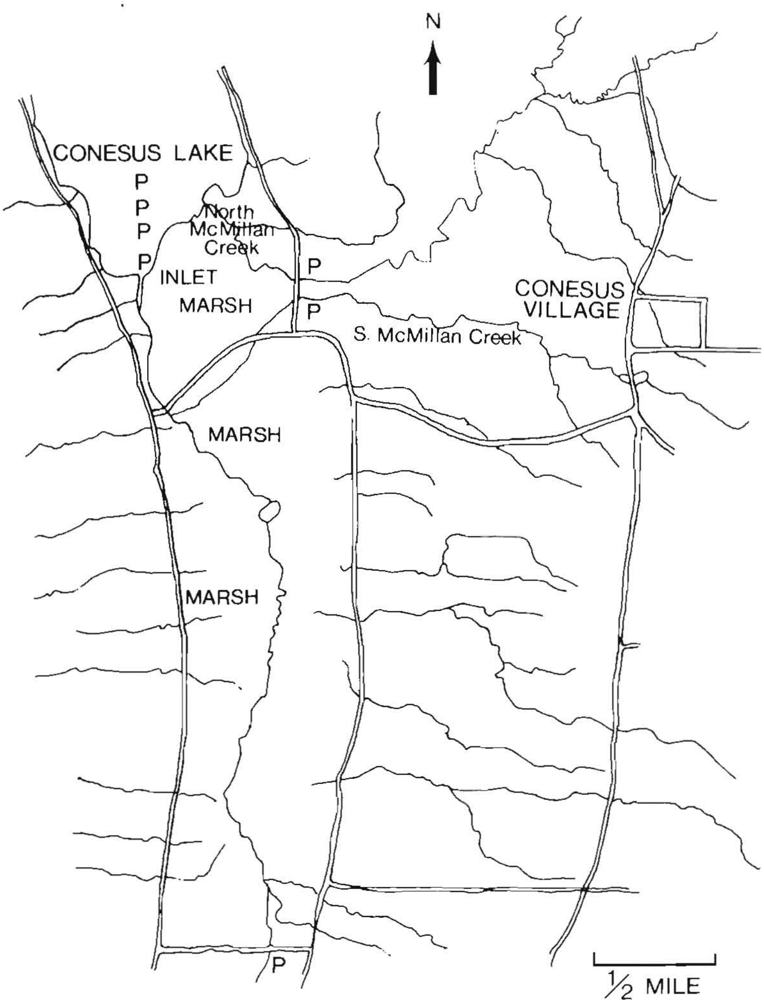


FIGURE 3. Sites of Collection of Water for Phosphate Analysis, South End of Conesus Lake.

Although the data are limited, a surprisingly clear pattern seems to have been established.

1. The phosphorus content of the open waters of the lake is within the range of expectation of natural waters, and the water at the outlet is only slightly higher (perhaps double); both values increased proportionally (about double) after a period of extended moderate rain (6/20/68).

Table II

Total Phosphate in Waters of Conesus Lake and Adjoining Streams

	Date	PO_4 mg/l
Inlet Area		
North McMillan Creek	6/27/68	.18
South McMillan Creek	6/27/68	.19
	7/4/68	.14
Conesus Inlet Creek:		
a. upstream from swamp	7/4/68	.17
b. near lake, at bridge	6/13/68	.57
	6/20/68	.48
	6/27/68	.48
	7/4/68	.31
Lake		
a. 100 feet N of inlet	7/4/68	.35
b. 100 feet N of inlet	8/1/68	.22
c. 500 feet N of inlet	8/1/68	.14
d. 1000 feet N of inlet	8/1/68	.14
e. 1500 feet N of inlet	8/1/68	.07
Mid Lake		
Reservoir Road (Geneseo pumping station)	6/6/68	.13
	6/13/68	.05
	6/20/68	.1
	6/27/68	.11
Streams before entry:		
Cottonwood Point (west side, southern half)	6/27/68	.06
Long Point (west side, waist of lake)	6/6/68	.17
	6/27/68	.19
Wilkins Creek (east side about one mile from inlet; carrying effluent from Livonia Village disposal plant)	6/6/68	4.6
	6/13/68	4.7
	6/20/68	5.0
	6/27/68	1.6
Outlet Stream	6/13/68	.11
	6/20/68	.24
	6/27/68	.18

2. Small streams draining farmlands, and (surprisingly) even South McMillan Creek which drains the Village of Conesus, contribute little added phosphorus, their content being in the range of the outlet stream.

3. A rather heavy contribution of phosphorus is made by the inlet stream (about quadruple the lake value). The inlet stream probably furnishes more than half of the volume of the lake water, perhaps much more, so the volume as well as the content is considerable.

4. On the basis of present evidence (6/27 and 7/4 collections) the phosphorus in the inlet stream seems to come from the marsh through which it flows for a mile before entering the lake. Streams entering the marsh were similar to small streams entering the lake directly.

5. Removal of phosphate from solution in waters entering the lake occurs rapidly, or at least near the mouths of streams (note the collections made on 8/1/68), and the phosphate level of the lake as a whole is substantially below that of the principal feeder streams. The high lime content of the lake water reasonably accounts for the removal to bottom sediments.

6. Not surprisingly, the phosphorus contribution of the Livonia sewage plant, through Wilkins Creek, is enormous in value, easily from five to ten or more times the value of the open lake. The volume of Wilkins Creek is considerably less than that of the inlet stream (no more than 1/6), but certainly consequential in the north-eastern portion of the lake. In addition to Wilkins Creek, phosphate is certainly contributed in high concentration by "middle" creek and by at least five outlets of sewage from individual residences in the north-eastern corner of the lake. Circulation in that portion of the lake is limited by Sand Point, the water is shallow, and the shore is generally leeward. By chance, the two areas of the lake (its extremities) which are most shallow, also receive the heavy fertilization.

Analysis of the pattern of phosphorus distribution provides a beautiful model of the dynamics of the phosphorus budget of the lake. There is a deposit of phosphorus in the lake. The phosphorus in algae is most probably much smaller in amount and much more likely to be returned to solution than the phosphorus in aquatic angiosperms, inasmuch as the standing crop is very large, and it persists to a high degree through winters, perennially. Quite apparently, the phosphorus is "banked" on the bottom both directly and after circulating through plants and animals, so that the phosphate level of the open lake and the outlet remains substantially lower than that of the input waters. Phosphorus retention was similarly documented in Wisconsin Lakes (Hasler, 1963). Causality of the bottom-plant-water equilibrium is not known in detail, and unquestionably is both complex and variable in different situations. The Conesus situation is particularly instructive because of the marsh drained by the inlet stream. Here the old "account" composed principally of decayed plant materials is being withdrawn, enters the lake and is largely deposited again on the bottom. The portion of phosphorus retained in the Wisconsin lake in the summer was calculated as 44.7%. A rough estimate of retention may be made by assuming the Conesus inlet stream to contribute 60% to the lake's volume, the north-eastern streams 8%; at least 48% must be retained in Conesus. A more precise retention figure must await more information on the volume of input and output waters.

Part II—AQUATIC ANGIOSPERMS

H. S. Forest and E. L. Mills, with assistance
of
John Recktenwald, Danny N. Bodine, Peter G. Savard
(and others as noted)

Muenscher (1927) provided the only previous study and publication of aquatic plants in Conesus Lake. Through personal communication, Kenneth B. Donnell stated that he had made a study of the aquatics at five year intervals for 15 years ending approximately in 1945. Unfortunately, no record of the studies was retained in the files of the State Conservation Department, and the effort to see if a personal copy had been retained has been fruitless.

The Muenscher report consists of a combined floral list for both Conesus and Silver Lakes, with the specific lake identified by its initial, and the tabulated data of the nature of the bottom (including plants) along five transects laid out approximately east-west (perpendicular to the long axis of the lake) and about two miles apart. An additional short transect ran south from Sand Point to intersect the middle of the first east-west transect about one-quarter mile south (Figure 4). A total of 38 stations were sampled along these transects. Some species on the floral list were noted as being predominant, but the specific lake is not identified.

The studies which have been initiated establish a new list. They will use the Muenscher transects again to locate sampling stations which will be observed at intervals, and, in addition, will attempt to formulate ideas of the structure of the aquatic plant community and its dynamics.

Floral List

Muenscher noted that specimens had been preserved at Cornell, and a search of the Wiegand Herbarium was made by E. L. Mills on July 31, 1968. The collecting data from the specimens present are included in the list; other species reported were not represented by specimens.

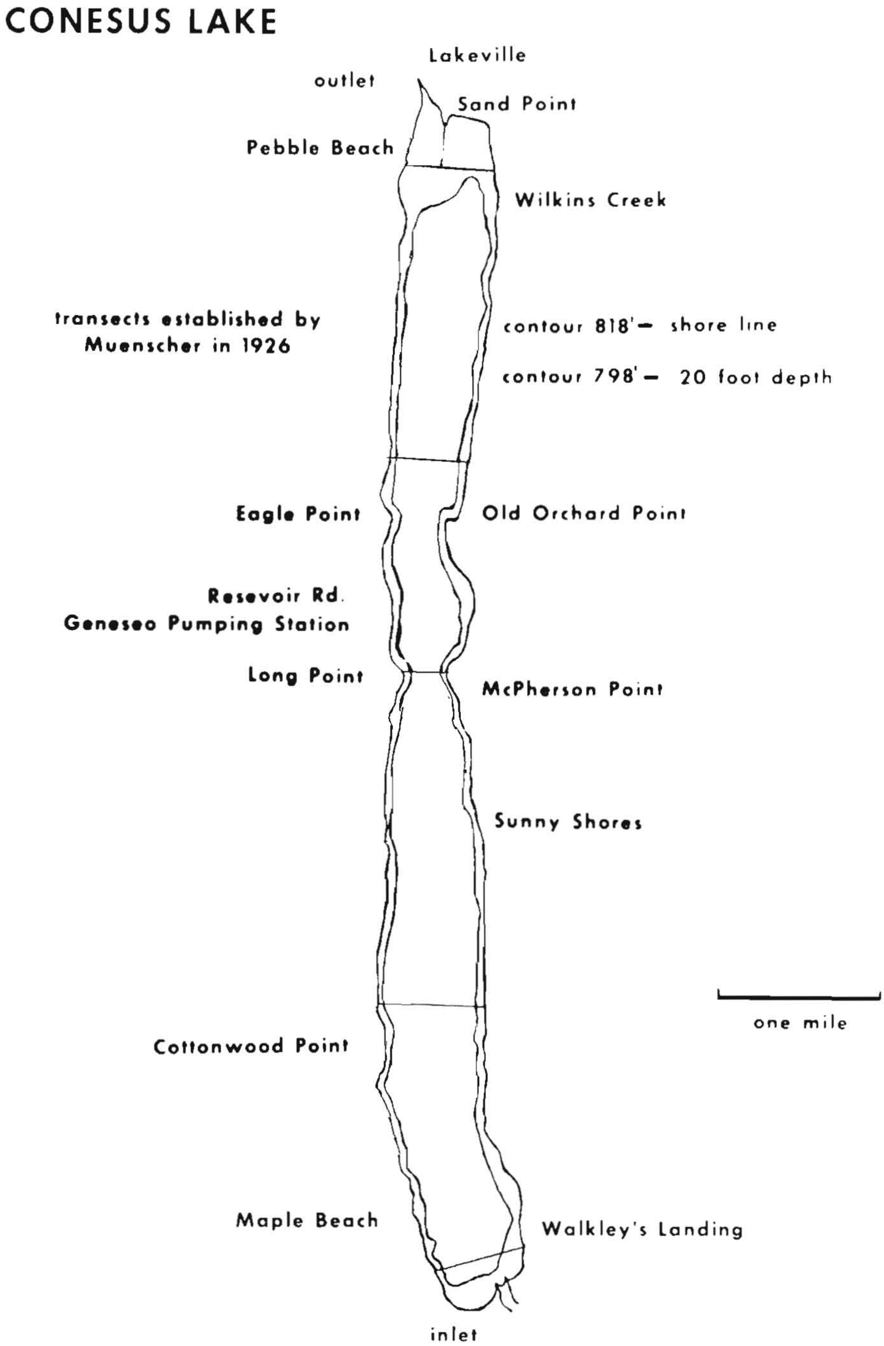

CONESUS LAKE
Lakeville
outlet
Sand Point
Pebble Beach
Wilkins Creek
transects established by
Muenscher in 1926
contour 818' — shore line
contour 798' — 20 foot depth
Eagle Point
Old Orchard Point
Resevoir Rd.
Geneseo Pumping Station
Long Point
McPherson Point
Sunny Shores
one mile
Cottonwood Point
Maple Beach
Walkley's Landing
inlet

FIGURE 4.

CU—Wiegand Herbarium at Cornell University

GEN—Herbarium at State University College, Geneseo, N. Y.

Bidens beckii Torr.—Muenscher, 1927 and CU, lagoon southeast corner of lake, 8/26/26.

Ceratophyllum demersum L.—Muenscher, 1927, predominating; Inlet, 10/4/67 and 7/9/68, GEN. Generally elsewhere.

Cephalanthus occidentalis L.—Inlet 8/1/68, GEN.

Cicuta maculata L.—Inlet 7/6/66 and 8/1/68 GEN.

Decodon verticillatus (L.) Ell.—Inlet 8/1/68, and 8/15/68, GEN.

Elodea canadensis Michx.—Muenscher, 1927, predominating, and CU Inlet 9/2/26 and off Eagle Point 8/31/26; 1620 W. Lake Rd. (near inlet), Sand Point 10/4/67, 7/22/68 GEN. Elsewhere usually in small quantities, but abundant in outlet.

Heteranthera dubia (Jacq.) MacM.—Muenscher, 1927, predominating, and CU in 15 feet of water off Long Point (mid-lake) 9/1/26 and N. of Carl's Marina (east shore) 7/15/68 GEN. Elsewhere sometimes in dense stands.

Lemna minor L.—Muenscher, 1927; 1620 W. Lake Rd. 10/4/67 Sand Point swamp spring and summer, 1968, GEN.

Lemna trisulca L.—Muenscher, 1927; 1620 W. Lake Rd. 10/4/67 Sand Point swamp spring and summer, 1968, GEN.

Lobelia cardinalis L.—Inlet 8/1/68, GEN.

Myriophyllum exalbescens Fernald—Muenscher, 1927; predominating; 1620 W. Lake Rd. 10/4/67, inlet 7/9/68, ½ m. N. of Carl's Marina 7/15/68 GEN. Almost pure, very dense stands can be found in waters from 6–15 feet in depth in early summer. The plant over-winters in good condition whereas many others disintegrate.

Najas flexilis (Willd.) Rostk. & Schmidt—Muenscher, 1927, predominating; inlet (2 ft. depth) 7/17/68 GEN. Occasionally elsewhere in very small quantity.

Nuphar variegatum Engelm.—Muenscher, 1927, and CU south end 9/2/26 as *Nymphozanthus variegatus* (Engelm.) Fernald; shallow water of inlet stream 10/4/67 and southeast corner of lake 6/13/68 GEN. The species is considered here to include *N. advena* Ait. Fassett (1940) and others have noted the difficulty in separating them, and the Conesus specimens have flowers conforming to one species and vegetative parts to the other.

Nymphaea odorata Ait.—Muenscher, 1927; Inlet 8/1/68 GEN.

Peltandra virginica (L.) Kunth.—Muenscher, 1927; Sand Point swamp (predominant) 8/6/68, south end 7/22/68 GEN.

Polygonum amphibium L.—Sand Point swamp 7/22/68, inlet 8/1/68 GEN.

Pontederia cordata L.—Muenscher, 1927, and CU, in narrow lagoon southwest corner; southwest corner 10/4/67 and 8/1/68 GEN.

Potamogeton americanus var. *novaeboracencis* (Morong) Benn.—Muenscher, 1927, and CU shallow water near outlet 8/31/26.

Potamogeton amplifolius Tuckerm.—Muenscher, 1927, predominating, and CU in narrow lagoon southwest corner 9/2/26; south end 8/1/68 GEN.

Potamogeton angustifolius Berch. & Presl.—Inlet 7/9/68, Sunny Shore (East, south of McPherson Point) at 8 ft., Sand Point 7/22/68 GEN. Never found in quantity, but most plentiful near inlet.

Potamogeton compressus L.—Muenscher, 1927, predominating, and CU in 15 ft. water off Long Point 9/2/26, narrow lagoon southwest corner 9/2/26; inlet 6/12/68, 7/22/68 and at other times GEN. Elsewhere in lake, but never found in quantity.

Potamogeton crispus L.—Muenscher, 1927, predominating, and CU in 15 ft. of water near south end; inlet 6/12/68, 7/22/68, and in other times GEN. Elsewhere in lake, but never found in quantity except in inlet area.

Potamogeton epihydrus var. *cayugensis* (Wiegand) Benn.—Muenscher, 1927, and CU narrow lagoon southwest corner.

Potamogeton foliosus Raf.—Muenscher, 1927.

Potamogeton gramineus var. *Graminifolius* Fries.—Muenscher, 1927.

Potamogeton natans L.—Muenscher, 1927, and CU shallow water near outlet 8/31/26.

Potamogeton pectinatus L.—Muenscher, 1927, predominating. Observed only in small quantities, summer 1968.

Potamogeton richardsonii (Benn.) Rydb.—Muenscher, 1927, predominating, and CU north end 8/31/26; inlet 10/4/67, Sand Point 7/22/68 3324 E. Lake Rd. 8/6/68 GEN. Elsewhere in lake but never found in quantity.

Ranunculus aquatilis, approximating var. *capillaceus* DC. 3324 E. Lake Rd. (near mouth of Wilkins Creek) 7/15/68, inlet and adjacent area 7/22/68 GEN, also observed at Sunny Shores (east side) on 7/22/68.

Sagittaria latifolia Willd.—Muenscher, 1927, and CU shallow water south end 9/2/26; Sand Point swamp 8/6/68 GEN. Observed at south end and Sand Point swamp fall, 1967, and spring, 1968.

Sagittaria rigida f. *elliptica* (Engelm.) Fernald—Muenscher, 1927, and CU muddy shore south end as *S. heterophylla* Pursh.; Sand Point swamp 7/22/68 GEN.

Scirpus acutus Muhl.—Muenscher, 1927, and CU swamp south of lake 9/2/26 as *S. occidentalis* (Wats.) Chase.

Scirpus americanus Muhl.—Muenscher, 1927, and CU shallow water gravelly shore Long Point (west shore, at constriction) 9/1/26; 1620 W. Lake Rd. (south end) 10/4/67, east side of Sand Point 8/6/68 GEN.

Scirpus atrovirens Willd.—beside road at northern edge of Sand Point 8/6/68, lagoon at inlet 8/8/68 GEN.

Scirpus validus Muhl.—Muenscher, 1927, and CU swampy shore south end 9/2/26; south end 8/8/68 GEN.

Sparganium chlorocarpum Rydb.—Muenscher, 1927, and CU in narrow lagoon southwest corner of lake 9/2/26; lagoon at inlet 8/8/68 GEN.

Sparganium eurycarpum Engelm.—Muenscher, 1927; lagoon at inlet 8/8/68 GEN.

Spirodela polyrhiza (L.) Schleid.—Muenscher, 1927; Sand Point swamp 8/6/68 GEN. Observed at same site throughout summer, and at south end 8/1/68.

Typha angustifolia L.—Muenscher, 1927; Sand Point swamp 7/29/68 GEN.

Typha latifolia L.—Muenscher, 1927; lagoon at inlet 8/8/68 GEN.

Utricularia vulgaris L. var. *americana* Gray—Muenscher, 1927; south end 10/4/67 GEN. Observed Sand Point swamp summer 1968.

Vallisneria americana Michx.—Muenscher, 1927, and CU McPherson Point (east shore at constriction) 9/1/26, shallow water 1 ft. deep north end 8/31/26; 1620 W. Lake Rd. 10/4/67, inlet 7/9/68 GEN. Frequently encountered on sides and at ends of lake, sometimes in large quantity.

In comparing the floral lists of 1926 and 1967–68, it is obvious that no great change in the species composition has occurred. Some differences between the lists are explained by the inclusion in the current list of semi-aquatic emergent plants: *Decodon*, *Cicuta* and others. Some differences are seasonal: the *Sparganium* species were found in late summer. In one case, *Ranunculus aquatilis* blooms fairly early in summer and may have been missed in the 1926 survey; it was blooming at both ends of the lake and at the sides in mid summer, but may have disappeared by late August 1926—or, it may be a newly established species. There is some disparity in the list of *Potamogeton* species. Among the narrow leaved species reported by Muenscher, only *P. epihydrus* and *P. foliosus* were not found. Among the broad leaved species *P. americanus* has not been found, but *P. angustifolius* has been added. Although the two resemble each other somewhat, it appears unlikely that we have confused the two.

Quantitative studies of the aquatic angiosperm community.

In a survey such as Muenscher conducted, judgments of predominance are necessarily quite subjective and their value is related to the skill of the surveyor and the time available to him. Only cautious comparisons are warranted at this time. Muenscher listed eleven species as "predominating" without distinguishing Conesus from Silver Lake. The impression from day-to-day observations has been that only four of these, *Ceratophyllum, Heteranthera, Myriophyllum,* and *Vallisneria* occur in great quantity and in dense stands. Although five species of *Potamogeton* were listed as predominant in 1926, the sum total of all species hardly qualifies as predominant in 1968. Unfortunately, there is insufficient evidence to judge whether or not there has been a real shift in the community composition. It is also quite uncertain as to whether the total amount of bulk or the total area covered have changed. Muenscher designated the depth of 15 feet as the limit of rooted vegetation (but scoured shores were frequently bare from the surface to 5 feet). The present limit is certainly deeper than 15 feet on gradual slopes, which are extensive at the ends of the lakes but are also present at the sides. The slope of most of the side area is rather uniformly steep to a depth of 50 feet at 4–500 feet from the shore. The width of the productive belt at the sides varies from less than 50 feet on steep noses to 300 feet in coves, while the crescent at the north end of the lake extends 2200 feet south of the tip of Sand Point, and the crescent at the south end extends 1000 feet north of the inlet.

The methodology of community analysis of submerged aquatics is much less developed than that for terrestrial vegetation. Hasler (1963) selected the work of Swindale and Curtis (1957) as an exemplary study; indeed, it is the only quantitative community study included within the entire volume of Limnology in North America. In essence, Swindale and Curtis devised two arbitrary indexes for their difficult task. A chart of physiognomy compared the spacial occupancies of different plants, and a compositional index represented total occupancy of the community. Within the communities the species were compared by relative frequency (the proportion of horizontal area occupied).

The current studies employ quadrants (defined by metal barrel hoops) which have been distributed along transects. All of the plant material in the quadrants except for rooted portions are brought to the surface by diving, and species separated to some extent until their percentage of the total bulk can be estimated. Diving has been employed for the study of aquatic communities by Wood (1963), Schmidt (1964) and others, but plants have been studied in place, not removed to the surface for examination. When almost complete separation is possible the individual species can be weighed; if not, the entire plant mass is weighed (after draining and removal of most mud and rooted portions). Therefore, two types of analyses are sought: species composition by percentage of bulk (volume), and fresh weight of the standing crop. Differences in density among species are masked by the other variables involved in this necessarily imprecise procedure.

Composition of the aquatic plant community, exploratory study

Data by Calvin C. Brown and John Recktenwald

The graphs in Figures 5 and 6 are based on data collected October 4, 1967. The quadrant size was 2.4 sq. ft. and the transect extended for 600 feet to a depth of 25½ feet. The transect started at 1620 W. Lake Road, .1 mile north of the inlet, and ran NNE. The data support two observations: At depths of from two to six feet, the community was decidedly mixed, with Vallisneria and Heteranthera being predominant. The deeper water (7½ to 20 feet) was occupied by an almost pure stand of Heteranthera, the quantity at 20 feet being about 7% as much as at the most productive depth of 6½ feet and about half as much as the standing crop produced at a depth of 10 feet.

Total standing crop of lake and productivity

The available information is insufficient to support generalizations about either community structure or quantity of plants produced in the lake as a whole. However, a preliminary determination was made based on the average standing crop found in the south end of the lake on the 600-foot transect, .58 lb/square foot. If the entire area of the lake from the shore down to a depth of 20 feet is equally productive, the standing crop of the lake in early October would be about 8500 tons. Further studies will be required to validate the estimate of standing crop and to furnish information of net productivity during the growing season.

REFERENCES

BERG, C. O. (1963) Ch. 6, Middle Atlantic States. In, Frey, D. G. (editor) Limnology in North America, 191–238, Univ. of Wisc., Madison.

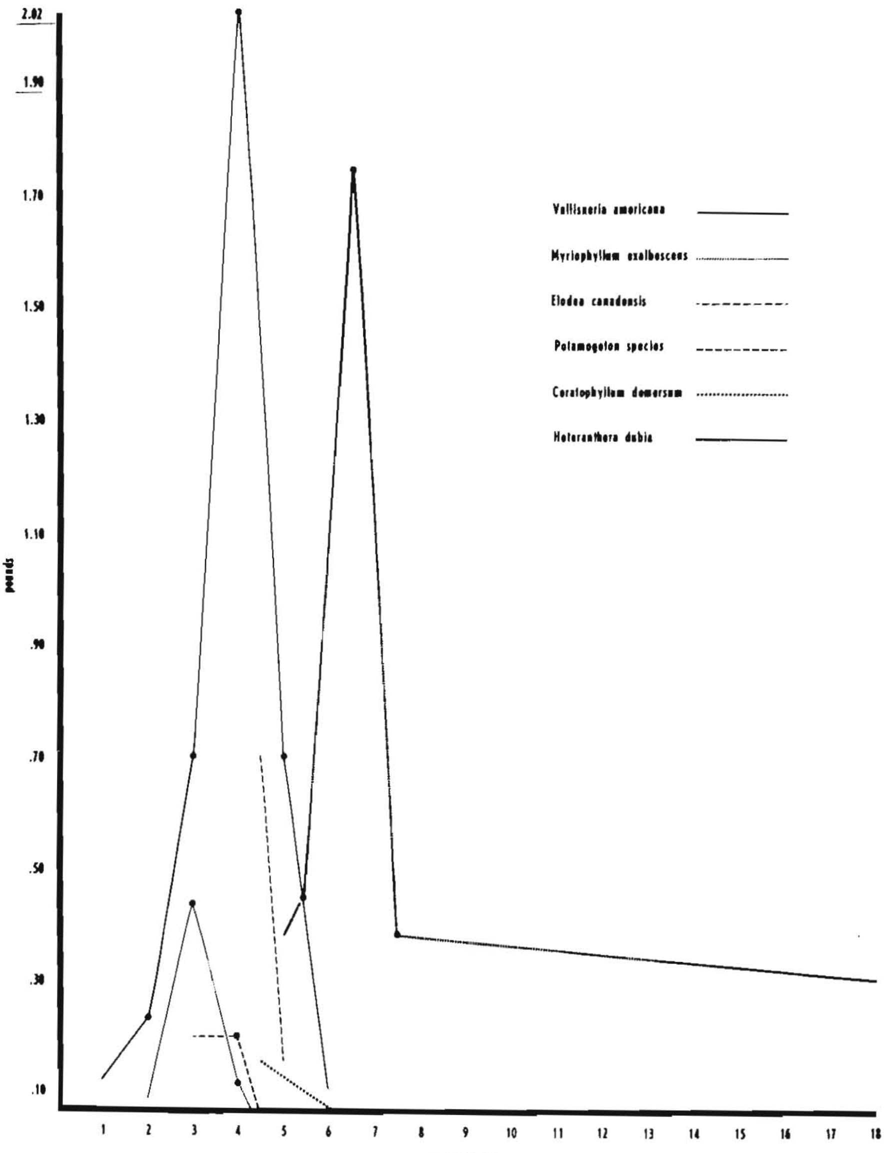


FIGURE 5. Weight of Principal Aquatic Angiosperms in 2.4 ft.² Quadrants at Depths from shore to 18 feet.

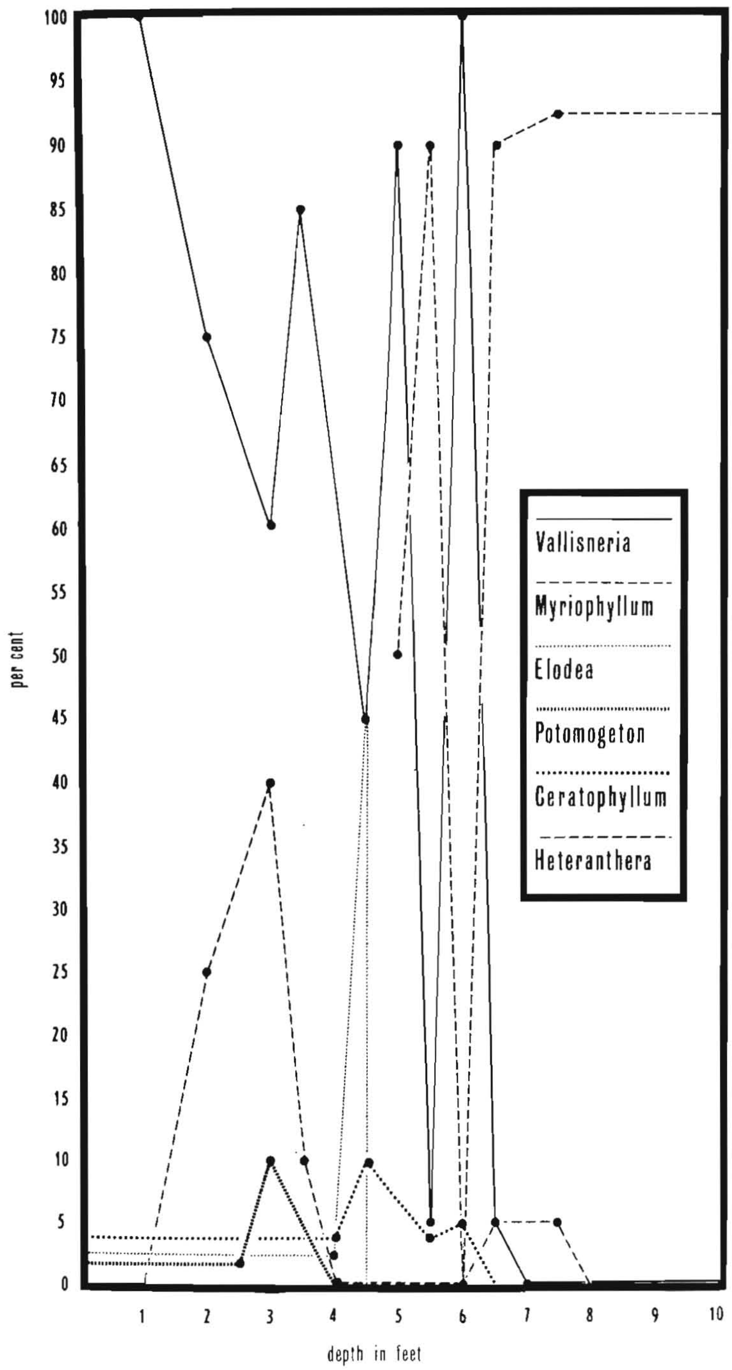


FIGURE 6. Percentage Composition of Principal Aquatic Angiosperms in 2.4 ft.[2] Quadrants at Depths from shore to 10 feet.

BIRGE, E. A. and CHAUNCEY JUDAY (1914) A Limnological Study of the Finger Lakes of New York. Bull. U.S. Bur. Fish, 32, 525–614.

(1921) Further Limnological Observations on the Finger Lakes of New York. Ibid. 37, 210–252.

FOREST, H. S. (1968) Cladophora as an Urban Problem. XIth International Great Lakes Research Conference. Milwaukee Wisc., April 1968.

GENESEE RIVER DRAINAGE BASIN SURVEY SERIES (1961) Report No. 2. Upper Genesee River Drainage Basin New York State Department of Health, Water Pollution Control Board, Albany.

GEOLOGIC MAP OF NEW YORK (1961, 1962) The State of New York Education Department. State Museum and Science Service Geological Survey, Map and Chart Series No. 5. Finger Lakes Sheet. Albany.

GILBERT, B. K. and J. C. KAMMERER (1965) Summary of Water-Resources Records at Principal Measurement Sites in the Genesee River Basin through 1963. United States Department of Interior Geological Survey in cooperation with State of New York Conservation Department, Water Resources Commission Bulletin 56.

HASLER, A. D. (1963) Ch. 2, Wisconsin 1940–1961. In, Frey, D. G. (editor) Limnology in North America, 55–93, Univ. of Wisc., Madison.

MUENSCHER, W. C. (1927) Ch. 5, Vegetation of Silver Lake and Conesus Lake. In, A Biological Survey of the Genesee River System.

Supplemental to the State of New York Conservation Department Sixteenth Annual Report (1926), 66–86, Albany.

PERRY, R. F. (1948) Conesus Lake, The New York State Conservationist (August–September).

SCHMIDT, W. D. (1965) Distribution of Aquatic Vegetation as Measured by Line Intercept with SCUBA, Ecology, 46, 816–823.

SOIL SURVEY, Livingston County, New York (1956) Series 1941, No. 15. United States Department of Agriculture Soil Conservation Service in cooperation with Cornell University Agriculture Experiment Station. Text and Maps.

STANDARD METHODS FOR THE EXAMINATION OF WATER AND WASTEWATER (1965) Prepared and published jointly by the American Public Health Association, the American Water Works Association, and the Water Pollution Control Federation. 12th Edition. New York.

SWINDALE, D. N. and J. T. CURTIS (1957) Phytosociology of the Large Submerged Plants in Wisconsin, Ecology, 38, 397–407.

WOOD, R. D. (1963) Adapting SCUBA to Aquatic Plant Ecology, Ecology, 44, 416–419.

7. The Ferns of Livingston County, New York

DAVID P. GOLDEN[1] and ELWOOD B. EHRLE[2]

ABSTRACT. The frequency and distribution of ferns in Livingston County, New York is described. Ferns were found at fifty of the seventy collecting stations visited. The ecological distribution and taxonomic disposition of the twenty-one species collected within the area are described and discussed.

INTRODUCTION

The distribution of ferns in Livingston County has not previously been investigated. Except for the lists prepared by Short and Dake (1942) for Letchworth State Park, there are no published records of ferns in the county. Botanically, the area has not been studied in depth until recently. The work of Ehrle and Coleman (1963, 1968), Coleman and Ehrle (1969), and Hachten and Ehrle (1969) as well as the present study indicate an increase in interest in the botany of the area. Since the above-cited papers provide a description of the Genesee Country in general and Livingston County in particular, that information will not be repeated here. The purpose of the present study was to examine Livingston County for its fern populations and to ascertain and comment upon the distribution, ecology, and taxonomic problems relating to the species involved.

METHODS

The field work for this study was undertaken during the summer of 1967. Collecting stations were chosen for the most part only after reference to topographic maps of the area. The most likely environments such as shaded ravines, large stands of deciduous woods, bogs, and swamps were selected. The amount of time spent at each stop was dependent on the topography, ecology, and the number of species of ferns present. More time was spent in the central and southern portions of the county due to the higher frequency of ferns in these areas. The higher slopes and greater number of ravines and gorges, along with larger stands of trees, were responsible for this higher frequency of ferns.

Two types of maps were kept as part of the data for this study. One type showed all locations where ferns were observed and/or collected. The second type indicated the distribution of the individual species within the county. Along with the maps, a daily log book recording all stops and the ecology of each was kept throughout the study. This log includes

1. 523 West Broad St. Horseheads, New York.

2. Associate Director, AIBS Office of Biological Education, Washington, D. C.

a list of all species found and indicates any stations where ferns were not found to be growing.

The collections of ferns made during this study are on file in the Herbarium of the Department of Biology at the State University College at Geneseo, New York. Duplicates, when available, were prepared for the Herbarium of the Rochester Academy of Science, presently housed by the Monroe County Parks Department in Rochester, New York.

Ferns are not uniformly distributed in the county. They are found with greater frequency in the southern portion of the county and, even here, occur more frequently in some habitats than in others. The list which follows indicates the most common types of habitats in Livingston County and the ferns found in them.

COMMON HABITAT TYPES AND FERNS ASSOCIATED WITH THEM

A. Deciduous woods.

1. Moist to wet open woods (e.g. Pokamoonshine Hollow, 1.5 mi. NW of Wayland, N. Y.). *Adiantum pedatum, Athyrium felix-femina, Botrychium virginianum, Cystopteris bulbifera, Dryopteris cristata, D. hexagonoptera, D. marginalis, D. spinulosa, Onoclea sensibilis, Polystichum acrostichoides, Pteretis pensylvanica.*
2. Dry open woods (e.g. Geneseo College Camp, 3 mi. NE of Spring-water, N. Y.). *Adiantum pedatum, Asplenium platyneuron, Dennstaedtia punctilobula, Dryopteris goldiana, D. marginalis, D. spinulosa, Polystichum acrostichoides, Pteridium aquilinum.*
3. Low wet woods (e.g. near Cement Plant Pond, 1.7 mi. ENE of Caledonia, N. Y.). *Athyrium felix-femina, Botrychium virginianum, Cystopteris bulbifera, Dryopteris cristata, D. spinulosa, D. thelypteris, Onoclea sensibilis, Osmunda cinnamomea.*

B. Ravines, gullies, and gorges.

1. Rock outcroppings and cliffs (e.g. Lower Falls at Letchworth State Park, 1.6 mi. NE of Portageville, N. Y.). *Cystopteris bulbifera, C. fragilis, Woodsia obtusa, Polypodium virginianum.*
2. Sunny gully slopes (e.g. steep gully off Rt. 63, 2 mi. S of Groveland Station, N. Y.). *Dennstaedtia punctilobula.*

C. On rocks, tree bases, stumps, or fallen logs (e.g. woods along Wildcat Gully, 1 mi. W of Union Corners, N. Y.). *Cystopteris fragilis, Polypodium virginianum, Woodsia obtusa.*

D. Water associated habitats.

1. Edges of bogs and swamps (e.g. bog 3.8 mi. W of Nunda, N. Y.). *Athyrium felix-femina, Dryopteris cristata, D. thelypteris, Onoclea sensibilis, Osmunda cinnamomea.*

2. Stream banks, drainage ditches, and alluvium (e.g. East bank of the Genesee River near deserted R.R. tracks, NW of Portageville, N. Y.). *Athyrium felix-femina, Cystopteris bulbifera, Dryopteris spinulosa, D. thelypteris, Onoclea sensibilis, Osmunda cinnamomea, O. claytoniana, Pteretis pensylvanica.*

3. Lake inlets (e.g. the southern tip of Conesus Lake, 7 mi. S of Lakeville, N. Y.). *Onoclea sensibilis.*

E. Roadsides.

1. Moist to wet shaded or open roadsides (e.g. near Geneseo College Camp, 3.5 mi. NE of Springwater, N.Y.). *Athyrium felix-femina, Onoclea sensibilis, Osmunda cinnamomea, O. claytoniana, Pteretis pensylvanica.*

2. Dry shaded roadsides (e.g. off Rt. 256, overlooking Conesus Lake, 6 mi. S of Lakeville, N.Y.). *Dennstaedtia punctilobula, Dryopteris marginalis, Pteridium aquilinum.*

CATALOGUE OF THE FERNS OF LIVINGSTON COUNTY, NEW YORK

The nomenclature used below is based on that of Fernald (1950). Each catalogue entry includes the scientific name and appropriate author citations, common name, frequency estimate, types of habitat, collection numbers of D. P. Golden, and any comments pertaining to that particular species. The frequency estimates are based on the number of locations at which a species was seen. As modified from the system of Thorne and Cooperrider (1960), the estimates have the following meanings: rare, species found at one stop: infrequent, two to four stops; frequent, five to seven stops; common, eight to ten stops; and, abundant, eleven or more stops.

OPHIOGLOSSACEAE (ADDER'S TONGUE FAMILY)

Botrychium virginianum (L.) Sw. Rattlesnake Fern. Frequent. Moist to wet deciduous woods, less often in dry woods. Usually present as widely scattered individuals. 27, 135, 136, 161, 166, 172.

OSMUNDACEAE (FLOWERING FERN FAMILY)

Osmunda cinnamomea L. Cinnamon Fern. Frequent. Swamp edges, low wet woods, and wet stream banks. 31, 34, 138, 146, 156.

Osmunda claytoniana L. Interrupted Fern. Infrequent. Moist rich deciduous woods and wet stream banks. 139.

POLYPODIACEAE (FERN FAMILY)

Adiantum pedatum L. Maidenhair Fern. Common. Dry rich deciduous woods, seldom in moist to wet woods. Often found in large numbers in continuous stands. 19, 66, 122, 140, 162.

Asplenium platyneuron (L.) Oakes. Ebony Spleenwort. Rare. Edges of open or rocky deciduous woods. 153, 154.

Athyrium felix-femina (L.) Roth. Lady Fern. Abundant. var. *sitchense* Rupr. Moist sunny roadsides, swamp edges, and deciduous wooded slopes. 9, 10, 49, 53, 61, 62, 63, 114. var. *michauxii* (Spreng.) Farw. Swamp edges and moist to wet deciduous woods. 5, 25, 26, 29, 30, 32, 35, 55, 58, 72, 73, 86, 115, 131, 144, 149, 165.

forma *rubellum* (Gilbert) Farw. Wet low peaty woods and swamp edges. 160.

Cystopteris bulbifera (L.) Bernh. Bulblet Fern. Abunduant. Wet to moist shaded ravines, slopes, creek banks, and cliffs. 6, 7, 39, 40, 41, 42, 45, 47, 70, 76, 77, 95, 96, 101, 102, 104, 107.

Cystopteris fragilis (L.) Bernh. Fragile Fern. Infrequent. On damp rocks, stumps, rotting logs, and tree bases in moist deciduous woods. 13, 85, 169, 171.

Dennstaedtia punctilobula (Michx.) Moore Hay-Scented Fern. Frequent. Habitats variable; usually moist to dry open deciduous woods. 20, 84, 110, 137, 147.

Dryopteris cristata (L.) Gray Crested Shield Fern. Infrequent. Wet deciduous woods and bog edges. 50.

var. *clintoniana* (D.C.Eat.) Underw. Rich peaty deciduous woods. 163.

Dryopteris goldiana (Hook.) Gray Goldie's Fern. Rare. Rich deciduous woods. 119.

Dryopteris hexagonoptera (Michx.) Christens. Broad Beech Fern. Rare. Moist rich roadside woods. 141.

Dryopteris marginalis (L.) Gray Marginal Shield Fern. Abundant. Habitats variable; present in dry to wet deciduous woods, on rocky slopes, and in shaded gullies. 14, 17, 18, 43, 44, 48, 52, 57, 78, 82, 88, 92, 93, 94, 97, 98, 103, 105, 109, 111, 112.

Dryopteris spinulosa (O.F. Muell.) Watt. Spinulose Shield Fern. Abundant. Low moist woods, bog and swamp margins, and wet shaded stream banks. 16, 21, 37, 60, 75, 80, 83, 90, 116, 120, 121, 124, 126, 133, 142, 148.

var. *fructuosa* (Gilbert) Trudell Wet to dry deciduous woods. 51, 54, 65, 74, 87, 91, 100, 118, 128.

var. *intermedia* (Muhl.) Underw. Dry to wet peaty deciduous woods. 64, 89.

Dryopteris thelypteris (L.) Gray Marsh Fern. Infrequent. Wet stream banks and low peaty woods and bogs. 8, 155, 158, 167, 168.

Onoclea sensibilis L. Sensitive Fern. Abundant. Bog, swamp, and stream edges, open wet roadsides, and wet deciduous woods. Often found in massive colonies. 1, 2, 3, 4, 67, 150.

Polypodium virginianum L. Rock Polypody. Infrequent. Crests of rock ledges and bases of trees on rocky slopes. 79, 81, 152.

Polystichum acrostichoides (Michx.) Schott. Christmas Fern. Abundant. Dry deciduous woods and rocky slopes. Occasionally in moist areas of otherwise dry deciduous woods. 12, 22, 28, 36, 68, 69, 123, 125, 175.

Pteretis pensylvanica (Willd.) Fern. Ostrich Fern. Abundant. Dry to wet deciduous woods, shaded drainage ditches, and river banks. A population of this species about 150 yards long and 100 feet wide, with individuals averaging six feet tall, exists along the east bank of the Genesee River in Letchworth State Park, near a deserted R.R. track, NW of Portageville, N. Y. Elsewhere, it is usually one to three feet tall. 11, 24, 38, 46, 108, 143, 151, 164.

Pteridium aquilinum (L.) Kuhn. Bracken Fern. Common. var. *latiusculum* (Desv.) Underw. Dry woods, rocky roadsides, and clearings. Rarely in moist deciduous woods. 23, 33, 117, 130, 174.

Woodsia obtusa (Spreng.) Torr. Blunt-Lobed Woodsia. Infrequent. Shaded rocky roadsides and dry open deciduous woods. 113, 132.

OBSERVATIONS AND CONCLUSIONS

Twenty-one species of ferns were collected in Livingston County. The dominant family was *Polypodiaceae*, which was represented by eighteen species. Besides those listed, *Camptosorus*, *Woodwardia*, and *Pellaea* probably exist in the area. Suitable habitats for their growth exist in the county and future collecting will probably locate them.

Ferns are almost totally absent from the northern section of Livingston County with the exception of the bog areas around Caledonia, New York. The land in the northern section has been almost entirely converted into agricultural land. An immediate inference would be that cultivation is responsible for the lack of ferns. While this may be true, a more complete analysis of the area reveals other factors. The northern portion of the county, even before cultivation, was a low, flat, outwash plain, without the high rugged hills, gorges, and ravines of the southern portion. Thus, the northern portion was better suited for conversion into farm land than the southern portion. Consequently, even before cultivation, the topography was such that in the southern section, the greater number of habitat types would have presented a greater variety of ferns.

The most involved taxonomic problems encountered in this study dealt with the genus *Dryopteris*. Historically there has been much confusion regarding the interpretation of some of the members of this genus. Perusal of a few manuals reveals several different definitions of the genus and a tangled synonymy as various species are moved from one interpretation to another.

Furthermore, infra-specific variability is apparently not yet well understood in this genus. During the present study, a fern was collected that resembled *D. marginalis*, but did not satisfactorily fit any of the listed varieties or forms of this species. The question arises as to whether the variation encountered is the result of hybridization, ecological adaptation, or some other form of as yet unanalyzed infra-specific variability.

Another species that presents confusion is *D. spinulosa*. Although there are few questions about the salient characteristics of the varieties of this species, the variety *intermedia* does present some problems. The authenticity of this as a distinct variety has been questioned. On the other hand, some feel that this fern should be given specific rank. More study is needed to clarify the situation.

The genus *Dryopteris* is apparently not well understood. A taxonomic revision is needed, based upon extensive studies of hybridization, variation within populations, and other biosystematic parameters.

BIBLIOGRAPHY

COLEMAN, B. B. & E. B. EHRLE. 1969. Studies on the Plants of the Genesee Country. 2. A Description of the Genesee Country. Proc. Roch. Acad. Sci. 12(1) 13–23.

EHRLE, E. B. & B. B. COLEMAN. 1963. The Bryoflora of the Genesee Country. 1. The Bryophytes of Wheelers Gully. The Bryologist 66(2) 61–66.

EHRLE, E. B. & B. B. COLEMAN. 1968. The Bryoflora of the Genesee Country. 4. The Bryophytes of Livingston County. The Bryologist 71(3) 275–281.

FERNALD, M. L. 1950. Gray's Manual of Botany, 8th edition. N. Y.: American Book Company.

HACHTEN, D. F. & E. B. EHRLE. 1969. Studies on the Plants of the Genesee Country. 3. The Genus Lycopodium in Livingston County. Proc. Roch. Acad. Sci. 12(1) 46–49.

SHORT, F. W. & W. E. DAKE. 1942. Native and Exotic Trees, Shrubs, Vines and Ferns Occurring in Letchworth State Park. Genesee Park Commission. Castile, New York.

THORN, R. F. & T. S. COOPERRIDER. 1960. The Flora of Giles County, Virginia. Castanea 25(1) 1:52.

8. Algae of Conesus Lake, Livingston County, New York: Initial Report[1]

P. G. SAVARD and D. N. BODINE[2]

ABSTRACT. This report is based chiefly on collections made during the summer of 1968, although, collections made during 1966–67 were also studied. The floral list consists of 66 genera and 101 species. A dense planktonic bloom and a profuse growth of Cladophora have been given special attention. The monthly distribution of plankton algae during 1967 is summarized.

I — Background

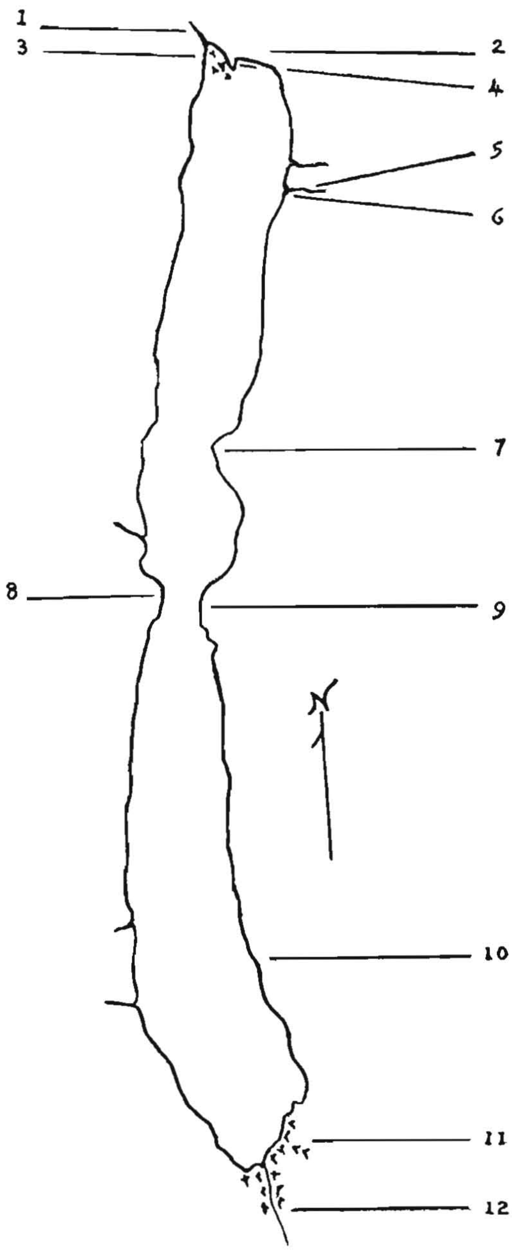
Conesus Lake, the most western of the Finger Lakes, is located in the central part of Livingston County. The lake surface is at an elevation of 817–818 feet, its depth is almost 70 feet and the surface area is approximately 5 mi^2. The lake lies partly in the Conesus quadrangle, but mostly in the Livonia quadrangle of the United States Geological Survey maps, 7.5 minute series, topographic. Further background material on Conesus Lake is to be found in Forest and Mills, elsewhere in this issue.

This was an initial study of the algae of Conesus Lake, including taxonomy, frequency, distribution, and phenology. This report is intended as the groundwork for future studies. Most attention is given to a qualitative description of the algal flora, with some quantitative treatments in certain areas, but these are limited.

Although it is impossible to make a thorough search of all the literature which might bear on this study, a valuable bibliography has been available to us in the Annotated Bibliography of Periodical Literature Dealing with Algae of New York State and Contiguous Waters by John M. Kingsbury. From this list of references we were able to ascertain that no concerted study of the algae of Conesus Lake has ever been attempted. The only botanical study which we were able to find that is directed specifically at the lake was that of W. C. Muenscher (1927), who was concerned chiefly with vascular aquatics of the lake. Of the algae, only *Chara* and *Nitella* were included. A search was made of the Wiegand Herbarium at Cornell University for the Characeae by E. L. Mills, and the following species were found: *C. coronata* A.Br., *C. foetida* A.Br., and *C. fragilis* Desv. *Nitella* has been found neither in the herbarium nor in current field studies.

1. The authors are indebted to Charles W. Reimer for the identification of many of the diatoms.

2. Department of Biology, State University College of Arts and Sciences, Geneseo, New York.



1. Outlet Stream
2. Lakeville
3. Marsh at Sand Point
4. Sand Point
5. Wilkin's Creek
6. 3324 East Lake Road
7. Orchard Point
8. Long Point
9. McPherson Point
10. Carl's Marina
11. Marsh at Inlet
12. Inlet Stream

Figure 1. Conesus Lake, Reference Points

The Kingsbury list contains references to several other studies of algae in the state. These, however, are not comprehensive. There are several studies which deal with a specific group of algae such as those of J. L. Blum (1951) on the Vaucheriaceae, Blum (1956) on Zygnemataceae, and Hylander (1923) on desmids. Other studies deal only with planktonic algae; P. R. Burkholder (1931) and Giebner (1951). A few studies deal with the ecology of algae; G. T. Hastings (1921) on succession and Birge and Juday (1914) in a limnological study of the finger lakes. All of these studies contain work done in New York State. None were state wide and most dealt with a specific lake or reservoir. Only Blum and Hylander did regional studies covering an area greater than that surrounding a single large body of water. None give a complete listing of algae in all classes. Schumacher (1969) did a regional study of the Susquehanna River Basin, but concentrated chiefly on the desmids. The only broad floral list is that of Day (1883), in a study of plants of the Buffalo area; it was of little direct use in the preparation of this paper, but in some cases it did serve as a reference to species which had been previously reported from western New York.

II - - Floral List

Following is a list of the algae which have been identified from the collections which were made in Conesus Lake. Dr. K. M. Stewart, State University of New York at Buffalo provided us with 24 collections of plankton made during 1967. G. Palesch and E. L. Mills made some collections in 1968 and assisted in the identification. The algae are listed in alphabetical order within their class. All collection data available is given for each alga. Collection dates are in 1968 unless specifically noted as 1967. The collections from which this list was drawn were made at random on the lake. In some cases, in areas of easy access, collections were made at frequent intervals. The surface collections were made from a boat, and collections under water were obtained with SCUBA gear. Most of the Stewart plankton samples were depth integrated. A few were taken at the surface or between 0–5 meters. A standard reference source for identification and description of each species is included.

CHLOROPHYTA

Ankistrodesmus falcatus (Corda) Ralfs (Prescott, 1950)
date: 6/30, loc.: 3324 E. Lake Rd., surface.

Apiocystis brauniana Naegeli (Prescott, 1950)
date: 8/7, loc.: marsh at inlet, surface.

Asterococcus limneticus G. M. Smith (Prescott, 1950)
date: 8/7, loc.: E. Lake 2nd cove from inlet, surface.

Chaetophora incrassata (Huds.) Hazen (Prescott, 1950)
date: 6/30, loc.: inlet stream, 3′, Alga was attached to rocks.

Chara braunii Gmelin (Prescott, 1950)
date: 7/22, loc.: Sand Point in lake, surface.
This is synonymous with Muenscher's *C. fragilis* Desv.

Chara vulgaris L. (Prescott, 1950)
date: 7/14, loc.: E. Lake ½ mi. N. of inlet, 4′.
This is synonymous with Muenscher's *C. foetida* A.Br.

Chlamydomonas globosa Snow (Prescott, 1950)
date: 8/8, loc.: inlet swamp, surface.

Cladophora glomerata (L.) Kuetz. (Prescott, 1950)
date: 7/12, loc.: 3324 E. Lake Rd., 6′, and commonly elsewhere. The species is discussed specifically below.

Closterium dianae Ehr. (Irenee-Marie, 1938)
date: 2/10/67

Closterium ehrenbergii Menegh. (Irenee-Marie, 1938)
date: 7/29, loc.: Marsh at Sand Point.

Closterium lanceolatum Kuetz. (Irenee-Marie, 1938)
date: 7/22, loc.: Marsh at Sand Point, 1′.

Closterium lunula (Muell.) Nitzsch. (Irenee-Marie, 1938)
class collection 1968.

Coleochaete pulvinata A.Br. (Prescott, 1950)
date: 7/19, loc.: 3324 E. Lake Rd., surface.

Coleochaete scutata Breb. (Prescott, 1950)
date: 7/19, loc.: 3324 E. Lake Rd., surface.

Cosmarium bipunctatum Börg. (Irenee-Marie, 1938)
class collection 1968.

Cosmarium margaritatum (Lund.) Roy-Biss. (Irenee-Marie, 1938)
date: 8/8, loc.: inlet, in lake, surface.

Cosmarium pseudopyramidatum Lund. (Irenee-Marie, 1938)
date: 8/8, loc.: inlet, in lake, surface.

Eudorina unicocca G. M. Smith (Prescott, 1950)
date: 6/15, loc.: inlet stream, surface, temp.: 20°C.

Gomontia holdenii Collins (Smith, 1950)
This alga was found on July 2, 1968 in a clam shell lying in ten feet of water. It was cultured by putting bits of clam shell in liquid mineral medium. The vegetative cells were about 21 microns in diameter and the akinetes were 19.25 microns long and

from 3.5 to 7.0 microns wide. In the akinetes, there were eight aplanospores, ovoid to spherical, with diameters ranging from 3.5 to 6.1 microns.

Gonium pectorale Muell. (Prescott, 1950)
See Table III.

Micractinium pusillum Fres. (Prescott, 1950)
class collection 1968.

Mougeotia sp. Ag. (Prescott, 1950)
date: 7/22, loc.: Sand Point, 4′, temp.: 26°C.

Oedogonium sp. Link (Prescott, 1950)
date: 7/17, loc.: E. Lake Rd. above Carl's Marina, 15–20′, temp.: 26°C.

Oocystis lacustris Chod. (Prescott, 1950)
date: 8/7, loc.: inlet, surface.

Palmella mucosa Kuetz. (Prescott, 1950)
date: 8/22, loc.: 3324 E. Lake Rd. growing in small gelatinous balls which covered some of the higher aquatic vegetation to total extent of several square yards.

Palmodictyon varium (Naeg.) Lemm. (Prescott, 1950)
date: 5/30, loc.: inlet, surface. Found attached to some floating vegetation.

Pandorina morum (Muell.) Bory (Prescott, 1950)
date: 7/8, loc.: 3324 E. Lake Rd. Part of bloom which covered an area of about 2000 square yards. See note below.

Pediastrum biradiatum Meyen (Prescott, 1950)
date: 9/30/67, loc.: inlet stream.

Pediastrum boryanum (Turp.) Menegh. (Prescott, 1950)
date: 5/30, loc.: Long Point, surface, temp.: 20°C.

Pediastrum duplex Meyen (Prescott, 1950)
date: 2/29, loc.: Marsh at Sand Point.

Pediastrum tetras (Ehr.) Ralfs. (Prescott, 1950)
date: 8/8, loc.: inlet, surface.

Rhizoclonium hieroglyphicum (Ag.) Kuetz. (Prescott, 1950)
date: 9/30/67, loc.: inlet swamp.

Scenedesmus arcuatus Lemm. (Prescott, 1950)
date: 8/7, loc.: inlet, surface.

Scenedesmus bijuga (Turp.) Lagerheim (Prescott, 1950)
date: 7/17, loc.: 1/2 mi. N. of Carl's Marina on E. side, 15–20′, temp.: 26°C.

Scenedesmus denticulatus Lagerheim (Prescott, 1950)
date: 8/8, loc.: inlet, surface.

Scenedesmus incrassatulus Bohlin (Prescott, 1950)
date: 8/8, loc.: inlet, surface.

Scenedesmus longus Meyen (Prescott, 1950)
date: 7/22, loc.: Marsh at Sand Point, 4′.

Scenedesmus obliquus (Turp.) Kuetz. (Prescott, 1950)
date: 7/7, loc.: Marsh at Sand Point.

Schizomeris leibleinii Kuetz. (Prescott, 1950)
date: 9/30/67, loc.: inlet stream.

Spirogyra ellipsospora Transeau (Prescott, 1950)
date: 7/16, loc.: E. Lake 1/2 mi. N. of inlet, 9′, temp.: 22°C.

Spirogyra maxima (Hass.) Wittrock (Prescott, 1950)
date: 7/14, loc.: E. Lake 1/2 mi. N. of inlet, 4–6′, temp.: 28°C.

Spirogyra protecta Wood (Prescott, 1950)
date: 7/22, loc.: Maple Beach Rd., 5′, temp.: 20°C.

Spirogyra varians (Hass.) Kuetz. (Prescott, 1950)
date: 7/9, loc.: Sand Point in lake, 4′, temp.: 26°C.

Staurastrum alternans Breb. (Irenee-Marie, 1938)
date: 7/22, loc.: Sand Point in lake, 6′.

Staurastrum paradoxum Meyen (Irenee-Marie, 1938)
date: 11/15/67, loc.: inlet, temp.: 11°C.

Stigeoclonium sp. Kuetz. (Prescott, 1950)
date: 9/30/67, loc.: inlet.

Tetraedron minimum (A.Br.) Hansgirg (Prescott, 1950)
date: 8/8, loc.: inlet, surface.

Volvox globator (L.) Ehr. (Prescott, 1950)
date: 8/2/67, loc.: inlet.

Zygnema sp. Ag. (Prescott, 1950)
date: 7/22, loc.: Sand Point in lake, 4′, temp.: 26°C.

CYANOPHYTA

Anabaena flos-aquae (Lyngb.) Breb. (Forest, 1954)
date: 7/2, loc.: in bloom over entire lake surface. See note below.

Anacystis cyanea (Kuetz.) Dr. & Daily (Drouet & Daily, 1956)
date: 7/13, loc.: E. Lake 1-1/2 mi. N. of inlet, surface.

Anacystis dimidiata (Kuetz.) Dr. & Daily (Drouet & Daily, 1956)
date: 7/29, loc.: Marsh at Sand Point.

Gleotrichia echinulata (J. E. Smith) Richter (Forest, 1954)
date: 7/12, loc.: 3324 E. Lake Rd., surface. During the course of the summer, this species spread all over the lake. Some of the larger balls key out as *Calothrix parietina* but these may be the same as the others.

Gomphosphaeria lacustris Chod. (Drouet & Daily, 1956)
date: 7/22, loc.: Sand Point in lake, 4′, temp.: 26°C.

Johannesbaptistia pellucida (Dick.) W. R. Taylor & Dr. (Drouet & Daily, 1956)
date: 7/22, loc.: Sand Point, 1′.

Microcoleus lyngbyaceus Kuetz. (Drouet, 1968)
date: 9/30/67, loc.: inlet stream.

Porphyrosiphon splendidus (Grev.) Dr. (Drouet, 1968)
date: 9/30/67, loc.: inlet at lake.

Schizothrix calcicola (Ag.) Gom. (Drouet, 1968)
date: 7/29, loc.: Sand Point marsh.

Schizothrix mexicana Gom. (Drouet, 1968)
date: 8/7, loc.: E. Lake 1/2 mi. N. of inlet, surface.

Stigonema ocellatum (Dillw.) Thur. (Forest, 1954)
date: 9/30/67, loc.: inlet at lake.

CHRYSOPHYTA

Chrysophyceae

Dinobryon cylindricum Imhof (Prescott, 1950)
date: 5/14/67.

Synura uvella Ehr. (Smith, 1950)
date: 8/67, loc.: inlet, surface.

Bacillariophyceae

Achnanthes clevei var. *rostrata* Hust. (Patrick & Reimer, 1966)
See Table III.

Achnanthes hustedtii (Krasske) Reim. (Patrick & Reimer, 1966)
Stewart plankton collection 1967.

Achnanthes lanceolata (Breb.) Grun. (Boyer, 1927)
date: 7/14, loc.: south end of lake, 4′.

Achnanthes minutissima Kuetz. (Patrick & Reimer, 1966)
See Table III.

Amphora coffaeiformis (Ag.) Kuetz. (Boyer, 1927)
date: 7/14, loc.: south end of lake, 4′.

Amphora ovalis Kuetz. (Boyer, 1927)
See Table III.

Asterionella formosa Hass. (Boyer, 1927)
See Table III.

Cocconeis pediculus Ehr. (Boyer, 1927)
Stewart plankton collection, 1967.

Cocconeis placentula Ehr. (Boyer, 1927)
Stewart plankton collection, 1967.

Coscinodiscus lacustris Grun. (Boyer, 1927)
date: 7/8, loc.: W. shore 100 yards from inlet, 6′, 22°C.

Cymbella sinuata Greg. (Boyer, 1927)
Stewart plankton collection, 1967.

Cymbella ventricosa Kuetz. (Boyer, 1927)
Stewart plankton collection, 1967.

Epithemia argus (Ehr.) Kuetz. (Boyer, 1927)
See Table III.

Fragilaria capucina Desm. (Boyer, 1927)
See Table III.

Fragilaria crotonensis Kitton. (Boyer, 1927)
See Table III.

Frustulia rhomboides (Ehr.) DeToni (Boyer, 1927)
date: 7/9, loc.: 1/2 mi. N. of Carl's Marina, 5′, 22°C.

Frustulia vulgaris (Thw.) DeToni (Boyer, 1927)
date: 7/9, loc.: 1/2 mi. N. of Carl's Marina, 5′.

Gomphonema olivaceum (Lyngb.) Kuetz. (Boyer, 1927)
See Table III.

Gyrosigma sp. Hass. (Boyer, 1927)
See Table III.

Hantzschia sp. Grun. (Boyer, 1927)
See Table III.

Melosira sp. Ag. (Boyer, 1927)
See Table III.

Melosira granulata (Ehr.) Ralfs (Boyer, 1927)
date: 9/30/67, loc.: N. end of lake.

Meridion circulare (Grev.) Ag. (Boyer, 1927)
See Table III.

Navicula sp. Bory (Boyer, 1927)
See Table III.

Navicula cryptocephala Kuetz. (Boyer, 1927)
See Table III.

Navicula pupula Kuetz. (Boyer, 1927)
date 7/17, loc.: 1 mi. N. of Carl's Marina, 5′.

Nitzschia sp. Hass. (Boyer, 1927)
See Table III.

Rhoicosphenia curvata (Kuetz.) Grun. (Boyer, 1927)
See Table III.

Stephanodiscus astraea (Ehr.) Grun. (Boyer, 1927)
See Table III.

Stephanodiscus sp. Ehr. (Boyer, 1927)
See Table III.

Synedra cyclopum Brutschy (Patrick & Reimer, 1966)
See Table III.

Synedra vaucheriae Kuetz. (Boyer, 1927)
See Table III.

Tabellaria fenestrata (Lyngb.) Kuetz. (Boyer, 1927)
See Table III.

EUGLENOPHYTA

Entosiphon sulcatum (Duj.) Stein (Forest, 1954)
date: 7/17, loc.: marsh at Sand Point.

Euglena antefossa Johns. (Forest, 1954)
date: 7/29, loc.: marsh at Sand Point.

Trachelomonas perforata (Aersw.) Defl. (Forest, 1954)
date: 8/8, loc.: inlet, surface.

PYRROPHYTA

Ceratium hirundinella O.Fr.M. (Forest, 1954)
date: 5/14/67, Stewart plankton collection.

Cystodinium bataviense Klebs (Forest, 1954)
date: 7/29, loc.: marsh at Sand Point, 4′.

Glenodinium sp. Stein (Forest, 1954)
date: 1/14/67, Stewart plankton collection.

III—Special Notes on Occurrence and Distribution

During the summer of 1968 we observed three blooms on the lake.

The bloom noted first, on June 16, consisted of *Pandorina morum*. It was located in an area surrounding the mouth of Wilkin's Creek in the northeast section of the lake. The bloom extended for about 100 yards north and south of the mouth of the creek and about 150 yards into the lake. It was observed to undergo a diurnal rhythm which brought it close to the surface during the daylight hours.

By July 10, a second bloom had replaced the first. This bloom consisted almost entirely of *Anabaena flos-aquae* with *Vorticella* sp. universally attached to its gelatinous matrix. The bloom was first observed at the same location as the *Pandorina*, but quickly spread over the entire surface of the lake and remained visible for almost one month, unchanged in species composition. The density of colonies varied from two or three per ml of water to solidly packed along the shore.

After one month the bloom became a mixture of the *Anabaena* and another blue green alga, *Gleotrichia echinulata*. At first the *Gleotrichia* was present only in small quantities, but gradually became dominant. The mixed bloom remained until mid October.

A collection of plankton making up the bloom was made on September 28, 1968, 100 yards offshore (west) of 3324 E. Lake Rd. This plankton contained both of the above mentioned algae and some *Palmella mucosa* which probably had become dislodged from the shallow bottom near shore. The sample was viewed under a microscope and the number of colonies of each alga was counted. Ten random fields were counted to obtain an indication of the relative colony numbers. The size of the colonies was measured. The results are given in Tables I and II. The number of colonies of *A. flos-aquae* and *G. echinulata* are almost equal. However, the colony size of *A. flos-aquae* is much smaller so that the mass of *G. echinulata* is greater.

Observations for identification and frequency of phyto-plankton were made using mounted millipore filters provided by Dr. K. M. Stewart. Since 200 ml. of water had been filtered, each mount of a half filter contained algae from 100 ml. Twenty-five typical fields were chosen, and the percentage of fields in which each organism occurred was calculated. The results are given in Table III. A higher percentage of fields indicates prominence of an alga in the flora. The method of collection and analysis of data do not provide information on absolute abundance either of individual species or the total flora. The distribution of species through the year is also indicated to some extent. Only two diatom species *Synedra cyclopum* and *Tabellaria fenestra* show a consistent presence throughout the year, although not in all samples, and a third *Asterionella formosa* was absent only in the middle of the year. In contrast,

Table I Number of Individual Colonies

FIELDS	Anabaena flos-aquae	Gleotrichia echinulata	Palmella mucosa
1	13	2	0
2	8	0	0
3	8	7	3
4	7	1	0
5	7	0	0
6	3	0	0
7	7	1	1
8	1	2	0
9	4	9	0
10	5	1	1

Table II Average Size of All Colonies Observed (microns)

FIELDS	Anabaena flos-aquae	Gleotrichia echinulata	Palmella mucosa
1	78.75	566.4	———
2	123.9	———	———
3	88.5 X 123.9	708.0 X 619.5	265.5 X 123.9
4	88.5 X 123.9	725.7 X 708.0	———
5	177.0 X 123.9	———	———
6	88.5 X 123.9	———	———
7	177.0	619.5 X 654.9	112.5 X 127.5
8	212.4 X 442.5	672.6 X 796.5	———
9	442.5 X 354.0	708.0 X 654.9	———
10	88.5 X 106.2	672.6 X 637.2	123.9 X 106.2

Anabaena flos-aquae appeared only in mid year and remained during the typical warm water season, and *Fragilaria crotonensis* was absent from the late fall and winter collections, except for three collections; in one it had a frequency of 32% of the fields, however. The highest frequency encountered was for *Stephanodiscus astraea:* 100% on November 11,

Table III Frequency by Percentage of 25 Selected Fields (.166mm²) of Filters (8670mm²) Containing Plankton From 100 ml. Lake Water

ORGANISM	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Achnanthes clevei	—	—	—	—	—	—	—	—	—	4	—	—	4	—	—	—	—	—	—	—	—	—	—	—
A. minutissima	—	—	—	—	—	—	4	—	—	—	—	—	4	—	4	—	—	—	—	—	—	—	—	—
Amphora ovalis	—	—	—	—	—	—	4	—	—	5	—	—	8	12	—	—	—	—	4	10	—	—	—	5
Anabaena flos-aquae	—	—	—	—	—	—	—	—	—	—	16	28	12	—	32	12	4	12	4	—	—	4	—	—
Asterionella formosa	4	64	52	76	—	20	8	8	12	—	—	—	—	12	—	—	12	5	4	—	—	8	16	15
Cocconeis sp.	—	4	—	—	—	—	—	—	—	—	4	—	44	4	4	4	—	20	8	15	—	4	—	—
Cosmarium sp.	—	—	—	—	—	—	—	—	—	5	—	—	12	4	8	—	—	—	4	—	—	4	4	5
Cymbella sp.	—	4	—	—	—	—	4	4	—	—	—	—	16	—	—	—	—	4	—	5	—	—	—	—
Epithemia argus	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	4	—
Fragilaria crotonensis	32	—	—	—	—	—	12	4	12	4	8	—	8	—	8	8	36	10	20	—	—	8	8	—
Fragilaria sp.	—	—	—	—	—	—	—	8	—	—	—	—	4	—	—	—	—	—	—	10	—	—	—	—
Gomphonema olivaceum	—	—	—	—	—	4	—	4	—	—	—	—	4	—	—	—	—	—	—	—	—	—	—	—
Gonium pectorale	—	—	12	—	—	—	—	—	—	—	—	—	—	—	—	4	—	—	—	—	—	—	—	—
Glenodinium sp.	36	—	—	—	—	—	—	—	—	—	—	—	—	—	4	8	—	—	—	—	—	—	—	—
Gyrosigma sp.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	4	—	—	—	—	—	—	—	—	—
Hantzschia sp.	—	—	—	—	—	—	—	4	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Melosira sp.	16	—	—	16	5	—	—	4	—	4	—	—	—	—	—	—	—	—	8	—	—	24	40	40
Meridion circulare	—	—	—	—	—	—	12	8	—	—	4	—	8	—	—	—	4	—	—	—	—	—	—	—
Navicula cryptocephala	4	4	—	—	—	5	8	—	—	—	—	—	4	—	—	—	—	4	—	—	—	4	12	5
Navicula sp.	—	4	—	—	—	—	4	—	—	—	—	—	—	—	—	—	4	—	4	—	—	—	4	—
Nitzschia sp.	—	4	—	—	—	—	8	—	—	—	4	—	—	—	—	4	—	—	4	—	—	—	4	—
Pediastrum sp.	—	—	—	—	—	—	—	—	—	—	—	4	4	—	—	—	—	—	—	—	—	—	—	—
Rhoicosphenia curvata	—	—	—	—	—	—	4	—	—	—	—	—	4	—	—	—	—	—	—	—	—	—	—	—
Staurastrum sp.	—	4	—	—	—	5	—	—	—	—	—	8	20	20	12	8	4	—	4	—	—	—	—	10
Stephanodiscus sp.	—	—	4	—	—	—	8	—	12	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
S. astraea	32	—	—	—	5	5	8	—	—	—	—	16	—	16	—	—	—	—	28	50	—	80	—	80
Synedra cyclopum	—	36	32	12	—	—	16	88	96	50	32	48	16	4	—	4	4	25	8	20	—	4	—	—
S. vaucheriae	—	—	—	—	—	—	—	—	—	—	—	—	—	—	4	—	—	—	—	—	—	—	—	—
Tabellaria fenestrata	20	52	36	72	95	35	32	24	36	35	—	4	—	36	40	36	—	—	4	25	—	4	12	10

1—Jan. 14, 1967; 2—2/3; 3—2/10; 4—2/17; 5—3/2; 6—3/24; 7—4/14; 8—5/5; 9—5/22; 10—6/8; 11—6/26; 12—7/3; 13—7/10; 14—7/25; 15—8/8; 16—8/22; 17—9/5; 18—9/19; 19—10/3; 20—10/6; 21—10/17; 22—10/28; 23—11/11; 24—11/14.

80% on October 28 and November 14. Its occurrence except in late fall and early winter was sporadic.

Cladophora glomerata (L.) Kuetz. warrants special attention because of its being a notable nuisance on the beaches at Lake Ontario, and it is frequently abundant in New York streams. We found the alga present in many different areas of the lake, though in differing quantities. It was almost always attached to rocks or other objects in the water. In the attached form it usually had a tuffed appearance. The entire plants were less than 18 inches in length, and branching was profuse, averaging one branching or more for three cell lengths. However, in the area around the mouth of Wilkin's Creek, Cladophora grew to great, thick mats which completely covered the bottom and eventually grew to the surface. This growth became apparent early in June and by the first of July it had almost completely covered the bottom. The growth continued and by September 30 it had reached a distance of 200 yards north and south of the stream mouth. It was then in water about five feet deep. A few Cladophora balls were collected at this time. The growth of Cladophora completely covered all rooted aquatics. By the beginning of October few other attached plants occupied the area. The filaments of Cladophora taken from this area were quite long (several feet) and sparsely branched. The cells were 308 microns long and 126 microns in diameter. This was the only section in the entire lake in which the growth of Cladophora was so spectacular, and its relationship to the high phosphate content of Wilkin's Creek is certainly suggested.

REFERENCES

BIRGE, E. A. and C. JUDAY (1914). A limnological study of the Finger Lakes. Bull. U.S. Bur. Fisheries 32:524–609.

BLUM, J. L. (1951). Notes on Vaucheria with particular reference to western New York. Bull. Torrey Bot. Club 78:441–448.

BLUM, J. L. (1956). Zygnemataceae of western New York. I. Papers of the Michigan Academy of Science, Art, and Letters 41:3–19.

BOYER, CHARLES S. *Synopsis of North American Diatomaceae* Vol. 78–79. Philadelphia: Academy of Natural Sciences, 1927.

BURKHOLDER, P. R. (1931). Studies of the phytoplankton of the Cayuga Lake Basin. New York. Bull. Buffalo Soc. Nat. Sci. 15:15–181.

DAY, D. F. (1882–83). The plants of Buffalo and vicinity. Bull. Buffalo Soc. Nat. Sci. 4:(3)65–152; (4)153–290.

DROUET, FRANCIS. *Revision of the Classification of the Oscillatoriaceae.* Philadelphia: Academy of Natural Sciences, 1968.

DROUET, FRANCIS, and WILLIAM A. DAILY. *Revision of the Coccoid Myxophyceae.* Indianapolis: Dept. of Botany, Butler University, 1956.

FOREST, HERMAN S. *Handbook of Algae.* Knoxville: The University of Tennessee Press, 1954.

GIEBNER, B. M. (1951). The plankton algae of the southeast end of Chautauqua Lake. Proc. Rochester Acad. Sci. 9:409–420.

HASTINGS, G. T. (1921). Succession of algae in the Grassy Sprain Reservoir. J. N.Y. Bot. Gard. 22:64–66.

HYLANDER, C. J. (1923). Notes on the desmids of New York. Torreya 23:59–62.

IRENEE-MARIE, FRERE. *Flore Desmidiale de la Region de Montreal.* LaPraire, 1938.

KINGSBURY, J. M. (1967). Annotated bibliography of periodical literature dealing with algae of New York State and contiguous waters. New York State Dept. of Health.

MUENSCHER, W. C. (1927). Vegetation of Silver Lake and Conesus Lake. Suppl. to Ann. Rept. N.Y.S. Conservation Dept. 16 (1926): 66–71.

PATRICK, RUTH and CHARLES W. REIMER. *The Diatoms of the United States Exclusive of Alaska and Hawaii* Vol. 1. Philadelphia: Academy of Natural Sciences, 1966.

PRESCOTT, G. W. *Algae of the Western Great Lakes Area.* Bloomfield Hills: Cranbrook Press, 1950.

SCHUMACHER, G. J. (1969). *Algae of the Susquehanna River Basin.* Bull. N.Y.S. Mus. 412.

SMITH, GILBERT M. *The Fresh Water Algae of the United States.* New York: McGraw-Hill Book Co., 1950.

9. Some Aspects of the Ecology of Orleans County, New York

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A study of bryophytes in Orleans County, New York was undertaken in 1960 as part of a projected bryoflora of the Genesee Country. Investigations and exploration of sites deemed suitable for the collection of bryophytes yielded abundant material for the laboratory study of the bryophytes, for lists of vascular plants, and for ecological information pertaining to the sites. Members of the Botany Section of the Rochester Academy of Science on a field trip to several of the sites in August, 1960, added to the above information. Resulting from the data obtained are: distribution tables of the mosses and liverworts, a distribution table of the vascular plants observed, a geologic profile of the county, a map and brief descriptions of the collecting sites. Of local interest is the analysis of the Orleans County flora and some of the factors influencing its present distribution. This information was not included in the original publication dealing with the bryophytes. (Lyman and Coleman, 1966)

Visible geologic history of Orleans County extends from beginnings in the Ordovician upward into the Silurian. The Queenston formation, upper limit of the Ordovician, continues under Lake Ontario as heavy sheets of compact red sandstone, topped by friable red shales. The latter are found along the beaches of the lake and may also be seen in profile on the banks of Marsh Creek east of its junction with Oak Orchard Creek as well as along the banks of Oak Orchard Creek in its descent to the lake at Point Breeze. Red Medina sandstone, the base of the Silurian, underlies most of the central part of the county. (It is quarried presently and has been used extensively in building and paving). The Medina is capped with a thin layer of bleached sandstone of similar composition. Above it is the Clinton formation composed of variable limestones and shales through which runs a narrow layer of Furnaceville hematite. Upward the Rochester shales follow the Clinton formation. These friable gray shales may be seen at the top of the Oak Orchard Creek gorge in the village of Shelby. The escarpment of Lockport dolomite at Clarendon faces east and in the village which grew up around Farwell's mills, built in 1811, and 1813, a small waterfall flows over the escarpment. Erosion has produced cavities in the dolomite outcrops in which bryophytes and other plants grow. There is some indication from soil borings made by Mr. Troy Yoakum (soil scientist with the U. S. D. A. Soil Survey Team in Orleans County for several years), that there are thin

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deposits of Salina shales in the southern towns of Orleans County, but there are no visible outcrops reported.* The bedrock substrates of the county are sedimentary and calcareous and may influence to a degree the soils and flora which exist above them.

Table 1. Geological Profile of Orleans County, New York

Location	*Geologic Era*	*Formation*	*Description*
USDA soil borings		SALINA SHALES *(Vernon & Camillus shales)	Salt shales
Clarendon Escarpment and Outcrops		LOCKPORT DOLOMITE	Sugary textured gray dolomite
Oak Orchard Creek Gorge at Shelby		ROCHESTER SHALE	Friable gray calcareous shales
Oak Orchard Creek Gorge at Shelby		CLINTON	Variable limestones and shales through which run a negligible layer of Furnaceville hematite
Quarries along Erie Canal	SILURIAN	MEDINA CAP	Bleached gray sandstone of similar composition.
		MEDINA	Lighter red and coarser calcareous sandstones
Lake Ontario and banks	ORDOVICIAN	QUEENSTON	Heavy sheets of compact calcareous red sandstone and shales

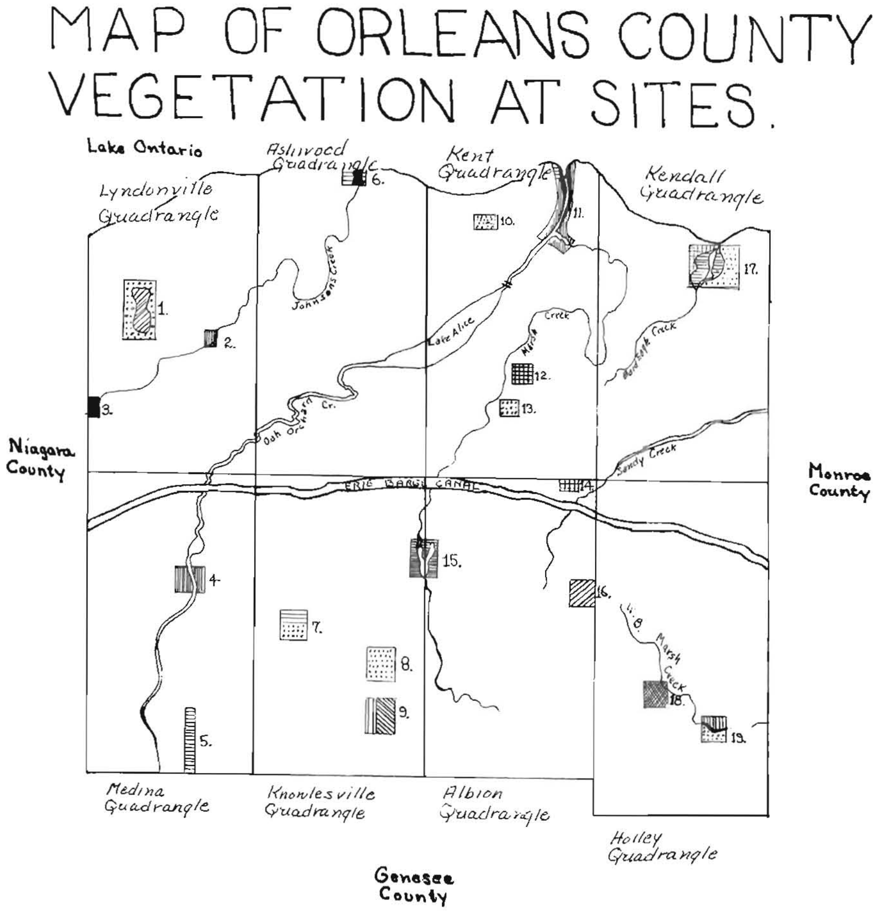
Adapted from Fairchild (1925)

* (Bradford Higgins, U.S.D.A. Soil Conservation Service. 20 South Main Street, Albion, New York)

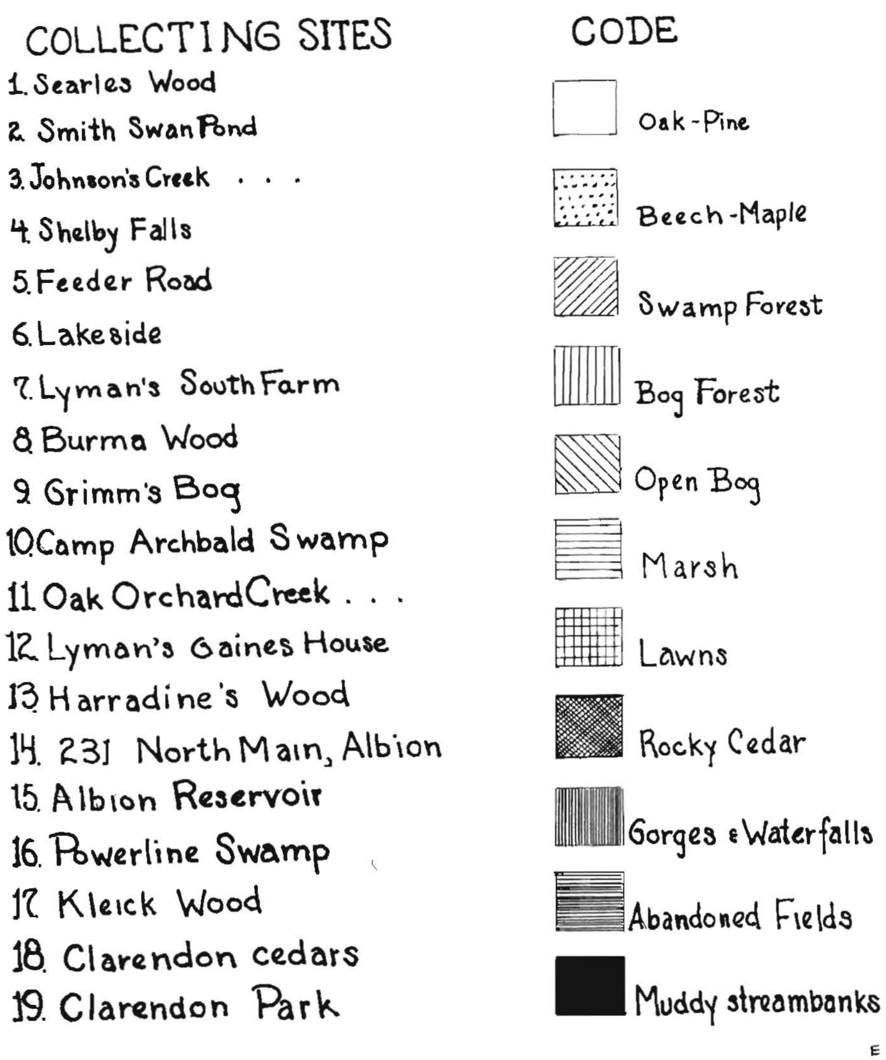
Orleans County displays evidence of intensive glaciation with two extensive eskers (Giles, 1918) and a number of long northeast-southwest gravel undulations indicative of the terminal stages of drumlinization

* Results of the Soil Survey will be available eventually as a report with map. Until the survey is complete, information about Orleans County soils is obtainable in the U.S.D.A. Soil Conservation Office at South Main Street, Albion, New York.

(Fairchild, 1927), but few true drumlins exist as in the counties to the east and south (Alteri and Coleman, 1965). The Pine Hill area in the



Town of Barre contains high gravel hills and two late stage bogs and thus resembles the kame and kettle topography of the Mendon Ponds Park area in Monroe County. In the southern portion of the county, swamps and muck farmlands, extending into Genesee County, are said



to be the bed of old glacial Lake Tonawanda. North of the swamps the county rises gradually to the Ridge Road which is some 20 to 40 feet higher than the flat, sandy plain lying to the north and reaching the shores of Lake Ontario.

Most of the land in the county has been under cultivation for more than fifty years with the result that few undisturbed areas remain. Farm woodlots have been extensively lumbered. The swamp woods of the Powerline Road was divided into small parcels in the last century to provide firewood for the residents of the village of Albion. Similar use was made of other swamps. Sand and gravel ridges are still leveled to provide road building materials. One of the two existing bogs has been stripped of its living vegetation to remove deep layers of peat for commercial purposes. However, since the advent of the Federal Soil Bank* in 1956 and the resulting decline in local agriculture, there is now an abundance of abandoned fields returning to second growth.

An additional factor which may influence the flora in Orleans County may be the relatively dry climate. Of the ten counties of the Genesee Country (Ehrle and Coleman, 1963), Orleans County has the least annual precipitation: average 26.59 inches. Livingston County shows the maximum precipitation: average 37.71 inches (Yearbook of Agriculture, 1941).

ECOLOGICAL NOTES FOR SPECIFIC COLLECTING AREAS

Nineteen areas in the county were selected for the collection of bryophytes. For the most part, site names given are those of the authors, and not necessarily those in common usage in the areas mentioned. Each of the eight quadrangles of the Geological Survey of Orleans County has not less than one and not more than four sites where bryophytes were examined and collected. (See map, Figure 1).

Brief notes on the ecology of the various sites as reported in field notes follow:

1. Searles Wood (Lyndonville Quadrangle) between West County Line Road and the Murdock Road, north of Mill Road and south of the

* The Federal Soil Bank in 1956 took cultivated land out of active production for a ten year period with a requirement for annual mowing to preserve usable land for future cultivation. The program, however, resulted in a decline in local agriculture and since 1966, when such contracts with the Federal Government began to expire, the annual mowing was discontinued. Thus, many farms returned to second growth and successional stages toward a natural climax forest were initiated. From the Census of Agriculture for Orleans County 1959 and 1964 the following data show the trend:

Land Use	1950	1954	1959	1964
Land in acres	253,440			
Acres in farms	201,125	188,438	175,732	165,631

New York Central Railroad is a large farm woodlot, centrally a swamp woods around which beech-maple woodland has developed. Along the eastern border in a lumbered section, conifers, which have currently attained a height of forty feet, have been planted. Here there are signs of browsing by deer as well as other evidences of disturbance such as the dense growth of poison ivy (*Rhus radicans*). Areas of bryophyte collection include the borders of the lane from the farmhouse into the woods and 40 feet on either side of a trail passing from beech-maple woodland through the swamp from east to west. Here *Sphagnum* moss hummocks grow around roots of swamp red maple (*Acer rubrum*).

2. Smith Swan Pond (Lyndonville Quadrangle). Two specimens only of moss were collected from crevices in the cement overflow through which pond drainage enters Johnson Creek. The area, a private park with various plantings from worldwide collections of the owners, is maintained in a naturalized condition. The borders of the pond by the dam and roadside are much trampled by people who come to feed the swans and goldfish in the pond.

3. Johnson's Creek at West County Line Road (Lyndonville Quadrangle). Collections of bryophytes were made from the weedy, disturbed, muddy banks of the creek, on the mud flats under the bridge over the county road and from fallen trees holding debris from spring floods and extending over the stream. The tree layer includes red (*Quercus rubra*) and white (*Quercus alba*) oak, basswood (*Tilia americana*), sugar maple (*Acer saccharum*) ; the understory, shadbush, flowering dogwood (*Cornus florida*) and arrowwood (*Viburnum dentatum*); the herb layer, false solomon's seal (*Smilacina racemosa*), asters (*Aster* spp.), and goldenrods (*Solidago* spp.)

4. Shelby Falls, where Blair Road crosses Oak Orchard Creek in the Village of Shelby, in the Oak Orchard Gorge (Medina Quadrangle). The area around the falls, the streambed above and below, the cap and other rock of the falls, and the walls of the gorge below were extensively collected. Touch-me-not (*Impatiens* spp.), red osier dogwood (*Cornus stolonifera*), and various mints (*Mentha* spp.) were among the vascular plants in the rock crevices along the bank above the falls. Silver maple (*Acer saccharinum*) and willows (*Salix* spp.) overhang the falls. Notable mosses found include the following: *Fissidens minutulus* growing as a green film on the damp vertical faces of rocks in the spray; on the muddy embankment *Pohlia wahlenbergii* attained a height of from 8 to 10 centimeters; in a shallow shale cavern under the caprock, *Gymnostomum calcareum*, a minute moss, grew, encrusted with lime; *Brachythecium rivulare* dominated other collections which were made because of the seeming differences in the observed specimens. The variability of this moss

proved to be astonishing but in only one collection was the dencroid form (Welch, 1958) noted.

5. Feeder Road (Medina Quadrangle) was a four-wheel-drive dirt road through the Oak Orchard Swamp (Iroquois Game Refuge). It parallels the Feeder Canal that drains into Oak Orchard Creek south of Shelby. The adjacent meadows are covered by an interwoven and matted growth of several species of marsh grasses on which the moss *Leptodictyum* grows. The grasses are interspersed with meadowsweet (*Spiraea latifolia*). In the ditch bordering the marsh, willow bases support two species of the moss *Anomodon. Fontinalis dalicarlica,* an aquatic moss, is found in the Feeder Canal attached to the submerged roots of trees. Canada anemone (*Anemone canadensis*) and the pinkish flowered Penstemon (*Penstemon digitalis*) occupy roadside ditches with grasses and rushes. Management of the game refuge has altered this area.

6. Lakeside, the outlet of Johnson's Creek into Lake Ontario (Ashwood Quadrangle). This area has been much disturbed by the activities of cottagers, fishermen, and boaters, because the creek flows through the center of the summer community of Lakeside. There are willows along the banks, but the general vegetation, excepting the bryophytes, did not seem to warrant close inspection.

7. Lyman's South Farm, now owned by the Wilkins Family (Knowlesville Quadrangle) on the west side of Wilkins Road between West Lee Road and Park Road is a carefully farmed forty acres adjoining a lumbered-over beech-maple farm woodlot. The latter is old and heavily shaded, sustaining little understory vegetation save at the borders where poison ivy and red osiers spill over into the edge of the cultivated area. The groundcover within the woods produces *Trillium* spp., violets (*Viola* spp.) and *Dentaria* spp. in the spring along with wild leek (*Allium tricoccum*), *Carex* spp. and beechdrops (*Epifagus virginiana*). Here the tree moss *Climacium kindbergii* grows in round clumps in muddy depressions.

8. Burma Wood (Knowlesville Quadrangle), west of the Bennett Gravel pit on the West Barre Road and south of Maple Street is slowly being destroyed as bulldozers and trucks carry away its foundation. The dominant beech-maple woodland lies mainly on the high, irregular gravel ridges of the Barre Terminal Moraine with deep swampy kettles in which most trees appear to be swamp red maple. The area remains relatively undisturbed in those portions which are not used for production of gravel. The woodland is dense, with little understory vegetation, but the forest floor abounds with several species of spring violets, trilliums, blue cohosh and some bryophytes.

9. Grimm's Bog (Knowlesville Quadrangle), approximately one-half mile south of Burma Wood, is a late stage bog which has been destroyed in all but the westernmost end by the Buffalo Topsoil Company for the production of commercial peat. The bog has been stripped of its upper layers of vegetation exposing the peat which is then removed, drained and carted away. The stripped portion supports a dense cover of such bryophytes as *Polytrichum commune, P. juniperinum, Pohlia wahlenbergii* on the margin and within, a continuous carpet of gemmiferous *Tetraphis pellucida*, a moss usually found on acidic decaying wood. The peat here shows a pH reading of 4, certainly a factor which may account for the prolific growth of acid-loving mosses. Near the less disturbed western borders of the bog a large station of Virginia chain fern (*Woodwardia virginica*) occurs beyond which are high bush blueberry (*Vaccinium corymbosum*) and the large cranberry (*Vaccinium macrocarpon*). This late stage bog grades into bog forest, dominated by yellow birch (*Betula lutea*) and white pine (*Pinus strobus*). Here the cover is dense.

10. Camp Archbald Swamp (Kent Quadrangle) is a swamp woodland south of Route 18, just west of Archbald Road. Near the edge of the road on fallen logs and hummocks, broom moss (*Dicranum scoparium*), fern moss (*Thuidium delicatulum*), and the dendroid *Climacium americanum* grow among such spring flowers as Canada mayflower (*Maianthemum canadense*) and blue cohosh (*Caulophyllum thalictroides*). The woodland slopes upward to the south, and the vegetation gradually becomes characteristic beech-maple with a few red oaks at the crest of the rise. Several mosses of the genus *Plagiothecium* dominate drier spots.

11. Oak Orchard and Marsh Creek banks (Kent Quadrangle) are the red, Queenston shale walls of the gorges of these two creeks which meet at the hamlet known as The Bridges. The combined waters wend their way to the outlet of Oak Orchard Creek at Point Breeze. The creek walls are notable for their dryness and lack of vegetation. Occasionally a gnarled and durable hemlock grows from the shale which supports no bryophytes. Mosses appear to occur only in muddy patches at the top of the banks or on collected debris. On the rim of Oak Orchard Creek gorge white pine and red oaks of considerable age grow with some scattered hemlock (*Tsuga canadensis*).

Lower slopes of the banks of Marsh Creek have some maple and elm. (The latter trees have since fallen victim to the Dutch elm disease which between 1963 and 1969 claimed nearly all of the elms of Orleans County). Mudflats along Marsh Creek support a luxuriant growth of cattails (*Typha angustifolia*), and some blue vervain (*Verbena hastata*), wild cucumber (*Echinocystis lobata*), cardinal flower (*Lobelia cardinalis*), and the liverwort *Ricciocarpus natans.* Numbered among the varied and numerous "aquatics" in Marsh Creek are five species of *Potomogeton,* a bladderwort (*Utriuclaria*), pond lilies, and arrowhead (*Sagittaria*). Marsh Creek was relatively undisturbed and frequented, at the time of the bryophyte collections, chiefly by fishermen in rowboats and "birders" in canoes. However, since 1960, cottages have sprung up along its banks and motors are replacing muscle power in boats. At the present writing the number of plant species appears to be diminishing (personal observation), and animals and birds are less numerous than they were formerly, perhaps because of increasing pollution from the cottages.

The condition of mounting pollution early existed in Oak Orchard Creek where boat traffic has been frequent due to its navigability south to the dam at Lake Alice (Waterport Pond). Here the numerous cottages which have stood on the east rim of the creek since the 1920's are also doubtless responsible.

12. Lyman's, Gaines House (now owned by Barnett Ogden), (Kent Quadrangle) on Route 279, northwest of Five Corners produced a single specimen of the moss *Bryum argenteum* at the edge of the cinder drive in full sunlight. South of the lawn, however, was an unmowed field in which the early double daffodils had spread, and during the summer such roadside weeds as oxeye daisies (*Chrysanthemum leucanthemum,* var. *pinnatifidum*), blue vetch (*Vicia* spp.), wild geranium, (*Geranium maculatum*), sulfur cinquefoil (*Potentilla recta* L.), goldenrods (*Solidago* spp.), purple asters (*Aster* spp.), and wild morning glory (*Convolvulus arvensis*) abounded. In a marshy corner of the field grew the grape fern (*Botrychium multifidum*) and the common scouring rush (*Equisetum arvense*). The field has since become an extension of the lawn.

13. Harradine's Wood (Kent Quadrangle) is reached by travelling a quarter mile up the lane south of the former Gaines Town Dump on the Bacon Road, west of Five Corners. This dry beech-maple woodland was filled with such wild flowers as *Hepatica acutiloba* (blue, pink, and a variation of the pink with green and pink-striped sepals), white and red trillium (*Trillium grandiflorum* and *T. erectum*), blue cohosh, lion's paw (*Prenanthes serpentaria*), beechdrops (*Epifagus virginianum*), Indian pipe (*Monotropa uniflora*), enchanter's nightshade (*Circea quadriculata*), and doll's eyes (*Actaea alba*). The tree layer consisted of a few remaining sugar maples (*Acer saccharum*), the aforementioned beech (*Fagus grandifolia*), basswood (*Tilia americana*) at the borders of the wood, and ironwood (*Carpinus caroliana*). Increased sunlight as a result of the lumbering of larger trees in 1962 has encouraged weedy undergrowth, discouraged spring wild flowers and altered stations for bryophytes.

14. At 231 North Main Street, Albion (Albion Quadrangle) there is a lawn. In 1960 the lawn was heavily shaded with elms. At the time of bryophyte collection, the dense shade permitted only sparse growth of grasses among which the mosses *Mnium rostratum* and *Amblystegium varium* were found. The latter moss also grew in the fibers of an old cocomat at the cellar door. *Bryum argenteum* occurred at the borders of the cinder driveway and *Ceratadon purpureus* grew on the wooden shingles of the garage roof, now replaced by asphalt roofing. To the rear of the garage in a neglected and infrequently mowed area, there was an abundance of herb robert (*Geranium robertianum*) and Star-of-Bethlehem (*Ornithogalum umbellatum*), a garden escape. Here, too, mats of sweet woodruff (*Asperula odorata*) tangled with poison ivy among the canes in the bed of black cap raspberry (*Rubus occidentalis*). Since 1960 all the elms have died from Dutch elm disease and been removed. The mosses and other wild plants have been obliterated or discouraged by increased sunlight, fertilizing, mowing, and foot traffic.

15. Albion Reservoir (Knowlesville Quadrangle) South of Route 31 on the east side of the Eagle Harbor, West Barre Road is the former water reservoir for the village of Albion and is surrounded by farmland. It was a ravine of Marsh Creek dammed in 1914 to supply water for the nearby village. The north, east and south margins were planted to white pines by the Albion Boy Scouts in 1934. The pond was dredged deeper and a cement face added to the dam in 1947. A peninsula to the south shows remnants of some native vegetation with spring wild flowers and ground pine (*Lycopodium clavatum*) under an old white pine and other trees. At the foot of the dam on pads of soil between the rocks grow turtlehead (*Chelone glabra*), white and purple Eupatorium (*E. perfoliatum* and *E. maculatum*), and purple asters. In spring the marshy borders of the stream below the dam show a few marsh marigolds (*Caltha palustris*) and blue flag (*Iris versicolor*). Mosses collected on the rocks in the stream belong chiefly to the genus *Leptodictyum*. *Gymnostomum calcareum* occurs sparsely in cracks in the masonry of the supporting structure of the dam.

16. Powerline Road Swamp (Albion Quadrangle), located on either side (east and west) of Powerline Road, east of Lee Road, was, and still is, relatively undisturbed since the advent of oil, gas and electricity for heating and cooking. Prior to 1920 it was lumbered in spotty fashion as a source of firewood by Albion residents who might own an acre or two, during winters when "the ice was on." The red-maple coppice is now grown up to fair-sized clumps of trees which appear to have sprouted from the old stumps, interspersed with a few remaining white pines and hemlocks. The American yew (*Taxus canadensis*) surrounds cut-over

stumps. Mossy hummocks diplay such spring flowering plants as gold thread (*Coptis groenlandica*), Canada mayflower, and foam flower (*Tiarella cordifolia*). Here and there is a wild azalea or pinxter flower (*Rhododendron nudiflorum*). Royal fern (*Osmunda spectabilis*) and cinnamon fern (*Osmunda cinnamomea*) grow in ephemeral swamp pools and on hummocks near the road, and the tall, delicate horsetail *Equisetum fluviatile* flourishes in the temporary pools by the roadside. Poison sumac (*Rhus vernix*), which once grew at the edge of the swamp, was eliminated when the road was widened after 1960. There is a marsh at the southwest border of the swamp supporting sedges, cattails, and the marsh meadowsweet. At the edge of the road are more cattails, buttonball bush (*Cephalanthus occidentalis*), sweet flag (*Acorus calamus*), and water parsnip (*Sium suave*) growing in the sunny ditch. Where the area rises to a rocky slope on the east side of the swamp, there are northern white cedars (*Thuja occidentalis*).

17. Kleick Wood (Kendall Quadrangle) is set well back from the Norway Road near the shore of Lake Ontario and occupies an area of broad ridges, dominated by sugar maple and beech, with low areas between the rises, where swamp red maple grows. Here fallen logs abound with several species each of the mosses *Amblystegium, Brachythecium, Dicranum, Eurhynchium, Hypnum, Plagiothecium*, and others. To the west the area descends to a broad marsh, the silted-over outlet of Bald Eagle Creek, in which buttonball bush abounds.

18. Clarendon Cedars (Holley Quadrangle) was, no doubt, a damp pasture at one time, but the farms along the Upper Holley Road, south of Lee Street, are largely abandoned now. This area is growing up to white cedar between outcrops of eroded Lockport Dolomite. Occasional cavities in the dolomite (known locally as cave rock, Niagara limestone, or Clarendon rock) may support calciphilous mosses requiring little moisture. Two species of *Grimmia* are found in such rock pockets where debris has collected. On the surface, now overgrown with grasses, in a relatively unshaded area, tree moss (*Climacium americanum*) which usually grows in heavily shaded swampy woods, occurs. Several small mosses also grow on the bark of hemlock in a cluster of the cedars, among them *Pohlia proligera*. (No observations of additional vascular plants were made in this area.)

19. Clarendon Park (Holley Quadrangle) was set aside at the site of Farwell's mill* as a small community park within the hamlet of Clarendon on Route 237 south of Lee Street. The mill, in the southwest corner of the park, has long since become a ruin. Remnants of the

* Farwell's Mills, Clarendon, New York. In 1811 a sawmill was built, and in 1813 the gristmill was added. (New York State historical marker.)

masonry and mortar support bryophyte growth. The park is partially circled to the south and west by the Clarendon portion of the Niagara escarpment of Lockport dolomite. A small tributary of the East Branch of Sandy Creek falls over the escarpment north of the mill site and winds off to the south and east. Where rock rubble of the escarpment forms a more gradual slope from the south, a dense growth of sugar maple occurs between the fossiliferous boulders. Deep shade and considerable foot traffic appear to have discouraged ground cover although some bryophytes are found. There are two species of Fissidens on damp soil, *Mnium cuspidatum* on rock and soil alike, and three species of *Amblystegium* (*A. serpens*, *A. varium*, and *A. juratzkanum*) on rock, soil, and masonry. Crumbling mortar from burned limestone supports "lush" *Funaria hygrometrica*. Round patches of *Orthotrichum strangulatum* grow on drier boulders between the mill and the falls. *Brachythecium rivulare* and *Leptodictyum* species occur on rocks around and adjacent to the falls.

DISCUSSION

Tables showing the county distribution for mosses and liverworts collected and studied and for vascular plants observed, are presented. In these the genera of the group are arranged alphabetically, with the species of the genus similarly arranged. Common names, seldom used for the bryophytes, are omitted, but are given, if in use, for the vascular plants.

For each species of moss and liverwort the number of times it was collected in the several habitats is indicated. For the vascular plants the table shows the number of times a given species was observed in a habitat, based on the field records.

It may be noted from examining the vascular plants in the table that a greater effort was made to record native species rather than introduced species, also that the list, compiled from field notes, incorporates only those species of vascular plants in the notes, not all of the vascular plants observed by the authors in the county.

In the table for vascular plants the scientific name for each is preceded by a letter or letters. These, modified from a system used by Shanks, indicate the growth form of the plant and are as follows:

D — dominant, referring to trees of the several forest types
A — associate, a tree associated with the dominants
St — small tree
Sh — shrub
V — vine
G — ground cover plant, herbaceous for the most part
Aq — aquatic plant

Habitat type designations of the tables attempt to suggest the ecology of the collecting sites and broadly, therefore, of the county. They are adapted from Shanks for the present study. They represent the vegetation types evolved and apparent at the present time in the county. They suggest that the beech-sugar maple climax forest was extensive and that remnants of the hemlock-northern hardwoods, mixed mesophytic aspects of the latter, and also kinds of swamp forest still remain in evidence. The habitat designations also indicate the presence of successional stages in this vegetational development and represent some of the major seres which precede the climax forests above. Among these are bog forests, bogs, swamp shrub vegetation, marsh meadows, marshes, and emergent and submersed aquatic plants of hydrophytic habitats. Quotations from *Land Use in Orleans County (Inventory and Analysis)* point to similar conclusions regarding the vegetation of the county. "Forest lands as included in this report include developing forests, mature forests and tree plantations. Forest lands account for 17.0% or 43,100 acres of the County's total land area. Forest lands for the most part closely parallel those lands with a restricted development potential resulting in substantial forested areas, located to the north of Ridge Road, Route 104, and along the drainageways and poorly drained areas throughout the County.

"The water areas category encompasses all natural and artificial bodies of water within the County and also, due to its importance as a resource, a portion of Lake Ontario extending outward from the shoreline of the County. Under these definitions water areas account for 2.0% of the overall area of the County or approximately 5,100 acres . . .

"Wetlands include bogs, marshes and wooded wetlands accounting for 7.7% of the land area of the County or an approximate acreage of 19,500 . . ."

From the table of totals it is noted that the largest number of liverworts (5 species) was collected in the swamp forest habitat, with the number in the beech-sugar maple forest second (4 species). The greatest number of moss species (67) was collected in the beech-maple woodland, with the gorges and waterfalls habitat second in the number of moss species (57). Of the vascular plants 103 species were observed and recorded from the beech-sugar maple woodlands and 81 species were observed and recorded from the swamp forest.

The several types of habitat where most species of vascular plants, mosses, and liverworts appear to occur—the beech-sugar maple forest, the swamp forest, and gorges and waterfalls—remain in relatively natural condition and are among the areas least disturbed in the county.

The question arises why the greatest number of species of plants should be found in these areas. Is it that of the several successional seres in the development of the climax vegetation of the county these seres offer the greatest diversity of ecological niches and therefore the widest variety of microhabitats for the occupation of plant organisms? Is it that the beech-maple woodland, which represents the climax situation for the county, provides moderate conditions of habitat such that some organisms from earlier seres can tolerate them and have persisted?

Evidence from the geological history and present physiography points to similarities between Monroe and Orleans Counties. This preliminary examination of the vegetation also suggests close vegetational development and alliance between these two counties.

It is significant that among the major ecological sites of this study, a third have been greatly disturbed, i.e. homes, parks, a summer cottage area, but as a matter of fact, all of the sites may be said to have undergone some disturbance by man.

In exploring the county it has been impossible not to recognize that the areas of natural vegetation are diminishing. Native vegetation has resulted from a very long developmental history. It was first disturbed by westward expansion 150 years ago. Its remnants are even now subject to the drastic changes demanded by the needs of a growing population and a subsequent decline of agriculture. Changes in farm methods, advances in technology, road building, and housing in subdivisional quantities appear to leave small hope for the survival of natural areas for parklands and areas for study, aesthetic recreation, and non-pollution.

The beech-sugar maple climax vegetation exists at the present time in the increasingly smaller farm woodlot and certain of these areas are now considered to be choice spots for the development of exclusive housing, with the potential reduction and destruction not only of the dominant trees but also the members of the understory and herbaceous layers. Bogs are "mined" for peat, other areas for gravel, and marshes are valued as possible marinas rather than for their unexplored and all too little known wildlife. The only protection, other than that given by the occasional private individual, that has been accorded any of the natural ecology of the county, from which its vegetational and other history can be read and its wildlife populations explored and studied, is that of the relatively small areas of swamp forest, swamp shrub, and meadows which are part of the Oak Orchard Swamp and the Iroquois Game Refuge under the administration of the State of New York and the Federal Government.

Some hope for the future of the natural vegetation in the county should be forthcoming from far-seeing local communities and alert individuals. There is abundant abandoned farm land, which is potential forest, some wetlands and wet areas. Examples of these in significant acreages should be permitted to develop naturally without disturbance and, before it is too late, be spared the onslaught of further incursion by man's activities. The presence of such lands affords an opportunity for the county, local communities and individual businessmen, farmers, politicians, and club women and housewives to take stock of a natural heritage and to give thought, support, and action toward its preservation. The present time is almost too late; immediate action can help. Areas should be set aside as parks, playgrounds, green spaces, and areas of cultural and aesthetic resource where no pollution is tolerated and where no disturbance is permitted, or kept to the barest minimum. Such areas should be recognized as filling a deep need of the expanding population and future generations and without delay should be set aside and fully protected. Action of this nature by everyone interested in the county should be recommended to the County Planning Board and to those persons involved in the detailed study of the Orleans County Parks, Recreation, and Open Space presently underway. It is imperative that citizens demand that biologists and ecologists work with such planning groups and have a voice in the disposition of county properties.

This paper, originally intended as an invitation to investigate the remaining natural areas of the county, is now presented as a fragmentary record of an otherwise unrecorded flora of Orleans County and as a challenge to the citizens of the county to preserve a valuable resource and heritage.

BIBLIOGRAPHY

ALTERI, CHARLOTTE and BABETTE BROWN COLEMAN. 1965. The Bryoflora of the Genesee Country. 2. The Mosses of Northern Wayne County. The Bryologist 68 (3): 349–353. Autumn.

BRAY, W. L. 1915. The development of the vegetation of New York State. Tech. Pub. 3. New York State College of Forestry. (Republished 1930, Tech. Pub. 29: 1–189.)

CENSUS OF AGRICULTURE. 1959. Orleans County. Prepared by C. A. Bratton, Department of Agricultural Economics, New York State College of Agriculture, a Unit of the State University of New York. Cornell University, Ithaca, New York A. E. Ext. 207–33. Sept. 1962.

CENSUS OF AGRICULTURE. 1964. Orleans County. (as above) A. E. Ext. 475–32. Oct. 1967.

CRUM, HOWARD, WILLIAM C. STEERE, and LEWIS E. ANDERSON. 1965. A List of the Mosses of North America. The Bryologist 68(4) :377–434. Winter.

EHRLE, ELWOOD B. and BABETTE BROWN COLEMAN. 1963. The Bryoflora of the Genesee Country. 1. The Bryophytes of Wheelers Gully. The Bryologist 66(2) : 61–66. Summer.

FAIRCHILD, HERMAN L. 1925. Geology of Western New York. Published by the author, Rochester, New York. November. (Reprinted from "Geologic History of the Genesee Country." The Genesee Country, vol. 1, Chapter 1. S. J. Clarke Pub. Co., Chicago, 1925.)

——— 1929. New York Drumlins. Proc. Roch. Acad. Sci. 7 (1) : 1–37.

FERNALD, M. L. 1950. Gray's Manual of Botany. Eighth edition. American Book Company, New York, New York.

GILES, ALBERT W. 1918. Eskers in Vicinity of Rochester, New York. Proc. Roch. Acad. Sci. 5: 161–240.

GLEASON, H. A. 1952. The New Britton and Brown Illustrated Flora of the Northeastern United States and Adjacent Canada. Vol. 1–3. Fourth printing. The New York Botanical Garden. Hafner Publishing Company, Inc.

GROUT, A. J. 1903. Mosses with a Hand Lens and Microscope. Eric Lundberg, Ashton, Maryland (Reprinted 1965).

——— 1936. Mosses of North America, north of Mexico Vol. I–III. Published by the author, Newfane, Vermont (More recently obtainable through the Chicago Museum of Natural History, Chicago, Illinois).

KETCHLEDGE, EDWIN H. 1957. Checklist of the Mosses of New York State. New York State Museum, University State of New York, State Ed. Dept., Albany, New York Bull. 363.

LAND USE IN ORLEANS COUNTY: INVENTORY AND ANALYSIS. Prepared for the Orleans County Planning Board by the Genesee Finger Lakes Regional Planning Board. Report No. 1.

LYMAN, EVELYN and BABETTE BROWN COLEMAN. 1966. The Bryoflora of the Genesee Country. 3. A Preliminary Survey of the Bryophytes of Orleans County, New York. The Bryologist 69 (1): 118–124. Spring.

SCHUSTER, R. M. 1949. The Ecology and Distribution of Hepaticae in Central and Western New York. The Amer. Midl. Nat. 42: 513–712.

SHANKS, ROYAL E. 1966. An Ecological Survey of the Vegetation of Monroe County. Proc. Roch. Acad. Sci. 11 (3) : 108–252. November.

WELCH, WINONA. 1958. Mosses of Indiana. State of Indiana, Dept. of Conserv. p. 478.

YEARBOOK OF AGRICULTURE. 1941. Climate and Man. U. S. D. A. Washington, D. C.

ORLEANS COUNTY SPECIES DISTRIBUTION TABLE

SPECIES: *Hepaticeae*	SPECIFIC HABITAT											
	Oak Pine	*Beech Maple*	*Swamp Forest*	*Bog Forest*	*Open Bog*	*Abandoned Fields & Roadsides*	*Rocky Cedar Swamp*	*Gorges and Water-falls*	*Marsh*	*Muddy Stream Banks*	*Water*	*Lawns*
Chiloscyphus pallescens (Ehr.) Dum.		2	1					1				
Conocephalum conicum (L.) Dum.								4				
Harpanthus scutatus (W. & M.) Spruce			1									
Jamesoniella autumnalis (Spruce) Steph.		2										
Lophocolea heterophylla (Schrad.) Dum.		14										
Lophocolea minor Nees.		3										
Marchantia polymorpha L.			1									

ORLEANS COUNTY SPECIES DISTRIBUTION TABLE

SPECIES:	SPECIFIC HABITAT											
Hepaticeae	*Oak Pine*	*Beech Maple*	*Swamp Forest*	*Bog Forest*	*Open Bog*	*Abandoned Fields & Roadsides*	*Rocky Cedar Swamp*	*Gorges and Water-falls*	*Marsh*	*Muddy Stream Banks*	*Water*	*Lawns*
Ptilidium pulcherrimum (Web.) Hampe			1				2					
Radula complanata (L.) Dumort.			1									
Reboulia hemisphaerica (L.) Raddi.								4				
Ricciocarpus natans (L.) Corda.									1			

ORLEANS COUNTY SPECIES DISTRIBUTION TABLE

Page 1

SPECIES: *Musci*	SPECIFIC HABITAT											
	Oak Pine	*Beech Maple*	*Swamp Forest*	*Bog Forest*	*Open Bog*	*Abandoned Fields & Roadsides*	*Rocky Cedar Swamp*	*Gorges and Water-falls*	*Marsh*	*Muddy Stream Banks*	*Water*	*Lawns*
Amblystegium juratzkanum Schimp.	1	7					2	2				
Amblystegium serpens (Hedw.) B.S.G.		4					4	8			2	
Amblystegium varium (Hedw.) Lindb.		18	1					6		2	1	1
Amblystegium varium var. lancifoleum Grout								1				
Amblystegium varium var. ovatum (Grout) Grout								1				
Amblystegium varium var. parvulum (Aust.) Grout		4						4				
Anomodon attenuatus (Hedw.) Hüb.	3	1					1	1	2	1		

ORLEANS COUNTY SPECIES DISTRIBUTION TABLE

SPECIES: *Musci*	SPECIFIC HABITAT											
	Oak Pine	*Beech Maple*	*Swamp Forest*	*Bog Forest*	*Open Bog*	*Abandoned Fields & Roadsides*	*Rocky Cedar Swamp*	*Gorges and Water-falls*	*Marsh*	*Muddy Stream Banks*	*Water*	*Lawns*
Anomodon minor (Hedw.) Fürnr.											3	
Anomodon rostratus (Hedw.) Schimp.		2					1					
Astomum muhlenbergianum (Sw.) Grout												1
Atrichum undulatum (Hedw.) P. Beauv.	1	1	1									
Aulacomium palustre (Hedw.) Schwaegr.			1									
Bartramia pomiformis Hedw.								1				
Brachythecium calcareum Kindb.	2	1						1				

ORLEANS COUNTY SPECIES DISTRIBUTION TABLE

SPECIES:	SPECIFIC HABITAT											
Musci	*Oak Pine*	*Beech Maple*	*Swamp Forest*	*Bog Forest*	*Open Bog*	*Abandoned Fields & Roadsides*	*Rocky Cedar Swamp*	*Gorges and Water-falls*	*Marsh*	*Muddy Stream Banks*	*Water*	*Lawns*
Brachythecium campestre (C. Müll.) B.S.G.		1										
Brachythecium oxycladon (Brid.) Jaeg. & Sauerb.										1		
Brachythecium plumosum (Hedw.) B.S.G.		1										
Brachythecium rivulare B.S.G.		1						18		1		
Brachythecium rutabulum (Hedw.) B.S.G.	3	8	1					1				
Brachythecium salebrosum (Web. & Mohr.) B.S.G.	1	3					1	1				
Bryum angustirete Kindb. ex Mac.		1						1				

ORLEANS COUNTY SPECIES DISTRIBUTION TABLE

SPECIES:	SPECIFIC HABITAT											
Musci	*Oak Pine*	*Beech Maple*	*Swamp Forest*	*Bog Forest*	*Open Bog*	*Abandoned Fields & Roadsides*	*Rocky Cedar Swamp*	*Gorges and Water-falls*	*Marsh*	*Muddy Stream Banks*	*Water*	*Lawns*
Bryum argenteum Hedw.		1						2				
Bryum caespeticium Hedw.	1	1				1		1				
Bryum capillare Hedw.					1			2				
Bryum creberrimum Tayl.								1				
Bryum intermedium Brid.			1		1							
Bryum pseudotriquetrum (Hedw.) Gaertn; Meyer, Scherb.			2					6				
Calliergon cordifolium (Hedw.) Kindb.		1										

ORLEANS COUNTY SPECIES DISTRIBUTION TABLE

SPECIES: *Musci*	SPECIFIC HABITAT											
	Oak Pine	*Beech Maple*	*Swamp Forest*	*Bog Forest*	*Open Bog*	*Abandoned Fields & Roadsides*	*Rocky Cedar Swamp*	*Gorges and Water-falls*	*Marsh*	*Muddy Stream Banks*	*Water*	*Lawns*
Campyllium chrysophyllum (Brid.) J. Lange.	1	1						2				
Campyllium hispidulum (Brid.) Mitt.									1			
Ceratodon purpureus (Hedw.) Brid.	3	1	1			1	2					
Climacium americanum var. Kindbergii Ren. & Card.		1	1				2					
Climacium dendroides (Hedw.) Web. & Mohr.			2									
Desmatodon obtusifolius (Schwaegr.) Schimp.								1				
Dicranella heteromalla (Hedw.) Schimp.								1		2		

ORLEANS COUNTY SPECIES DISTRIBUTION TABLE

SPECIES: *Musci*	SPECIFIC HABITAT										
	Oak Pine	*Beech Maple*	*Swamp Forest*	*Bog Forest*	*Open Bog*	*Abandoned Fields & Roadsides*	*Rocky Cedar Swamp*	*Gorges and Water-falls*	*Marsh*	*Muddy Stream Banks*	*Water*	*Lawns*
Dicranella heteromalla var. orthocarpa (Hedw.) Jaeg. & Sauerb.		1										
Dicranella varia (Hedw.) Schimp.		5										
Dicranum flagellare Hedw.		1		1								
Dicranum fulvum Hook.		2										
Dicranum montanum Hedw.		2			1			1		1		
Dicranum sabuletorum Ren. & Card.		1					1					
Dicranum scoparium Hedw.		2										

ORLEANS COUNTY SPECIES DISTRIBUTION TABLE

SPECIES: *Musci*	SPECIFIC HABITAT											
	Oak Pine	*Beech Maple*	*Swamp Forest*	*Bog Forest*	*Open Bog*	*Abandoned Fields & Roadsides*	*Rocky Cedar Swamp*	*Gorges and Water-falls*	*Marsh*	*Muddy Stream Banks*	*Water*	*Lawns*
Diphyscium foliosum (Hedw.) Mohr.		2										
Ditrichum flexicaule (Schwaegr.) Hampe.								1				
Drepanocladus fluitans (Hedw.) Warnst.											2	
Drepanocladus vernicosus (Lindb. ex C. Harten.) Warnst.											1	
Entodon cladorrhizans (Hedw.) C. Muell.		1										
Entodon seductrix (Hedw.) C. Muell.		1										
Eurynchium hians (Hedw.) San de Lac		3										

ORLEANS COUNTY SPECIES DISTRIBUTION TABLE

SPECIES:	SPECIFIC HABITAT											
Musci	*Oak Pine*	*Beech Maple*	*Swamp Forest*	*Bog Forest*	*Open Bog*	*Abandoned Fields & Roadsides*	*Rocky Cedar Swamp*	*Gorges and Water-falls*	*Marsh*	*Muddy Stream Banks*	*Water*	*Lawns*
Eurynchium pulchellum (Hedw.) Jenn.		3										
Eurynchium riparioides (Hedw.) Rich.							1	2				
Fissidens bushii (Card. & Thér.) Card. & Thér.		4					1					
Fissidens minutulus Sull.		2						2				
Fissidens taxifolius Hedw.		2										
Fontinalis dalecarlica Schimp. ex B.S.G.											1	
Funaria flavicans Michx.								1				2

ORLEANS COUNTY SPECIES DISTRIBUTION TABLE

SPECIES: *Musci*	SPECIFIC HABITAT											
	Oak Pine	*Beech Maple*	*Swamp Forest*	*Bog Forest*	*Open Bog*	*Abandoned Fields & Roadsides*	*Rocky Cedar Swamp*	*Gorges and Water-falls*	*Marsh*	*Muddy Stream Banks*	*Water*	*Lawns*
Funaria hygrometrica Hedw.								2				1
Grimmia apocarpa Hedw.		1					2	1				
Grimmia apocarpa var. conferta (Funck) Spreng.							2					
Grimmia unicolor Hook. ex Grer.							1					
Gymnostomum calcareum Nees, Hornsch.								1				
Gymnostomum recurvirostrum Hedw.								1				
Haplocladium microphyllum (Hedw.) Broth.									2			

ORLEANS COUNTY SPECIES DISTRIBUTION TABLE

SPECIES: *Musci*	SPECIFIC HABITAT											
	Oak Pine	*Beech Maple*	*Swamp Forest*	*Bog Forest*	*Open Bog*	*Abandoned Fields & Roadsides*	*Rocky Cedar Swamp*	*Gorges and Water-falls*	*Marsh*	*Muddy Stream Banks*	*Water*	*Lawns*
Heterophyllium haldanianum (Greve) Kindb.			2	1			4	1				
Homomalium adnatum (Hedw.) Broth.		2										
Hygroamblystegium fluviatile (Hedw.) Loeske.								2				
Hygroamblystegium fluviatile var. orthocladon (P. Beauv.) Crum, Steere, & Anderson								1				
Hygroamblystegium tenax (Hedw.) Jenn.			2					8		1		
Hygroamblystegium tenax var. spinifoleum (Schimp.) Jenn.			1					1				
Hygrohypnum luridum (Hedw.) Jenn.	1		2									

ORLEANS COUNTY SPECIES DISTRIBUTION TABLE

SPECIES: *Musci*	SPECIFIC HABITAT											
	Oak Pine	*Beech Maple*	*Swamp Forest*	*Bog Forest*	*Open Bog*	*Abandoned Fields & Roadsides*	*Rocky Cedar Swamp*	*Gorges and Water-falls*	*Marsh*	*Muddy Stream Banks*	*Water*	*Lawns*
Hypnum cupressiforme Hedw.			1									
Hypnum curvifolium Hedw.			1									
Hypnum imponens Hedw.			2									
Hypnum lindbergii Mitt.			2									
Hypnum pallescens (Hedw.) P. Beauv.			3									
Isopterygium borrerianum (C. Müll) Lindb.							1					
Isopterygium drummondii Crum, Steere, & Anderson							1					

ORLEANS COUNTY SPECIES DISTRIBUTION TABLE

SPECIES: *Musci*	SPECIFIC HABITAT											
	Oak Pine	*Beech Maple*	*Swamp Forest*	*Bog Forest*	*Open Bog*	*Abandoned Fields & Roadsides*	*Rocky Cedar Swamp*	*Gorges and Water-falls*	*Marsh*	*Muddy Stream Banks*	*Water*	*Lawns*
Isopterygium micans (Sw.) Broth.	1	1	3			3		5				
Isopterygium mullerianum (Schimp.) Lindb.		1										
Isopterygium pulchellum (Hedw.) Jaeg. & Sauerb.	1	1						1				
Isopterygium turfaceum (Lindb.) Lindb.			1									
Leptodictyum brevipes (Card. & Thér. ex Holz) Broth.								1				
Leptodictyum laxirete (Card. & Thér.) Broth.								4				
Leptodictyum riparium (Hedw.) Warnst.			3					5	4			

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SPECIES: *Musci*	SPECIFIC HABITAT											
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Leptodictyum trichopodium (Schultz) Warnst.		1						4	1		2	
Leptodictyum trichopodium var. Kochii (B.S.G.) Broth.		1						2	2	2		
Leskea arenicola Best.							1					
Leskea gracilescens Hedw.		1										
Leskea obscura Hedw.							1					
Leucobryum glaucum (Hedw.) Ångstr. ex Fr.		3	1									
Mnium affine Bland. ex Funk.				1								

ORLEANS COUNTY SPECIES DISTRIBUTION TABLE

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Mnium cuspidatum Hedw.		11	3	1	1			8				
Mnium marginatum (With.) Brid. ex P. Beauv.		1										
Mnium rostratum Schrad.								5				1
Orthotrichum anomalum Hedw.								1				
Orthotrichum strangulatum P. Beauv.							2	3				
Plagiothecium denticulatum (Hedw.) B.S.G.	1	12	1					1				
Plagiothecium roseanum (Hampe) B.S.G.		8				2		3				

ORLEANS COUNTY SPECIES DISTRIBUTION TABLE

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	Oak Pine	*Beech Maple*	*Swamp Forest*	*Bog Forest*	*Open Bog*	*Abandoned Fields & Roadsides*	*Rocky Cedar Swamp*	*Gorges and Water-falls*	*Marsh*	*Muddy Stream Banks*	*Water*	*Lawns*
Plagiothecium sylvaticum (Brid.) B.S.G.		16						1				
Platydictya confervoides (Brid.) Crum.		2						2				
Platydictya subtile (Hedw.) Crum.		2										
Platygyrium repens (Brid.) B.S.G.		5										
Pohlia elongata Hedw.		1								1		
Pohlia nutans (Hedw.) Lindb.		1										
Pohlia proligera (Kindb. ex Limpr.) Lindb. ex H. Arnell.							1					

ORLEANS COUNTY SPECIES DISTRIBUTION TABLE

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Pohlia pulchella (Hedw.) Lindb.		1										
Pohlia wahlenbergii (Web. & Mohr.) Andr.		1		1	1							
Polytrichum commune Hedw.		1										
Polytrichum commune var. Jensenii (I. Hag.) Frye					1							
Polytrichum juniperinum Hedw.		1										
Polytrichum juniperinum var. gracilens Wahlenb.				1								
Polytrichum ohioense Ren. & Card.		2										

ORLEANS COUNTY SPECIES DISTRIBUTION TABLE

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Musci	*Oak Pine*	*Beech Maple*	*Swamp Forest*	*Bog Forest*	*Open Bog*	*Abandoned Fields & Roadsides*	*Rocky Cedar Swamp*	*Gorges and Water-falls*	*Marsh*	*Muddy Stream Banks*	*Water*	*Lawns*
Polytrichum piliferum Hedw.							1					
Pottia truncata (Hedw.) Fürnr. ex B.S.G.												1
Pylaisiella intricata (Hedw.) Grout.								1				
Rhynchostegium serrulatum Jaeg. & Sauerb.		11	2				1	1				
Schwetschkeopsis denticulata (Sull.) Broth.		1										
Sphagnum palustre L.			1	1								
Taxiphyllum taxirameum (Mitt.) Fleisch.	1	1										

ORLEANS COUNTY SPECIES DISTRIBUTION TABLE

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Musci	*Oak Pine*	*Beech Maple*	*Swamp Forest*	*Bog Forest*	*Open Bog*	*Abandoned Fields & Roadsides*	*Rocky Cedar Swamp*	*Gorges and Water-falls*	*Marsh*	*Muddy Stream Banks*	*Water*	*Lawns*
Tetraphis pellucida Hedw.		1	1	1	1		1					
Thuidium allenii Aust.										1		
Thuidium delicatulum (Hedw.) B.S.G.		5					1					
Thuidium minutulum (Hedw.) B.S.G.		1					1					
Tortula ruralis (Hedw.) Gaertn., Meyer, & Scherb.							2					
Ulota crispa (Hedw.) Brid.								1				
Weisia controversa Hedw.			1									

ORLEANS COUNTY SPECIES DISTRIBUTION TABLE

Page 1

SPECIES: *Vascular Plants*	SPECIFIC HABITAT											
	Oak Pine	*Beech Maple*	*Swamp Forest*	*Bog Forest*	*Open Bog*	*Abandoned Fields & Roadsides*	*Rocky Cedar Swamp*	*Gorges and Water-falls*	*Marsh*	*Muddy Stream Banks*	*Water*	*Lawns*
D, A—Acer rubrum L. (Red maple)		4	2	1	1		1	1		1		
A—Acer negundo L. (Ash-leaved maple)				1								
A—Acer saccharinum L. (Silver maple)		1	2									
D—Acer saccharum Marsh. (Sugar maple)		6	2					1		1		
G—Actea pachypoda Ell. (Dolls' Eyes, White baneberry)		1										
G—Actea rubra (Ait.) Willd. (Red baneberry)		1	3									
G—Actea rubra (Ait.) Willd. f. neglecta (Gillman) Robins (Red baneberry)		1										

ORLEANS COUNTY SPECIES DISTRIBUTION TABLE

SPECIES: *Vascular Plants*	SPECIFIC HABITAT											
	Oak Pine	*Beech Maple*	*Swamp Forest*	*Bog Forest*	*Open Bog*	*Abandoned Fields & Roadsides*	*Rocky Cedar Swamp*	*Gorges and Water-falls*	*Marsh*	*Muddy Stream Banks*	*Water*	*Lawns*
Aq—Alisma triviale Pursh (Water plantain)			1									
Sh—Alnus incana (L.) Moench (Alder)		1	1						1			
G—Allium tricoccum Ait. (Wild leek)		2										
G—Amaranthus albus L. (Tumbleweed)					1							
St—Amelanchier sp. (Shadbush)								1		1		
G—Amphicarpa bracteata (L.) Fern. (Hog peanut)			1									
G—Anemone canadensis L. (Thimbleweed)				1				1		1		

ORLEANS COUNTY SPECIES DISTRIBUTION TABLE

SPECIES: *Vascular Plants*	SPECIFIC HABITAT											
	Oak Pine	*Beech Maple*	*Swamp Forest*	*Bog Forest*	*Open Bog*	*Abandoned Fields & Roadsides*	*Rocky Cedar Swamp*	*Gorges and Water-falls*	*Marsh*	*Muddy Stream Banks*	*Water*	*Lawns*
Sh—Aronia sp. (Chokeberry)			1	1								
G—Aralia hispida Vent. (Bristly Sarsaparilla)		2		1								
G—Aralia nudicaulis L. (Wild sarsaparilla)		3	1									
G—Aralia racemosa L. (Spikenard)			1	1								
G—Arisaema sp. (Jack-in-the-pulpit)		1	1									
G—Arisaema atrorubens (Ait.) Blume (Jack-in-the-pulpit)		1										
G—Asarum canadense L. (Wild ginger)		2										

ORLEANS COUNTY SPECIES DISTRIBUTION TABLE

SPECIES:	SPECIFIC HABITAT											
Vascular Plants	*Oak Pine*	*Beech Maple*	*Swamp Forest*	*Bog Forest*	*Open Bog*	*Abandoned Fields & Roadsides*	*Rocky Cedar Swamp*	*Gorges and Water-falls*	*Marsh*	*Muddy Stream Banks*	*Water*	*Lawns*
G—Asclepias incarnata L. (Swamp milkweed)			1				1	1		1		
G—Asclepias syriaca L. (Milkweed)						1						
*—Asimina triloba (L.) Donal (Pawpaw)												
G—Asperula odorata L. (Sweet woodruff)												1
G—Aster umbellatus Mill. (Aster)										1		
G—Aster sp.										1		
G—Athyrium felix-femina (L.) Roth (Ladyfern)		1			1							

* *Asimina triloba* (L.) Duval (Pawpaw) did not occur at any of the specifically selected collecting sites reported in the above study, but it was observed at times in Orleans County:
1) at Miller's quarry immediately south of the Barge Canal approximately 1/2 mile west of Densmore Road bridge over the canal.
2) a depauperate stand occurs along an intermittent stream course north of Telegraph Road just west of Groth Road.

ORLEANS COUNTY SPECIES DISTRIBUTION TABLE

SPECIES: *Vascular Plants*	SPECIFIC HABITAT											
	Oak Pine	*Beech Maple*	*Swamp Forest*	*Bog Forest*	*Open Bog*	*Abandoned Fields & Roadsides*	*Rocky Cedar Swamp*	*Gorges and Water-falls*	*Marsh*	*Muddy Stream Banks*	*Water*	*Lawns*
G—Barbarea vulgaris R. Br. (Wintercress)					1							
St—Betula lenta L. (Black birch)		1										
St—Betula lutea Michx. (Yellow birch)		2	1	1								
G—Bidens sp. (Spanish needles)			1									
G—Boehmeria cylindrica (L.) Sw. (Bog hemp)			1									
G—Botrychium multifidum (Geml.) Rupr. (Grape fern)		1	1			1						
G—Botrychium virginianum (L.) Sw. (Rattlesnake fern)		1	1									

ORLEANS COUNTY SPECIES DISTRIBUTION TABLE

SPECIES:	SPECIFIC HABITAT											
Vascular Plants	*Oak Pine*	*Beech Maple*	*Swamp Forest*	*Bog Forest*	*Open Bog*	*Abandoned Fields & Roadsides*	*Rocky Cedar Swamp*	*Gorges and Water-falls*	*Marsh*	*Muddy Stream Banks*	*Water*	*Lawns*
G(Aq)—Calla palustris L. (White calla lily)					1							
St—Carpinus caroliniana Walt. (Ironwood or Muscletree)		1										
G, Aq—Caltha palustris L. (Marsh marigold)			2	1					1			
G—Capsella bursa-postaris (L.) Medic. (Shepherd's purse)				1								
G—Carex spp. (Sedge)		4							1	1		
A—Carya ovata (Mill.) K. Koch (Shagbark hickory)		1										
G—Caulophyllum thalictroides (L.) Michx. (Blue cohosh)		5										

ORLEANS COUNTY SPECIES DISTRIBUTION TABLE

SPECIES:	SPECIFIC HABITAT											
Vascular Plants	*Oak Pine*	*Beech Maple*	*Swamp Forest*	*Bog Forest*	*Open Bog*	*Abandoned Fields & Roadsides*	*Rocky Cedar Swamp*	*Gorges and Water-falls*	*Marsh*	*Muddy Stream Banks*	*Water*	*Lawns*
S—Cephalanthus occidentalis L. (Buttonbush)			1						1	1		
S—Chamaedaphne calyculata (L.) Moensch (Leatherleaf)					3							
G—Chelone glabra L. (Turtlehead)			2					2		1		
G—Chrysanthemum leucanthemum L. var. pinnatifidum LeCoq & Lamotte (Oxeye daisies)						2		1		1		
G—Cicuta maculata L. (Water hemlock)			1									
G—Circaea quadrisculata (Maxim.) Franch & Sav. (Enchanters nightshade)		2										
G—Claytonia virginica L. (Spring beauty)		1										1

ORLEANS COUNTY SPECIES DISTRIBUTION TABLE

SPECIES:	SPECIFIC HABITAT											
Vascular Plants	*Oak Pine*	*Beech Maple*	*Swamp Forest*	*Bog Forest*	*Open Bog*	*Abandoned Fields & Roadsides*	*Rocky Cedar Swamp*	*Gorges and Water-falls*	*Marsh*	*Muddy Stream Banks*	*Water*	*Lawns*
G—Claytonia sp. (Spring beauty)		1										
G—Collinsonia canadensis L. (Horsebalm)		1	1									
V—Convolvulus arvensis L. (Wild morning-glory)						1						
V—Convolvulus serpium L. (Wild morning-glory)			1			1						
G—Coptis groenlandica (Oeder) Fern (Goldthread)		1	2									
G—Corallorhiza sp. (Coralroot orchid)		1										
St—Cornus florida L. (Flowering dogwood)								1		1		

ORLEANS COUNTY SPECIES DISTRIBUTION TABLE

SPECIES:	SPECIFIC HABITAT											
Vascular Plants	*Oak Pine*	*Beech Maple*	*Swamp Forest*	*Bog Forest*	*Open Bog*	*Abandoned Fields & Roadsides*	*Rocky Cedar Swamp*	*Gorges and Water-falls*	*Marsh*	*Muddy Stream Banks*	*Water*	*Lawns*
Sh—Cornus racemosa Lam. (Gray dogwood)		1										
Sh—Cornus rugosa Lam. (Round-leaved dogwood)										1		
Sh—Cornus stolonifera Michx. (Red osier dogwood)		1				1				1		
St—Crategus monogyna Jacq. (English hawthorn)		1										
V—Cuscuta sp. (Dodder)									1			
G—Cyperus esculentus L. (Sedge)			1									
G—Cyperus sp. (Sedge)									1			

ORLEANS COUNTY SPECIES DISTRIBUTION TABLE

SPECIES: *Vascular Plants*	SPECIFIC HABITAT											
	Oak Pine	*Beech Maple*	*Swamp Forest*	*Bog Forest*	*Open Bog*	*Abandoned Fields & Roadsides*	*Rocky Cedar Swamp*	*Gorges and Water-falls*	*Marsh*	*Muddy Stream Banks*	*Water*	*Lawns*
G—Dennstaedtia punctilobula (Michx.) Moore (Hay-scented fern)		1										
G—Dentaria diphylla Michx. (Toothwort)		1										
G—Dentaria laciniata Muhl. (Toothwort)		4										
G—Disporum lanuginosum (Michx.) Nicholson (Yellow mandarin)		1										
G—Dryopteris cristata (L.) Gray (Crested shield fern)			1									
G—Dryopteris marginalis (L.) Gray (Marginal shield fern)		1										
G—Dryopteris noveboracensis (L.) Gray (New York fern)		1										

ORLEANS COUNTY SPECIES DISTRIBUTION TABLE

SPECIES:	SPECIFIC HABITAT											
Vascular Plants	*Oak Pine*	*Beech Maple*	*Swamp Forest*	*Bog Forest*	*Open Bog*	*Abandoned Fields & Roadsides*	*Rocky Cedar Swamp*	*Gorges and Water-falls*	*Marsh*	*Muddy Stream Banks*	*Water*	*Lawns*
G—Dryopteris spinulosa (O. F. Muell.) Watt. (Spiney toothed shield fern)		3	2									
G—Dryopteris thelypteris (L.) Gray (Marsh fern)		2										
G—Dulichium arundinaceum (L.) Britt. (Round-leaved sedge)		1										
V—Echinocystis lobata (Michx.) T. & G. (Wild cucumber)									1			
A—Elodea canadensis Michx. (Waterweed)											1	
G—Epifagus virginiana (L.) Bart. (Beechdrops)		7										
G—Epilobium angustifolium L. (Fireweed)		1										

ORLEANS COUNTY SPECIES DISTRIBUTION TABLE

SPECIES:	SPECIFIC HABITAT											
Vascular Plants	*Oak Pine*	*Beech Maple*	*Swamp Forest*	*Bog Forest*	*Open Bog*	*Abandoned Fields & Roadsides*	*Rocky Cedar Swamp*	*Gorges and Water-falls*	*Marsh*	*Muddy Stream Banks*	*Water*	*Lawns*
G—Epilobium coloratum Biehler (Willowherb)			1									
G—Epilobium hirsutum L. (Willowherb)			2									
G—Equisetum arvense L. (Common horsetail)		1				1				1		
G—Equisetum hyemale L. (Scouring rush)				1								
A—Equisetum fluviátale L. (Horsetail)			1									
A—Equisetum palustre L. (Horsetail)			1									
G—Equisetum variegatum Schleich. (Horsetail)			1									

ORLEANS COUNTY SPECIES DISTRIBUTION TABLE

SPECIES:	SPECIFIC HABITAT										
Vascular Plants	*Oak Pine*	*Beech Maple*	*Swamp Forest*	*Bog Forest*	*Open Bog*	*Abandoned Fields & Roadsides*	*Rocky Cedar Swamp*	*Gorges and Water-falls*	*Marsh*	*Muddy Stream Banks*	*Water*	*Lawns*
G—Eragrostis sp. (Lovegrass)					1							
G—Erigeron strigosus Muhl. (Daisy fleabane)								1				
G—Eriophorum virginicum L. (Cottongrass)					1							
G—Erythronium amencanum Ker. (Yellow trout lily)		7		1								
G—Eupatorium perfoliatum L. (Boneset)			1			1						
G—Eupatorium rugosum Houlth. (White snakeroot)												
G—Eupatorium sp. (Joe Pye weed)			1					1		2		

ORLEANS COUNTY SPECIES DISTRIBUTION TABLE

SPECIES: *Vascular Plants*	SPECIFIC HABITAT											
	Oak Pine	*Beech Maple*	*Swamp Forest*	*Bog Forest*	*Open Bog*	*Abandoned Fields & Roadsides*	*Rocky Cedar Swamp*	*Gorges and Water-falls*	*Marsh*	*Muddy Stream Banks*	*Water*	*Lawns*
D—Fagus grandifoleum Ehrh. (Beech)		6							1			
G—Fragaria virginiana Duchesne (Wild strawberry)		1		1								
A—Fraxinus americanum L. (White ash)			1							2		
A—Fraxinus nigra Marsh. (Black ash)			1									
A—Fraxinus sp. (Ash)		3										
G—Geranium maculatum L. (Wild geranium)						1						
G—Geranium robertianum L. (Herb robert)		1										

ORLEANS COUNTY SPECIES DISTRIBUTION TABLE

SPECIES: Vascular Plants	SPECIFIC HABITAT											
	Oak Pine	*Beech Maple*	*Swamp Forest*	*Bog Forest*	*Open Bog*	*Abandoned Fields & Roadsides*	*Rocky Cedar Swamp*	*Gorges and Water-falls*	*Marsh*	*Muddy Stream Banks*	*Water*	*Lawns*
G—Geum sp. (Avens)										1		
G—Gnaphalium sp. (Cudweed)			1									
G—Hedeoma pulegioides L. Pers. (Pennyroyal)		1										
G—Hepatica acutiloba D.C. (Hepatica)		5										
G—Hepatica americana (D. C.) Ker. (Hepatica)		1										
G—Hydrophyllum virginianum L. (Waterleaf)		1										
G—Hypericum perforatum L. (Common St. Johnswort)					1	3						

ORLEANS COUNTY SPECIES DISTRIBUTION TABLE

SPECIES:	SPECIFIC HABITAT											
Vascular Plants	*Oak Pine*	*Beech Maple*	*Swamp Forest*	*Bog Forest*	*Open Bog*	*Abandoned Fields & Roadsides*	*Rocky Cedar Swamp*	*Gorges and Water-falls*	*Marsh*	*Muddy Stream Banks*	*Water*	*Lawns*
Sh—Ilex verticillata (L.) Gray (Wild holly)					1							
G—Impatiens biflora Walt. (Jewelweed)			1					3		3		
G—Impatiens capensis Meerb. (Jewelweed)		1										
G—Iris versicolor L. (Blue flag)						1				1		
G—Juncus spp. (Rush)								1	3			
A, St—Larix laricina (DuRoi) K. Koch (Tamarack larch)				1	2							
A—Lemna sp. (Duckweed)											3	

ORLEANS COUNTY SPECIES DISTRIBUTION TABLE

SPECIES: *Vascular Plants*	SPECIFIC HABITAT											
	Oak Pine	*Beech Maple*	*Swamp Forest*	*Bog Forest*	*Open Bog*	*Abandoned Fields & Roadsides*	*Rocky Cedar Swamp*	*Gorges and Water-falls*	*Marsh*	*Muddy Stream Banks*	*Water*	*Lawns*
G—Lilium canadense L. (Canada lily)			1									
Sh—Lindera benzoin (L.) Blume (Spicebush)		2	1	1								
G—Lobelia cardinalis L. (Cardinal flower)										2		
G—Lobelia siphilitica L. (Great blue lobelia)										1		
Sh—Lonicera canadensis Bartr. (Early honeysuckle)			1	1								
G—Lycopodium complanatum L. (Ground pine)		1			2							
G—Lycopodium clavatum L. (Ground pine)		1										

ORLEANS COUNTY SPECIES DISTRIBUTION TABLE

SPECIES:	SPECIFIC HABITAT											
Vascular Plants	*Oak Pine*	*Beech Maple*	*Swamp Forest*	*Bog Forest*	*Open Bog*	*Abandoned Fields & Roadsides*	*Rocky Cedar Swamp*	*Gorges and Water-falls*	*Marsh*	*Muddy Stream Banks*	*Water*	*Lawns*
G—Lycopodium obscurum L. (Ground pine)		1		1								
G—Lycopus sp. (Bugleweed)			1									
G—Lysimachia ciliata L. (Loosestrife)										1		
G—Lysimachia nummularia L. (Moneywort)									1	1		
G—Maianthemum canadense Desf. (Canada mayflower)		2		1								
G—Medeola virginiana L. (Indian cucumber)			1									
V—Menispermum canadense L. (Moonseed vine)			1									

ORLEANS COUNTY SPECIES DISTRIBUTION TABLE

SPECIES:	SPECIFIC HABITAT											
Vascular Plants	*Oak Pine*	*Beech Maple*	*Swamp Forest*	*Bog Forest*	*Open Bog*	*Abandoned Fields & Roadsides*	*Rocky Cedar Swamp*	*Gorges and Water-falls*	*Marsh*	*Muddy Stream Banks*	*Water*	*Lawns*
G—Mentha canadensis (L.) Briq. (Mint)			1									
G—Mentha spicata L. (Spearmint)								1				
G—Mimulus ringens L. (Monkey flower)								1		1		
G—Mitchella repens L. (Partridge berry)		1	1	1								
G—Mitella nuda L. (Miterwort)		1										
G—Monotropa uniflora L. (Indian pipe)		2										
A—Myriophyllum sp. (Watermilfoil)											1	

ORLEANS COUNTY SPECIES DISTRIBUTION TABLE

SPECIES:	SPECIFIC HABITAT											
Vascular Plants	*Oak Pine*	*Beech Maple*	*Swamp Forest*	*Bog Forest*	*Open Bog*	*Abandoned Fields & Roadsides*	*Rocky Cedar Swamp*	*Gorges and Water-falls*	*Marsh*	*Muddy Stream Banks*	*Water*	*Lawns*
Aq—Najas sp. (Naiad)											1	
G—Narcissus psuedonarcissus L.						1						1
S—Nemopanthus mucronata (L.) Trel. (Mt. holly)			1	1								
Aq—Nuphar advena (Ait.) Ait. f. (Yellow water lily)											1	
Aq—Nymphaea odorata Ait. (Fragrant water lily)											1	
St, A—Nyssa sylvatica Marsh. (Sourgum)				2								
G—Oenothera biennis L. (Evening primrose)		2										

ORLEANS COUNTY SPECIES DISTRIBUTION TABLE

SPECIES:	SPECIFIC HABITAT											
Vascular Plants	*Oak Pine*	*Beech Maple*	*Swamp Forest*	*Bog Forest*	*Open Bog*	*Abandoned Fields & Roadsides*	*Rocky Cedar Swamp*	*Gorges and Water-falls*	*Marsh*	*Muddy Stream Banks*	*Water*	*Lawns*
G—Onoclea sensibilis L. (Sensitive fern)		1	2									
H—Ornithogalum umbellatum L. (Star of Bethlehem)						1						2
G—Osmorhiza claytoni (Michx.) C. B. Clarke (Sweet cicely)		1										
G—Osmunda Cinnamomea L. (Cinnamon fern)			2									
G—Osmunda claytoni L. (Interrupted fern)			1									
A—Ostrya virginiana (Mill.) K. Koch Hop horn beam)		2										
G—Panax quinquefolia L. (Ginseng)		1										

ORLEANS COUNTY SPECIES DISTRIBUTION TABLE

SPECIES: *Vascular Plants*	SPECIFIC HABITAT											
	Oak Pine	*Beech Maple*	*Swamp Forest*	*Bog Forest*	*Open Bog*	*Abandoned Fields & Roadsides*	*Rocky Cedar Swamp*	*Gorges and Water-falls*	*Marsh*	*Muddy Stream Banks*	*Water*	*Lawns*
G—Penstemon digitalis Nutt. (Wild penstemon)						2						
G—Phytolacca americana L. (Pokeweed)		1		1								
G—Pilea pumila (L.) Gray (Clearweed)			2									
A—Pinus strobus L. (White pine)	2	2	1	1				2				
G—Podophyllum peltatum L. (May apple)		2										
G—Polygonatum biflorum (Walt.) Ell. (Solomon's seal)		3										
G—Polygonum hydropiper L. (Smartweed)			1							3		

ORLEANS COUNTY SPECIES DISTRIBUTION TABLE

SPECIES:	SPECIFIC HABITAT											
Vascular Plants	*Oak Pine*	*Beech Maple*	*Swamp Forest*	*Bog Forest*	*Open Bog*	*Abandoned Fields & Roadsides*	*Rocky Cedar Swamp*	*Gorges and Water-falls*	*Marsh*	*Muddy Stream Banks*	*Water*	*Lawns*
G—Polygonum sp. (Knotweed)									3			
G—Polypodium virginianum L. (Polypody)								1				
G—Polystichum acrostchoides (Michx.) Schott (Christmas fern)		2										
A—Populus deltoides Marsh. (Cottonwood)				1								
A—Populus grandidenta Michx. (Large-toothed aspen)		1										
St—Populus tremuloides Michx. (Trembling aspen)		1		1								
St—Populus sp. (Poplar)		1										

ORLEANS COUNTY SPECIES DISTRIBUTION TABLE

SPECIES:	SPECIFIC HABITAT											
Vascular Plants	*Oak Pine*	*Beech Maple*	*Swamp Forest*	*Bog Forest*	*Open Bog*	*Abandoned Fields & Roadsides*	*Rocky Cedar Swamp*	*Gorges and Water-falls*	*Marsh*	*Muddy Stream Banks*	*Water*	*Lawns*
Aq—Potamogeton crispus L. (Pondweed)											1	
Aq—Potamogeton filiformis Pers. (Pondweed)											1	
Aq—Potamogeton natans L. (Pondweed)											1	
Aq—Potamogeton pusillus L. (Pondweed)											1	
G—Potentilla recta L. (Sulfur cinquefoil)						1						
G—Prenanthes serpentaria Pursh (Lion's foot)		1	3									
A—Prunus serotina Ehrh. (Wild black cherry)		1		1								

ORLEANS COUNTY SPECIES DISTRIBUTION TABLE

SPECIES:	SPECIFIC HABITAT											
Vascular Plants	*Oak Pine*	*Beech Maple*	*Swamp Forest*	*Bog Forest*	*Open Bog*	*Abandoned Fields & Roadsides*	*Rocky Cedar Swamp*	*Gorges and Water-falls*	*Marsh*	*Muddy Stream Banks*	*Water*	*Lawns*
St—Prunus sp. (Cherry)		3		1								
G—Pteridium aquilinum (L.) Kuhn (Bracken fern)		1										
G—Pyrola sp. (Shin leaf)		1										
St—Pyrus americana (Marsh.) DC. (Mountain ash)				1								
G—Quercus alba L. (White oak)										1		
A—Quercus macrocarpa Michx. (Burr oak, mossy cup oak)			1									
G—Quercus rubra L. (Red oak)	1	1								1		

ORLEANS COUNTY SPECIES DISTRIBUTION TABLE

SPECIES:	SPECIFIC HABITAT											
Vascular Plants	*Oak Pine*	*Beech Maple*	*Swamp Forest*	*Bog Forest*	*Open Bog*	*Abandoned Fields & Roadsides*	*Rocky Cedar Swamp*	*Gorges and Water-falls*	*Marsh*	*Muddy Stream Banks*	*Water*	*Lawns*
G—Ranunculus abortivus L. (Small-flowered buttercup)		2			1							
G—Ranunculus acris L. (Tall buttercup)								1				
Sh—Rhamnus cathartica L. (Common buckthorn)			1									
Sh—Rhododendron nudifloram (L.) Torr. (Azalea, Pinxter flower)			1									
Sh—Rhus radicans L. (Poison ivy)		2	2			1		1				
St—Rhus typhina L. (Staghorn sumac)			1	1	1	1						
Sh—Rhus vernix L. (Poison sumac)			1									

ORLEANS COUNTY SPECIES DISTRIBUTION TABLE

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SPECIES: *Vascular Plants*	SPECIFIC HABITAT											
	Oak Pine	*Beech Maple*	*Swamp Forest*	*Bog Forest*	*Open Bog*	*Abandoned Fields & Roadsides*	*Rocky Cedar Swamp*	*Gorges and Water-falls*	*Marsh*	*Muddy Stream Banks*	*Water*	*Lawns*
G—Ribes sp. (Wild currant)		1										
Sh—Rubus allegheniensis Porter (Blackberry)		2			3	2						
Sh—Rubus odoratus L. (Purple flowering raspberry)		2										
Sh—Rubus occidentalis L. (Blackcap raspberry)				1	1	1						
Sh—Rubus occidentalis L. forma pallidus Bailey (Yellow raspberry)						1						
G—Rubus pubescens Raf. (Dwarf raspberry)			1									
G—Rubus sp.		1										

ORLEANS COUNTY SPECIES DISTRIBUTION TABLE

SPECIES: *Vascular Plants*	SPECIFIC HABITAT											
	Oak Pine	*Beech Maple*	*Swamp Forest*	*Bog Forest*	*Open Bog*	*Abandoned Fields & Roadsides*	*Rocky Cedar Swamp*	*Gorges and Water-falls*	*Marsh*	*Muddy Stream Banks*	*Water*	*Lawns*
G—Rudbeckia hirta L. (Brown-eyed susan)					1	1						
G—Rudbeckia laciniata L. (Green cone flower)			1									
G—Rumex sp. (Dock)			1									
D—Salix sp. (Willow)						1			1	2		
Sh—Sambucus canadensis L. (Elderberry)		1										
Sh—Sambucus racemosa L. (Red-berried elder)		1										
Aq—Saururus cernuus L. (Lizard's tail)											1	

ORLEANS COUNTY SPECIES DISTRIBUTION TABLE

SPECIES: *Vascular Plants*	SPECIFIC HABITAT											
	Oak Pine	*Beech Maple*	*Swamp Forest*	*Bog Forest*	*Open Bog*	*Abandoned Fields & Roadsides*	*Rocky Cedar Swamp*	*Gorges and Water-falls*	*Marsh*	*Muddy Stream Banks*	*Water*	*Lawns*
G—Scirpus sp. (Bulrush)										1		
G—Scutellaria sp. (Skull cap)			1									
G—Silene antirrhina L. (Sleepy catchfly)					1							
G—Silene cucubalus Wipel (Bladder campion)			1			1						
G—Sisyrinchium sp. (Blue eyed grass)									1	1		
G—Sium suave Walt. (Water parsnip)			1			1				1		
G—Smilacina racemosa (L.) Desf. (False Solomon's Seal)		3						1				

ORLEANS COUNTY SPECIES DISTRIBUTION TABLE

SPECIES:	SPECIFIC HABITAT											
Vascular Plants	*Oak Pine*	*Beech Maple*	*Swamp Forest*	*Bog Forest*	*Open Bog*	*Abandoned Fields & Roadsides*	*Rocky Cedar Swamp*	*Gorges and Water-falls*	*Marsh*	*Muddy Stream Banks*	*Water*	*Lawns*
G—Smilacina stellata (L.) Desf. (Star Solomon's Seal)		1	1									
G—Smilax herbacea L. (Carrion flower)			1									
V—Solanum dulcamara L. (Purple nightshade)			2			3		1		1		
G—Solidago caesia L. (Blue stemmed goldenrod)		1								1		
G—Solidago graminifolia (L.) Salisb. (Flat-topped goldenrod)					1							
G—Solidago juncea Ait. (Goldenrod)					1							
G—Solidago nemoralis Ait. (Goldenrod)					1							

ORLEANS COUNTY SPECIES DISTRIBUTION TABLE

SPECIES: *Vascular Plants*	SPECIFIC HABITAT											
	Oak Pine	*Beech Maple*	*Swamp Forest*	*Bog Forest*	*Open Bog*	*Abandoned Fields & Roadsides*	*Rocky Cedar Swamp*	*Gorges and Water-falls*	*Marsh*	*Muddy Stream Banks*	*Water*	*Lawns*
G—Solidago rugosa Ait. (Rough leaved goldenrod)					1							
G—Solidago sp. (Golden rod)										1		
G—Sparganium sp. (Bur-reed)									2			
Sh—Spirea latifolia (Ait.) Borkh. (Meadow-sweet)			1						1			
G—Stellaria media (L.) Cyrillo (Chickweed)								1				
G—Symplocarpus foetidus (L.) Nutt. (Skunk cabbage)			1	1								
G—Tanacetum vulgare L. (Tansy)								1				

ORLEANS COUNTY SPECIES DISTRIBUTION TABLE

SPECIES: *Vascular Plants*	SPECIFIC HABITAT											
	Oak Pine	*Beech Maple*	*Swamp Forest*	*Bog Forest*	*Open Bog*	*Abandoned Fields & Roadsides*	*Rocky Cedar Swamp*	*Gorges and Water-falls*	*Marsh*	*Muddy Stream Banks*	*Water*	*Lawns*
Sh—Taxus canadensis Marsh. (American yew)			1	1			1					
G—Thalictrum polygamum Muhl. (Tall meadow-rue)			2									
A—Thuja occidentalis L. (White cedar)			2				4	1				
G—Tiarella cordifolia L. (Foam flower)		1										
A—Tilia americana L. (Bass wood)		3										
G—Trifolium repens L. (White clover)					1	1						
G—Trillium erectum L. (Wake robin)		5										

ORLEANS COUNTY SPECIES DISTRIBUTION TABLE

SPECIES:	SPECIFIC HABITAT											
Vascular Plants	*Oak Pine*	*Beech Maple*	*Swamp Forest*	*Bog Forest*	*Open Bog*	*Abandoned Fields & Roadsides*	*Rocky Cedar Swamp*	*Gorges and Water-falls*	*Marsh*	*Muddy Stream Banks*	*Water*	*Lawns*
G—Trillium grandiflorum (Michx.) Salisb. (Large flowered trillium		5										
G—Trillium undulatum Willd. (Painted trillium)		1										
D, A—Tsuga canadensis (L.) Carr. (Hemlock)	1	4	1					2				
Aq—Typha latifolia L. (Cattail)									3			
D—Ulmus americana L. (American elm)	1	7				1				2		
Aq—Utricularia vulgaris L. (Bladderwort)											1	

ORLEANS COUNTY SPECIES DISTRIBUTION TABLE

SPECIES:	SPECIFIC HABITAT											
Vascular Plants	*Oak Pine*	*Beech Maple*	*Swamp Forest*	*Bog Forest*	*Open Bog*	*Abandoned Fields & Roadsides*	*Rocky Cedar Swamp*	*Gorges and Water-falls*	*Marsh*	*Muddy Stream Banks*	*Water*	*Lawns*
G—Uvularia perfoliata L. (Bellwort)					1							
Sh—Vaccinium corymbosum L. (Highbush blueberry)				2	2							
V—Vaccinium macrocarpon Ait. (Large cranberry)					1							
Sh—Vaccinium sp. (Blueberry)					1							
G—Verbena hastata L. (Blue vervain)									1			
G—Verbena urticifolia L. (White vervain)					1							
Sh—Viburnum acerifolium L. (Maple-leaved viburnum)		2		1				1				

ORLEANS COUNTY SPECIES DISTRIBUTION TABLE

SPECIES:	SPECIFIC HABITAT											
Vascular Plants	*Oak Pine*	*Beech Maple*	*Swamp Forest*	*Bog Forest*	*Open Bog*	*Abandoned Fields & Roadsides*	*Rocky Cedar Swamp*	*Gorges and Water-falls*	*Marsh*	*Muddy Stream Banks*	*Water*	*Lawns*
Sh—Viburnum alnifolium Marsh. (Hobblebush)		1										
Sh—Viburnum dentatum L. (Southern arrowwood)			1							1		
Sh—Viburnum lentago L. (Nannyberry)			1									
Sh—Viburnum recognitum Fern. (Arrowwood)		1	1						1			
G—Viburnum trilobum Marsh. (Highbush cranberry)						1						
G—Vicia sp. (Blue vetch)						1						
G—Viola conspera Reichenb. (Violet)		1										

ORLEANS COUNTY SPECIES DISTRIBUTION TABLE

SPECIES: *Vascular Plants*	SPECIFIC HABITAT											
	Oak Pine	*Beech Maple*	*Swamp Forest*	*Bog Forest*	*Open Bog*	*Abandoned Fields & Roadsides*	*Rocky Cedar Swamp*	*Gorges and Water-falls*	*Marsh*	*Muddy Stream Banks*	*Water*	*Lawns*
G—Viola cucullata Ait. (Blue violet)										1		
G—Viola pallens (Banks) Brainerd (White violet)		1										
G—Viola pennsylvanica Michx. (Smooth yellow violet)		1										
G—Viola pubescens Ait. (Downy yellow violet)		1										
G—Viola rostrata Pursh. (Long-spurred violet)		1										
G—Viola sp. (Violet)		3										
G—Woodwardia virginica (L.) Sm. (Virginia chain fern)					1							

TOTALS ORLEANS COUNTY SPECIES DISTRIBUTION TABLE

SPECIES:	SPECIFIC HABITAT											
	Oak Pine	*Beech Maple*	*Swamp Forest*	*Bog Forest*	*Open Bog*	*Abandoned Fields & Roadsides*	*Rocky Cedar Swamp*	*Gorges and Water-falls*	*Marsh*	*Muddy Stream Banks*	*Water*	*Lawns*
LIVERWORTS	0	4	5	0	0	0	1	3	1	0	0	0
MOSSES	14	67	20	4	7	4	27	57	7	13	7	8
VASCULAR PLANTS	3	103	81	34	29	23	4	23	19	32	14	2

CITATIONS IN THE ROCHESTER ACADEMY OF SCIENCE

1970

WOLF VISHNIAC

Honorary Member

When the mind of man was freed from the geocentric treadmill, it lifted-off into infinite orbits. But the works of man were still shackled to terrestrial gravity. Then came the space age and now his tools and he himself are inserting the trajectories of his mind. One of the new pioneers is our candidate tonight. His work is more fundamental than answering the question as to whether or not there are intelligent beings on Mars, for we must first find out whether there is life upon the red planet and study the organic chemistry of the universe. Microbiological study is needed and this discipline has to be coupled with the amazing technology of tele-monitoring in order to implement the science of exobiology.

Tonight we honor a professor of biology at the University of Rochester and Associate Director of the Space Science Center there. In 1946 he changed his Latvian citizenship to that of the United States. He earned his doctorate at Stanford University in 1949. His research is in the metabolism of chemisynthetic and photosynthetic organisms. He is foremost among those in the development of instrumentation for the automatic detection of microorganisms in planetary exploration. One of his devices has been nicknamed the wolf trap and has the capability of sampling soil, conducting several tests, and transmitting the results back to Earth.

He has written over eighty papers in his field and is a member of nine erudite societies. He received NASA's Apollo Achievement Award for his part in man's first moon landing.

Not too far in the future the wolf trap will descend into the dawn and settle in the red dust. Its appearance may answer the long-asked Martian question as to whether or not there is life on Earth. We are proud to recognize this possibility by extending our Honorary Membership to him.

Kenneth Jay Brown

Fellow

For every man who walks on the moon there are many who have to be content to observe our satellite. Our candidate is a former member of the Rochester moonwatch team. In addition, through his efforts in our Astronomy Section and by manning the public telescope in the Planetarium of the Rochester Museum and Science Center, he has expanded the minds and outlooks of thousands of the young and old.

His boyhood days in Glens Falls, New York, were influenced by a 6-inch telescope built by his father. His scientific leanings led to graduation from Rochester Institute of Technology in 1947. He is employed in the Synthetic Chemicals Division of the Eastman Kodak Company. He is a member of the American Chemical Society and of the Museum.

As member and officer of our Academy, as Chairman of the Astronomy Section, and as the maker and sharer of 6- and 8-inch telescopes, he has encouraged worthwhile interest in astronomy. Two National Astronomical League Conventions have had the guidance and benefit of his energies. He has chased two total eclipses—one even, in a clear-sky area.

For showing those who cannot visit the moon that it is a nice place to look at, we are pleased to make him one of our Fellows.

Gertrude Freitag Brown

Fellow

Amateur astronomer by marriage, our next candidate does her best to show the children of Rochester that Earth is a good place to live. She is presently Chairman of the Neighborhood Museum Project of the Rochester Museum and Science Center. Last year this program brought Museum collections to 45,000 inner-city residents. Small, single-concept exhibits were installed every few weeks in six community centers by a corps of volunteers led by the Women's Council.

As chairman of the project, she is involved with recruiting, training, and directing the volunteers. She has shown great creativity in planning exhibits dealing with nature, technology, local history, and ethnic cultures. This arises out of her own genuine and active interest in such fields.

Childhood in Clifton Springs, New York, and two inquiring children of her own account for hobbies of gardening, enjoying nature, and camping. She is past Secretary-Treasurer of our Astronomy Section and has edited our monthly bulletin and its intriguing science notes for some years.

For bringing the Museum to thousands who could not themselves go to the Museum, we offer her our appreciation and our honor of Fellow.

Dorothy Lind

Fellow

One of the essential ingredients to the survival, stature and growth of any organization is the maintenance of accurate records of the activities of the organization and of the deliberations of its officers and committees.

Our next candidate this evening has served the Academy well as Recording Secretary, and has also found time to be Secretary of the Mineral Section of the Academy. In addition, her contributions as Secretary and Publicity Chairman of the Rochester Gem and Mineral Shows are recognized as having played an important role in the success of the 19th Annual Convention of the Eastern Federation of Gem and Mineral Societies held in Rochester in June, 1969, and co-sponsored by the Mineral Section of the Academy.

After active service in the U. S. Marines, she attended the University of Rochester, from which she obtained her BA degree. A geology class at the University aroused a latent interest in minerals and in mineral collecting.

She is presently Executive Assistant to the President of the firm where she is employed, a capacity which reinforces the talent that she has applied to her valued services to the Academy and to its Mineral Section.

For exemplary enthusiasm and ready services, we are most happy to confer upon her the honor of Fellow.

ROCHESTER ACADEMY OF SCIENCE

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Mrs. Sarah Talpey (1969)
Gerhard W. Leubner (1970)
John W. Foster (1971)
Joel T. Johnson (1969)
Charles F. Wray (1970)
Robert G. McKinney (1971)

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(Also Members of Council)

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William N. Fitzgerald

BOTANY
M. Joseph Klingensmith

MINERAL
Henry E. Byers

ORNITHOLOGY
Mrs. Mary Ann Sunderlin

(In the 1965–1966 listing of officers, Clair F. Smith was erroneously recorded as Chairman of the Mineral Section instead of Dr. Albert C. Smith.)

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BOTANY
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ROBERT G. MCKINNEY (1971)
MRS. SARAH TALPEY (1972)
JAMES S. WISHART (1973)

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