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WISCONSIN ACADEMY

OF

SCIENCES, ARTS, AND LETTERS

VOL. L

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MADISON, WISCONSIN
1961

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PRESIDENTIAL ADDRESS

AN ACADEMY . . . OF ARTS AND LETTERS

MERRITT Y. HUGHES
President, Wisconsin Academy of Sciences, Arts, and Letters, May 7, 1960 to May 6, 1961

Our name declares a triple faith which we share with only one other academy in this country, the Michigan Academy of Sciences, Arts, and Letters. In our early *Transactions* little space may have been given to Arts and Letters, and in that space there may have been much candid doubt about the purpose and even about the meaning of the words themselves. Though like other state academies, ours owed its birth to its founders' confidence in Science as the servant, if not the saviour, of the commonwealth, its founders gave it a name which implies that man does not live by bread alone.

Were the founders trying to save our young economy from ever needing the warning which those words carry in the title of a recent Russian novel? It would be pleasant to think of them as trying to forestall the cultural "imbalance" which is now puzzling our efforts to overtake the Russians in scientific education. In the early *Transactions* there are indications of such foresight. Though they may not indicate much anxiety about the future, they do suggest wisdom in interpreting the past. Our founders may have regretted the growing imbalance in the Anglo-American tradition—the attitude towards science for which Bacon's *Advancement of Learning* has been principally blamed. Our founders seem to have shared Bacon's understanding of the importance of the imagination in both science and literature. They were not deceived by his narrowly utilitarian interpreters.

Perhaps the founders remembered that when the Royal Society was chartered by Charles II in 1662, although the "glory of God" was one of its avowed objects, the humanities were ignored in the charter. Its purpose was starkly declared to be to "promote by the authority of experiments the sciences of natural things, and of useful arts." Of course it is a mistake to regard the founders of the Royal Society as enemies of the fine arts or of literature. With a dramatist like the Duke of Buckingham, a scientific romancer like John Wilkins (later bishop of Chester), an architect like Sir Christopher Wren, an antiquarian and essayist like John Evelyn, and an astronomically-minded Christian apologist like Bishop Seth Ward among them, the founders might assume that they themselves were

* Address of the retiring president, delivered at the 91st annual meeting of the Academy, May 6, 1961.

the great white hope of English literature. In their routine reports they expected to set that literature an example that would firmly correct its faults of style.[1] But of its patronage they washed their hands. When a visiting member of the *Académie Française* hinted to the first historian of the Royal Society that it had a poor library, he was ready with the reply that "With Books they meddle not . . . ; their Revenue they designe for Operators and not for Lecturers."[2] And when later their historian proposed that they might set up a literary academy something like the *Académie Française,* they turned him down. Being both more modest and more ambitious than those confident Englishmen, our founders proposed to meddle with books and to make Arts and Letters a part of their business.

With the Arts it must be confessed that they meddled very little, so little indeed as to make it a question whether our Academy has ever taken the Fine Arts seriously or ever clearly discriminated between the Useful Arts and Applied Science. From the beginning there has never been any doubt of our passionate interest in the sciences, or that we have tried hard to be interested in Letters. But in our history the record of the Arts—aside from Letters, which is an art both useful and fine—has hardly corresponded with the honor that we do them by electing a vice-president to represent them. In our original "Plan of Operations"[3] Departments of the Fine and Useful Arts were projected, but the former was abandoned to a patron who could hardly be expected to take any but the most pragmatic interest in them. The "Plan" expressed[4] the pious hope "that such relations may be established with the State Agricultural Society as, without changing . . . the independence of that organization, will constitute said Society the proposed Department of the Useful Arts: leaving the field of the Fine Arts to be filled by a newly-created Department of the Fine Arts, which it is thought may be formed very soon.

The pious hope bore withered fruit. The report of our first President to Governor Washburn[5] easily demonstrated the living interest

[1] Enough has been written about the determination of the founders of the Royal Society to chasten English writing on all its levels, including those of syntax and metaphor, and to "beat the mythologists out of the republic of letters." The matter is well summed up by Jackson I. Cope and Harold Whitmore Jones in their Introduction (p. xxv) to their edition of *The History of the Royal Society,* by Thomas Sprat. (St. Louis, Missouri: Washington University Studies, 1958.) If the founders could rise to read *The Origin of Species,* they would be delighted to find Darwin ranked by Sir Arthur Keith (in his new Introduction to its sixth Everyman edition [1928], p. xix) "with that small select group of great Englishmen which holds Shakespeare."

[2] This reply of Sprat to Samuel Sorbière is quoted by Dorothy Stimson in *Scientists and Amateurs: A History of the Royal Society* (New York: Henry Schuman, 1948), p. 75.

[3] *Bulletin of the Wisconsin Academy of Sciences, Arts, and Letters,* No. 1 (1870),

[4] *Ibid.,* p. 25.

p. 20.

[5] *Transactions of the Wisconsin Academy of Sciences, Arts, and Letters,* Vol. I (1872). President Hoyt's Report contained a list of 141 articles on scientific subjects by residents of the state which were known to be in print in 1870 (pp. 17–25).

of our founders in the natural sciences, but nothing was said about any response by the Agricultural Society to its appointment as patron of the Useful Arts. The best that President Hoyt could say about them[6] was that in the past they had generally been "cultivated with considerable success." Of the Fine Arts he confessed that "they had made little impression upon the life and character of the people. Architecture," he mourned, "both in the construction of private dwellings and buildings for public use, gave here, as elsewhere in our country, painful proof of a prevailing ignorance of the principles of the art."

Though a "Department of the Arts" figured in the *Transactions* of our first decade, it never contained more than three articles as against a score or more on the natural or social sciences. Peaks of three articles pretending to deal with the Arts, either Useful or Fine, were achieved in 1872 with the help of history and ethnography, and in 1873 entirely with the help of engineering. The first of the three titles under "Arts" in 1872 headed a two-page article on "The Production of Sulphide of Mercury by a New Process and its Use in Photography." It was followed by two papers totalling seventeen pages on "The Rural Population of England as Classified in Domesday Book" and "On the Place of the Indian Languages in the Study of Ethnology." In 1873 the now uncompromisingly useful "Department of the Arts" consisted of speculations "On Wisconsin River Improvement," "On the Strength of Materials as Applied to Engineering," and on "Railway Gauges."

In spite of an attempt[7] to draw the attention of the annual meeting of 1876 away from "the mechanic arts, admirable as are their results," to "those arts which are called *par eminence* Fine Arts, or more commonly 'Art,' " the Academy could not be interested either in the Fine Arts as a part of education or in the "Mechanic Arts" from any point of view except their utility. Thirty-four years later, when President Davis[8] analyzed the distribution of articles among what seemed to him to be the distinct fields of interest in the first thirty-six years of the *Transactions*, only .07% of the titles belonged under "Art." Unless we except Letters, which seem always to have been regarded by our founders as outside the "Department of the Arts," by 1907 it was submerged and forgotten. Wisely perhaps, we have resigned painting and sculpture to strong, local groups like the Madison Art Association (now over sixty years old) and the Milwaukee Friends of Art. In the years while we have been diligently developing the Junior Academy of Science under the direction of Professor John Thomson—and now under that of Pro-

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[6] *Ibid.*, pp. 25–26.

[7] By Alford Payne, S.T.D., in a paper on "Art as Education" (*Transactions*, IV, 32).

[8] J. J. Davis in "The Academy, its Past and Future," *Transactions*, XV, ii (1907), 891.

fessor Jack Arndt—the mysteriously named and brilliantly successful "music clinics" have grown up independently of us on the University campus in Madison. Without serious help from us parallel services to artistic high school students have been emerging on the Madison campus and at many of the State Colleges.

Perhaps it is too late for the Academy to think of justifying its profession of interest in the Fine Arts by trying to set up organizations on the levels of the municipal art associations or of the "clinics" for students on the Madison campus. It may be too late for us to think of any over-all service to the arts throughout the state such as is being rendered by the Wisconsin Arts Foundation and Council from its offices in Milwaukee and Madison.

The time for leadership in the arts by the Academy may indeed be past. Independent action on our part now might well seem to be—and actually be—intrusion upon the work of the Wisconsin Arts Foundation and several other organizations. Perhaps in a society where local choruses, local semi-professional theatres, and local private exhibitions of painting, photography, and sculpture are widespread spontaneous growths, central support and leadership in the arts may be less and less needed. It is hard to imagine anything that the Academy could do to improve the symphonic technique or the morale of the orchestra which is one of our hosts here in Waukesha. And yet as long as there is no truly professional symphony orchestra anywhere in Wisconsin, and as long as almost all our cities lack even the meanest public art displays, the Academy can hardly be at ease with its record of indifference to the Fine Arts.

II

On the junior level in the field of Letters it may also be true that there is now no room for service of any kind by the Academy. In all the eighteen years of the life of the Junior Academy of Science no one seems to have dreamed of a Junior Academy of Letters. If by a miracle we were to receive an endowment fully sufficient to finance such a Junior Academy—headed by a member of the Department of English or of Speech at one of the private or State Colleges or at the University—could a leader be found to try to build up interests in reading and writing among adolescents in numbers justifying regional meetings rivalling the seven established regional meetings of the Junior Academy of Science? Could such a leader possibly contrive programs excelling or supplementing the existing pyramid of regional and state-wide forensic meets which are sponsored by the Department of Speech in the University Extension? With no broader base than the Academy affords, will it ever be possible to challenge or even in a modest way to supplement such developments in the field of "Letters" as the Speech Institute and the Summer High School Journalism Workshop which are to be launched in a few weeks on the Madison campus? In the neglected center of the field of "Letters" should the Academy attempt any initiative apart from the now vigorous Wisconsin Council of Teachers of English? On the level of a Junior Academy of Letters it is hard to imagine any work being done which is not already being better done by specialists. This is most obviously true in History, for our Academy itself is younger than the State Historical Society.[9] In numbers our Junior Academy of Science falls far short of the nearly twenty-two thousand Young Historians who subscribe to *The Thirtieth Star* and are challenged to compete in regional essay contests that culminate in the award, at the annual banquet, of prizes really commensurate with the hard work of both the contestants and the judges.

Policy and decency alike forbid the Academy to trespass in regions which belong to the established educational agencies in a state whose boundaries were long ago declared by the President of its University to be no wider than those of the campus. If the University were to propose a literary partnership with us on the lines of the Junior Academy of Science, we might not decline; but no such initiative seems probable on either side. Partnership on that level with institutions like the Historical Society and other Wisconsin organizations awarding prizes for compositions of various kinds in English or other languages is also hardly likely. Perhaps it might take the form of recognition in some way by us of a few of their top contestants. Something of that kind flanking the awards of our Junior Science Academy at our annual meetings might help to redress an imbalance which many of our scientific members have long been chivalrously regretting.

III

If then we are to become in any effective way an Academy of Letters, it must be on an adult level and in ways distinct from the adult education which is being constantly broadened by the University Extension and many other agencies, private as well as public. It must be done—I believe—on a basis of three principles. One of them is the principle that, at least in modern times, the main

[9] The senior position of the Historical Society was recognized in the Academy's original *Plan of Operations*, pp. 20–21, by a suggestion that, "with mutual advantage," the Academy's Department of Letters might "be formed about the State Historical Society, should that useful and prosperous institution favor the establishment of a relation of that sort; said Society maintaining its . . . independent existence and yet fulfilling the office of the proposed Department by an enlargement of its scope, so as to embrace investigations in the branches properly included, and by concentrating in its library all the works that may be accumulated by the Academy in whatever Department."

function of literary academies is the recognition of literary achievement. Another emerges from the fact that in the *Transactions* we have a small but sound inheritance of literary scholarship. The third emerges from the need in Wisconsin—as everywhere else—to create a working alliance between Science and Literature. The extraordinary thing about the three principles is that they can be put into effect without any addition to our budget or any change in our organization. They need only to be kept firmly in mind by the editors of the *Transactions* and the *Review,* and to be worked more and more effectively into the programs of our meetings and into the imagination of many people who ought to be interested in the Academy and perhaps have not even heard of it.

Recognition of literary achievement by prizes is beyond our resources and would hardly be possible even if we had an endowment equal to the Nobel funds in Stockholm. It would, of course, be a great pleasure if we could help serious young writers by "crowning" their really outstanding work as the *Académie Française* does in about a score of cases year by year. To undertake anything of the kind would require both a formidable tradition like that which is maintained by the French Academy and a force of technical assistants costing much more than the value of the awards that would be made. To be of any real importance the awards would have to be absolutely distinct from the scholarships which are made in ever increasing numbers by schools and Foundations to encourage young writers of "promise." Even if awards were restricted to authors having some vital connection with Wisconsin, the standard would have to approximate that of a national literary Hall of Fame. Whether we liked it or not, in awarding them we should be setting ourselves up as a kind of literary tribunal dedicated—as Matthew Arnold said in "The Literary Influence of Academies"[10]—to maintaining standards giving "the law, the tone to literature, and that tone a high one."

The responsibilities and pretensions of a literary tribunal may be unavoidable by any official organization calling itself an Academy of Letters. Certainly we ought not to try to avoid them. Yet we are in no position to assume them with an authority even remotely resembling that of the French Academy, of the Royal Society of Literature, or of the Royal Society of Canada. If ever we are in such a position, it can only be by some almost unimaginable change in the level of culture throughout the state. But at our annual meetings it is easily within our power *as we are* to add to the critical reputation of writers of real worth, minor as well as major, living as well as dead. It is strange that August Derleth's *Still Small Voice*

[10] *Essays Literary and Critical* by Matthew Arnold. (London and Toronto: J. M. Dent & Sons, 1906; reprinted 1914), p. 28.

was not anticipated by any criticism of Zona Gale in our *Transactions*. Stranger still is the silence there about the Son of the Middle Border, though it may be no stranger than the facts that his manuscripts are in the Doheny Library at the University of Southern California, and that our two biographies[11] of Hamlin Garland should both have been published by University Presses outside of Wisconsin. Yet in the *Transactions* we have had analyses of some minor Wisconsin writers, such as the study of Margaret Ashmun by Julia Grace Wales.[12]

IV

In a multi-national world any limitation of interest to the literature of an area no larger than our state is impossible for a publication of world-wide exchange like that of our *Transactions*. And in a society with as much interest as ours has had, and with changing motives still has, in the literature of the past and its interpretation, an Academy of Letters is naturally concerned—perhaps too much concerned—with antiquity. At the outset the "Department of Letters" in the *Transactions* typically consisted of only one or two "Studies in Comparative Grammar" like the short paper on "Some Weak Verbs in the Germanic Dialects"[13] which alone represented it in Volume II. That little investigation of the development of a few Gothic strong verbs into weak ones did well if it got as large an audience as presumably listened to the most specialized of the twenty-three scientific papers in that Volume, Dr. P. R. Hoy's description of the water puppy.[14] Over-specialized and remote from the larger issues of life though the little study in comparative grammar may have been, it represented a valid curiosity about language which incidentally linked the author to philologists in all the great universities of the world. For him and for them it had a beauty no less lovely than Dr. Hoy saw in his water puppy—"a most beautiful object, as it appears in its favorite surroundings, with the long scarlet plumose gills, continually waving backwards and forwards."

The slow relaxation of the grip of historical philology upon the "Department of Letters" in our *Transactions* betrays its dependence upon the men teaching languages in the University and upon the fashions of scholarship in the late nineteenth century. Misguided though the fashions may seem to us now, they helped to keep the Academy aware of widening horizons in literary history.

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[11] Donald Pizer's *Early Life of Hamlin Garland* (Los Angeles: University of California Press, 1961) and Jean Holloway's *Hamlin Garland: A Biography* (Austin: University of Texas Press, 1960).

[12] *Transactions*, XXXIV (1942), 221–30.

[13] By J. B. Fueling, Professor of Comparative Philology, in the University of Wisconsin.

[14] "Water Puppy (Menobranchus lateralis say)." By P. R. Hoy, M.D. Pp. 248–50.

The progress is hard to chart because the papers published in that "Department" were either very few, or—with increasing numbers—they became miscellaneous and remote from any literary or philological interest. The few with a fair claim to be printed there show philology chaperoning literature in studies like "The Ἅπαξ Λεγόμενα of Shakespeare"[15] and, in an article on "The Vocabulary of Shakespeare"[16] by the same writer twenty-five years later, being lured within distant sight of modern esthetic studies of the vocabularies of the poets.

Still moving in traditional channels of academic literary scholarship in the first quarter of the twentieth century, and still almost monopolized by men from the modern language departments at the University, the little current of literary studies became less specialized as it slowly broadened on its way through the sea of increasingly specialized scientific articles in the *Transactions*. In many of our papers in all fields over-specialization may have been a vice. But charges of that kind are most readily made by audiences whose interests are themselves too narrow. A glance back at the series of medieval and Chaucerian studies which Karl Young contributed to the *Transactions* before his translation from our University to Yale shows not merely a national scholarly reputation in the making but also a foundation being laid for our most recent illuminations of Chaucer's poetry against its whole literary and cultural background.

On the basis of Karl Young's papers it would be absurd to boast that in the twenties the *Transactions* made a major contribution to American scholarship. So on the basis of Ruth Wallerstein's study of "Cowley as a Man of Letters"[17] it would be absurd to think that in the thirties the Academy took a leading part in the extension of interest in the "Metaphysical Poets" to their heir who narrowly missed being elected a Fellow of the Royal Society. The important thing for the Academy is the fact that its programs have often included literary studies which were scholarly by the strictest academic standards and at the same time had an obvious bearing on the main developments in the literature of the past.

The literature of the past has had at least its full share of attention from the Academy. For this the influence of the universities has been partly responsible, but to that same influence our recent programs owe dissections of the plays of two prominent American dramatists, Arthur Miller and Tennessee Williams,[18] essays on con-

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[15] By Professor J. D. Butler, LL.D., of Madison. *Transactions,* V (1877–1881), 161–76.

[16] *Transactions,* XIV. i (1902), 40–55.

[17] *Transactions,* XVI (1932), 127–140.

[18] "Memory and Desire and Tennessee Williams' Plays," by John J. Enck, in *Transactions,* XLII (1953), 249–56, and "Arthur Miller: An Attempt at Modern Tragedy," by Alvin Whitley, in *Transactions,* XLII, 257–62.

temporaries like Camus,[19] Valèry Larbaud and Samuel Becket,[20] and at least one discussion of a debatable aspect of modern poetry.[21] In recent volumes of the *Transactions* the increasing majority of studies of contemporary writers seems to show that our liveliest interest is in the literature of the present.

The only literature that we neglect is that of the future, which in the past it has been the professed purpose of the great literary academies to foster and mould. That task the Academy has never seriously considered. On the level of help to writers young or old by prizes or scholarships the way is not open. On that of guidance for amateur writers we can only leave the responsibility to the creative writing seminars. In their encouragement we cannot compete with the poetry societies or offer a medium of publication that could possibly serve them as well as do the better poetry magazines, one of the best of which is published no further away than Beloit.

The best service within our power to the literature of both the present and the future lies most surely in more criticism of contemporary writers like that which has been slowly emerging in the *Transactions*. More and more of it is likely to seek us out. Three or four newspapers in the state are extending the audience for such criticism and helping to raise its standards. Rising enrolments in the University and State Colleges are fast increasing the staffs of modern language teachers eager to write such criticism. With the multiplication of advanced courses in literature in the hands of young men in the State Colleges in ranks often superior to those of men of comparable training in the University, critical scholarship of the best kind in many fields should be increasingly offered to us from all over the state. The amount may force us to find a literary assistant for the Editor of the *Transactions*. If the final results are not good, we shall have only ourselves to blame.

V

The great problem, of course, is to redress the imbalance between our interests in Science and Letters. It has always existed—less because the planners of our programs have been partial than because for many years practically no papers were offered for the "Department of Letters." Only by extension to offerings from sociology, anthropology, political science, and ethics could the caption be justified, and before the turn of the century it was dropped. In his analysis[22] of everything which had been published in the *Trans-*

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[19] Robert F. Roeming, "Camus Speaks of Man in Prison," in *Transactions*, XLIX (1960), 213–218.

[20] Melvin J. Friedman, "Valèry Larbaud and Samuel Becket," *Transactions*, XLIX (1960), 219–28.

[21] Haskell M. Block, "*Furor Poeticus* and Modern Poetry," *Transactions*, XLV (1956), 77–90.

[22] By J. J. Davis in *Transactions*, XV, ii (1907), 891.

actions down to 1906 President Davis found that only 13% could be classed under "Letters." By including papers in "Social and Political Science" the percentage rose to 33%. It became customary to lump those sciences with Letters under the term "Humanities." Some hardly humane wars were fought between partisans of the remote antiquity and the almost immediate contemporaneity of the Indian mounds. Some strange appeals to physiology and chivalry were made by both sides in the battle over women's rights. The problems of control of the railways and the "trusts" were solved more by faith than by knowledge of law or economics, and the state's obligations to its schools, its criminals, and the insane were treated with a speculative assurance that seems sadly unscientific today.

In spite of the embarrassing rhetoric and confused thinking on some of the pages dealing with what President Davis called "Social and Political Science," there were some solid papers on ethics. From an early discussion[23] of the mind's constraints upon its own liberty by the President of the University to Professor Frank Sharp's analysis[24] of "The Personal Equation in Ethics" the approach was psychologically realistic. On the level of public morals it often was learnedly and earnesty realistic in articles like Charles N. Gregory's on "Political Corruption and English and American Laws for its Prevention."[25]

In the studies which President Davis roughly described as "humanistic" a kind of true civic humanism was being worked out. Its effect upon our programs was felt first in the matter of forest conservation but—as President Davis sadly remarked—with no visible effect upon public policy. Some of its features were to emerge later in the noble but vague "Wisconsin Idea." In the *Transactions* it sometimes had Utopian overtones, but it was chastened by the standards of the scientific articles. Even in the wishful realm of geology those standards never fell, though a geologic survey of the state was the Academy's first enterprise. They stood firm from our earliest, unhopeful reports of precious metals to the grimly humorous treatment of the record of die-hard faith in them by our lately lost State Geologist, Ernest F. Bean. In the philosophy of our civic humanism the natural sciences have been a discipline quite as much as they have been a Baconian genie promising that by hitching our wagons to stars we can squeeze unlimited wealth out of nature.

If in reading old volumes of the *Transactions* we are sometimes puzzled by the confused roles of Sciences and Letters, there may be

[23] "Freedom of Will Empirically Considered" in *Transactions,* VI (1885), 2–20.
[24] *Transactions,* X (1894), 310–326.
[25] *Transactions,* X (1894), 262–297.

comfort for us in looking back for a moment at their confusion by the ancestor of all modern academies, the French Academy which flourished in the reign of Henri III under the leadership of the poet Jean-Antoine de Baïf, nearly a century before the founding of the Royal Society. Its philosophy was Platonic and owed much to the Neo-Platonic academic tradition in Italy. Its doctrine was the belief that poetry, the queen of all sciences and arts, could be cultivated only by men of universal knowledge. One of its manifestoes[26] describes a symbolic Temple of the Arts where Aristotle displays them all to the patroness of the Academy, Marguerite of Savoy. Though Poetry is their queen, the seven arts are led by Military Science. Rhetoric comes third and Grammar only fifth. Between them march Medicine and Architecture. The last is Agriculture. Though in this strange hierarchy the sciences do not seem to rank high, the interest in them was great. In the correspondence of some of the leaders—all of them poets—scientific interests constantly emerge. Their great concern was with cosmography or astronomy, and the main weight of evidence[27] shows pretty clearly that they were on the side of Copernicus in the debate in which so many Englishmen—including Francis Bacon—were against him.

In naming their Academy of Sciences, Arts, and Letters, our founders preserved more than a trace of the belief of Henri III's academicians that the disciplines are mutually indispensable. That faith forever needs reaffirmation. In a specialized world where scientists in different subdivisions of their fields cannot always understand one another, the reaffirmation of that faith is more and more necessary. James Bryant Conant's book *On Understanding Science*[28] might well be prescribed reading for scientists as well as for humanists. The response of the humanities to science in poetry and fiction might also be the basis of some widely prescribed reading of primary and secondary material. Of the latter Marjorie Hope Nicolson's *The Breaking of the Circle*[29] might be suggested for scientists. An example in our *Transactions* is Harry H. Clark's "The Role of Science in the Thought of W. D. Howells."[30] The situation is not helped by the revolt against the scientists and their "myths" by several only too representative living poets who have suffered con-

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[26] *Civitas veri sive morum Bartholmei Delbene Patricii Florentini Ad Christianissimum Henricum III Francorum et Poloniae Regem Aristotelis de Moribus doctrinam, carmine et picturis complexa et illustrata Commentariis Theodori Marcilii, Professoris Eloquentiae Regii,* Paris, 1609. The grand pictorial plan of the City of Truth is reproduced by Frances A. Yates in *The French Academies of the Sixteenth Century* (London: The Warburg Institute, 1947), opposite page 112.

[27] As presented by John C. Lapp in his Introduction to his edition of *The Universe of Pontus de Tyard* (Ithaca: Cornell University Press, 1950), pp. xliii–xlvi.

[28] New Haven: Yale University Press, 1947.

[29] Evanston: Northwestern University Press, 1950.

[30] Volume XLII (1953), pp. 263–304.

dign punishment in Joseph Warren Beach's *Obsessive Images*.[31] What is needed is an initiation for all of us in both Science and Letters. To that good end the programs of our annual meetings can help in a small way—but only if we succeed much better than our founders and leaders have yet done in trying to make the Academy justify its name.

[31] Minneapolis: University of Minnesota Press, 1960; pp. 286–93.

SCIENCES

PRELIMINARY REPORTS ON THE FLORA OF WISCONSIN NO. 44 CRUCIFERAE—MUSTARD FAMILY*

JACQUELINE P. PATMAN and HUGH H. ILTIS
Herbarium of the University of Wisconsin, Madison

There are few families in the Wisconsin flora that are as easy to recognize as the Cruciferae. In the course of its evolution an ancestral type hit upon a "streamlined" flower model, characterized by 4 sepals, 4 petals, and 6 stamens, of which two are shorter than the rest. The great success of this flower is attested by the large number of species and individuals in the family, and by the uniformity of floral structure. From genus to genus flower differences in the Cruciferae are often as small as the distinctions generally found in other families between species of the same genus. Thus, while it is easy to recognize a plant as belonging to the Cruciferae, the genera and species are often very difficult to tell apart. Fortunately for the taxonomist, however, natural selection did produce a highly varied assemblage of fruits of many shapes and types of dehiscence.

Our interest in the Cruciferae also stems from economic considerations, for aside from its many useful members such as cabbage, kale, brusselsprouts, cauliflower, radish, mustards and horse-radish, the family in Wisconsin contains many introduced garden plants as well as farm weeds, some of which, like the Yellow Rocket and Hoary Alyssum, are serious agricultural pests. And yet even the weeds, with their many bright flowers and large populations of individuals so characteristic of the group, help to give this family its special charm.

This treatment of the Cruciferae of Wisconsin is based on specimens in the herbaria of the University of Wisconsin, Madison, (WIS), University of Wisconsin–Milwaukee, Milwaukee Public Museum (MIL), the University of Minnesota (MINN), Northland College, Ashland, Eau Claire State Teachers' College, and Beloit College.

Dots on the maps represent specific locations, triangles county reports only. Numbers in the enclosures on the maps indicate the number of specimens in flower and fruit. Specimens in a vegetative condition are not included. These numbers indicate when the species is likely to flower and fruit in Wisconsin, and give a rough, though low, estimate of the amount of material that was available for this study.

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* A thesis submitted by the senior author in partial fulfillment of the requirements for the degree of Master of Science (Botany) at the University of Wisconsin, Madison, 1960. Published with aid of the Norman C. Fassett Memorial Fund.

The order of the genera is according to *Gray's Manual of Botany, ed. 8* (Fernald, 1950). In the general descriptions, liberal use was made of the above work, as well as of the *New Britton and Brown Illustrated Flora* (Gleason, 1952), and the *Flora of the British Isles* (Clapham, Tutin, and Warburg, 1952.)

Grateful thanks and acknowledgment for the loan of their Wisconsin Cruciferae are due to Drs. G. B. Ownbey, University of Minnesota, A. M. Fuller, Milwaukee Public Museum, A. L. Throne, University of Wisconsin, Milwaukee, F. C. Lane, Northland College, H. C. Greene, curator of the Cryptogamic Herbarium, University of Wisconsin, and Tom Hartley, Iowa State University, Iowa City.

We also wish to thank Drs. J .W. Thomson and J. D. Sauer for their constructive criticism, Mrs. Katharine S. Snell for her encouragement and invaluable assistance in the preparation of the manuscript, and Mr. J. E. Dallman for the execution of the *Cakile* drawings.

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CRUCIFERAE OF WISCONSIN

Annual, biennial or perennial herbs, with alternate or opposite, estipulate, simple, often lobed, or compound leaves. Flowers generally in various types of ebracteate racemes, regular, perfect, hypogynous; sepals and petals 4 (or rarely the latter lacking); stamens 6, with the two outer shorter than the 4 inner, all usually with nectariferous glands at their bases; pistil 2-carpellate, the ovary usually 2-celled by a thin partition, the *septum,* with many to as few as 1 ovule in each cell, or sometimes only one-celled with a single ovule. Fruit basically a capsule, though very variable, if elongate called a *silique,* if short a *silicle,* usually dehiscent with the 2 *valves* (ovary wall) deciduous, leaving the placenta *(replum)* and the intervening septum attached to the pedicel, or less commonly transversally septate with indehiscent segments *(Cakile, Raphanus, Erucastrum,* or *Brassica)* or completely indehiscent *(Neslia).*

ARTIFICIAL KEY TO GENERA

1. Cauline leaves compound or pinnately dissected more than halfway to the midrib, or at least the upper- or lowermost leaves pinnatifid -- 2

2. Plants aquatic, with finely dissected, submerged leaves; fruit a silicle; flowers white ---------------------- 23. ARMORACIA.
2. Plants terrestial or semi-aquatic, the leaves not finely dissected; fruit usually a linear silique, more than three times as long as broad, shorter in the yellow-flowered *Rorippa* -------- 3
3. Leaves few (2–3), palmately compound, the leaflets three or appearing as five or seven, the margins serrate or laciniate; flowers white to pink or pale purple ------ 25. DENTARIA.
3. Leaves generally numerous, pinnately dissected -------- 4
4. Fruits indehiscent, with a stout beak, often corky inside, (3–) 4–10 mm broad; leaves coarse with simple hairs, rough to the touch; petals 13–20 mm long, white, pink-purple or pale yellow ---------------------------- 11. RAPHANUS.
4. Fruits usually dehiscent (indehiscent in *Diplotaxis)*, non-corky, up to 4 mm broad ------------------------------ 5
5. Leaves, especially of the basal rosette, lyrate-pinnatifid, the margins entire; petals white, 5–8 mm long; siliques 2–4 cm long; plants small, slender, much branched ------------------------------ 27. ARABIS *(A. lyrata)*.
5. Leaves pinnate or pinnatifid ---------------------- 6
6. Seeds of ripe fruits arranged in *two* (often irregular) *columns in each locule* -------------------------- 7
7. Plants free-floating or creeping aquatics; petals white; leaves pinnate with rounded or elliptic leaflets ---------------------------- 22. NASTURTIUM.
7. Plants erect; petals yellow; leaves pinnatifid, not bearing distinct leaflets ------------------------ 8
8. Fruits linear, 2–5 cm long, with a prominent midnerve, indehiscent; leaves mostly at the base of the stem -------------------- 14. DIPLOTAXIS.
8. Fruits globose to oblong, plump, to 2 cm long, but mostly less than 1 cm, nerveless, dehiscent; stem leafy throughout ---------- 21. RORIPPA.
6. Ripe seeds (through elongation of their seed stalks) arranged *in a single column in each locule* ---------- 9
9. Leaves two or three times pinnate, sometimes once-pinnate; plants canescent or with glandular hairs ------------------------ 18. DESCURAINIA.
9. Leaves once pinnate or pinnatifid; plants neither canescent nor with glandular hairs ------------- 10
10. Petals white; leaves normally thin, pinnately divided with equal, linear, rounded or elliptical segments, the margins entire or wavy ---------------------------- 26. CARDAMINE.

10. Petals yellow; leaves often coarse, pinnatifid with segments of unequal size, the margins serrate or cleft ---------------------------------- 11

11. Uppermost leaves strongly clasping; stem and leaves glabrous above ---------------- 12

12. Uppermost leaves usually coarsely dentate, sometimes palmately lobed, broadly obovate to rounded ---------------- 24. BARBAREA.

12. Uppermost leaves entire or dentate, lanceolate to oblong ------------- 12. BRASSICA.

11. Uppermost leaves petioled or sessile; plants hispid throughout or at least at the base (except *Brassica juncea,* which is glabrous) -------- 13

13. Petals up to 4 mm long; fruit strictly appressed, sharp-pointed--- 17. SISYMBRIUM.

13. Petals 5–13 mm long -------------- 14

14. Cauline leaves pinnatifid with long linear segments, the uppermost feathery ----- -------------------- 17. SISYMBRIUM.

14. Cauline leaves pinnatifid, not feathery 15

15. All but the uppermost fruits leafy-bracted at the base, 4-angled ------------ ------------------ 13. ERUCASTRUM.

15. Fruits not leafy bracted, round in cross-section or nearly so ------------- --------------------- 12. BRASSICA

1. Cauline leaves simple, not cleft or pinnatifid (or if pinnatifid below, then perfoliate and simple above) ------------------- 16

16. *Fruit a linear silique,* more than three times as long as broad --- 17

17. Plants with a basal rosette, or bearing numerous distinct basal leaves; flowers white to pink or purplish, rarely pale yellow -- 18

18. Fruits oblong or oval, inflated or flattened and twisted, to 1.5 cm long -------------------------- 1. DRABA.

18. Fruits linear, 1.5–12.0 cm long ----------------- 19

19. Plants arising from a knobby tuberous base; pubescence of simple hairs or plants glabrous 26. CARDAMINE.

19. Roots non-tuberous, pubescence of simple, forked, or stellate hairs often only at base of stem, or plants glabrous ------------------------------------ 27. ARABIS.

17. Plants without a basal rosette or distinct basal leaves 20

20. Flowers white, pink, or purple ----------------- 21

21. Leaves obovate to oblanceolate, the margins sinuate toothed; petals 6–8 mm long; siliques indehiscent and transversely jointed; succulent beach plants of the Lake Michigan strand ---------------------- 10. CAKILE.
21. Leaves lanceolate or deltoid-ovate, not fleshy, the margins dentate or minutely toothed ----------------- 22
22. Petals white, about 4 mm long-- 16. ALLIARIA.
22. Petals pink or purple, rarely white, 10–20 mm long, showy -------------------------- 19. HESPERIS.
20. Flowers yellow -------------------------------- 23
23. Plants glabrous; leaves elliptic, auriculate-clasping --------------------------------- 15. CONRINGIA.

16. *Fruit a silicle,* less than three times as long as broad, triangular, oblongoid, or rounded ------------------------- 24
24. Fruits strongly flattened at least in the upper half, notched at the summit ------------------------------------ 25
25. Pods triangular-obcordate; flowers white 7. CAPSELLA.
25. Fruits circular or elliptic, when viewed from the flat side, strongly flattened; flowers white or greenish ----- 26
26. Seeds one per locule; fruits 2–4 mm broad ------------------------------------ 5. LEPIDIUM.
26. Seeds on per locule; fruits 8–15 mm broad ---------- ------------------------------------ 4. THLASPI.
24. Fruits various, flattened or not, often inflated or with a winged margin, not notched at summit ----------------- 27
27. Pods pear-shaped, tapering to the base ----------- 28
28. Flowers white or purple; fruits 3–4 mm long; plants low, bushy perennials ----- LOBULARIA (see genus 3.).
28. Flowers yellow; fruits 5–12 mm long; plants stiffly erect annuals ---------------------- 8. CAMELINA.
27. Pods nearly globose or ellipsoid, rounded or cordate at the base; *petals white* ----------------------------- 29
29. Margins of cauline leaves wavy to entire; plants annual -------------------------------------- 30
30. Fruits 5–8 mm long, elliptic, closely appressed to the stem; petals deeply 2-parted; plants densely white-hoary -------------------------- 2. BERTEROA.
30. Fruits to 3 mm long, circular, on divergent pedicels --- 31
31. Fruit dehiscent, with a narrow winged margin; seeds generally 4 per pod; low annual 3. ALYSSUM.
31. Fruit indehiscent, globose, not winged, the surface wrinkled; seeds one or two per pod; erect, strict annual -------------------------- 9. NESLIA.

29. Margins of cauline leaves serrate or crenate; plants perennial from a deep taproot ---------------------- 32
    32. Petals 5–7 mm long; silicles to 3 mm long, dehiscent though seeds never maturing; large-leaved, robust herb from a thick tap root ------------- 23. ARMORACIA.
    32. Petals about 2 mm long; silicles 2–3 mm long, indehiscent, with 1 seed in each half; leaves small, auriculate-clasping; slender weeds --------- 6. CARDARIA.

1. DRABA L.

[Hitchcock, C. L. 1941. *A Revision of the Drabas of Western North America.* University of Washington Publ. in Biology 11.]

Low slender annuals or perennial from a basal rosette, often stellate-pubescent throughout. Leaves small, simple, entire to dentate. Petals white or rarely pale yellow, the sepals ascending. Siliques flattened, often twisted; seeds numerous, red-brown, in two columns in each locule.

Key to Species

1. Fruits twisted, lanceolate, acuminate, the style elongate; plants perennial -- 2
    2. Pedicels and siliques glabrous or with a few simple hairs; seeds 1.0–1.7 mm long ------------------------ 1. *D. arabisans.*
    2. Pedicels and siliques heavily stellate-pubescent; seeds 0.8–1.0 mm long ---------------------------------- 2. *D. lanceolata.*
1. Fruits straight and flat, narrowly oblong, rounded at the apex; style lacking; plants annual or winter-annual ---------------- 3
    3. Plants 4–8 (–15) cm tall; leaves mainly basal, the cauline leaves few or lacking; raceme corymbiform, few-flowered; pedicels equalling or shorter than the fruits -------- 3. *D. reptans.*
    3. Plants (5–) 8–30 cm tall; cauline leaves present; inflorescence a loose raceme; pedicels longer than the fruit-- 4. *D. nemorosa.*

1. Draba arabisans Michx. Map 1.

Erect perennial, sparingly branched above, to 5 dm tall. Basal leaves oblanceolate, tapering to the base; cauline leaves oblanceolate to obovate, 5–45 mm long, broadly serrate, evenly but not heavily stellate-pubescent. Petals white, 3–4 mm long. Siliques lanceolate, acuminate, flattened and much twisted, glabrous or with very few simple hairs. Seeds oval, 1.0–1.7 mm long.

Rare, on shaded cliffs of Niagara Dolomite, in Door and Fond du Lac Counties. Flowering from mid-June through early July and fruiting from late June through July.

2. DRABA LANCEOLATA Royle Map 1.

Similar to *D. arabisans.* Stellate throughout. Basal leaves oblanceolate to spatulate, 7–30 mm long; cauline leaves lancelate to ovate. Petals white, 3–5 mm long; racemes leafy-bracted at base. Pods 4–14 mm long, densely and evenly stellate-pubescent. Seeds very small, ovoid, 0.8–1.0 mm long.

One collection, Door Co.: from summit of limestone cliff, Fish Creek, June 14 [in fruit], *Fassett 16216* (WIS), *16217* (MIL).

3. DRABA REPTANS (Lam.) Fern. Map 2.
Draba caroliniana Walt.

3a. DRABA REPTANS forma REPTANS

Minute annuals, 4–15 cm tall, branching from the basal rosette or slightly above. Stem sparingly pubescent with stellate and forked hairs. Basal leaves ovate, entire or nearly so, *densely stellate-pubescent;* cauline leaves few or lacking, usually entire. Inflorescence corymbiform, few-flowered; petals white, 4–5 mm long. *Siliques glabrous,* narrowly oblongoid, 0.8–1.3 cm long, slightly flattened. Seeds rounded, about 0.5 mm broad.

Frequent in sandy or gravelly places, especially in southern Wisconsin, on sandstone (sometimes limestone) cliffs, rocky hillsides, in sandy prairies, open sandy river terraces, often along sandy roadsides, gravel pits, cultivated fields and pastures. Flowering from mid-April through late May, being among our earliest flowering species, and fruiting from early May through early July.

3b. DRABA REPTANS forma MICRANTHA (Nutt.) Hitchc.

Siliques hispidulous; upper surface of leaves with *mostly simple hairs;* otherwise as f. *reptans.*

Dane Co.: crumbling sandstone, *Fassett 9884* (WIS) ; Dodge Co.: prairie relic along R.R., *Shinners 4252* (WIS).

4. DRABA NEMOROSA L. var. LEJOCARPA Lindbl. Map 1.

Widely branched slender annual, (5–) 8–30 cm tall, pubescent throughout with forked and stellate hairs. Basal leaves obtuse; cauline leaves oblong to ovate, acute. Petals pale yellow to white, about 2 mm long. Mature racemes very long with fruits nearly to the base of the plant. Siliques elliptic, 3–13 mm long, glabrous, the pedicels longer, slender, divergent.

Rare in Wisconsin, and doubtfully native, the two collections seemingly weedy: Marinette Co.: Marinette, June 25, 1916 [in fruit], *Goessl 4197* (MIL), *s.n.* (WIS) ; La Crosse Co.: dry sandy plain, Upper French Island (in Mississippi River), June 7, 1956 [in fruit], *Hartley 342* (WIS).

2. BERTEROA DC.

1. BERTEROA INCANA (L.) DC. Hoary Alyssum Map 3.

Erect, often much branched, to 1 m tall, *gray-green throughout* with dense, stellate pubescence. Leaves entire, lanceolate. *Petals white, deeply cleft,* 4–6 mm long. Silicles 5–8 mm long, inflated, ellipsoid, the style persistent. Seeds dark brown, 4 per locule.

A very common weed throughout the state, mostly on sandy or gravelly soil, along roadsides, railroads, in cultivated fields, pastures, sandy prairies, open woods and waste ground. Naturalized from Europe. Flowering from late May through early October and fruiting from mid-June through late October.

3. ALYSSUM L.

1. ALYSSUM ALYSSOIDES L. Small Alyssum Map 4.

Small annuals 7–25 cm tall, simple or branched from the base with several arched-ascending stems, whitish stellate-pubescent throughout. Leaves linear-spatulate, 8–15 mm long. Petals white or pale yellow; sepals persistent. Silicles round, lens-shaped with a winged margin, 2.5–3.5 mm in diameter, the valves smooth and nerveless, the style persistent. Seeds red-brown, generally 4 per fruit.

Locally abundant in sandy places, in prairies, sand dunes, beaches, along roadsides, and most often along railroads. Naturalized from Europe. Flowering from late May through early June and fruiting from early June through mid-July.

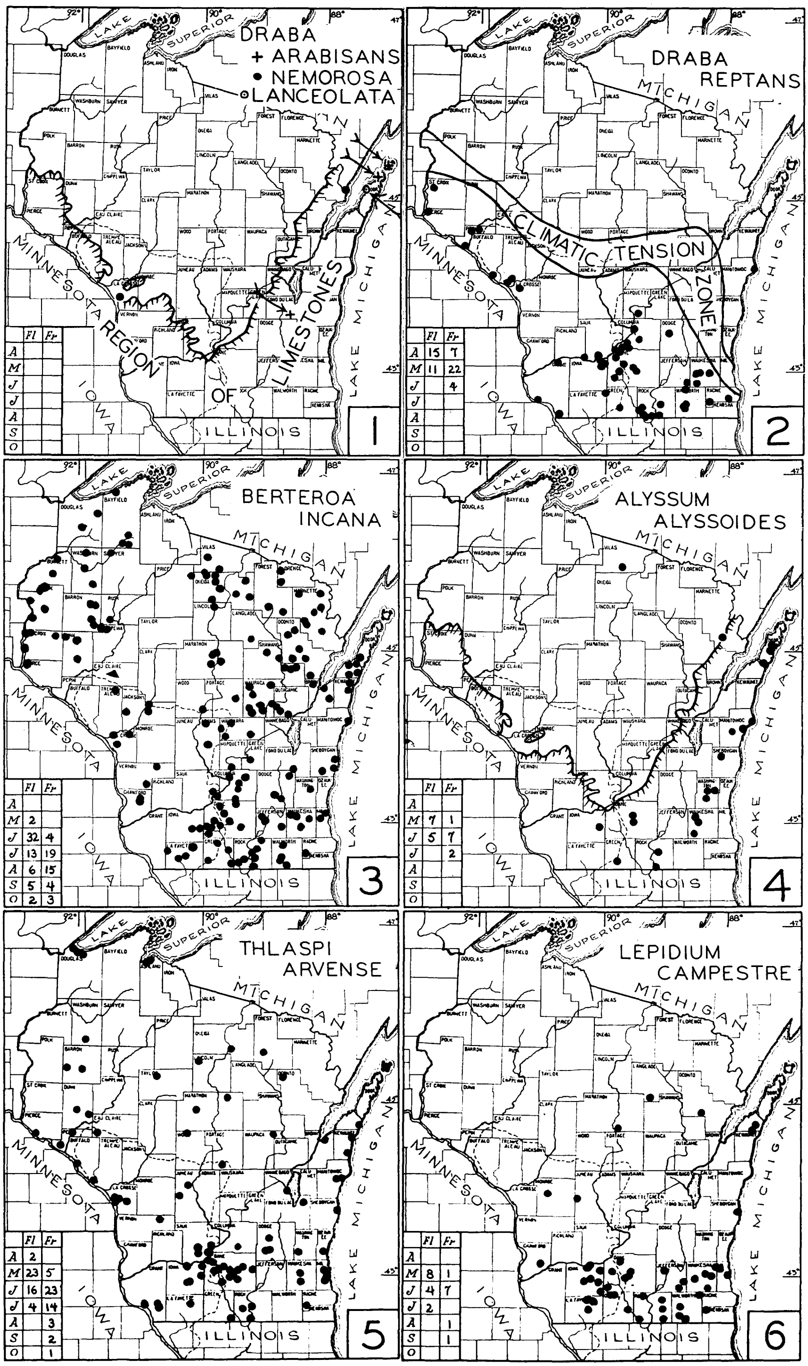
LOBULARIA MARITIMA (L.) Desv., "Sweet Alyssum", a low perennial with narrow leaves and white or purple petals, resembles *Alyssum,* though differing in having pyriform silicles. Introduced from Europe. Commonly cultivated as an ornamental and occasionally escaping: Ozaukee Co.: strand of Lake Michigan, probably escaped, *Iltis 8292;* Dane Co.: along highway, 1958, *Pirone, s.n.;* waste field, 1958, *Klisiewig* (all WIS).

4. THLASPI L.

1. THLASPI ARVENSE L. Penny Cress Map 5.

Erect glabrous annual, 1–5 (–8) dm tall. Leaves oblong to obovate, the upper sagittate-clasping, entire or with few teeth. Petals white, 2.5–4.0 mm long. Silicles much flattened, oblong to circular, broadly winged, 10–15 mm long, notched at the apex to about 3 mm.

Common weed of open, waste places, along railroads and roadsides, in cultivated fields, moist ground in pastures, and near marshes or streams. Naturalized from Europe. Flowering from late April through July and fruiting from late May through September (November).


DRABA
+ ARABISANS
• NEMOROSA
⊙ LANCEOLATA
MINNESOTA REGION OF LIMESTONES
LAKE SUPERIOR
LAKE MICHIGAN
IOWA
ILLINOIS
Fl Fr
1
DRABA REPTANS
MICHIGAN
CLIMATIC TENSION ZONE
MINNESOTA
Fl Fr
A 15 7
M 11 22
J 4
2
BERTEROA INCANA
Fl Fr
M 2
J 32 4
J 13 19
A 6 15
S 5 4
O 2 3
3
ALYSSUM ALYSSOIDES
Fl Fr
M 7 1
J 5 7
J 2
4
THLASPI ARVENSE
Fl Fr
A 2
M 23 5
J 16 23
J 4 14
A 3
S 2
O 1
5
LEPIDIUM CAMPESTRE
Fl Fr
M 8 1
J 4 7
J 2
A 1
S 1
6

5. LEPIDIUM L. PEPPERGRASS

[Hitchcock, C. L. 1936. The genus *Lepidium* in the *U. S. Madroño* 3:265–320.]

Petals small, white or greenish, or lacking. Racemes slender, elongate; pedicels divergent. Silicles small, dehiscent, rounded or obovate, usually much flattened contrary to the partition, notched at the apex, with one seed per locule.

KEY TO SPECIES

1. Upper leaves perfoliate and entire, the lower dissected; fruits 3.5–4.2 mm long; rare in Wisconsin ---------- 1. *L. perfoliatum.*
1. Leaves similar throughout, not perfoliate; fruits 2–6 mm long 2
   2. Fruits inflated, 4–6 mm long, broadly winged in their upper half; leaves auriculate-clasping, often closely appressed, imbricate ------------------------------------ 2. *L. campestre.*
   2. Fruits flattened, 2–4 mm long; leaves sessile and attenuate at base, spreading and not imbricate ---------------------- 3
      3. Petals present, exceeding sepals; silicles orbicular or nearly so, 2.5–3.3 mm long; cotyledons within the seed acumbent ---- -- 3. *L. virginicum.*
      3. Petals absent, if present minute and narrower and shorter than the sepals; siliques mostly elliptic or obovate, 1.8–3.0 mm long; cotyledons within the seed incumbent-4. *L. densiflorum.*

1. LEPIDIUM PERFOLIATUM L.

Erect, 1–7 dm tall, branching above. *Upper leaves rounded, perfoliate,* the middle leaves strongly cordate, acute at the apex, *the lower leaves dissected.* Petals white, to 1 mm long, slightly exceeding the sepals. Silicle rhombic-ovate, 3.5–4.2 mm long.

A weed of railroad stations and rights-of-way, naturalized from Europe. Walworth Co.: Delavan, June 9, 1934 [in fruit], *Wadmond 10334* (WIS); May 30, 1936 [in flower and fruit], *Wadmond s.n.* (WIS); Sheboygan Co.: July 1933 [in fruit], *Goessl s.n.* (WIS).

2. LEPIDIUM CAMPESTRE (L.) R. Br. Field Peppergrass Map 6.

Simple or branched, 1–6 dm tall. Stem densely pubescent with simple hairs. Leaves numerous, *imbricate,* lance-ovate, *auriculate-clasping,* entire to irregularly serrate; lower leaves with rounded apices, the upper ones acute. Petals white, 1.8–2.5 mm long, slightly exceeding the sepals. Silicles oblong-ovate, 4.0–6.5 mm long, papillose, swollen at base, the *apex with a broad flat wing.*

Frequent in southern Wisconsin in disturbed sandy places, cultivated fields, roadsides, railroads, waste places, grazed hillsides, and pastures. Naturalized from Europe. Flowering from mid-May through mid-July and fruiting from early June through August.

3. LEPIDIUM VIRGINICUM L. Peppergrass Map 7.

Stems erect, glabrous to minutely pubescent, usually much branched, 2–9 dm tall. Basal leaves dissected or pinnatifid. Cauline leaves linear to lanceolate, incised to entire. *Petals white, about 1 mm long and exceeding the sepals.* Silicles much flattened, nearly orbicular, 2.5–3.3 mm long; cotyledons acumbent (see drawing on map 7).

Common and weedy, mainly in southern Wisconsin, in dry places, along railroads, city streets, waste places, quarries, roadsides, open fields, pastures, open sand bars along streams and borders of open oak woods. Flowering from mid-May through mid-July and fruiting from mid-July through late November.

Easily confused with *L. densiflorum,* but distinguished by the white petals and acumbent cotyledons.

4. LEPIDIUM DENSIFLORUM Schrad. Peppergrass Map 8.

Lepidium apetalum of Auth., not Willd.

Stem erect, much branched. Sepals with thin white margins; *petals lacking or minute* and smaller than the sepals. Silicles 1.8–3.0 mm long, mostly elliptic to obovate, though sometimes nearly orbicular and broadly rounded at apex much as in *L. virginicum.* Cotyledons *incumbent;* when fruits are mature this is a most reliable character (see drawing with map 8).

Very common throughout the state, particularly in dry sandy places, roadsides, railroad embankments, city streets, waste places, fields, pastures, and common in native communities such as sandy prairies, borders of Jack Pine or Oak woods and on beaches and riversides. Flowering from early May to mid-July and fruiting from early June through October.

While this paper was in galley proof, the following notes were added as a result of Dr. G. A. Mulligan's studies of our *Lepidium* collections (cf. The genus *Lepidium* in Canada. Madroño 16:77–90. 1961). To Dr. Mulligan, of the Plant Research Institute, Canada Department of Agriculture, Ottawa, we extend our sincere thanks.

3a. LEPIDIUM DENSIFLORUM var. DENSIFLORUM. Nearly all of our collections fall into this variety. Mulligan *(loc. cit.)* states that it is an annual or winter annual with fruits averaging 2.5 mm long and 2 mm wide.

3b. LEPIDIUM DENSIFLORUM var. MACROCARPUM Mulligan *(loc. cit.* 16:86. 1961).

Lepidium densiflorum var. *bourgeauanum sensu* Hitchcock 1936, not *Lepidium bourgeauanum* Thellung.

Eight Wisconsin specimens have been assigned by Mulligan to this variety, who states in the original description that var. *macrocarpum* is a biennial distinguished by larger capsules (3.0–3.5 mm long and 2.0–2.5 mm wide) occurring naturally in Alberta, British Colombia and Saskatchewan. The Wisconsin records, from Adams, Barron, Dane, Marinette, Marquette, Polk, and Portage Counties, extend the known range of this variety from SW Saskatchewan to Southern Wisconsin. The introduction must have been very recent, for all but the 1928 Polk County and 1956 Dane County collections have been made since 1957.

LEPIDIUM DENSIFLORUM var. DENSIFLORUM X LEPIDIUM VIRGINICUM HYBRIDS

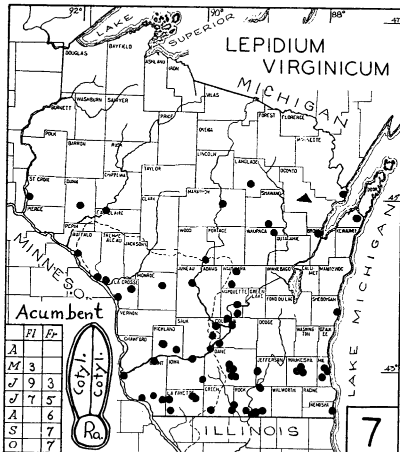
A score or more of either of these two species have been annotated by Mulligan as containing genes of the opposite species, while a few populations were shown by Mulligan to represent hybrid swarms, consisting of both parents and intermediates. Judging from this, as well as their frequent joint occurrence, hybridity between these two species appears to be quite common in Wisconsin.

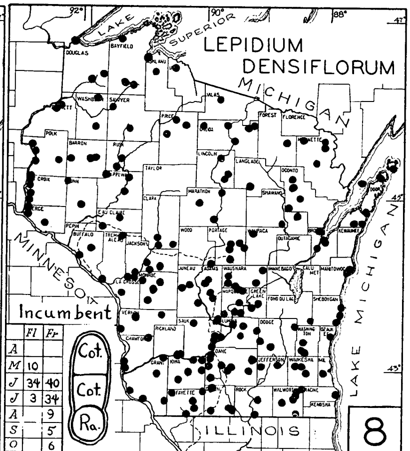
LEPIDIUM BOURGEAUANUM Thellung

Lepidium fletcheri Rydb.

The one specimen of this mainly western Canadian species so named by Mulligan was collected in "Sheboygan, common, Sept. 1918" by Chas. Goessl, a retired railroad man, whose collections are generally considered by us with suspicion, for he seemed to have been very careless in labelling his specimens. It is likely that this collection was not made in Wisconsin. The species is slenderer than *L. densiflorum,* and resembles *L. ruderale,* except that the leaves are only incised, and the sepals more robust and hairy. According to Mulligan, the species is supposed to have short petals, which are *not* evident in the *Goessel* specimen.

LEPIDIUM RUDERALE L. is very similar to *L. virginicum,* differing by the silicles gradually narrowed to the apical teeth, and by the bipinnatifid lower leaves. Milwaukee Co.: Railroad tracks, Gordon Park, Milwaukee, 1940, *Shinners 2176* (WIS); vacant lot, Fairmont Ave. on Green Bay Road, Milwaukee, 1938, *Shinners s.n.* (WIS).


LEPIDIUM VIRGINICUM
LAKE SUPERIOR
MICHIGAN
MINNESOTA
LAKE MICHIGAN
ILLINOIS
Acumbent
Cotyl.
Cotyl.
Ra.
Fl Fr
A
M 3
J 9 3
J 7 5
A 6
S 7
O 7
7


LEPIDIUM DENSIFLORUM
LAKE SUPERIOR
MICHIGAN
MINNESOTA
LAKE MICHIGAN
ILLINOIS
Incumbent
Cot.
Cot.
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A
M 10
J 34 40
J 3 34
A 9
S 5
O 6
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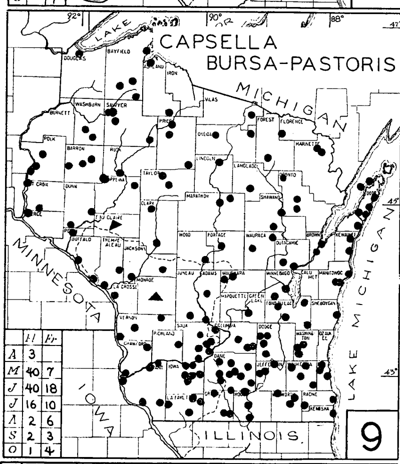
CAPSELLA BURSA-PASTORIS
LAKE SUPERIOR
MICHIGAN
MINNESOTA
IOWA
LAKE MICHIGAN
ILLINOIS
Fl Fr
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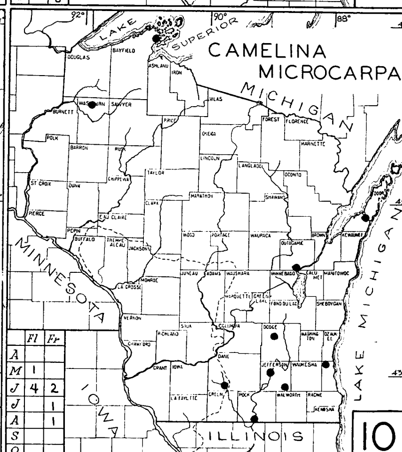
S 2 3
O 1 4
9


CAMELINA MICROCARPA
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MICHIGAN
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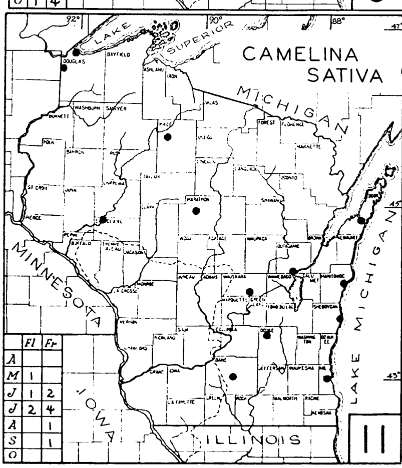
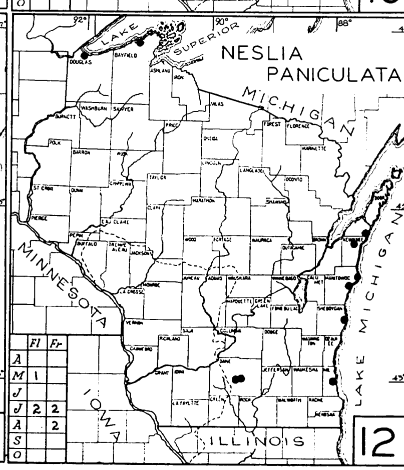
10


CAMELINA SATIVA
LAKE SUPERIOR
MICHIGAN
MINNESOTA
IOWA
LAKE MICHIGAN
ILLINOIS
Fl Fr
A
M 1
J 1 2
J 2 4
A 1
S 1
O
11


NESLIA PANICULATA
LAKE SUPERIOR
MICHIGAN
MINNESOTA
IOWA
LAKE MICHIGAN
ILLINOIS
Fl Fr
A
M 1
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J 2 2
A 2
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12

6. CARDARIA Desv.

[Rollins, R. C. 1940. On two weedy crucifers. *Rhodora* 42:302–326.]

Perennials similar in appearance to *Lepidium*. Cauline leaves serrate-dentate, sessile or clasping. Flowers small, white. Silicles ovoid to cordate, *somewhat inflated, indehiscent,* the style and pedicel slender.

1. Cardaria draba (L.) Desv. Hoary Cress

Silicles glabrous, broader than long, cordate and notched at the base.

One collection: Waukesha Co.: E. Millers farm, Big Bend [flower and young fruit] June 3, 1931, *Fuller 4033B* (MIL). Adventive from Europe; a troublesome weed in the western U.S.

2. Cardaria pubescens (C. A. Mey.) Whitetop

Silicles pubescent, longer than broad, more or less globose, not notched at the base.

One collection: Walworth Co.: on sandy soil at edge of field, Crane Farms, Williams Bay, July 1, 1941 [flower and young fruit] *Thomson s.n.* (WIS). Adventive from Europe.

7. CAPSELLA Medic.

1. Capsella bursa–pastoris (L.) Medic. Shepherd's Purse Map 9.

Erect annual, often much branched, to 4 dm tall, glabrous to somewhat hirsute. Rosette leaves highly variable, serrate or cleft to deeply pinnatifid. Cauline leaves sagittate-clasping, entire to serrate. Petals white, 2–4 mm long. *Silicles obcordate-triangular,* flattened contrary to the partition.

Very common and exceptionally weedy throughout the state, along roadsides, waste places, city streets, cultivated fields, open woods, pastures, etc. Naturalized from Europe. Flowering from late April through July, occasionally into October, and fruiting from mid-May through October.

8. CAMELINA Crantz. False Flax

Slender erect annuals, with simple stellate pubescence. Leaves linear to lanceolate, sagittate-clasping. Petals small, yellow; sepals erect. Silicles *obovoid* to pyriform, pointed, one-nerved, keeled at the sutures. Seeds numerous, small, elliptic to oblong.

Key to Species

1. Base of stem densely pubescent, the simple hairs projecting beyond the stellate hairs; silicles 5–7 (–8) mm long, about twice the length of the style .... 1. *C. microcarpa.*

1. Pubescence at the base of the stem appressed or lacking, or with few long simple hairs; silicles 7–12 mm long, about 3–4 times as long as the style ---------------------------------- 2. *C. sativa.*

1. CAMELINA MICROCARPA Andrz. False Flax Map 10.

Erect, simple or branching above, to 7 dm tall, rough-pubescent throughout with both simple and stellate hairs, the base of the stem with long simple hairs projecting beyond the stellate ones. Fruits about twice as long as the slender style, 5–7 (–8) mm long, 4–5 mm broad. Seeds brown, less than 1 mm long.

Occasional in waste places and along railroad embankments. Adventive from Europe. Flowering from mid-May through mid-June and fruiting from late June through mid-August.

Very similar to the following species, but separated by the smaller fruit size and the dense simple pubescence at the base of the stem. *C. sativa* may have a few simple hairs at the base, but these are neither dense nor spreading.

2. CAMELINA SATIVA (L.) Crantz Gold-of-Pleasure Map 11.

Stems to 9 dm tall, glabrous or with appressed stellate pubescence, occasionally with a few long simple hairs at the base. Silicles about 3–4 times as long as the style, 7–12 mm long, 5–7 mm broad. Seeds yellow-brown, 0.9–1.5 mm long.

Occasional in waste places and along railroads. Adventive from Europe. Flowering from mid-May through mid-July and fruiting from mid-June through early September.

BUNIAS ORIENTALIS L. is a tall, robust biennial, with simple upper leaves and lyrate-pinnatifid lower leaves, bright yellow flowers in slender glandular racemes, and ovoid, beaked, indehiscent silicles. One collection: Green Co.: In field along highway M, 1959, *Richards s.n.* (WIS). Adventive from Europe.

9. NESLIA DESV.

1. NESLIA PANICULATA (L.) Desv. Ball Mustard Map 12.

Slender erect annuals or biennials, to 6 dm tall. Leaves oblong to lanceolate, sagittate-clasping, the margins entire, wavy, or remotely serrate. Flowers pale yellow, in long racemes; petals 2–3 mm long. Silicles indehiscent, globose, very slighty flattened, 2–3 mm in diam.; style slender, 1 mm long; pedicels slender, divergent, 4–13 mm long. Seeds 1–2 per pod, nearly round.

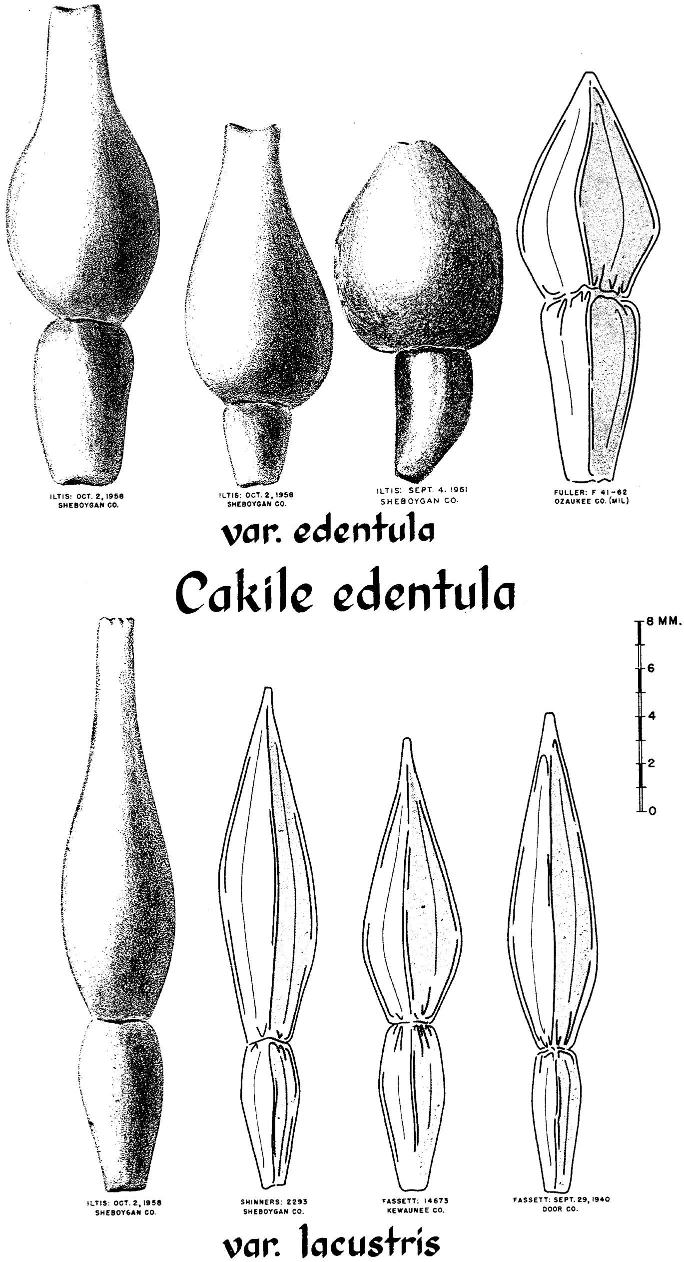


Figure 1. Fruits of Cakile: shaded drawings of fresh, line drawings of dried specimens.

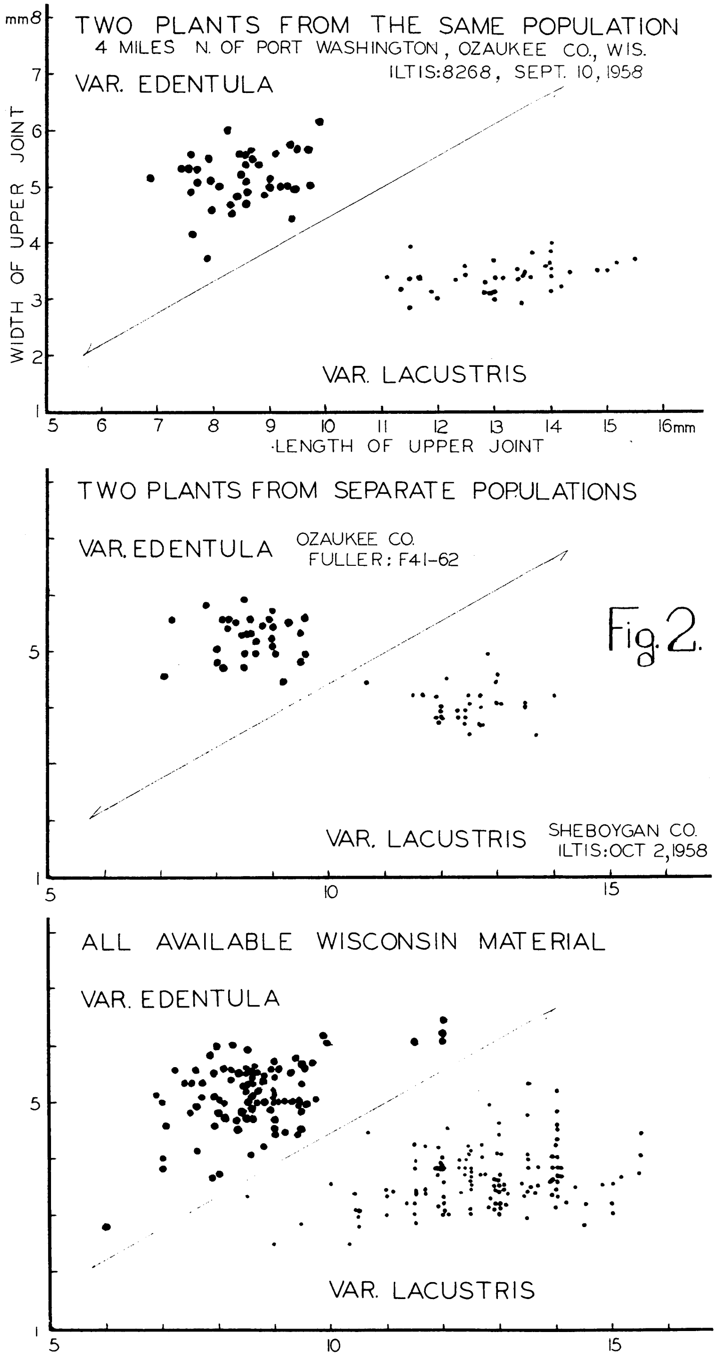

TWO PLANTS FROM THE SAME POPULATION
4 MILES N. OF PORT WASHINGTON, OZAUKEE CO., WIS.
ILTIS:8268, SEPT. 10, 1958
VAR. EDENTULA
VAR. LACUSTRIS
WIDTH OF UPPER JOINT
mm 8
7
6
5
4
3
2
1
5
6
7
8
9
10
11
12
13
14
15
16mm
LENGTH OF UPPER JOINT
TWO PLANTS FROM SEPARATE POPULATIONS
VAR. EDENTULA
OZAUKEE CO.
FULLER: F41-62
VAR. LACUSTRIS
SHEBOYGAN CO.
ILTIS: OCT 2, 1958
ALL AVAILABLE WISCONSIN MATERIAL
VAR. EDENTULA
VAR. LACUSTRIS

Fig. 2.

Occasional in Wisconsin from waste places in cities. Adventive from Europe. Flowering from late May through early July and fruiting from late June through early August.

10. CAKILE Hill SEA ROCKET

1. CAKILE EDENTULA (Bigel.) Hook. Sea Rocket
Map 13; figs. 1 & 2.

Erect, *glabrous* annuals, simple or much branched above, 5–60 cm tall. *Leaves fleshy,* obovate or oblanceolate, wavy-toothed and quite variable. Petals pale purple to nearly white, 6–8 mm long. Fruit a jointed, fleshy indehiscent transversally septate silique, the upper portion 6–15 mm long, 3–8 mm wide, often beaked, ovoid to lanceolate, the lower portion 2–8 mm long, 2–6 mm wide, often sterile and very small. Seeds elongate, red-brown, usually only one per joint.

A characteristic species of the Lake Michigan strand, especially on the upper sandy or gravelly beach (stormbeach), occasionally on dunes, often associated with the annual Chenopodiaceae *Salsola, Coriospermum,* and *Cycloloma,* as well as with *Potentilla anserina, Euphorbia polygonifolia,* etc., and at the base of dunes with *Ammophila, Calamovilfa, Agropyron,* and *Lathyrus maritimus.* A pioneer on the lower beaches, this is often the only species able to withstand the frequent disturbances due to rough waters. Flowering from early July through early September and fruiting from mid-July through late September.

KEY TO VARIETIES

1. Upper portion of silique broad, lance-ovoid to ovoid or subspherical, 7–10 (–12) mm long, 4–8 mm wide; pedicels 2–3 (–4) mm long ---------------------------------- 9a. var. *edentula.*

1. Upper portion of silique narrowly lanceolate, 9–16 mm long, (3–) 4–5 mm wide; pedicels (4–) 5–7 (–8) mm long ------------ -- 9b. var. *lacustris.*

The Great Lakes population was segregated from the typical East Coast variety by Fernald (cf. 1950) as var. *lacustris* Fern., "by the upper joint of the silicle ovoid-lanceolate, long beaked, its articulating surface with 2 deep and 4 shallow pits; articulating summit of lower joint with 2 long and 4 short subulate processes". The differences in the articulating surface appear to be very slightly if at all developed, and seem to be of next to no value in distinguishing the two varieties. Furthermore, contrary to Deam, and others, both varieties occur in Wisconsin, occasionally growing together (see insert, map 13), yet remaining very distinct morphologically (cf. fig. 2, graph 1).

Var. EDENTULA, the rarer of the two varieties in Wisconsin, has short, lance-ovoid to ovoid or even subspherical (!) siliques, while var. LACUSTRIS has elongate lanceolate fruits (fig. 1). When length and width of the upper silique joint are plotted on a graph (fig. 2), Lake Michigan plants show a *clear morphological separation into two taxa, which in Wisconsin at least seem to behave as two good species*. The taxa look different in the field, not only because of their distinctive fruits, but also because of inflorescence differences, var. *edentula* having fruits on shorter pedicels arranged in more congested racemes. The flowers and leaves seem identical. However, exploratory study has shown that when fruits of collections from along the St. Lawrence River and the East Coast are plotted on a graph, the position of the symbols falls approximately intermediate between those of the two Wisconsin varieties, these plants thus not separable into two clear-cut groups. The Cakile problem, currently under consideration, is certainly a fascinating one, whose solution will shed some light on the post-glacial migrations of vegetation from the eastern seabord to the Great Lakes.

11. RAPHANUS L. Radish

Coarse herbs with simple pubescence, the lower leaves pinnatifid. Petals large, broadly obovate. Silique cylindric, long-beaked, indehiscent, the stigma broad. Seeds spherical, in a single row.

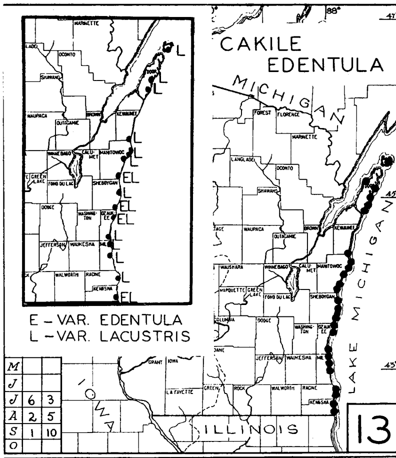
Key to Species

1. Silique linear, 4–5 mm broad, constricted around the seeds at maturity ____________________ 1. *R. raphanistrum.*
1. Silique lance-oblong, 6–10 mm broad, not constricted around the seeds ____________________ 2. *R. sativus.*

1. RAPHANUS RAPHANISTRUM L. Jointed Charlock; Wild Radish
Map 14.

Erect annual, often much branched above, to 10 dm tall. Stem somewhat pubescent, rough at base, from a non-tuberous tap root. Leaves pinnatifid, variable, rough to the touch. Petals white or pale lemon yellow,[1] often dark veined, to about 2 cm long. Siliques to 5 cm long, strongly constricted around the seeds *at maturity*. Seeds oval, red-brown.

[1] Both colors may occur in the same population *(fide R. Schlising 1518* [WIS]). Contrary to Gleason (1952), the color differences in some populations appear to be genetic, and not due to fading with age.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L – VAR. LACUSTRIS
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LAKE MICHIGAN
IOWA
ILLINOIS
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S 1 10
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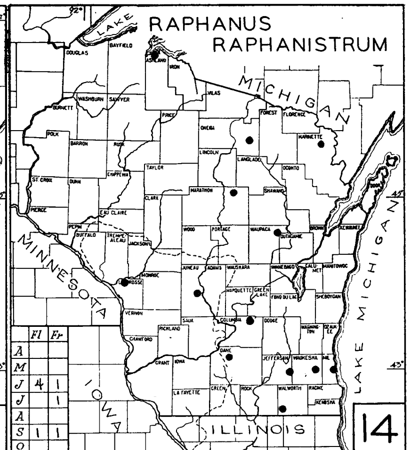
13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RAPHANISTRUM
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IOWA
ILLINOIS
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A
S 1 1
O
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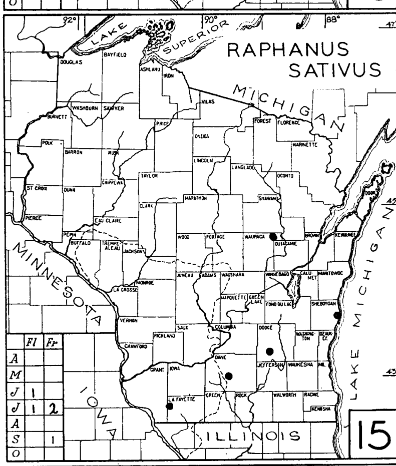
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SATIVUS
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LAKE MICHIGAN
IOWA
ILLINOIS
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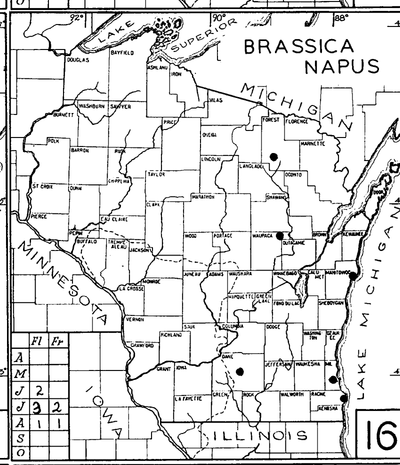
A
S 1
O
15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A 1 1
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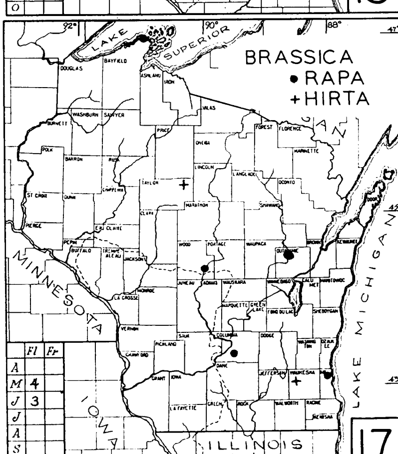
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+ HIRTA
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LAKE MICHIGAN
IOWA
ILLINOIS
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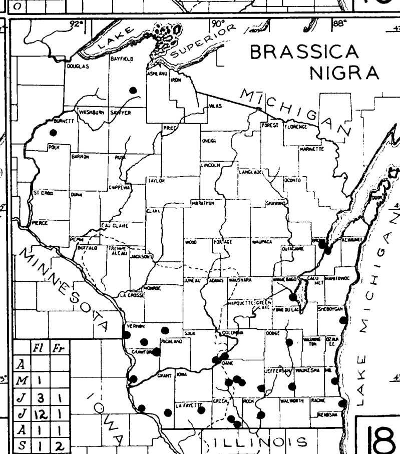
J
A
S
O
17


LAKE SUPERIOR
BRASSICA
NIGRA
MICHIGAN
MINNESOTA
LAKE MICHIGAN
IOWA
ILLINOIS
Fl Fr
A
M 1
J 3 1
J 12 1
A 1 1
S 1 2
O 3 2
18

Occasional along roadsides, railroads, cultivated fields and waste places, in sandy or gravelly soil. Naturalized from Europe. Flowering from mid-June on, and fruiting from late June through September.

2. RAPHANUS SATIVUS L. Radish Map 15.

Erect, much branched above, from a tuberous tap root. Leaves pinnatifid, the basal ones long-petioled. Petals white to pink-purple, not dark veined, to 13 mm long. Silique lance-oblong, spongy within, not constricted around the seeds.

Occasionally escaping from cultivation, along roadsides and in waste places. Native of Europe. Flowering from late June through late July and fruiting from late July.

RAPHISTRUM RUGOSUM (L.) All. is a slender annual or biennial weed with the siliques transversely two-jointed, their upper portion 8-ribbed, globose, and with a slender beak. One collection: Milwaukee Co.: Milwaukee, Courthouse Square, Sept. 5, 1939 [in flower and fruit], *Shinners 1478* (WIS). Adventive from Europe.

12. BRASSICA L. CABBAGE; MUSTARD; TURNIP

Erect annuals, the lower leaves often incised, pinnatifid or lyrate. Petals yellow, spatulate, 6–15 mm long. Siliques round to four-sided, with a stout, seedless or one-seeded, indehiscent beak, the valves 1- to 5-nerved. Seeds usually globose, in a single row in each locule. Including *Sinapis* L. All species are highly variable due to their long history in cultivation and as weeds.

KEY TO SPECIES

1. Leaves all clasping; stems of mature plants glabrous ________ 2
 2. Root thick and fleshy; young buds slightly overtopping the open flowers; petals generally bright yellow, 6–11 mm long ____ 1. *B. napus.*
 2. Root slender; young buds below the open flowers; petals pale yellow, 12–15 mm long __________________________ 2. *B. rapa.*
1. Lower leaves petioled, the upper sessile to somewhat clasping; stems glabrous to hispid throughout ________________________ 3
 3. Uppermost leaves entire or occasionally serrulate, oblong to lance-linear; beak of silique slender, 4-angled to round in cross-section, not 2-edged, 1-nerved or nerveless on each side, seedless_4
  4. Fruits, 8–22 mm long, appressed to the stem; plants more or less hirsute, green ___________________________ 3. *B. nigra.*
  4. Fruits 30–50 mm long, the pedicels ascending-divergent; plants mainly glabrous and glaucous __________ 4. *B. juncea.*

3. Uppermost leaves pinnatifid or toothed, often ovate to lanceolate; the beak of the silique stout, flattened and 2-edged, 3-nerved, often with one seed in the indehiscent locule ---------------- 5
    5. All leaves strongly pinnatifid; fruits not ridged, constricted around the seeds the very long flat beak longer than the densely bristly body of the silique; rare in Wisconsin ---- 5. *B. hirta.*
    5. Only lower leaves pinnatifid or all the leaves toothed; fruits with longitudinal ridges, not strongly constricted around the seeds, the short 4-angled flattened beak about half as long as the glabrous or slightly hairy body of the silique; very common in Wisconsin -------------------------------- 6. *B. kaber.*

1. BRASSICA NAPUS L. Turnip Map 16.

Brassica rapa L. of Gleason (1952), Bailey (1949), and other authors.

Erect, robust, often branching above; stems glabrous, arising from a thickened tuber-like base. *Leaves clasping,* entire to remotely toothed. Petals generally bright yellow, 6–11 mm long. Young buds above the open flowers, the inflorescence convex in outline. Siliques 4–8 (–10 ?) cm long, on widely divergent pedicels.

A rare weed of waste places, occasionally persistent after cultivation. Adventive from Europe. Flowering from earliest June through mid-August and fruiting from late June through September.

2. BRASSICA RAPA L. Field Mustard; Navette; Rape Map 17.

Brassica campestris L. of Gleason (1952), and other authors.
Brassica campestris L. var. *rapa* of authors.

Very similar to and easily confused with *B. napus*. Young stems with scattered hairs; roots neither swollen nor fleshy. Petals pale yellow, 12–15 mm long, about twice the length of the sepals. Young buds below the open flowers, the inflorescence thus concave in outline.

A rare weed of fields and waste places. Adventive from Europe. Flowering from late April through June.

3. BRASSICA NIGRA (L.) Koch Black Mustard Map 18.

Erect, widely branching, to 15 dm tall. Stems hirsute, especially below, often glaucous above. Lower leaves with a large terminal lobe and several smaller ones, the upper leaves lance-linear, entire or minutely serrulate; all leaves petioled. Petals yellow 6–8 mm long, with well-marked strong veins. *Siliques 8–22 mm long,* square in cross section, *closely appressed to the stem,* often somewhat overlapping; *pedicels short.* Seeds globose, dark brown.

A weed of waste ground, roadsides, cultivated fields, railroad embankments, farm yards, often in moist soil near disturbed streams. Naturalized from Europe. Flowering from late May through mid-October and fruiting from early June through October.

This species, in young fruit, is easily confused with *B. kaber,* from which it may be separated by the linear, entire upper leaves; and with *B. juncea,* which is nearly glabrous and which has long, divergent pedicels when in fruit.

4a. BRASSICA JUNCEA (L.) Coss. var. JUNCEA
Leaf Mustard; Brown Mustard; Indian Mustard. Map 19.

Erect, simple or branched above, to 12 dm tall. *Stems glabrous to somewhat hispid below, often glaucous above.* Lower leaves lyrate-pinnatifid, petioled, irregularly toothed or serrate, the upper leaves oblong to linear, entire. Petals pale to deep yellow, 5–10 mm long. *Siliques 3–5 cm long, 4-angled at maturity,* the valve midrib prominent, the valves somewhat constricted around the seeds, the beak slender. Seeds globose, red-brown, somewhat ridged.

An occasional weed of waste ground, fields, and railroad embankments. Adventive from Europe. Flowering from mid-June through mid-September and fruiting from late June through September.

4b. BRASSICA JUNCEA var. CRISPIFOLIA Bailey Curled Mustard.

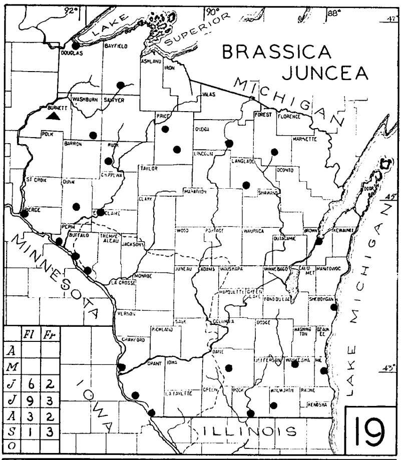
Leaves deeply laciniate and curled. This variety is occasionally cultivated for greens.

Sauk Co.: Prairie du Sac, *Smith 53871* (MIL). Milwaukee Co.: Milwaukee, 1941, *Goessl s.n.* (WIS); Milwaukee, cultivated, 1842, *Coll. unknown* (WIS). Introduced from Europe.

5. BRASSICA HIRTA (L.) Moench. White Mustard Map 17.
Brassica alba Gray

Widely branching, to 9 dm tall. Stems ridged, lightly pubescent with simple hairs. Leaves lyrate-pinnatified, pubescent along the veins. Petals generally pale yellow, about 1 cm long. Fruits 25–35 mm long, the valves constricted around the seeds at maturity, the *body heavily pubescent with long stiff white hairs,* about half as long as the *very long flattened beak; pedicels horizontally divergent.* Seeds pale brown.

A rare weed of waste places. Adventive from Europe. Taylor Co.: Rib Lake, waste ground, Sept. 27, 1915 [in flower with immature fruits]. *Goessl 37669* (MIL). Waukesha Co.: along R.R. between Hartland and Pewaukee, July 4, 1947 [in fruit], *Cull 892* (WIS).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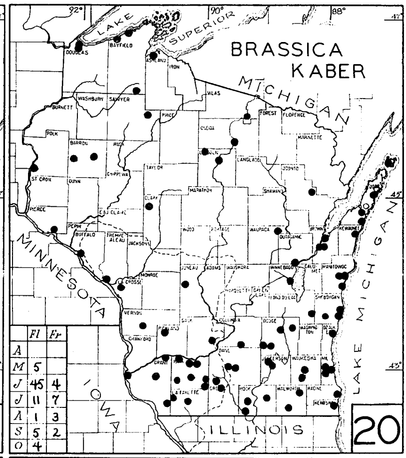
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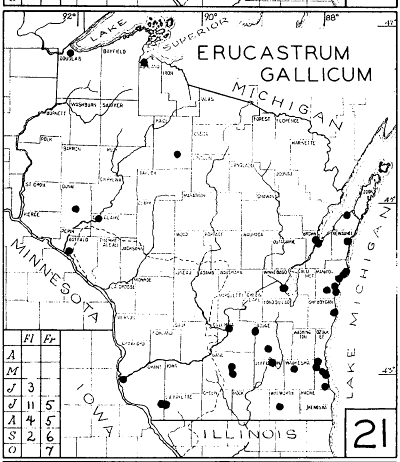
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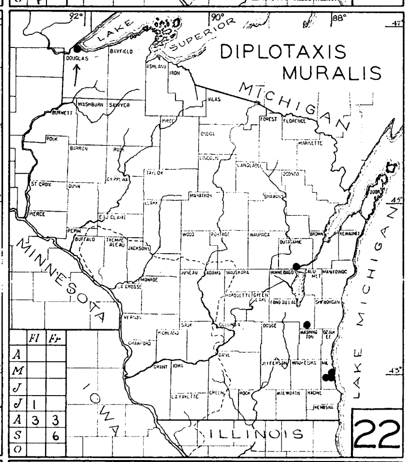
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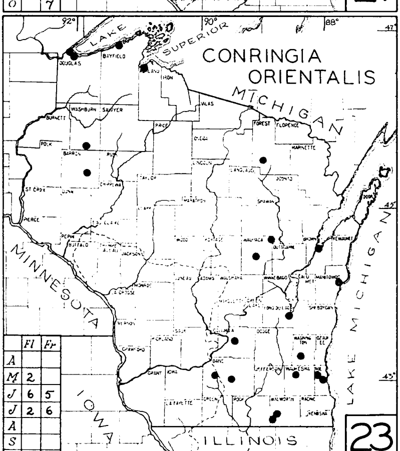
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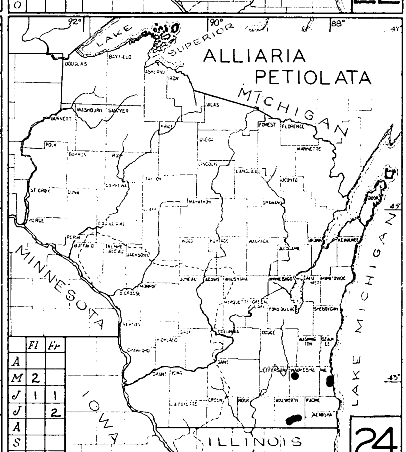
23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LAKE MICHIGAN
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J 2
A
S
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24

6. BRASSICA KABER (DC.) Wheeler var. PINNATIFIDA (Stokes) Wheeler Crunch Weed; Charlock Map 20.

Sinapis arvensis L.
Brassica arvensis (L.) Rabenh., not L.

Erect, simple to somewhat branched, to 9 dm tall, *coarse, the lower stem heavily pubescent with stiff white hairs.* Lower leaves obovate, lyrate-pinnatifid, or more often with margins only irregularly serrate to dentate; upper leaves oblong to ovate or rhombic, nearly sessile. Petals yellow, 9–12 mm long. *Fruiting pedicels thick, 2–5 (–6) mm long.* Mature fruits 2–4 cm long, with strong longitudinal ribs, not much constricted around the seeds, the short 4-angled beak flattened, 3-nerved, about half as long as the glabrous or slightly bristly body of the silique. Seeds red-brown.

A common weed of cultivated fields, pastures and waste places. Naturalized from Europe. Flowering from mid-May through mid-October and fruiting from mid-June through October.

At any given locality, *Barbarea vulgaris* flowers earlier, coloring the fields golden yellow. Later in the season, from late spring to the middle of the summer, the same fields may still be yellow, but then with *Brassica juncea,* or, more commonly, *B. kaber.*

13. ERUCASTRUM PRESL

1. ERUCASTRUM GALLICUM (Willd.) O. E. Schulz Map 21.

Erect, simple or branching annual or biennial, to 8 dm tall. Stems pubescent with simple hairs. Leaves rough-textured, oblong, pinnatifid with deep, rounded sinuses. Petals pale yellow, 7–8 mm long, the sepals about 5 mm long. Siliques 2–3 cm long, 1–2 mm broad, ascending on widely divergent pedicels. Seeds ellipsoid, red-brown, less than 1 mm long.

Scattered, though locally abundant especially in SE Wisconsin, in waste places, railroad yards, along roadsides, and on sandy beaches, especially of Lake Michigan. Naturalized from Europe. Flowering from late June through early September, and fruiting from early July through late October.

14. DIPLOTAXIS DC.

1. DIPLOTAXIS MURALIS (L.) DC. Map 22.

Erect annual, branching from the base, 1–5 dm tall, hispid below. Leaves near the base only, toothed to pinnatifid, 3–8 cm long. Petals pale yellow, 5–6 mm long, about twice the length of the acute, green sepals. Siliques 2–4 cm long, 2–4 mm broad; pedicels divergent, 1–2 cm long; stigma broad. Seeds rounded, red-brown, in a double column in each locule.

A rather rare weed of railroad yards and city streets. Naturalized from Europe. Flowering from early July though August and fruiting from early August through September.

15. CONRINGIA LINK

1. CONRINGIA ORIENTALIS (L.) Dumort. Hare's-ear Mustard Map 23.

Erect annuals, to 6 dm tall, *glabrous* and glaucous, sometimes branched above. Leaves elliptical, *strongly auriculate-clasping,* simple, entire to slightly wavy. Petals cream or pale yellow, 6–10 mm long, the sepals 4–6 mm long. Siliques 4–11 cm long, four-angled, erect, on divergent pedicels 5–20 mm long. Seeds elliptic, deep brown.

Occasional in waste places, along railroads, on borders of cultivated fields, and on beaches of Lake Michigan. Naturalized from Europe. Flowering from mid-May through mid-July and fruiting from early June through July.

This species has been confused with *Brassica rapa* and *B. napus,* but may be separated by the oblong, broadly rounded, entire leaves, and the absence of basal rosettes.

16. ALLIARIA B. EHRH.

1. ALLIARIA PETIOLATA Cav. & Grande Garlic Mustard Map 24.
Alliaria officinalis Andrz.

Erect, simple branched, robust annuals to 12 dm tall, glabrous or with simple pubescence at the base. Leaves cordate, deltoid-ovate, with regularly dentate margins. Petals white, 3–4 mm long. Siliques 3–5 cm long, spreading; pedicels short, thick. Seeds brown, elongate, 10–18 in a single row.

Occasional in southeastern Wisconsin, in sand or gravel, at the base of bluffs, along roadsides, or on sandy beaches. Naturalized from Europe. Flowering from mid-May through early June and fruiting from late May through mid-July.

17. SISYMBRIUM L.

Erect annuals, glabrous or with simple hairs; leaves pinnatifid. Petals yellow, small. Siliques linear, cylindric or long-subulate; valves nerved; stigma 2-lobed. Seeds oblong, in one row in each locule, smooth.

KEY TO SPECIES

1. Leaflets of upper leaves linear, rarely more than 2 mm broad; fruits widely divergent, 6–10 cm long; petals pale yellow ____ 1. *S. altissimum.*

1. Leaflets of upper leaves angularly toothed, the terminal segment ovate or elliptic; fruits closely appressed to the stem, 1–2 cm long; petals deep yellow ____________________________ 2. *S. officinale.*

1. SISYMBRIUM ALTISSIMUM L. Tumble-Mustard Map 25.

Loosely branching, to 10 dm tall. Leaves pinnatifid with long linear segments. Petals 5–8 mm long, pale lemon yellow; sepals 3–5 mm long. Fruits widely divergent, 6–10 cm long.

Common throughout the state, along roadsides, waste places, in cinders along railroads, borders of and in cultivated fields and in sandy prairies. Naturalized from Europe. Flowering from mid-May through early September and fruiting from late June through late September.

2. SISYMBRIUM OFFICINALE (L.) Scop. Hedge-Mustard

Erect from a taproot, loosely branched above, to 12 dm tall. Stem pubescent with simple hairs. Leaves pinnatifid, the terminal segment ovate or elliptic and toothed. Petals to 4 mm long, deep yellow; sepals less than one-third the length of the petals. Fruit 10–17 mm long, closely appressed to the stem; pedicels 2–3 mm long.

2a. SISYMBRIUM OFFICINALE var. OFFICINALE Map 26.

Racemes, pedicels and fruits with *dense, soft pubescence.*

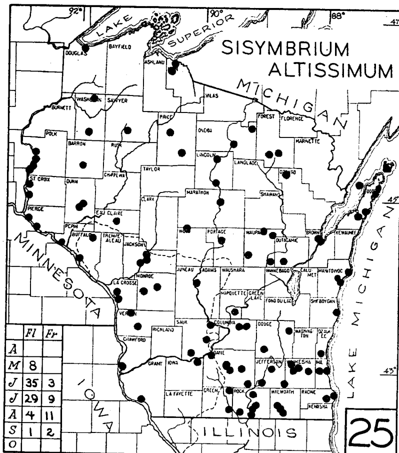
Less common than the following variety, mainly in southern Wisconsin. A weed of waste places and pastures. Introduced from Europe. Flowering from early July through mid-August and fruiting from early July through August.

2b. SISYMBRIUM OFFICINALE var. LEIOCARPUM DC. Map 27.

Racemes, pedicels and fruits *glabrous or with few scattered hairs;* plants somewhat greener.

A common weed throughout Wisconsin in waste places, along railroads, roadsides, and in pastures and borders of cultivated fields. Naturalized from Europe. Flowering from late May through mid-September and fruiting from early June through late October.

SISYMBRIUM LOESELII L., a to 1 m tall, often robust herb with pilose-hirsute stems, deeply lyrate-pinnatifid essentially glabrous leaves, greatly elongating inflorescences with yellow petals about 6 mm long, and narrowly *linear widely divergent siliques 17–28 mm long and about 2 or 3 times as thick as the pedicels* (and thickest


SISYMBRIUM ALTISSIMUM
LAKE SUPERIOR
MICHIGAN
MINNESOTA
IOWA
ILLINOIS
LAKE MICHIGAN
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A
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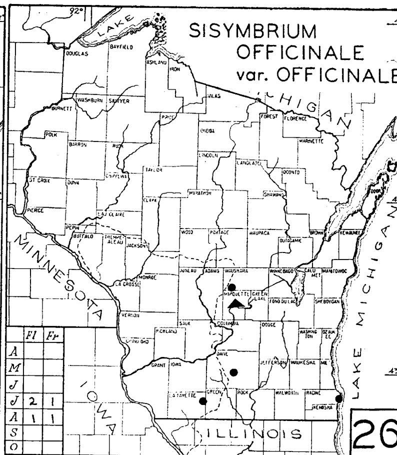
J 35 3
J 29 9
A 4 11
S 1 2
O
25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IOWA
ILLINOIS
LAKE MICHIGAN
Fl Fr
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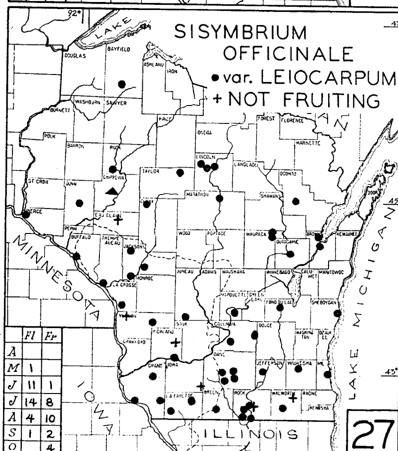
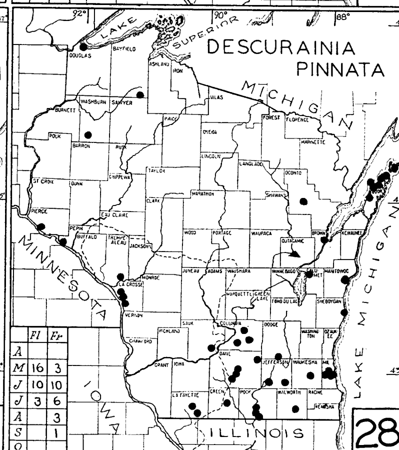
26


SISYMBRIUM OFFICINALE
• var. LEIOCARPUM
+ NOT FRUITING
LAKE
MINNESOTA
IOWA
ILLINOIS
LAKE MICHIGAN
Fl Fr
A
M 1
J 11 1
J 14 8
A 4 10
S 1 2
O 4
27


DESCURAINIA PINNATA
LAKE SUPERIOR
MICHIGAN
MINNESOTA
IOWA
ILLINOIS
LAKE MICHIGAN
Fl Fr
A
M 16 3
J 10 10
J 3 6
A 3
S 1
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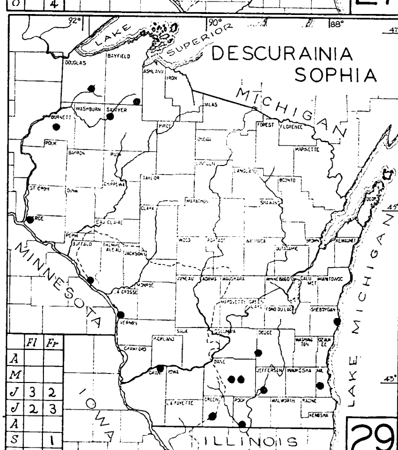
28


DESCURAINIA SOPHIA
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IOWA
ILLINOIS
LAKE MICHIGAN
Fl Fr
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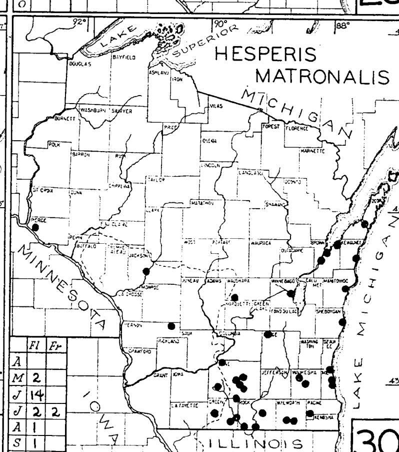
J 2 3
A
S 1
O
29


HESPERIS MATRONALIS
LAKE SUPERIOR
MICHIGAN
MINNESOTA
IOWA
ILLINOIS
LAKE MICHIGAN
Fl Fr
A
M 2
J 14
J 2 2
A 1
S 1
O
30

near the base), has been collected once as a weed in cold frames behind the Horticulture Greenhouses, University of Wisconsin, Madison, August 6 [fl. & fr.], 1961, *Iltis s.n.* (WIS). This Eurasian weed, common in Canada and the western U.S. and occasionally in the NE U.S., can be expected to spread in Wisconsin.

18. DESCURAINIA Webb. & Berthelot   Tansy Mustard

[Detling, L. E. 1939. A revision of the North American species of *Descurainia. Am. Midl. Nat.* 22:481–520.]

Erect annuals, the stems canescent or with distinct glandular hairs. Leaves uni-, bi-, or tri-pinnate. Petals yellow, about 2 mm long. Fruit a straight or clavate silique, the valves faintly one-nerved. Seeds elliptic or oblong, in one or two rows in each locule.

Key to Species

1. Stems pubescent and glandular; siliques 6–10 mm long, club shaped; leaves once or twice pinnate ------------------------------- 1. *D. pinnata* var. *brachycarpa.*
1. Stems lightly appressed pubescent to canescent, but never glandular; siliques linear, 12–21 mm long; leaves twice or three times pinnate -- 2. *D. sophia.*

1. Descurainia pinnata (Walt.) Britt. var. brachycarpa (Richards) Fern. Tansy Mustard   Map 28.

Sisymbrium canescens Nutt. var. *brachycarpa* (Richards) Fern.

Erect, to 7 dm tall, often branched above; stems glandular throughout, often also appressed pubescent. Leaves pinnate or bipinnate. Petals pale yellow. Siliques 6–10 mm long, narrowly clavate; pedicels slender, divergent. Seeds small, red-brown, ovoid, in two rows in each locule.

Frequent, mainly in southern Wisconsin, in sandy places, along beaches and waste places, most commonly along railroad embankments. Flowering from early May through early July and fruiting from mid-May through September.

2. Descurainia sophia (L.) Webb. Herb Sophia   Map 29.

Similar to *D. pinnata;* stems lightly appressed pubescent to canescent. Leaves twice to three times pinnate. Siliques 12–21 mm long, 1 mm wide, linear. Seeds in one row.

Occasional as a weed of farmyards, railroad embankments and roadsides. Naturalized from Europe. Flowering from mid-June to mid-July and fruiting from late June through early September.

19. HESPERIS L.

1. HESPERIS MATRONALIS L. Dame's Violet; Dame's Rocket; Mother-of-the-Evening Map 30.

Erect perennials or biennials, pubescent throughout, generally rough to the touch, leaves simple, lanceolate, sessile or short-petiolate, the margins nearly entire or minutely toothed. Petals purple to pink, sometimes white, showy, to 2 cm long; sepals elliptic with watery margins. Silliques to 14 cm long, constricted between the elliptic dark brown to black seeds.

Frequently cultivated for its showy flowers and evening fragrance, and escaping along roadsides, railroads, fields and city streets, and occasionally in woods. Introduced from Europe. Flowering from late May through mid-July (one specimen September 20), and fruiting from mid-June to August.

MALCOLMIA MARITIMA R. Br., the "Virginia Stock", is a low annual, to about 2 dm tall, pubescent throughout with appressed forked and stellate hairs, with petiolate leaves and white or purple flowers. It is occasionally cultivated as an ornamental and has escaped in Dane Co.: roadside, *Steinhoff 50* (WIS); streambank, Manitou Way, Madison, 1958, *Stromberg s.n.* (WIS).

IODANTHUS PINNATIFIDUS (Michx.) Steud. is a tall, robust, glabrous annual with auricled, serrate cauline leaves and purplish flowers. There is one, doubtfully native, collection from Wisconsin: Waukesha Co.: Hunters Lake, vicinity of Dousman [in flower and young fruit], 1942, *Schenk s.n.* (WIS). This may have been introduced from Illinois where it is frequent, from the central part southward, along river banks and in alluvial soils.

20. ERYSIMUM L. TREACLE MUSTARD

Erect weedy annuals or perennials, simple to much branched, pubescent with closely appressed, stellate or two-parted hairs. Leaves simple, linear to lanceolate, entire or nearly so. Petals yellow or orange; ovary pubescent, the style short. Fruits linear, four-angled, with a strong midvein. Seeds numerous, oblong, in a single row in each locule.

KEY TO SPECIES

1. Petals 15–23 mm long, bright yellow or orange; fruits 4–10 cm long; rare ---------------------------------- 1. *E. asperum*.
1. Petals 3–8 mm long; fruits 1–4 cm long ------------------ 2
    2. Pedicels slender, widely diverging; petals bright yellow to orange; leaves lance-linear to broadly lanceolate, green, minutely stellate-pubescent --------------------- 2. *E. cheiranthoides*.

2. Pedicels, when mature, stout and stiff and nearly as broad as the fruit, strongly ascending; petals lemon-yellow; leaves linear, gray-green with appressed, mostly two parted hairs ---------- -- 3. *E. inconspicuum.*

1. ERYSIMUM ASPERUM (Nutt.) D.C. Western Wallflower Map 31.

Erect, 2–4 dm tall, appressed-pubescent nearly throughout. Cauline leaves linear to lance-linear, entire to repand toothed. *Petals bright yellow to orange, 15–23 mm long;* pedicels 5–7 mm long. Siliques linear, strongly keeled and 4-angled.

Rarely introduced in Wisconsin from the western U.S. Bayfield Co.: headwaters of the Marengo River, *Knowlton 72197* (MIL). Grant Co.: along railroad embankment, Wyalusing, 1958, *Hartley 4479* (WIS). Waupaca Co.: Marion, along railroad, *Goessl s.n.,* 1915 (WIS). Flowering in early June and fruiting in mid-July.

2. ERYSIMUM CHEIRANTHOIDES L. Wormseed Mustard Map 32.

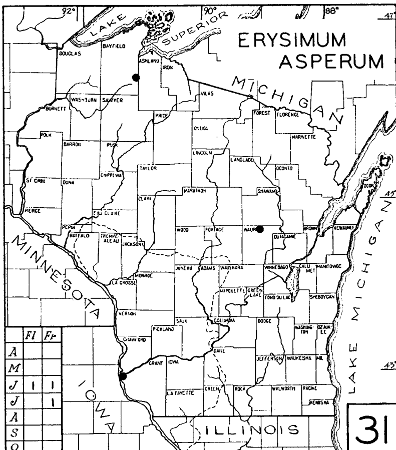
Erect annual or winter annual, simple to much branched above, to 10 dm tall; stems appressed-pubescent. Leaves lance-linear to broadly lanceolate, entire to repand-toothed, minutely stellate-pubescent. *Petals bright yellow to orange, 3–5 mm long;* pedicels slender, widely diverging, 5–13 mm long. Siliques linear, 1–2 (–3) cm long; stigma only slightly notched.

Very common throughout the state, mainly in sandy places, along shores of lakes and rivers, on sand bars and islands, often in prairies, less commonly on sandstone or limestone cliffs, wooded slopes, marshes, often weedy along roadsides, railroads, waste places, farmyards, pastures, and in cultivated fields. Adventive from Eurasia. Flowering from early May through mid-October and fruiting from early June through early November.

3. ERYSIMUM INCONSPICUUM (Wats.) MacMillan Map 33.

Erect, appressed-pubescent perennial, often branched above, to 6 dm tall. Leaves linear, mostly entire. *Petals lemon-yellow, 5–7 mm long,* the sepals about 4 mm long, stiffly erect. Siliques 2–4 cm long, heavily appressed-pubescent; stigma conspicuously capitate, two-parted; pedicels nearly as broad as the fruits, about 4–6 (–8) mm long.

Frequent in dry open places, often on cinders and ballast along railroad embankments, occasionally on bluffs and in waste places. Flowering from early June through mid-July and fruiting from mid-June until early August.


ERYSIMUM
ASPERUM
LAKE SUPERIOR
MICHIGAN
MINNESOTA
IOWA
ILLINOIS
LAKE MICHIGAN
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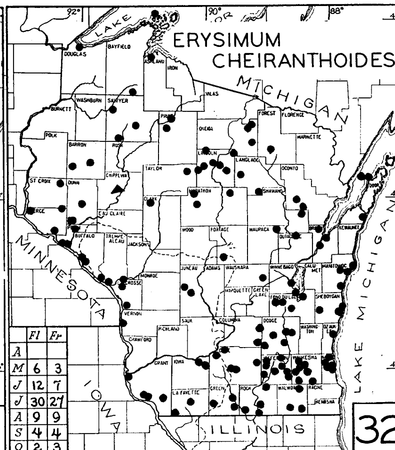
J 1
A
S
O
31


ERYSIMUM
CHEIRANTHOIDES
LAKE SUPERIOR
MICHIGAN
MINNESOTA
IOWA
ILLINOIS
LAKE MICHIGAN
Fl Fr
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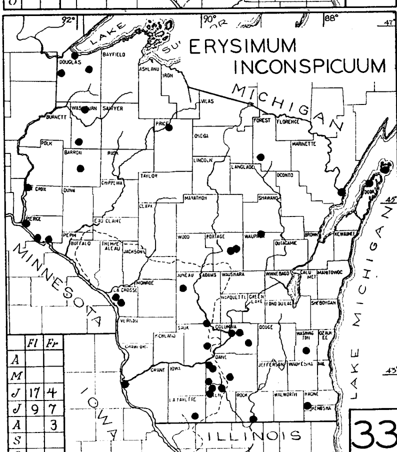
J 12 7
J 30 27
A 9 9
S 4 4
O 2 3
32


ERYSIMUM
INCONSPICUUM
LAKE SUPERIOR
MICHIGAN
MINNESOTA
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ILLINOIS
LAKE MICHIGAN
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A 3
S
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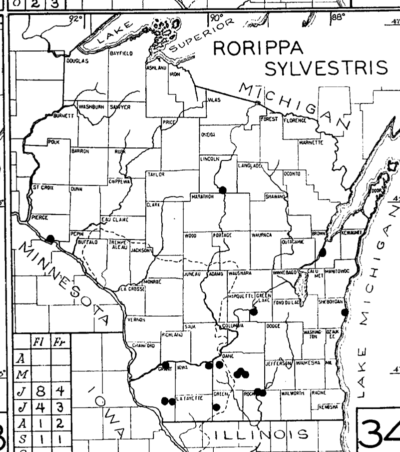
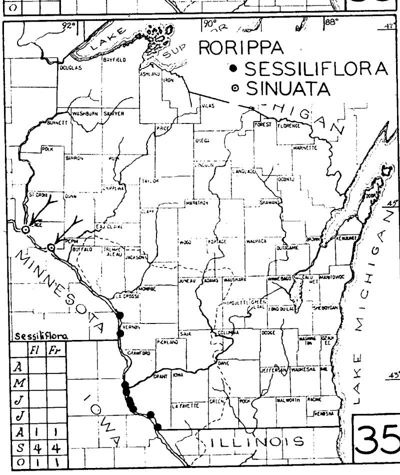
33


RORIPPA
SYLVESTRIS
LAKE SUPERIOR
MICHIGAN
MINNESOTA
IOWA
ILLINOIS
LAKE MICHIGAN
Fl Fr
A
M
J 8 4
J 4 3
A 1 2
S 1 1
O
34


RORIPPA
SESSILIFLORA
SINUATA
LAKE
MINNESOTA
IOWA
ILLINOIS
LAKE MICHIGAN
Sessiliflora
Fl Fr
A
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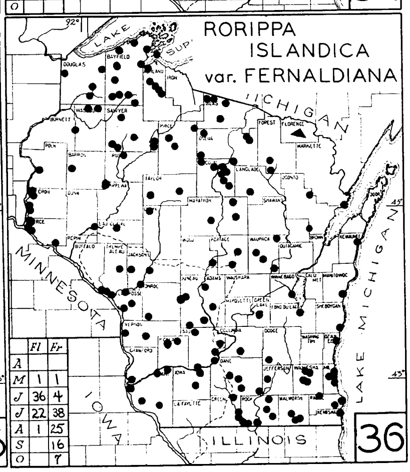
J
J
A 1 1
S 4 4
O 1 1
35


RORIPPA
ISLANDICA
var. FERNALDIANA
LAKE
MINNESOTA
IOWA
ILLINOIS
LAKE MICHIGAN
Fl Fr
A
M 1 1
J 36 4
J 22 38
A 1 25
S 16
O 7
36

21. RORIPPA Scop. Yellow Cress, Yellow Watercress

Annuals or perennials. Leaves pinnate or pinnatifid. *Petals yellow, small;* pedicels divergent, generally short and slender. Fruit a short silique or *silicle, terete* or nearly so. Seeds numerous, small, wingless, in two rows in each locule; *Radicula* Hill; *Nasturtium* of many authors, not R. Br.

Key to Species[1]

1. Petals 4–6 mm long, exceeding sepals ____________________ 2
   2. Plants much branched, 1–2 (–3) dm tall; stem with oblongoid to subspheroid hairs; all leaves with rounded sinuses, none cleft to the rachis (rare) __________________________ 1. *R. sinuata.*
   2. Plants often simple, slender, 2–5 (–6) dm tall; stem with slender or only slightly inflated hairs; leaves deeply pinnatifid, often to the rachis, the lateral leaflets of upper leaves linear ____ 2. *R. sylvestris.*
1. Petals 1–2 (–3) mm long, equalling or shorter than the sepals 3
   3. Pods, except the lowermost, sessile or nearly so; style short, knobby; leaves mostly oblong-ovate; stem glabrous; only along Mississippi River __________________________ 3. *R. sessiliflora.*
   3. Pods on filamentous and divergent pedicels; style slender; leaves mostly lance-ovate ____________________ 4. *R. islandica.*

1. Rorippa sinuata (Nutt.) Hitchcock Map 35.

Perennial with underground rhizomes, much branched and spreading ascending, 1–3 dm tall. Stem pubescent with oblongoid to subspheroid hairs. Leaves oblong or elliptic-lanceolate, 2–5 cm long, with regularly sinuate margins like an oak leaf. Petals pale yellow, 4–6 mm long, exceeding the sepals. Fruit cylindric to lanceolate, curved at maturity, 7–15 mm long, the style and pedicels both quite slender.

Only two collections (MIL) from Wisconsin from near the Mississippi River in Pierce County. Introduced from the western U.S., where it is widespread in bottomlands, roadsides, fields, and along sandy or rocky shores. Flowering and fruiting in July and August.

2. Rorippa sylvestris (L.) Besser Creeping Yellow Water Cress Map 34.

Perennial with underground rhizomes. Stems erect, slender, often weak and branched, to 5 (–6) dm tall, with scattered short stiff hairs mostly near the base. Leaves oblong-elliptic, pinnatifid to the rachis; leaflets generally toothed or serrate, the lateral ones of the

[1] Rorippa austriaca (Crantz) Besser is reported from Wisconsin by Fernald (1950), Gleason (1952), and C. L. Wilson (1927). There are no voucher specimens for these reports, and this species apparently does not occur in Wisconsin.

upper leaves mostly linear. Petals yellow, 4–5 mm long, exceeding the sepals. Pedicels slender, divergent, 5–10 mm long. Fruits linear, 5–13 mm long.

Occasional, in moist places in the southern part of the state, along sandy or gravelly shores of lakes or rivers, often weedy in ditches, low fields and waste places. Introduced from Europe. Flowering from mid-June, fruiting from July through September.

3. RORIPPA SESSILIFLORA (Nutt.) Hitchcock
Sessile-Flowered Watercress Map 35.

Annual or biennial, glabrous, often much branched from the base, 10–35 cm tall. Leaves oblong-ovate, crenate to pinnatifid, but rarely cleft to the rachis. Petals pale yellow, to 1 mm long, shorter than sepals. *Fruits plump,* 5–12 mm long, 1–3 mm broad, *sessile* except for the lowest; style capitate; seeds minute, ca. 200 per fruit, red brown.

Mud flats of the Mississippi River, from Grant to La Crosse Counties. Flowering and fruiting from mid-August to mid-October.

This species is here at the northern limit of its range. In Grant County it is fairly common, occurring continuously to the Illinois state line. There seems every reason to believe that the lack of specimens from northern Illinois, which results in a 100 mile disjunction (cf. Jones and Fuller, 1955), is due to lack of collecting, and not due to some "historical factor" related to glaciation and the unglaciated "Driftless Area."

4. RORIPPA ISLANDICA (Oeder) Borbas Marsh Cress, Yellow Watercress Maps 36, 37
Rorippa palustris (L.) Bess.

Annual or biennial, simple or widely branching, to 10 dm tall. Leaves quite variable, mostly lance-ovate, pinnate or pinnatifid, variously toothed. Petals yellow, 1–2 mm long, shorter than the sepals. Fruits ellipsoid to sub-globose, inflated, 2–5 (–7) mm long, on slender divergent pedicels; seeds ca 40–60, small.

KEY TO VARIETIES

1. Stem glabrous or occasionally hispid below ____________________ 4a. *R. islandica* var. *fernaldiana.*
1. Stem hispid nearly throughout with stiff spreading hairs ____________________ 4b. *R. islandica* var. *hispida.*

4a. RORIPPA ISLANDICA var. FERNALDIANA Butters & Abbe Map 36.
Rorippa hispida (Desv.) Britt. var. *glabrata sensu* Fernald (1928), not Lunell (1908).

Stems glabrous throughout or somewhat hispid below only. Fruits slightly larger than in var. *hispida,* 3.0–6.4 mm long, averaging 4.3 mm long *(fide* Butters & Abbe, 1940).

Common throughout the state in moist or wet places, on sandy, rocky, or muddy river and lake shores, in mucky sloughs, sedge meadows, wet prairies, marshes with *Sagittaria* and *Typha,* often weedy along wet roadsides, railroads, old fields and in waste places. Flowering in the southern part of the state in late May, northward from mid-June through July and fruiting in late May in the south, mostly from mid-June to October in the north.

4b. RORIPPA ISLANDICA var. HISPIDA (Desv.) Butters & Abbe
Rorippa hispida (Desv.) Britt. Map 37.

Stem hispid throughout with simple, stiff white hairs. Fruits 2.2–4.6 mm long, averaging 3.4 mm long (*fide* Butters & Abbe, 1940).

Infrequent but widespread throughout the state, in open, sandy or mucky, wet soil, particularly in sedge meadows, borders of bogs, wet marshy places, often along the muddy shores of lakes and rivers. Flowering from mid-June through August and fruiting from early July into October.

22. NASTURTIUM R.BR. WATER CRESS

1. NASTURTIUM OFFICINALE B.Br. Water Cress Map 38.

Free-floating or creeping emergent aquatic, glabrous to sparingly pubescent with simple hairs. Leaves pinnate, the leaflets narrowly elliptic to rounded. *Petals white,* 3–5 mm long. Pedicels widely divergent, to 25 mm long; fruits ascending 10–27 mm long, linear, plump, often curving. Seeds in a double row in each locule.

Mainly in southern Wisconsin, most frequent in or along springs, and shallow, clear running streams, in roadside and drainage ditches, cattail marshes, sloughs, and less commonly along lake shores, often forming extensive and pure colonies. Flowering from late May through mid-October and fruiting from earliest July through mid-October.

23. ARMORACIA GAERTN.

Perennials with deep tap roots or with rhizomes. Flowers white. Silicles subglobose, obovoid or ellipsoid, the valves nerveless. Seeds wingless, in two rows in each locule.

KEY TO SPECIES

1. Plants aquatic; submerged leaves finely dissected
-- 1. *A. aquatica.*
1. Plants terrestial; basal leaves oblong-ovate, long-petiolate
-- 2. *A. rusticana.*

1. ARMORACIA AQUATICA (A. Eaton) Wieg. Lake Cress Map 39.

Neobeckia aquatica (A. Eaton) Greene
Radicula aquatica (A. Eaton) Robinson

Aquatic with the appearance of *Proserpinaca* or *Myriophyllum*. *Submerged leaves finely pinnately divided into linear or filiform segments;* upper leaves lanceolate, the margins serrate. Petals white, 5–7 mm long; sepals 5 mm long. Silicles somewhat flattened, to 1 cm long, 3–4 mm broad; beak slender; pedicels slender, divergent.

Only three specimens from Wisconsin: Brown Co.: Green Bay, 1891, *Schuette 38887* (WIS). Green Lake Co.: in 15 ft. of water, Green Lake, 1921, *Rickett s.n.* (WIS). Lincoln Co.: submersed in quiet water, Tomahawk, 1915, *Goessl 2651* (MIL); to be expected elsewhere, since its rarity may be due to the difficulty with which this species is collected.

2. ARMORACIA RUSTICANA Gaertn. Horse-Radish Map 39.

Erect robust annual, 5–10 dm tall, from a thickened and deep tap root. Stems glabrous or hispid below. Basal leaves to 3 dm long; cauline leaves numerous, with crenate margins. Petals white, 5–7 mm long. Silicles elliptic, 3–4 mm long, with swollen bases; pedicels slender, spreading, 5–8 mm long.

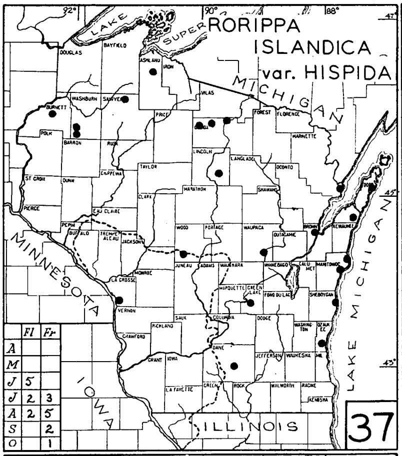
A weed of waste places, often in moist ground in dumps and along railroads, escaped from cultivation. Native of Europe. Flowering from late May through late June and fruiting from mid-June through early July.

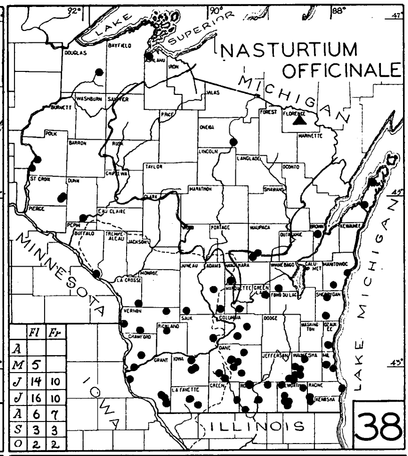
24. BARBAREA R.BR. YELLOW ROCKET

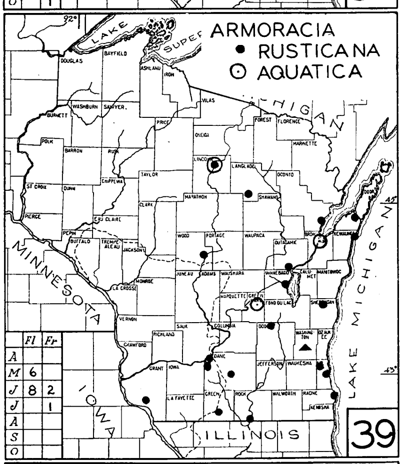
1. BARBAREA VULGARIS R.Br. Yellow Rocket; Winter Cress Maps 40, 41.

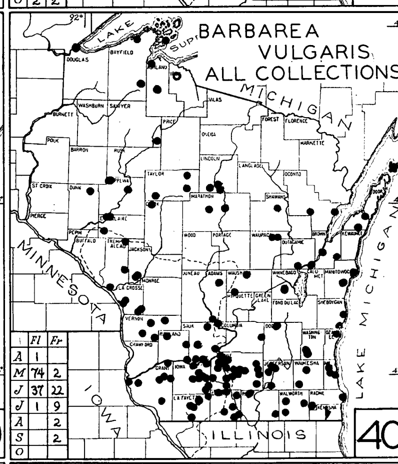
Erect, often robust biennials or perennials, simple to much branched, 3–9 dm tall. Basal leaves deeply pinnatifid with a large elliptic to nearly orbicular, often cordate terminal lobe, the lower cauline leaves pinnatifid to lyrate, the upper rounded or obovate to elliptic, coarsely dentate to palmately dissected, the base sessile or clasping. Petals pale to bright yellow or yellow-orange, 4–8 mm long. Fruits appressed or ascending to arched-ascending on horizontally divergent pedicels, 18–40 mm long; style 0.5–3.0 mm long.

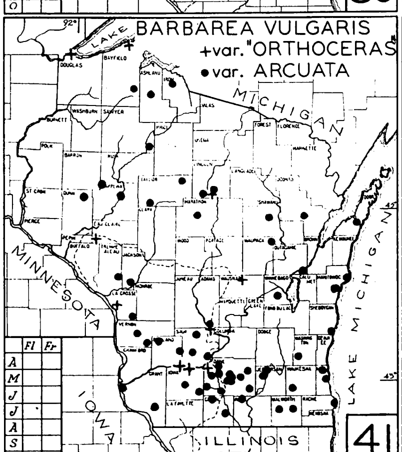
Common, especially in southern Wisconsin, in moist places, along the banks of streams rivers and lakes, borders of woods, in disturbed places in oak and maple woods, in low prairies and sedge meadows; and very frequent in waste places, along railroads, road-

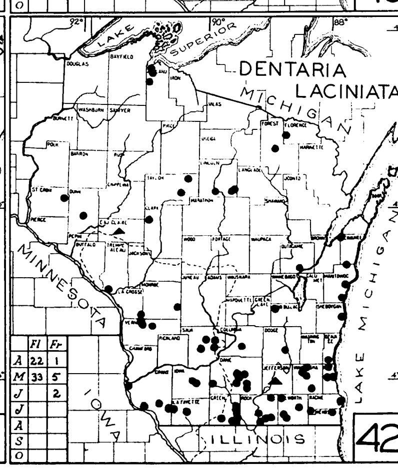

RORIPPA
ISLANDICA
var. HISPIDA
Fl Fr
A
M
J 5
J 2 3
A 2 5
S 2
O 1
37


NASTURTIUM
OFFICINALE
Fl Fr
A
M 5
J 14 10
J 16 10
A 6 7
S 3 3
O 2 2
38


ARMORACIA
• RUSTICANA
⊙ AQUATICA
Fl Fr
A
M 6
J 8 2
J 1
A
S
O
39


BARBAREA
VULGARIS
ALL COLLECTIONS
Fl Fr
A 1
M 74 2
J 37 22
J 1 9
A 2
S 2
O
40


BARBAREA VULGARIS
+var. "ORTHOCERAS"
•var. ARCUATA
Fl Fr
A
M
J
J
A
S
O
41


DENTARIA
LACINIATA
Fl Fr
A 22 1
M 33 5
J 2
J
A
S
O
42

sides, and often a pernicious weed in cultivated fields and pastures. Flowering from earliest May through mid-July and fruiting from mid-May through September.

Several of the Wisconsin specimens (Map 41) have short thick styles, small pale flowers, rather strict fruits and somewhat dissected cauline leaves. These plants, using the petal and style length as criteria, would "key" to *B. orthoceras* Ledebour in both Fernald (1950) and Gleason (1952). Very similar, but with somewhat longer petals and styles, are a small number of specimens which may belong to *B. vulgaris* var. *vulgaris*. However, *Barbarea stricta* Andrz. *(=B. orthoceras)*, according to Clapham, *et al.* (1952), has "hairy buds." Pubescence is not present on the buds of any of the Wisconsin specimens. In the European and Alaska material of the University of Wisconsin Herbarium, curved bristles are present on the *sepal margins,* and are especially visible in the bud stage. On the basis of this and other more minor characters, it seems to us that the true *B. orthoceras* does not occur in Wisconsin despite the report of Fernald (1950:717). Incidentally, neither Fernald (1950) nor Gleason (1952) mention this "hairy bud" character.

The greater percentage of our specimens have large, deep yellow flowers, *arched-ascending fruits on slender pedicels, and long slender styles,* and have been called var. *arcuata* (Opiz) Fries. Only those with mature and clearly arcuate-ascending siliques are included on Map 41. When in flower or even young fruit, the varieties of *B. vulgaris* are nearly indistinguishable.

25. DENTARIA L. TOOTHWORT

[Montgomery, F. H. 1955. Preliminary studies in the genus *Dentaria* in eastern North America. *Rhodora* 57:161–173.]

Slender, glabrous, erect, spring-flowering woodland perennials from horizontal rhizomes. Leaves palmately or compound dissected. Petals white to pale pink or pale purple. Siliques linear-lanceolate, erect or nearly so, the seeds wingless, flattened, in a single row in each locule.

Sexual sterility is very common in *Dentaria* in Wisconsin, as elsewhere, and plants with fruits are rarely found. This condition is no doubt related to the remarkable high polyploid levels within the genus, the 2n numbers for our species reported by Montgomery (1955) as ±240 for *D. diphylla,* ±208 for *D. maxima,* and 96 for *D. laciniata.*

KEY TO SPECIES

1. Leaves divided into 4–7 linear to lanceolate segments; rhizome of fusiform, easily separable segments ____________ 1. *D. laciniata.*
1. Leaves divided into 3 ovate segments; rhizome continuous and toothed ____ 2

2. Hairs on the leaflet margin 0.1 mm long, appressed; diameter of the rhizome uniform; leaves usually 2; Eastern Wisconsin -- 2. *D. diphylla.*

2. Hairs on the leaflet margin 0.2–0.3 mm long, spreading; diameter of rhizomes reduced at regular intervals; leaves usually 3; very rare, Northern Wisconsin (Ashland County) 3. *D. maxima.*

1. DENTARIA LACINIATA Muhl. Cut Toothwort Map 42.

Rhizome constricted, the segments 15–30 mm long. Stems 1–3 dm tall. Leaves palmately divided into 4–7 linear to lanceolate segments, these entire to sharply toothed or laciniate. Petals pale pink to pale purplish, 10–15 mm long; sepals 4–8 mm long. Siliques linear-lanceolate, 30–45 mm long with a long and slender style, not commonly collected in fruit in Wisconsin and then when the leaves are nearly withered, the elastically rapidly coiling valves like those of *Impatiens,* the Jewel-weed.

Widespread throughout the state, mainly in the southern mesic deciduous forests (Curtis, 1959), in rich Sugar Maple, Maple-Basswood, Oak-Hickory and bottomland forests, often with *Trillium, Podophyllum, Claytonia, Uvularia,* etc. Flowering from early April to the end of May, and fruiting from late May through June. Plants soon withering.

2. DENTARIA DIPHYLLA Michx. Toothwort; Crinkleroot Map 43.

Rhizome continuous, with uniform diameter, as much as 40 cm or more long; stems to 35 cm tall. Leaves two, occasionally three, opposite or nearly so, the 3 leaflets ovate and toothed, the terminal leaflet broader than the lateral ones, the hairs along the leaflet margins 0.1 mm long, appressed (fig. 3). Petals white, 8–14 mm long; sepals 4–6 mm long. Siliques straight, lanceolate, rarely maturing in Wisconsin.

Eastern Wisconsin, in deep humus of rich Maple-Beech or Maple-Basswood forests, one collection from a White Cedar bog *(Fassett 18241* [WIS]), in Florence Co. on steep, wooded slopes with *Tsuga,* Maple and Basswood, at nearby Lost Lake very abundant in a Sugar Maple-Basswood forest with a rich herb layer of *Caulophyllum, Viola canadensis, Adiantum pedatum, Trillium grandiflorum, Sanguinaria,* etc. Flowering from mid-May through early June, the fruits appearing in late May, rarely maturing.

3. DENTARIA MAXIMA Nutt. Toothwort Map 43; Fig. 3.

Very similar to *D. diphylla;* rhizome interrupted by abrupt constrictions. Leaves commonly 3, alternate, the 3 leaflets more sharply,

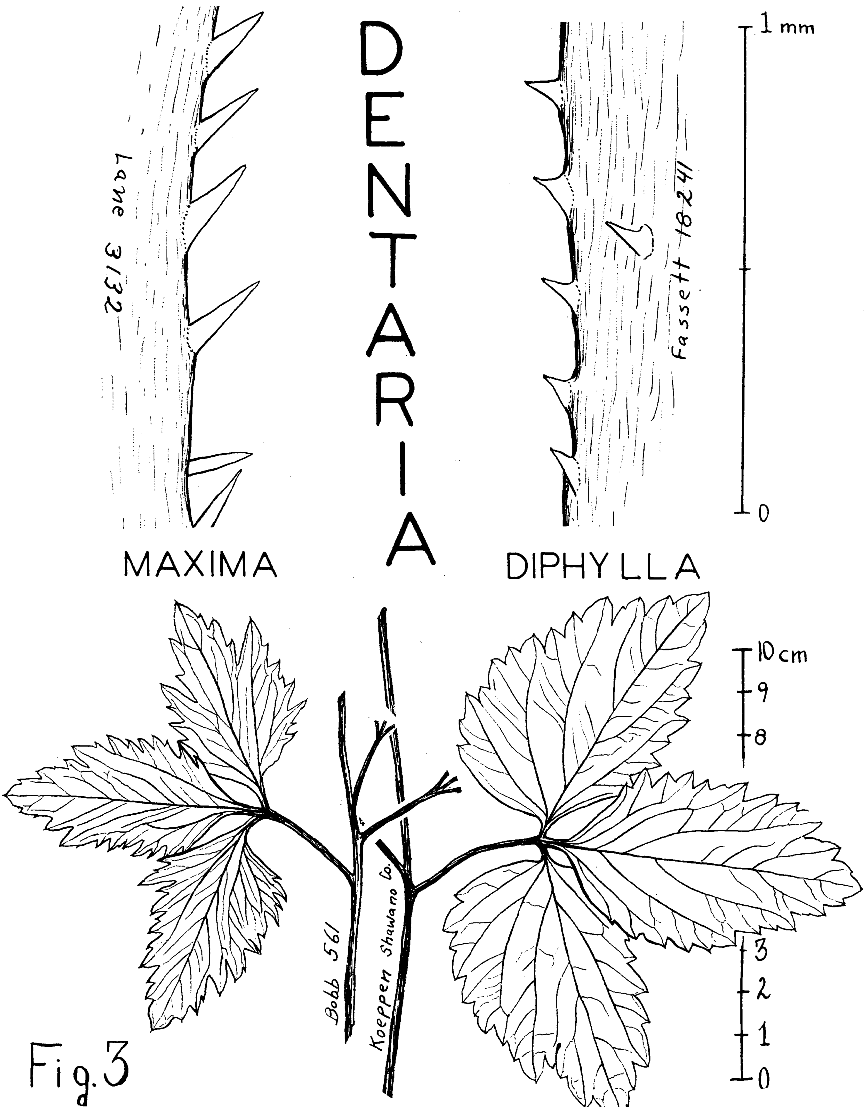


Fig. 3

deeply, and irregularly toothed than those of *D. diphylla;* hairs on the leaflet margin 0.2–0.3 mm long, spreading (fig. 3).

The only Wisconsin station is in Ashland Co.: river bottom forests, about 3.5 mi. south of Ashland along Wis. 13, near crossing of White River, April 22, 1958, *Lane 3132* (WIS); White River Bottoms, May 16, 1931, *Bobb 561* (WIS), May 28, 1931, *122* (WIS), *Rowland* and *Arnson,* May 28, 1930 (Northland College Herb.).

Dr. F. C. Lane of Northland College writes that in this mesic river bottom elm forest *D. maxima* is very abundant, forming large clones, and is associated with *Erythronium americanum,* and *Viola* spp.

26. CARDAMINE L. Bitter Cress

Slender perennial herbs; petals white to pink or pale purplish. Siliques linear, usually flattened, tipped with a persistent style, the valves nerveless; pedicels divergent. Seeds flattened, wingless, in a single row in each locule.

Key to Species

1. Stem leaves simple -- 2
   2. Flowers usually pink to purplish, rarely white, nodding; stem often minutely hirsute with slender straight hairs throughout, rarely glabrous throughout; stem leaves 2–4 (–5); plants 1–2 (–3) dm tall ------------------------------ 1. *C. douglassii.*
   2. Flowers white, erect or ascending; stems densely puberulent with small incurved hairs *on lower* ⅓ *of stem,* glabrous above (very rarely glabrous throughout); stem leaves (4–) 5–12; plants 2–5 (–6) dm tall ---------------------------- 2. *C. bulbosa.*
1. Stem leaves pinnately divided ---------------------------- 3
   3. Petals 7–14 mm long; leaflets of the basal leaves nearly circular; cauline leaves 2–5 (–6); stems simple ----- 3. *C. pratensis.*
   3. Petals 2–4 mm long; leaflets of the basal leaves irregular, not circular; cauline leaves few to numerous; stems generally branching -- 4
      4. Lateral leaflets of the cauline leaves oval or oblong, decurrent on the rachis; plants 1–7 dm tall; stems often hirsute; mature siliques with style 0.5–2.0 mm long 4. *C. pensylvanica.*
      4. Lateral leaflets of the cauline leaves linear, not decurrent on the rachis; plants 1–3 dm tall; stems glabrous; mature siliques with style 0.2–0.9 mm long ---------------- 5. *C. parviflora.*

1. Cardamine douglassii (Torr.) Britt. Pink Spring Cress; Pink Bitter Cress Map 44.

   Cardamine bulbosa (Schreb.) B.S.P. var. *purpurea* (Torr.) B.S.P.

Similar to *C. bulbosa,* but only 1–2 (–3) dm tall. Stems usually minutely or sparsely hirsute throughout, the hairs longer than in *C. bulbosa* and divergent, if sparsely pubescent or glabrous above, then glabrous also to the very base. Cauline leaves 2–4 (–5), the lower one or two often deeply cordate and with petioles, the upper often coarsely toothed. Sepals purple-tinged; petals pink-purple to white or nearly so (in forma *albidula* Farw.), 10–20 mm long, the flowers generally nodding. Siliques rarely maturing in Wisconsin, linear, 22–35 mm long (including the filiform style).

Occasional, though locally abundant, in low or moist, rich woods in the southern mesic forests (Curtis, 1959) and in wooded boggy places underlain by dolomites, mainly in eastern Wisconsin. Flowering from mid-April until early June and fruiting from mid-May on, about 2 to 3 weeks earlier than *C. bulbosa.*

Field observations on this species were made in the spring of 1960, in a White Cedar *(Thuja)* and Yellow and Paper Birch *(Betula lutea, B. papyrifera)* woods, about 100 yards from the strand of Lake Michigan, 1 mile SE of Lake Church, Ozaukee County. Here the soil varied from sandy loam on higher ground to black wet humus in the depressions, and was only a few feet above the bedrock of the Niagara Dolomite. The rich herb layer included Skunk Cabbage *(Symplocarpus foetidus)*, Marsh Marigold *(Caltha palustris)*, Small Ginseng *(Panax trifolia)*, Trillium *(Trillium grandiflorum* and *T. cernuum macranthum)*, Yellow Dogtooth Violet *(Erythronium americanum)*, and many shrubs of several species of Gooseberries *(Ribes triste, R. americanum, R. cynosbati)*, all growing with *Cardamine douglassi,* which, in full bloom on May 15th, was particularly common in the moister area. Its showy petals ranged from an occasional white[1] to the more common pale lilac-purple. Several of the plants examined, perhaps 10%, were either glabrous throughout (!) or with only 2 or 3 slender hairs on the whole plant. They were in every respect typical for the species, however: small, few-leaved, and with colored, nodding flowers. The remaining specimens showed the characteristic pubescence all the way to the inflorescence.

The isolated collection in Vernon County (cf. Map 44) is from a mature and wonderfully preserved Red Oak-Sugar Maple forest in the Champion Valley area, to which the second author was taken by Drs. J. T. Curtis and G. Cottam. Here a densely forested ravine is banked by steep slopes, where spring seepage produces some local wet areas. *Cardamine douglassii* is abundant here, with *Galium aparine, Floerkia proserpinacoides, Poa alsodes,* and other interesting species. These Cardamine plants were more robust than the ones from Lake Michigan and had very large, deeply cordate, basal leaves. By May 20, all plants were past flowering. The Sauk County collection is from a Sugar Maple forest with seepage similar to the above.

[1] The white petals changed to a pale purple on drying!

2. CARDAMINE BULBOSA (Schreb.) B.S.P. Spring Cress; Bitter-cress Map 45.

Stems erect from a short tuber, 2–6 dm tall, glabrous above, usually with very short, *dense, fine appressed puberulence on the lower* ⅓. Leaves (4–) 5–12, simple, the 2 to 5 lowest ones petioled, cordate-ovate or reniform to obovate, the upper sessile, entire to remotely dentate, rarely coarsely toothed. Sepals green with white margins; petals white, 7–15 mm long, smaller than in *C. douglassii*, the flowers generally erect. Siliques linear lanceolate, rarely reaching maturity in Wisconsin, 18–24 mm long.

Frequent, mainly in the southern part of the state, in open, moist or wet places, especially in marshes with *Iris, Caltha,* etc., wet sedge meadows, damp prairies, swales, sloughs, along muddy shores of lakes and streams, dense thickets near water, *Thuja* or Tamarack *(Larix)* bogs with *Rhus vernix* and *Salix,* bottomland forests, damp spots in Maple-Basswood forests, rarely in sandy places, moist talus slopes, dripping wet limestone cliffs (Grant Co.), and in pastures or along railroad embankments. Flowering from early May through mid-June, the fruits, which appear in mid-May, rarely maturing in Wisconsin in June and July.

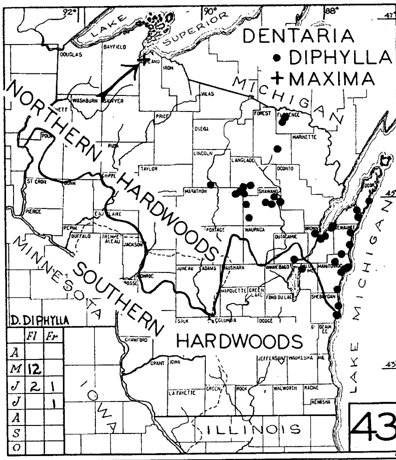
Sometimes confused with the earlier flowering *C. douglassii,* but may be differentiated by the glabrous upper stems and minute incurved puberulence on the lower stem, more numerous, less coarsely toothed stem leaves, and smaller, generally erect (not nodding) white flowers, as well as by the rather different ecology and later flowering period.

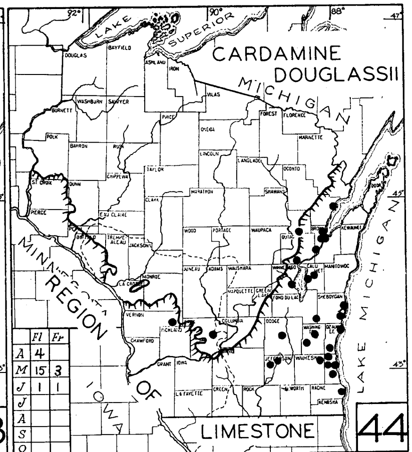
3. CARDAMINE PRATENSIS L. var. PALUSTRIS Wimm. & Grab. Cuckoo Flower Map 46.

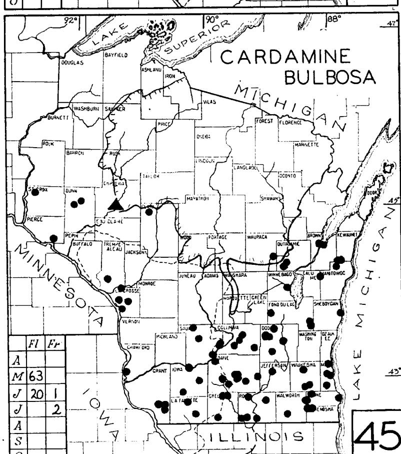
Stem erect, glabrous, simple, arising from a short rhizome. Leaflets of basal leaves nearly orbicular; cauline leaves 2–6, the leaflets elliptic to linear. Petals white to pinkish, 7–14 mm long, about three times the length of the sepals. Fruits rare, often aborted, when present 1–3 cm long; style short.

Occasional, mostly in the eastern part of the state, in wet open places, marshes, swampy areas, along lakes, springs, wet sedge meadows, rarely in quaking or Alder bogs, and open White Cedar *(Thuja)* hardwoods. Flowering from late May through mid-June, the fruits first appearing in late May.

The isolated station in Polk County is from Cedar Lake *(Moyle 2688* [MINN]).


DENTARIA
• DIPHYLLA
+ MAXIMA
NORTHERN HARDWOODS
SOUTHERN HARDWOODS
LAKE SUPERIOR
MICHIGAN
MINNESOTA
IOWA
ILLINOIS
LAKE MICHIGAN
D. DIPHYLLA
Fl Fr
A
M 12
J 2 1
J 1
A
S
O
43


CARDAMINE
DOUGLASSII
LAKE SUPERIOR
MICHIGAN
REGION OF LIMESTONE
IOWA
LAKE MICHIGAN
Fl Fr
A 4
M 15 3
J 1 1
J
A
S
O
44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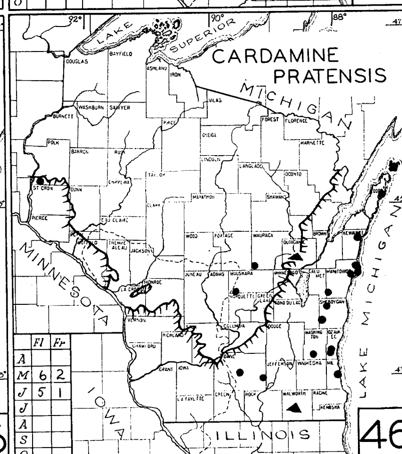
BULBOSA
LAKE SUPERIOR
MICHIGAN
MINNESOTA
IOWA
ILLINOIS
LAKE MICHIGAN
Fl Fr
A
M 63
J 20 1
J 2
A
S
O
45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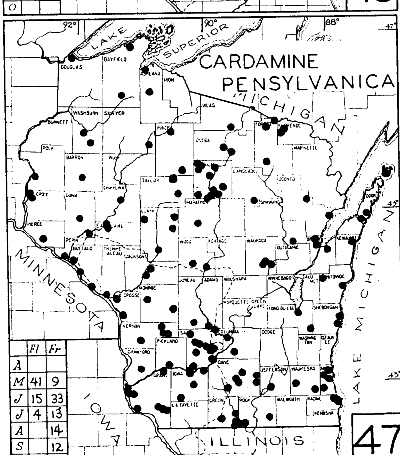
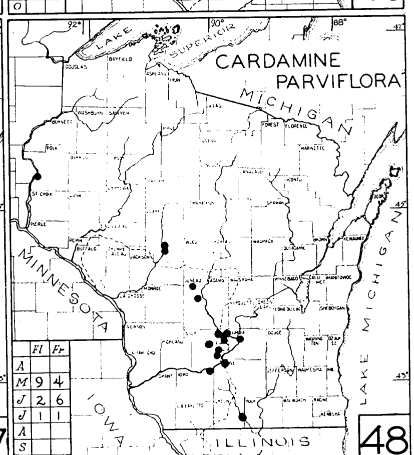
PRATENSIS
LAKE SUPERIOR
MICHIGAN
MINNESOTA
IOWA
ILLINOIS
LAKE MICHIGAN
Fl Fr
A
M 6 2
J 5 1
J
A
S
O
46


CARDAMINE
PENSYLVANICA
LAKE SUPERIOR
MICHIGAN
MINNESOTA
IOWA
ILLINOIS
LAKE MICHIGAN
Fl Fr
A
M 41 9
J 15 33
J 4 13
A 14
S 12
O 6
47


CARDAMINE
PARVIFLORA
LAKE SUPERIOR
MICHIGAN
MINNESOTA
IOWA
ILLINOIS
LAKE MICHIGAN
Fl Fr
A
M 9 4
J 2 6
J 1 1
A
S
O
48

4. CARDAMINE PENSYLVANICA Muhl. Pennsylvania Bittercress Map 47.

Cardamine hirsuta L. var. *pensylvanica* Muhl. ex Willd.

Stems hispidulous at least at the base, often throughout, except when submerged or decumbent, then often glabrous, simple to much branched, to 1–5 (–7) dm tall. Leaves pinnate; lateral leaflets of cauline leaves linear to obovate, the terminal leaflets (except of uppermost leaves) broader than the lateral leaflets, their bases decurrent on the rachis. Petals white, 2–4 mm long, more than half the length of the sepals. Siliques 10–27 mm long; style 0.5–2.0 mm long.

Common throughout Wisconsin, mostly in moist or wet places: bottomland forests and rich wet woods, moist ravines, along the shores of lakes, rivers and streams, on open sand flats, in springs, marshes, wet meadows, and occasionally weedy in cultivated fields and along roadsides. Flowering from early May through July and fruiting from late May through October.

5. CARDAMINE PARVIFLORA L. var. ARENICOLA (Britt.) Schulz

Cardamine arenicola Britt. Map 48.

Stems simple to much branched, *glabrous*, to 3 dm tall. Leaves all pinnate; leaflets of basal rosettes ovate to suborbicular, the terminal leaflets of cauline leaves only slightly broader than the *linear lateral leaflets*, these *not decurrent on the rachis*. Petals white, 2.5–4.0 mm long, the sepals about half as long. Siliques linear, 1–3 cm long; style 0.2–0.9 mm long; fruiting pedicels 6–10 mm long.

Occasional, especially in central Wisconsin, in dry or damp rocky woods, sandstone or quartzite bluffs or hillsides, and in moist sand, sandy muck, willow thickets along rivers, or roadsides. Flowering from early May through June (one specimen July 22), and fruiting from late May through July.

Very easily confused with *C. pensylvanica*, but separated by *the total absence of stem pubescence*, by the narrower leaflets, smaller size, shorter styles, and by the generally drier habitats in which it occurs. Xeromorphic extremes of *C. pensylvanica*, however, are (nearly?) indistinguishable from this species.

27. ARABIS L. ROCK CRESS[1]

[Hopkins, M., 1937. *Arabis* in eastern and central North America. *Rhodora* 39:63–98; 106–148; 155–186. Rollins, R. C. 1941. Monographic study of *Arabis* in western North America. *Rhodora* 43:289–325; 348–411; 425–481.]

Perennials or less often biennials from a basal rosette, the leaves simple, mostly entire. Petals white to yellowish or pale purplish.

[1] We are very grateful to Dr. Reed C. Rollins, of the Harvard University Herbarium, Cambridge, Mass., for checking the identification of most of the specimens of this difficult genus on which the following treatment is based.

Siliques linear, flattened or terete, with several to many seeds in each cell, the valves usually one-nerved. Seeds flattened, often winged at the margin.

A. Key to Flowering Material

1. Stem leaves attenuate to a narrow base, not clasping or auriculate ---------- 2
   2. Plants 1–3 (–4) dm tall, often with many slender branches; stem leaves mostly linear, 1–5 mm wide; petals 5–8 mm long ---------- 1. *A. lyrata.*
   2. Plants (3–) 4–11 dm tall, erect and strict, generally unbranched; stem leaves oblanceolate to narrowly elliptic, 6–50 mm wide; petals 3–5 mm long ---------- 8. *A. canadensis.*
1. Stem leaves, at least the lowermost, strongly clasping or auriculate ---------- 3
   3. Pedicels 1–4 mm long; petals 2–4 mm long; plants 2–5 (–6) dm tall, weak-stemmed and much branched from the base, usually stellate-pubescent throughout; leaves oblanceolate to oblong-ovate ---------- 9. *A. shortii.*
   3. Pedicels (5–) 6–15 mm long; petals (4–) 5–10 mm long; plants simple, erect and strict, generally unbranched, glabrous or pubescent ---------- 4
      4. Plants glabrous throughout (the basal rosette leaves rarely pubescent in No. 4) ---------- 5
         5. Basal rosette leaves normally lacking at anthesis; largest stem leaves (except in depauperate plants) (5–) 8–20 cm long; pedicels divergent; sepals nearly equalling the length of the petals ---------- 7. *A. laevigata.*
         5. Basal rosette leaves lanceolate, usually ascending, entire to shallowly serrate; largest stem leaves 2–5 (–9, rare) cm long; pedicels generally appressed to subappressed; sepals about half the length of the petals ---------- 4. *A. drummondi.*
      4. Plants pubescent, *at least at the very base of the stem,* the stem leaves and upper stem often glabrous ---------- 6
         6. Leaves of basal rosette often lyrate-pinnatifid, glabrous except for few, simple, stiff hairs on the margin (these often only at the tip of each tooth or laciniation) ---------- 6. *A. missouriensis.*
         6. Leaves of basal rosette entire or serrate, stellate-pubescent on both surfaces ---------- 7
            7. Pubescence at base of stem spreading, mostly of simple, hirsute hairs ---------- 8
               8. Plants robust, glaucous above, the stems hirsute only at the base; stem leaves 2–12 cm long, strongly sagittate-clasping ---------- 2. *A. glabra.*

8. Plants often slender, not glaucous, the stems hirsute to above the middle;[1] stem leaves 1–4 cm long, sessile to slightly auriculate ---- 3a. *A. hirsuta* var. *pycnocarpa.*

7. Pubescence at the base[2] of the stem mostly of appressed stellate or forked hairs ---------------------------- 9

9. Petals white, 3–6 mm long; fruits *at maturity* erect; seeds of young fruits in a single row; stems sparsely to densely pubescent on at least the lower third, often throughout (only rarely the stem nearly glabrous throughout) ------- 3b. *A. hirsuta* var. *adpressipilis.*

9. Petals whitish-pink to purple, 5–8 mm long; fruits *at maturity* widely spreading; seeds of young fruits in a double row; stems glabrous except for the lowermost 5 cm's ------------------------- 5. *A. divaricarpa.*

B. Key to Mature Fruiting Material

1. Fruiting pedicels erect or strongly ascending; *fruits* not curved, straight or nearly so, erect and *closely appressed to the stem*---- 2

2. Fruits somewhat quadrangular to terete at maturity; base of stem hirsute with stiff, spreading hairs; style rather broad, often somewhat capitate; plant glaucous, often robust-- 2. *A. glabra.*

2. Fruits flattened; hairs at the base of the stem, if present, spreading or appressed; style much narrower than the fruit-- 3

3. Fruits 0.7–1.1 mm broad; seeds broadly winged, in a single row in each locule; stem often pubescent throughout, or at least the lower ⅓ (rarely glabrous, except at very base); plants generally slender -------------------- 3. *A. hirsuta.*

3. Fruits 1.2–2.1 mm broad; seeds not winged, in a double row in each locule; stem glabrous (or rarely with a few scattered hairs at the base only); plants generally robust -------- ------------------------------------ 4. *A. drummondi.*

1. Fruiting pedicels ascending to diverging; *fruits* straight to strongly arched, erect to divergent or recurved, *not closely appressed to the stem* -------------------------------------- 4

4. Fruits strongly curved and much flattened 1.2–3.3 mm wide 5

5. Fruits pendulous, 2.5–3.3 mm broad; seeds broadly winged; leaves with a narrow base, often slightly petiolate, *never clasping* ---------------------------------- 8. *A. canadensis.*

5. Fruits recurving, 1.5–2.0 mm broad; seeds narrowly winged; leaves sagittate- or auriculate-clasping ---------- 6

6. Largest cauline leaves 1–5 (–7) cm long; stems with 19–50 nodes (leaves) to the lowest fruiting pedicel; base of stem

[1] Collections of *Arabis hirsuta* var. *adpressipilis* may be hirsute, but then only at the *very base,* the remainder of the stem clothed with more or less appressed, *forked* hairs.

[2] Often only at the *very* base.

pubescent with short simple hairs; rosette leaves often lyrate-pinnatifid, glabrous, except for a few stiff hairs on the margin .... 6. *A. missouriensis.*

6. Largest cauline leaves 8–20 cm long; stems with 8–16 (–19) nodes to the lowest fruiting pedicel; plants glabrous even at base; rosette leaves serrulate ..... 7. *A. laevigata.*

4. Fruits straight or nearly so, terete to flattened, 1–2 mm broad 7

7. Cauline leaves auriculate-clasping at the base; fruits diverging or ascending 8

8. Plants usually unbranched and strict, robust, glabrous except at the base; pedicels 5–13 mm long; basal leaves oblanceolate to spatulate, stellate-pubescent on both surfaces .... 5. *A. divaricarpa.*

8. Plants much branched from the base, slender and weak-stemmed, stellate-pubescent throughout; pedicels 1–4 mm long; basal leaves long-petiolate, spatulate ... 9. *A. shortii.*

7. Cauline leaves sessile, spatulate to linear, or the lowest lyrate-pinnatifid; fruits ascending to erect; plants slender, much branched, 1–4 (–5) dm tall .... 1. *A. lyrata.*

1. ARABIS LYRATA L. Lyreleaf Rock Cress Map 49.

Slender and much branched, 1–4 dm tall. Stem usually pubescent at the base. Rosette leaves 2–4 cm long, lyrate-pinnatifid to dentate. Cauline leaves spatulate to linear, mostly entire. Petals showy, white (rarely cream or pale pink), 5–8 mm long. Siliques erect or ascending, on divergent pedicels, 20–45 mm long, 1 mm or less wide. This species is quite variable, reflecting the diversity of habitats in which it occurs.

Very common, particularly in the "Driftless Area", in a large number of communities (Curtis 1959), most abundant in open, very sandy and sunny places, on beaches and dunes, sand flats, sandy, gravelly, or rocky dry prairies, in open, dry Pine or Oak woods, on sandstone cliffs and rocky slopes, less commonly on limestone cliffs and quartzite outcrops, frequently weedy in pastures, gravel pits, railroad embankments and roadsides, essentially lacking from the eastern Wisconsin Niagara Dolomite formation, and from the Northern Highlands except along roadsides, railroads and lake shores. Flowering from late April through September and fruiting from mid-May through September.

2. ARABIS GLABRA (L.) Bernh. Tower Mustard Map 50.

Stiffly erect, to 9 dm tall. *Stem with stiff, spreading, simple hairs at the base,* glabrous and often glaucous above. Leaves lanceolate, strongly sagittate-clasping, strictly appressed, only the basal ones hirsute. Petals white to yellowish, mostly 4 (–5) mm long, slightly longer than the sepals. Siliques sub-terete, (5–) 8 (–11) cm long, 1.0–1.5 mm broad, strictly appressed; stigma broad, often somewhat capitate. Seeds in one or two rows in each locule, very narrowly or not at all winged.

Widespread throughout the state in dry, well-drained, often open places, especially common in sandy fields, prairies and "bracken grassland" (Curtis 1959), in open, sandy Jack Pine or Aspen woods with Bracken Fern, *Comptonia* (Sweet-fern) and Blueberry understory, less common on sand dunes or beaches, gravelly or rocky places as streambeds, railroad embankments, gravel pits, etc., frequently weedy along roadsides or in pastures, and rarely on sandstone (Richland Co.) or limestone cliffs [Racine Co., *Wadmond 2145* (WIS)]. Flowering from late May through mid-July, and fruiting from mid-June to late September.

This species is often confused with the more slender *A. hirsuta,* which has winged seeds, and when in young fruit with *A. drummondi,* which lacks the distinctive hirsute pubescence at the stem base.

3. ARABIS HIRSUTA (L.) Scop. Hairy Rockcress Maps 51, 52.

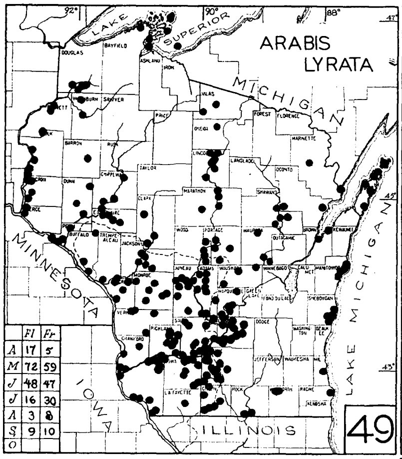
Slender, erect, sometimes slenderly branching above, 6–60 (90) cm tall, pubescent at least at the very base. Rosette leaves stellate-pubescent on both surfaces. Cauline leaves 1–5 (–7) cm long, auriculate-clasping. Petals white, 3–6 mm long. Flowering pedicels diverging, becoming ascending or appressed. Siliques ascending and more or less appressed to the stem, flattened, 3.0–6.5 cm long, 0.7–1.1 mm broad. Seeds rectangular, broadly winged, in a single row in each locule.

KEY TO VARIETIES

1. Stem pubescence mostly of simple, spreading, hirsute hairs; cauline leaves often heavily pubescent ---------- 3a. var. *pycnocarpa.*
1. Stem pubescence (except sometimes at the very base) mostly of appressed forked hairs; cauline leaves often glabrous or nearly so ---------------------------------- 3b. var. *adpressipilis.*

3a. ARABIS HIRSUTA var. PYCNOCARPA (Hopkins) Rollins Map 51.

In the western, southern, and eastern parts of the state, almost exclusively on ridges or in crevices of vertical, dry to moist or rarely wet *limestone or dolomite cliffs* (these usually in the open, sometimes in Maple-Basswood forests), rocky limestone shores of lakes, and rarely on dunes (see notes after var. *adpressipilis).* Flowering from mid-May to early July and fruiting from late May until September.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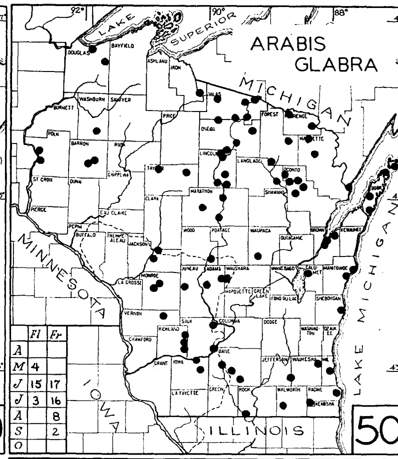
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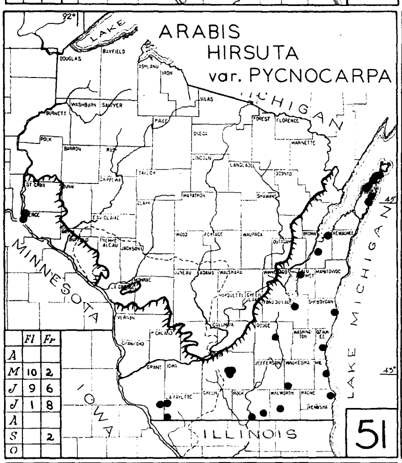
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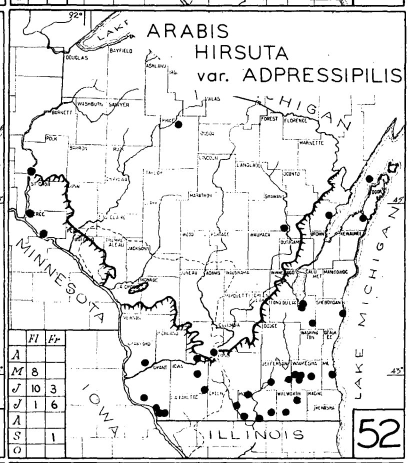
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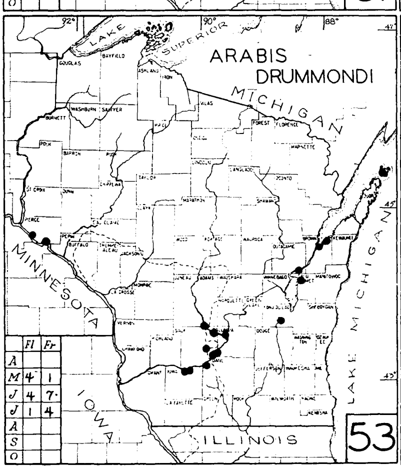
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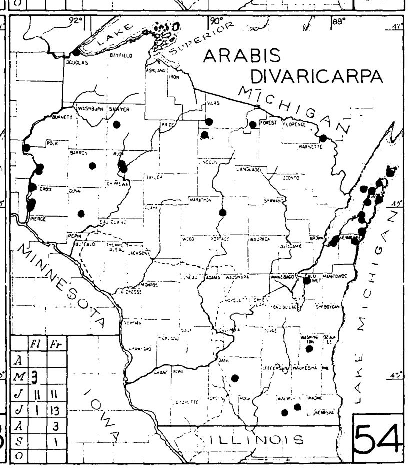
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3b. ARABIS HIRSUTA var. ADPRESSIPILIS (Hopkins) Rollins Map 52.

Slightly wider-ranging than var. *pycnocarpa* and occasionally tending to be weedy, in rich, rocky, dry woods (Oak-Hickory, Waukesha Co.), on wooded, pastured hillsides, occasionally on moist or dry, open or shaded limestone cliffs, along railroad embankments, and in sandy or gravelly fields and shores, with one specimen from "Muckwonago Swamp" [*Fassett 20627* (WIS)]. Flowering from about May 20 through early July, and fruiting from mid-June through September.

Hopkins (1937:116) cites *Fassett 13457* and *13369,* (both WIS), both from damp cliffs in Grant Co., as *A. pycnocarpa* var. *glabrata.* Rollins (1941) restricts the name var. *glabrata* only to the "large flowered plants with diverging pedicels and somewhat saccate outer sepals from the northwestern U. S. and adjacent Canada," and states that this variety does not occur in Wisconsin. While these two plants, which both fall within var. *adpressipilis,* are perhaps somewhat more glabrous than usual, the fact that they were collected in the "Driftless Area" very possibly influenced Hopkins' taxonomic judgment, who, as a student of Fernald in the early 1930's, must have been strongly exposed to the "Nunatack Hypothesis" of his teacher [See Iltis & Shaughnessy (1960:118–119) for a nearly identical error due to "Phytogeographic Suggestion," in this case in *Dodecatheon,* Primulaceae].

The two varieties may grow very close together. Thus, along the Kinnickinnic River in Pierce County (E and NE of the County Trunk F bridge), we find var. *adpressipilis* in crevices of limestone boulders on a sunny, steep south-facing dry prairie, growing with *Campanula rotundifolia, Pellaea-glabella, Aquilegia canadensis,* and *Muhlenbergia cuspidata.* Looking south across the valley, we see a very high, vertical, N-facing limestone cliff. At its base, on the moist open ledges and cliffs right above the river, there is abundant var. *pycnocarpa,* in association with *Erigeron philadelphicus, Veronicastrum virginicum, Cystopteris bulbifera, C. fragilis, Aquilegia canadensis, Lycopus americanus, L. uniflorus, Mitella diphylla, Arabis lyrata,* and *Besseya Bullii.* Between Hager City and Bay City, in the same county, var. *pycnocarpa* grows in a nearly pure *Juniperus virginiana* stand on a steep south-facing talus slope beneath a dolomite bluff. Within a few yards grow *Artemisia frigida, Chrysopsis Ballardii,* and *Symphoricarpus occidentalis,* attesting to the xeric nature of this woods. In contrast, on the massive, vertical, NW-facing St. Croix River bluffs just below Osceola in Polk County, var. *pycnocarpa* grows in moss cushions on shaded sandstone rocks densely covered with deciduous mesophytic forest vegetation, sharing this niche with *Cryptogramma stelleri* and other ferns, with *Taxus canadensis* and *Acer spicatum* in the immediate vicinity.

4. ARABIS DRUMMONDI Gray Drummond Rockcress Map 53.

Erect, unbranched, glabrous, to 10 dm tall. Leaves of the basal rosette narrowly oblanceolate, glabrous (rarely with a few hairs, especially at their very base), generally ascending, the cauline leaves auriculate-clasping. Petals white to pale purple, 5–10 mm long, exceeding the sepals. Siliques erect and appressed, (6–) 7–12 cm long, 1.2–2.2 mm broad, the valves with a strong midvein. Seeds in a double row in each locule, 1.1–1.5 mm long, 0.8–1.1 mm broad, narrowly winged.

Locally abundant, in a Juniper woods on dolomite talus in Pierce Co.; at Devil's Lake on rocky east-facing cliffs; along the Wisconsin River in sandy, open flood plain woods, sand bars, and pastures; and on bluffs and talus slopes following the western border of the Niagara Dolomite, from lower Fond du Lac Co. to Washington Island, Door Co. Flowering from early May to mid-June and fruiting in June and July.

This species in young fruit may be confused with *A. divaricarpa* or *A. glabra,* but can be separated by the lack of pubescence at the very base of the stem. In some collections *(Zimmerman 1180,* Devil's Lake, Sauk Co.; *Fassett 16225,* High Cliff, Calumet Co.—both WIS), the basal rosette leaves are slightly pubescent on the margins and under surfaces.

5. ARABIS DIVARICARPA A. Nelson Map 54.

Arabis brachycarpa (T.&G.) Britton

Erect, often somewhat branched from the base, to 9 dm tall. Stems with stellate pubescence at the base. Basal leaves oblanceolate to spatulate, stellate-pubescent on both surfaces. Cauline leaves glabrous, oblong to linear lanceolate, auriculate or sagittate-clasping at the base, entire. Petals pale pink-purple or nearly white, 5–8 mm long. Siliques straight, 2.5–8.0 cm long, 1.2–2.0 mm broad, on widely diverging pedicels. Seeds narrowly winged at the top, 1 mm in diameter, in two rows in each locule in young fruit, becoming somewhat uniseriate.

In dry, well-drained, rather open wooded places, in rocky or sandy soil, frequently on limestone or dolomite cliffs, outcrops, bluffs, and talus slopes, rarely on granite outcrops (basic lava flows), on the inner strand and on dunes of the Great Lakes, and occasionally along railroad embankments and roadsides. Flowering from late May to mid-June (rarely in early July) and fruiting from mid-June through August.

6. ARABIS MISSOURIENSIS Greene, var. DEAMII (Hopkins) Hopkins
Arabis viridis Harger, var. *Deamii* Hopkins Map 55.

Erect, with one main stem, to 6 dm tall; stem slightly hispid at the base, glabrous above, *with 19–50 nodes to the first flower* or branch. *Basal leaves* lanceolate to oblanceolate, serrulate to *lyrate-pinnatifid, glabrous except for a few marginal hairs, these singly at the tip of each tooth or laciniation.* Cauline leaves sagittate-clasping, imbricated, the upper narrowly lanceolate and entire, the lower broadly lanceolate, and serrulate to laciniate. Petals white to cream, 6–8 mm long, about twice the length of the sepals. Siliques flattened, at first erect, becoming arched and recurved, 6–9 cm long, 1.5–2.0 mm broad. Seeds in a single row, 1.4–1.8 mm long, 1 mm wide.

Occasional, mainly in the northern half of Wisconsin, usually in dry, sunny, sandy, gravelly or rocky (acidic?) places, often on the border of rocky, open oak woods, with six of the central and northern Wisconsin specimens on Pre-Cambrian granite or quartzite outcrops. Flowering from earliest June to earliest July and fruiting from late June through August.

When in fruit, this species is very similar to *A. laevigata,* but is easily separated by the much larger number of nodes to the first flower, and by the distinctive basal rosettes.

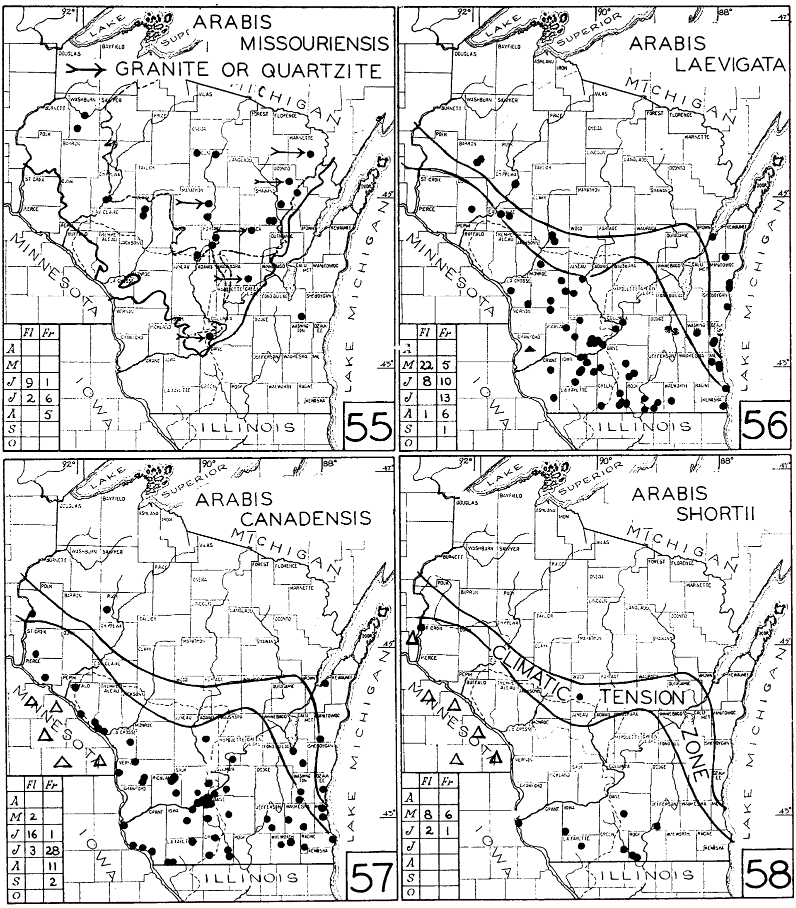
Hopkins (1938) cites, in error, a Wisconsin collection of this species *(Hermann 8760,* Sauk Co. (WIS)) as typical *A. viridis.* This plant was found on "mossy granitic boulders, in a wooded ravine at Parfrey's Glen". It is perhaps significant that this, the southernmost station in Wisconsin and a rather isolated one, is in one of the most unusual habitats in the state—a deep, cool, dark gorge which harbors many rare plants (e.g. *Aconitum noveboracense).*

7. ARABIS LAEVIGATA (Muhl.) Poir. Smooth Rockcress Map 56.

Stem glabrous throughout, even at the very base, to 10 dm tall, *with only 8–16 nodes (leaves) to the first flower or branch.* Cauline leaves clasping, linear to oblong-lanceolate, not imbricated, to 2 dm long. Lower leaves serrate-dentate, the upper entire. Petals equalling or only slightly exceeding the sepals. Fruits similar to those of *A. missouriensis.*

Frequent in the southern part of the state, north to the "tension zone", in moderately damp or moist wooded places, mostly on or at the base of more or less wooded sandstone cliffs, and, in eastern Wisconsin, on wooded limestone cliffs and ledges, often in sandy or gravelly, mesic, generally rocky and steep Oak or Sugar Maple-Basswood woods (on very rocky, wet talus, with understory of

Taxus—Grant Co.), on pine relics on sandstone bluffs in southern Wisconsin, on damp, rocky cliffs in Northern Hardwoods of *Tsuga*—White Pine, Yellow Birch, *Circaea alpina, Streptopus roseus,* (Vernon Co.) and occasionally on sand flats (with *Hypoxis, Sisyrinchium, Castilleja coccinea, Pedicularis canadensis*—Juneau Co.) and stream or river banks. Flowering from May through June (occasionally in August) and fruiting from June through September.



8. ARABIS CANADENSIS L. Sickle-Pod Map 57.

Erect biennial, often unbranched, hispid at base, glabrous above, 4–9 (–13) dm tall. Cauline leaves oblong-lanceolate, 3–13 cm long and 0.5–4.0 cm broad, entire or with small remote serrations, the pubescence mostly of simple hairs. Petals white to yellowish-green, 3–5 mm long, less than twice the length of the sepals, the racemes long and loose. Siliques much flattened, slightly curved, 2.5–4.0 mm broad, 6–10 cm long, divergent to deflexed,[1] the valves with a conspicuous midvein. Seeds broadly winged, 3 mm long, red-brown, in a single row in each locule.

Frequent in the southern part of the state, mainly in dry oak forests (Curtis, 1959), mostly Oak-Hickory, Bur Oak-Black Oak, sometimes in mesic woods, with Maple, Basswood, and Ash, on rocky or gravelly, wooded, north-facing sandstone hillsides, on rocky bluffs, talus slopes, wooded borders of xeric prairies and occasionally on them, often on the wooded banks of streams or rivers, with one collection on limestone [*Fassett 15250,* Fond du Lac Co. (WIS)]. Flowering from late May into early July and fruiting in July through August.

9. ARABIS SHORTII (Fern.) Gl. Shorts Rockcress Map 58.

Arabis perstellata E.L.Br. var. *shortii* Fern.
Arabis dentata T.&G.

Slender and weak-stemmed, much branched from the base, to 5 dm tall, stellate-pubescent throughout. Rosette leaves long-petioled and spatulate (a good character for vegetative recognition). Cauline leaves oblanceolate to oblong-ovate, clasping, wavy to dentate, 2–7 cm long, with simple hairs above and stellate only along the midrib, densely stellate-pubescent below. Petals white to pale pink, 2–4 mm long, rarely exceeding the sepals. Pedicels 1–3 (–4) mm long, divergent. Siliques linear, widely spreading 1.5–3.0 cm long, 1 mm broad.

On sandy alluvial soil in southern Wisconsin; rare, but locally abundant in river bottom forests or rich, damp, deciduous woods near streams or lakes, occasionally weedy (Park Hq., Wyalusing St. Pk.); in the "Avon Bottoms" in the Sugar River Valley abundant in stands of Silver Maple, Elm *(Ulmus americana),* Swamp White Oak *(Quercus bicolor),* Hackberry *(Celtis occidentalis),* Sycamore *(Platanus occidentalis),* Basswood, *Diarrhena americana, Arisaema dracontium, Cephalanthus occidentalis, Chaerophyllum procumbens* and *Euonymous atropurpureus;* formerly in the woods at Picnic Point, Lake Mendota, Madison; the isolated Wood Co. collection *(Fassett 14124)* from near Little Bull Falls of the Yellow River; along the St. Croix R., often in extensive colonies, sometimes the only species growing in bare leaf mulch, or with *Galium aparine, Ranunculus abortivus, Menispermum, Phlox divaricata* etc., in *Acer saccharinum-Ulmus-Fraxinus* flood plain forest. Flowering from early to late May and fruiting in late May and June.

[1] Plants projecting horizontally from steep banks have fruits at right angles to the peduncle, but in relation to the horizon *fruits are always vertical.*

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ERRATA

PRELIMINARY REPORT ON THE FLORA OF WISCONSIN
No. 43—*Primulaceae*

Transactions of the Wisconsin Academy of Sciences, Arts and Letters 49:113–135, 1960

The following errata all involve change in numbers, both of genera and species, in two of the main keys.

page 115. The numbers with the last four genera in generic key should read:

________ 5. ANAGALLIS
________ 4. LYSIMACHIA
________ 7. TRIENTALIS
________ 6. SAMOLUS

page 123. generic heading, middle of page, should read:

4. LYSIMACHIA, etc.

10th line from bottom: ______________________ 4. *L. nummularia*
page 124. 5th line from top: ____________________________ 5. *L. quadrifolia.*
page 125. 3rd line from top. ____________________________ 6. X *L. producta.*
7th line from top: __________________________ 7. *L. terrestris.*
9th line from top: __________________________ 3. *L. clethroides.*

PRELIMINARY REPORTS ON THE FLORA OF WISCONSIN. NO. 45. AMARANTHACEAE—AMARANTH FAMILY[1]

JONATHAN SAUER AND ROBERT DAVIDSON
University of Wisconsin, Madison and Catholic University of America, Washington, D. C.

Distribution maps are based on specimens in the herbaria of the University of Minnesota (MINN), the Milwaukee Public Museum (MIL), and the University of Wisconsin, including hosts of fungi in the cryptogamic collection (WIS). Type material discussed for some of the species was examined in the British Museum of Natural History (BM), the Linnaean Society of London (LINN), and the Museum Nationale d'Histoire Naturelle in Paris (P). We are indebted to the curators for making this material available for study.

AMARANTHACEAE OF WISCONSIN

Annual herbs, with simple, entire, estipulate leaves cuneate or attenuate at the base and decurrent on the petioles. Flowers very small, subtended by scarious, acuminate bracts, crowded in axillary or terminal inflorescences. Perianth uniseriate, the petals and sepals alike and designated as *tepals*. Stamens 3–5. Ovary superior, 1-celled, ripening into a membranaceous circumscissile or indehiscent utricle containing a single seed.

All the species begin flowering in summer and continue until frost. Flowering and fruiting specimens are not distinguished on the tables accompanying the maps, because all stages from new flower buds to ripe fruits are present on each plant after the first weeks of the season.

All members of the family found growing spontaneously in Wisconsin belong to the two genera treated below. Three common garden ornamentals belonging to other genera are often planted within the state: *Gomphrena globosa* (globe-amaranth), *Iresine Herbstii* (blood-leaf) and *Celosia cristata* (cockscomb).

KEY TO GENERA

A. Leaves alternate, green or reddish, glabrous or slightly pubescent. Flowers unisexual. Tepals free, neither lanate nor winged. Stamens free -------------------------- 1. AMARANTHUS.

AA. Leaves opposite, grayish-green, conspicuously pubescent. Flowers perfect. Perianth tube lanate, with longitudinal spiny wings. Stamens united into a tube ------- 2. FROELICHIA.

[1] Published with the aid of the Norman C. Fassett Memorial Fund.

1. AMARANTHUS L. Pigweed, Amaranth

Prostrate or erect annual herbs, with simple, alternate, entire, long-petioled leaves. Plants generally tinged with reddish anthocyanin pigment, some cultivated forms intensely colored. Flowers unisexual, monoecious or dioecious, in dense, cymose clusters located in leaf axils and, in some species, in dense leafless, terminal thyrses; each dichasium (group of 3 flowers) subtended by a spiny-tipped, persistent bract. Tepals free, 3–5 in staminate flowers, 0–5 in pistillate flowers. Stamens free, 3–5. Style-branches 3, plumose. Utricle circumscissile or indehiscent. Seed lenticular, dark brown or white, the embryo coiled around a starchy "endosperm".

Key to Species

A. Plants diffusely branched. Inflorescences wholly axillary. Leaves small, more or less spatulate. Stamens 3.

B. Prostrate carpet-plants. Bracts and tepals approximately equal in length. Tepals 4–5, with conspicuous, branching venation. Seed about 1.5 mm in diameter ___ 1. *A. blitoides.*

BB. Bushy tumbleweeds. Bracts much exceeding tepals. Tepals 3, with simple midveins. Seed less than 1 mm in diameter ____ 2. *A. albus.*

AA. Plants normally with a dominant erect main stem. Terminal, spike-like or panicle-like thyrses present. Leaves generally medium to large, ovate to lanceolate or elliptic to oblong. Stamens generally 5 (3–5 in No. 8).

C. Plants dioecious. Tepals generally 0–2, if more, then with conspicuous, branched midveins.

D. Bracts about 1 mm long, with very slender midribs. Pistillate tepals absent or rudimentary, lacking midveins. Utricle indehiscent ________ 3. *A. tuberculatus.*

DD. Bracts about 2 mm long, with stout midribs. Pistillate tepals present. Utricle circumscissile.

E. Pistillate tepals 1–2, lanceolate, with simple midveins. Outer staminate tepals much long and more acute than inner ___________ 4. *A. tamariscinus.*

EE. Pistillate tepals 5, spatulate, with branched midveins. Staminate tepals approximately equal, obtuse _________________________ 5. *A. arenicola.*

CC. Plants monoecious. Tepals 3–5, with simple midveins.

F. Upper cymes staminate, lower cymes pistillate. Rigid needle-like axillary spines present ___ 6. *A. spinosus.*

FF. Initial flower of each cyme staminate, the others pistillate. Spines absent.

G. Utricle exceeded by bract and longer tepals. Coarse, weedy plants, generally dull green with slight red pigmentation.

H. Tepals reflexed, obtuse or emarginate ________________________________ 7. *A. retroflexus.*

HH. Tepals straight, acute.

I. Terminal inflorescence stiff, simple or with a few widely spaced, long, lateral branches. Bracts very large, the lamina equalling utricle and with a very thick, excurrent midrib. Tepals and stamens 3–5. Style-branches spreading from base ______________________ 8. *A. Powellii.*

II. Terminal inflorescence lax, with many crowded, short, lateral branches. Bracts moderately large, the lamina shorter than utricle, and with a moderately thick and excurrent midrib. Tepals and stamens 5. Style-branches erect ________________________________ 9. *A. hybridus.*

GG. Utricle equalling or exceeding bract and tepals. Ornamental, domesticated plants, often brightly colored.

J. Shorter tepals less than 2 mm long, about ½ as long as utricle. Style-branches erect ______________________________ 10. *A. cruentus.*

JJ. Tepals all over 2 mm long, nearly equalling utricle. Style-branches spreading from base.

K. Tepals all lanceolate, acute. Inflorescence stiff _________ 11. *A. hypochondriacus.*

KK. Inner tepals spatulate, emarginate. Inflorescence lax _____ 12. *A. caudatus.*

1. AMARANTHUS BLITOIDES S. Wats. Map 1.

Prostrate, slightly succulent herbs, much branched, the fully developed leaves often crowded near tips of branches. Leaves usually very small, seldom over 4 cm long, spatulate, obtuse with shortly mucronate tips. Flowers monoecious, in axillary clusters. Bracts scarcely exceeding longer tepals, with slender, shortly excurrent midribs. Tepals 4–5, those of pistillate flowers variable, the larger almost as long as the utricle and with conspicuous, branching, green veins, acuminate, not recurved. Stamens 3. Style-branches short, recurved. Utricle smooth, circumscissile. Seed ca. 1.5 mm in diameter, black, rather glossy.

The species presumably originated in western North America as a pioneer of streambanks, talus, and other naturally disturbed habitats. A few Wisconsin collections are from such places, including the earliest, from Green Bay [Fox River banks at Fort Howard, 1881, *Schuette s.n.* (WIS).]. Conceivably, the species was a rare member of the aboriginal pioneer flora of this area. However, the bulk of its present populations in Wisconsin and in eastern North America in general are growing in artificially disturbed places. It is most abundant in trampled yards, along pathways, roads, and railroad tracks.

This species is named *A. graecizans* L. in the 8th edition of Gray's Manual and in some other floristic works, following Fernald's conclusion that it matches the type of a Gronovian name, cited by Linnaeus as a synonym of *A. graecizans* (Fernald 1954, pp. 139–140). Fernald identified Gronovius' specimen from a photograph on which the critical flower characters are not discernible. Examination of the actual specimen (BM!) together with another Linnaean specimen of *A. graecizans* (1117.3 LINN!) indicates that Fernald was mistaken and supports the contrary conclusion of Thellung (1914, pp. 285–286, 307) and Dandy and Melderis (Fernandes 1957). They found that Linnaeus' material of *A. graecizans* is different from material of *A. blitoides* and that the name *A. graecizans* properly belongs to an Old World species otherwise known as *A. angustifolius*. Thellung, however, believed that *A. graecizans* should be rejected as a *nomen confusum*.

An apparent hybrid with the next species is noted below.

2. AMARANTHUS ALBUS L. Map 2.

Low, stiff, bushy herbs, much branched, with fully developed leaves mainly towards the bases of the branches. Leaves usually very small, seldom over 5 cm long, narrowly spatulate, obtuse, with conspicuously mucronate tips. Flowers monoecious, in axillary clusters. Bracts more than twice as long as tepals, with very narrow laminas and stout, long excurrent midribs. Tepals 3, those of pistillate flowers shorter than the utricle, with simple midveins, acutish, not recurved. Stamens 3. Style-branches very short, erect. Utricle rugose, circumscissile. Seed 1 mm or less in diameter, dark brown, shiny.

The species is a native North American tumbleweed, widely distributed as a pioneer of naturally and artificially disturbed habitats. It was reported as a common weed in Wisconsin on the earliest collections, made in the early 1860's [Madison, Racine, Lead Mines, without dates, *T. J. Hale s.n.*, (all WIS)]. Most Wisconsin collections are from fields, gardens, roadsides, and railroad tracks, but a few are from natural habitats: sandy lakeshores, streambanks, and talus slopes.

Like the preceding, this species has been erroneously identified with *A. graecizans* L. in many floristic works. It agrees well with Linnaeus' specimens of *A. albus* (1117.1 LINN!).

Occasional individuals are known that appear to be hybrids between this and the preceding species, including one from Wisconsin [Waukesha Co.: along railroad near Waukesha, 12 Aug. 1939, *Oppel & Shinners 1337* (WIS)].

3. AMARANTHUS TUBERCULATUS (Moq.) Sauer. Map 3.

Acnida tuberculata Moq.

Acnida altissima (Riddell) Moq. ex Standl.

Prostrate, ascending, or erect annual herbs. Smaller leaves oblong to spatulate, obtuse; larger leaves ovate-lanceolate, acute. Flowers dioecious, in lax, terminal, spike-like or raceme-like thyrses. Bracts about half as long as utricles or staminate tepals, with slender, long-excurrent midribs. Pistillate tepals lacking or rudimentary; staminate tepals 5, nearly equal, midveins not excurrent. Stamens 5. Style-branches short, erect. Utricle smooth or rugose, indehiscent. Seed 1 mm or less in diameter, dark brown, shiny.

The species is native to lakeshores, stream banks, and marshy places in a wide region of the Great Lakes and Upper Mississippi; collected widely in Wisconsin since the mid 19th Century. Most of the collections from Wisconsin, as from the rest of the range, are from natural habitats. However, the species has become locally abundant as a weed, especially along wet ditches and in lowland fields.

Populations often grow where falling water levels expose a strip of bare sand or mud along a stream or lake. Such places offer highly variable lengths of the vegetative period, between germination and onset of the critical photoperiod for flower initiation. Consequently the species appears very heterogeneous vegetatively, although the taxonomically critical flower characters are quite constant. The Wisconsin specimens agree well with Moquin-Tandon's original material (Hort. Genev., Oct. 1847–P!).

Mixed populations of *A. tuberculatus* and weedy monoecious amaranths are common, yielding occasional sterile hybrids. In Wisconsin, the monoecious parent is usually *A. retroflexus* [Brown Co.: river banks below shanty town, Green Bay, 27 Sept. 1881, *Schuette s.n.*. Dane Co.: Madison, 14 Aug. 1890, *Cheney s.n.*. Sheboygan Co.: Sheboygan, 2 Aug. 1922, *Goessl s.n.*. Iowa Co.: Arena, 3 Oct. 1925, *Fassett 2633*. Pierce Co.: sandy river shore, Prescott, 30 Aug. 1927, *Fassett 5314* (all WIS)]. Recently *A. Powellii* has also begun hybridizing with *A. tuberculatus* [Dane Co.: lowland cornfield by University Bay, Madison, 27 Sept. 1951, *Sauer 1592* (WIS)]

4. AMARANTHUS TAMARISCINUS Nutt. *(See note below No. 6)*
Acnida tamariscina (Nutt.) Wood.

5. AMARANTHUS ARENICOLA I. M. Johnston. *(See note below No. 6)*

6. AMARANTHUS SPINOSUS L.

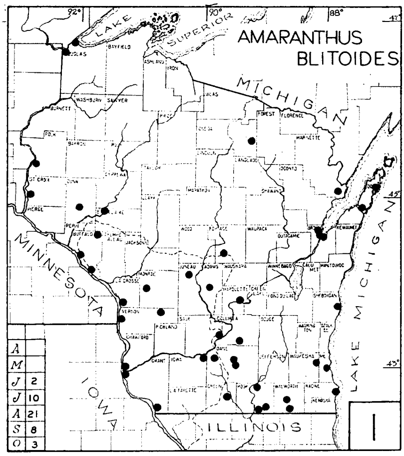
These three species are not treated in detail here, as they have not established themselves within the state, although they may be expected occasionally as ephemeral, adventive waifs. The first two are common riverbank pioneers and weeds in a wide belt between the Mississippi River and the Rockies. *Amaranthus spinosus* is a world-wide weed of tropical and warm temperate regions. *Amaranthus tamariscinus* has been found in two areas in Wisconsin [Milwaukee Co.: Milwaukee, no date, *Sartwell s.n.* (GH). Sheboygan Co.: railroad yards, Sheboygan 28 Aug. 1903, 9 Sept. 1914, one perhaps a hybrid with *A. tuberculatus, Goessl s.n.* (both WIS)]. A single plant of *A. arenicola* was found [Rock Co.: along railroad, Beloit, 16 Aug. 1942, *Shinners 4647* (WIS)] and the collector of *A. spinosus* noted only three plants present [Jefferson Co.: along railroad near Fort Atkinson, 31 Aug. 1949, *Anthes s.n.* (WIS].

7. AMARANTHUS RETROFLEXUS L. Rough Pigweed. Map 4.

Erect coarse herbs, sometimes much branched. Leaves medium sized, generally at least 15 cm long when mature, ovate, rhombic-oval, or lanceolate, usually obtuse. Flowers monoecious, in thick, stiff, panicle-like terminal thyrses, with many short, crowded lateral branches. Bracts far exceeding tepals and utricles, with thick, shortly-excurrent midribs. Tepals 5, those of pistillate flowers exceeding the utricle, with simple midveins, obtuse or emarginate, recurved. Stamens 5. Style-branches medium long, erect or slightly recurved. Utricle slightly rugose, circumscissile. Seed 1 mm in diameter, dark brown, shiny.

One of the commonest temperate-zone pigweeds, now spread around the world but probably originally native to eastern North America. It was already widespread in Wisconsin during the last half of the 19th Century. A small part of the Wisconsin populations occupy natural habitats, especially sandy lakeshores, but the species is usually found as a weed in gardens, fields, dumps, and roadsides. The Wisconsin specimens agree well with Linnaeus' original material (1117.22 LINN!).

Hybrids with *A. tuberculatus* occur, as noted above. Recently, *A. Powellii* has begun mixing with *A. retroflexus,* and some sterile hybrids have resulted (map 5). All of these were collected since 1922 in artificially disturbed sites.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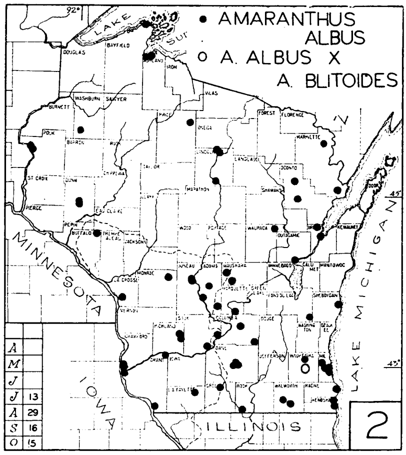
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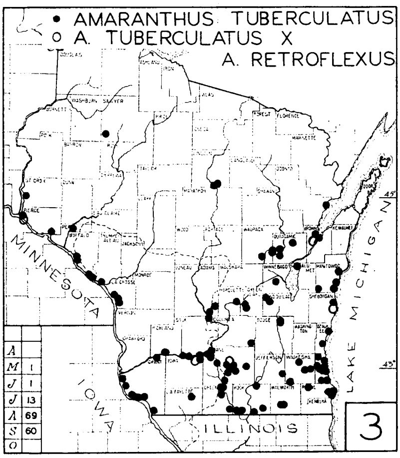
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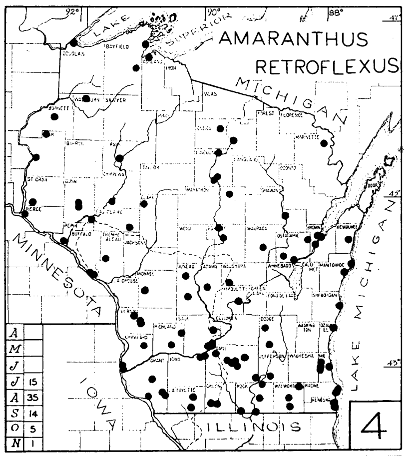
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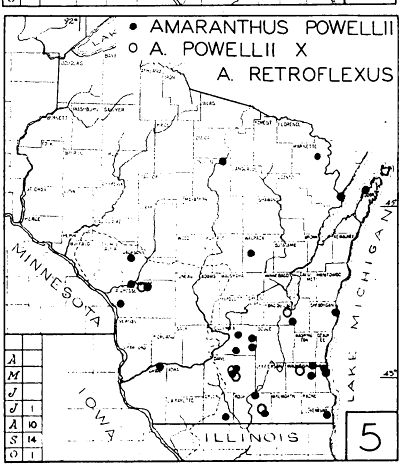
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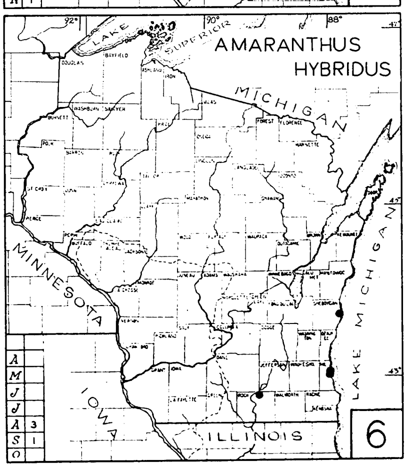
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8. AMARANTHUS POWELLII S. Wats. Map 5.

Erect, coarse, much branched herbs. Leaves rather small, generally under 10 cm long, ovate, rhombic-oval, or lanceolate, usually obtuse. Flowers monoecious, in long, thick, stiff, spike-like, terminal thyrses, some with a few, long, widely-spaced lateral branches. Bracts far exceeding tepals and utricles, with thick, moderately excurrent midribs. Tepals 3–5, the longer ones of pistillate flowers exceeding the utricle, with simple midveins, acute, nearly straight. Stamens 3–5. Style-branches long, recurved from base. Utricle slighly rugose, circumscissile. Seed about 1¼ mm in diameter, dark brown, shiny.

The species is apparently native to desert washes, mountain canyons, and other open habitats in western North America and the Cordillera of Central and South America. It has long been a common weed in the western U. S., particularly in irrigated land, and has recently been migrating eastward along roadsides and in cultivated ground. There were a few isolated collections of the plant from Wisconsin before 1939: Sheboygan Co.: Sheboygan, 28 July, 1903, perhaps cultivated, *Goessl s.n.* Grant Co.: Blue River, 24 Aug. 1927, *Davis, s.n.* (both WIS). The species has been found with increasing frequency since 1939, over two-thirds of the present collections dating from after 1955. It is now abundant in many localities and as mentioned above, is hybridizing with two older residents, *A. tuberculatus* and *A. retroflexus.*

9. AMARANTHUS HYBRIDUS L. Map 6.

Erect, coarse herbs, sometimes much branched. Leaves medium sized, generally at least 15 cm long when mature, ovate, rhombic-oval, or lanceolate, usually acute. Flowers monoecious, in slender, lax, terminal, panicle-like thyrses, with many short, crowded, lateral branches. Bracts slightly exceeding tepals and utricles, with medium thick, long-excurrent midribs. Tepals 5. those of pistillate flowers about equalling utricle, with simple midveins, acute, straight. Stamens 5. Style-branches rather short, erect. Utricle rugose, circumscissile. Seed about 1 mm in diameter, dark brown, shiny.

Aboriginally, this species was presumably a river-bank pioneer in tropical America and the warmer parts of eastern North America. As a weed of artificial habitats, it has migrated around the world and become one of the commonest amaranths. It is a conspicuous weed of cornfields and soybean fields through most of Illinois and established populations extend barely across the border into Wisconsin [Rock Co.: cornfield near Edgerton, 5 Sept. 1952, *Sauer 1597* (WIS)]. Occurrences farther north in Wisconsin may represent only ephemeral adventives [Sheboygan Co.: Sheboygan, 5 Aug. 1914, *Goessl s.n.* (WIS); Milwaukee Co.: heaps of top soil brought in for grading, waste ground, Milwaukee, 15–20 Aug. 1939, *Shinners, 983, 985* (MIL)].

10. AMARANTHUS CRUENTUS L. *(See note below No. 12)*
   A. paniculatus L.

11. AMARANTHUS HYPOCHONDRIACUS L. Prince's Feather. *(See note below No. 12)*
   A. flavus L.
   A. leucocarpus S. Wats.

12. AMARANTHUS CAUDATUS L. Love-lies-bleeding.
   A. sanguineus L.

These three species are not treated in detail here, because they have not established themselves within the state. All three are ancient cultigens, domesticated as grain crops in the highlands of Central America, Mexico, and South America, respectively. Each species has both dark and light seed color forms and a variety of plant leaf color forms, some of which have been given Latin names, although they are simple Mendelian variations that segregate within progenies. These species are now grown as ornamentals around the world and often sold in commercial flower seed packets. All three have undoubtedly been repeatedly planted and occasionally escaped in Wisconsin, although rarely collected. There is only one known collection of A. CRUENTUS [Dane Co.: along railroad track, Madison, Oct. 1938, *Shinners s.n.* (WIS)]. AMARANTHUS HYPOCHONDRIACUS has been collected 10 times, beginning late in the 19th century, always in urban areas in the southeastern part of the state; only one of these specimens is known to have been a volunteer [Dane Co.: dump near Madison, 22 Aug. 1945, *Hale & McCabe s.n.* (WIS)]. There is only one known collection of A. CAUDATUS [Dane Co.: Madison, Oct. 1924, *Davis s.n.* (WIS)].

The Wisconsin material agrees well with Linnaeus' specimens *(A. cruentus:* 117.24; *A. paniculatus:* 117.20; *A. hypochondriacus:* 117.24; *A. flavus:* 117.23; *A. caudatus:* 117.26; *A. sanguineus:* 117.21—all LINN!).

2. FROELICHIA MOENCH COTTONWEED

Erect to procumbent, hairy annual herbs with simple, opposite, entire, sessile or petiolate, apiculate leaves from often swollen nodes, the stems sometimes squarish. Flowers perfect, each subtended by two deciduous scarious bracteoles and one persistent scarious bract, densely spiral in spicate, paniculate inflorescences. Perianth tube woolly, apically 5-lobed, in age becoming strongly indurate and bearing two longitudinal irregularly toothed wings as well as (usually) a single tubercle on one face and a pair of tubercles on the other. Staminal tube membranaceous, the 5 oblong 1-locular anthers alternating with the 5-ligulate lobes. Pistil ovoid; style elongate; stigma capitate. Utricle membranaceous, indehiscent. Seeds smooth, tan to dark red-brown, ovoid, with annular embryo and farinaceous endosperm, usually germinating while still encased within the mature perianth.

KEY TO SPECIES

A. Mature fruiting perianths 5.0–5.5 mm (rarely less) high, flask-shaped, the neck rising more or less straight above the basal portion (Fig. 1). The larger of the 2 bracteoles generally 3 mm or more long. Flowers arranged in a 5-rowed spiral (twist until 5 rows come into line). Seeds mostly over 1.5 mm high, dark reddish-brown; larger leaves mostly 10–30 mm wide ---------------------------------- 1. *F. floridana.*

AA. Mature fruiting perianths rarely over 4 mm high, conic, the neck portion usually rising in a more or less asymmetrical "lop-sided" fashion above the basal portion (Fig. 1). The larger of the two bracteoles rarely more than 2 mm long. Flowers arranged in a 3-rowed spiral (twist until 3 rows come into line). Seeds mostly under 1.5 mm, tannish; larger leaves mostly 5–10 mm wide ---------------------- 2. *F. gracilis.*

The species appear to be distinct with no known evidence of hybridization or other taxonomic complexity. Confusion in their identity usually is a result of over-reliance on unstable characters, especially the nature of the mature perianth wings, whose expression depends primarily upon relative maturation. Differences in habit (mentioned below) are relatively constant except in the case of young plants which, apparently under the primary influence of short photoperiods, may commence flowering while vegetatively quite different from normal.

1. FROELICHIA FLORIDANA (Nutt.) Moq. Cottonweed

Map 7; fig. 1.

Erect or ascending tomentulose herbs with usually stout, mostly quadrangulate stems, simple to sparingly branched at base, (3–) 4–8 dm tall. Leaves thickish, papillose-puberulent above, sericeous-tomentose beneath, the larger mostly 10–27 mm wide, short-petiolate, typically *elliptic-oblanceolate* with obtuse apices and tapering bases, the uppermost reduced, subsessile and linear- to elliptic-oblong. Flowers 5-ranked (which may be seen by twisting inflorescence until 5 straight rows come into line), the mature spikes 11 (8–12)[1] mm in diameter, averaging 17 flowers/cm. Bracts acumi-

[1] The first number indicates the mean, the parenthetical numbers the size range in Wisconsin.

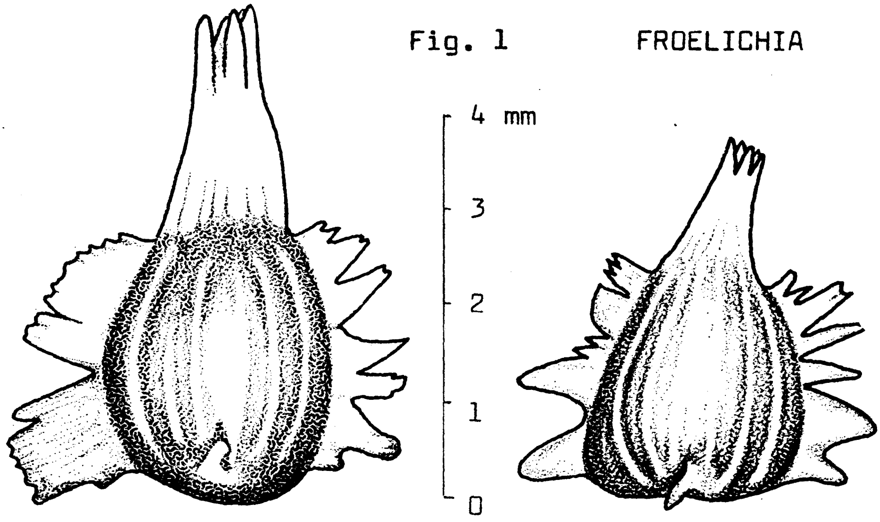
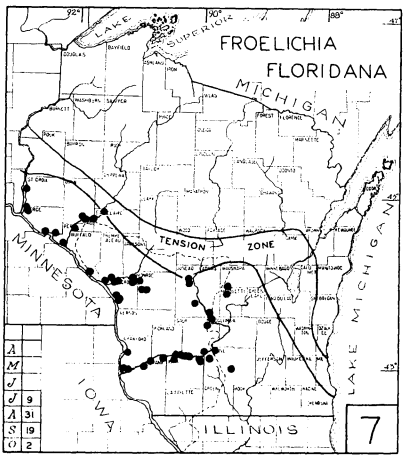
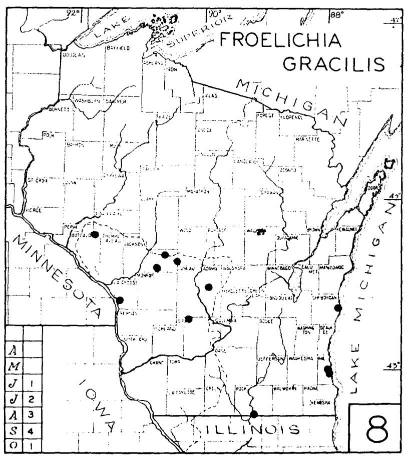


Fig. 1 FROELICHIA

FLORIDANA GRACILIS





nate, stramineous to blackish-brown. Bracteoles slightly unequal, the larger 3.4 (3.0–3.7) mm high. Mature perianth indurate, 5 (4.0–5.6) mm high, cottony, the neck symmetrically erect. Lobes of the staminal tube 1.0 (0.7–1.5) mm long. Anthers 0.8 (0.6–09) mm long. Seeds 1.6–1.8 mm high, dark reddish-brown and rather glossy.

Though the variational patterns within this range are not yet clearly defined, the range of the species usually is considered to extend from Delaware to Colorado, southeastward to Texas and Florida. The Wisconsin plants may be designated as var. *campestris*

(Small) Fern. with probable validity, inasmuch as they do vary considerably from the more southern typical variety. It is known (Davidson, unpublished) that these differences (mostly size distinctions) are maintained under greenhouse conditions. The species throughout its range seems restricted to sandy soil conditions and is often a prevalent pioneer in disturbed areas, in SW Wisconsin, south of the Tension Zone, in dunes, sandy prairie remnants, fields, and sand terraces along major rivers and in the central Wisconsin sand plains; near Arena, Iowa Co., or in SW Jackson Co., in "sandblows" with *Polygonella articulata, Oenothera rhombipetala, Aristida tuberculosa,* and *Hudsonia tomentosa,* with *Pinus banksiana* nearby. Flowering and fruiting from mid-July to mid-September (October).

2. FROELICHIA GRACILIS (Hook.) Moq. Slender Cottonweed.
Map 8; fig. 1.

Slender, erect to procumbent annual tomentulose herbs with stems usually terete and divergently branching at base, 2–4 dm tall. Leaves thickish, mostly papillose-puberulent above, sericeous-tomentose beneath, *linear* to *lanceolate* or *lance-elliptic,* the largest with mostly acute apices, 5–10 mm wide, the uppermost reduced. Flowers 3-ranked (which may be seen by twisting inflorescence until 3 straight rows come into line), the mature spikes 8 (6–9) mm in diameter, averaging 8 flowers/cm. Bracts acuminate, stramineous to blackish-brown. Bracteoles slightly unequal, the larger 2 (1.1–2.3) mm high. Mature perianth indurate, 4 (3.4–4.3) mm high, silvery sericeous, the neck oblique. Lobes of the staminal tube 0.5 (0.4–0.6) mm long. Anthers 0.5 (0.4–0.6) mm long. Seeds 1.2–1.4 mm high, tan to yellowish brown, rather dull.

This species usually is considered indigenous west of the Mississippi River from Iowa or Nebraska to Colorado, southward to Texas, Arizona and Chihuahua. Its range has expanded eastward in recent years, having been reported since 1924 as adventive in Illinois, Indiana, Ohio, Pennsylvania, Maryland, New Jersey, New York and Virginia (Blake, 1956). Although *F. floridana* has been known in Wisconsin since at least 1861 [Pepin Co.: Pepin, 1861, *Hale s.n.* (MINN, WIS)] and was collected several times during the late 19th century, *F. gracilis* apparently was not known in Wisconsin until 1927 [Sheboygan Co.: coal yard, Sheboygan, Aug. 1927, *Goessl s.n.* (WIS)]. In this state, as in others east of the Mississippi River, the species occurs in sandy, gravelly, or cindery soil, mostly along railroads, less frequently along roads, and in adjacent waste places. Flowering and fruiting from late June to early September (October).

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PRELIMINARY REPORTS ON THE FLORA OF WISCONSIN NO. 46. CARYOPHYLLACEAE—PINK FAMILY[1]

ROBERT A. SCHLISING and HUGH H. ILTIS
Herbarium of the University of Wisconsin

This treatment of the Caryophyllaceae of Wisconsin is based on specimens in the following herbaria: University of Wisconsin, Madison (WIS); Milwaukee Public Museum (MIL); University of Minnesota, Minneapolis (MINN); Chicago Natural History Museum (F); Northland College, Ashland; University of Wisconsin—Milwaukee; Iowa State College, Ames, Iowa; Eau Claire State Teachers College; Platteville State Teachers College; and Saint Norbert's College, De Pere.

Dots on the maps represent specific locations of collections, and triangles represent county records. The numbers in the map corner insets list the amount of flowering and fruiting material studied, and indicate approximate flowering and fruiting seasons for the species. The manuscript text is based in part on *The New Britton and Brown Illustrated Flora* (Gleason, 1952), and on *Gray's Manual of Botany,* Ed. 8 (Fernald, 1950). County records for Illinois, where given, are based mostly on the maps of Jones and Fuller (1955) and Winterringer and Evers (1960), those for Minnesota on preliminary maps prepared by Dr. Max Partch (St. Cloud, Minn.), to whom we extend our thanks.

Thanks and acknowledgment for loans of Wisconsin Caryophyllaceae are due Drs. Henry C. Greene, Curator of the Cryptogamic Herbarium, University of Wisconsin; M. J. Fay, Eau Claire State Teachers College; Eugene Hsi, Northland College; Emil P. Kruschke, Milwaukee Public Museum; John R. Millar, Chicago Natural History Museum, Gerald B. Ownbey, University of Minnesota; Richard W. Pohl, Iowa State College; Alvin L. Throne, University of Wisconsin—Milwaukee; and Russell D. Wagner, Platteville State Teachers College. Thanks are also due Dr. Carroll E. Wood, Jr., Harvard University, Cambridge, for information on Wisconsin *Herniaria;* Mr. Max A. Gratzl, for the excellent photographs of *Scleranthus;* Mr. Donald Ugent, for critically reading parts of the manuscript; Mrs. Russell Rill, for use of her excellent private herbarium of the Waupaca region; Mrs. Katherine S. Snell, Herbarium Assistant, for ready, cheerful assistance in the course of this study; and Miss Kathryn L. Wollangk and Mr. Stephen W. Gilson, for aid in the preparation of the maps.

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CARYOPHYLLACEAE OF WISCONSIN

Annual to perennial herbs, with *stems often swollen at the nodes. Leaves simple, entire, opposite* or rarely whorled, often narrow and small. Inflorescence of bracteate cymes. Flowers mostly perfect, hypogynous or rarely perigynous, regular, (4–) 5-merous. Sepals free, or fused and forming a tube, persistent in fruit. Petals free, usually 5, (or cleft to the base and appearing as 10), or rarely lacking. Stamens usually twice the number of petals. Styles 2–5 (rarely 1, 2-parted). Ovary 1–3-celled (or 5-celled in *Lychnis alba)*, with 1 to many ovules on basal or free-central placentae. Fruit a 1-seeded utricle or a few- to many-seeded capsule. Seeds usually with curved embryo surrounding a mealy albumen (perisperm).

The Wisconsin Caryophyllaceae, or Pinks, are predominantly a group of weedy species of open and disturbed places. Fewer than half of the species of Wisconsin Caryophs are native to the state and occur mostly as members of distinct plant communities with only several in weedy habitats. The majority of the Caryophs in Wisconsin are not native to the state or to North America, but are introduced and naturalized from Europe and Asia. Included here are many pestiferous weeds, which may have been inadvertently introduced, such as the "chickweeds" and Cockle or White Campion, as well as a number of showy garden species brought from the Old World, such as Maiden and Cottage Pinks, Carnations, and Catchflys. Some of these have escaped from cultivation and have become established locally as members of the Wisconsin flora, including Baby's Breath *(Gypsophila)* and Sweet William. All species of Caryophyllaceae known to be growing without cultivation in Wisconsin have been listed in this treatment of the family, one of which *(Scleranthus perennis)* is here reported for the first time for North America.

KEY TO GENERA

A. Sepals free from each other the entire length (in genera 1 and 2 only slightly fused at base or forming a perigynous calyx-tube around the ovary, with stamens inserted on the tube and with the free calyx-teeth longer than the calyx-tube); flowers generally less than 1 cm long.
  - B. Fruit an indehiscent 1-seeded utricle; petals lacking; styles 1 or 2.

C. Leaves with scarious stipules; sepals free their whole length to slightly fused at base; style 1, at tip 2-parted (PARONYCHIEAE) ________________ 1. PARONYCHIA.

CC. Leaves without stipules; sepals fused into a perigynous calyx-tube at base; styles 2 (SCLERANTHEAE) ____ 2. SCLERANTHUS.

BB. Fruit a several- to many-seeded capsule, opening by valves or teeth; petals 4 or 5, rarely 1–3 or lacking; styles 3–5; mostly weak-stemmed or small herbs (ALSINOIDEAE).

D. Styles 5; capsule with 5 or 10 valves or teeth.

E. Leaves filiform, appearing whorled, with minute scarious stipules; petals entire, shorter than the sepals or slightly longer _______ 3. SPERGULA.

EE. Leaves with flat blades, opposite, without stipules; petals notched at tip or cleft nearly to base (thus sometimes appearing as 10), equalling to longer than the sepals.

F. Capsule ovoid, with 5 often bifid valves; leaves ovate, the larger 3–6 cm long and 2–3 cm wide ___________________________ 4. MYOSOTON.

FF. Capsule cylindrical, often curved at end, with 10, often twisted teeth; largest leaves smaller, if ovate 1.5 cm or less wide 5. CERASTIUM.

DD. Styles 3 or 4 (rarely 5); capsule with 3, 4, or 6 (rarely 8) valves or teeth.

G. Leaves filiform, appearing whorled, with scarious stipules; petals pale rose; rare weed ______________________________________ 6. SPERGULARIA.

GG. Leaves filiform to ovate, oblong, or elliptic, opposite, without stipules; petals white.

H. Sepals usually 4 (sometimes 5); styles as many as, and alternate with the sepals; capsule with 4 teeth; small, tufted plant, with linear, mucronate leaves; northern Wisconsin; very rare weed _______________ 7. SAGINA.

HH. Sepals 5; styles 3, rarely 4; capsule with 3 or 6 (rarely 4 or 8) valves or teeth.

I. Petals 5, entire or rarely emarginate; styles 3 ______________________ 8. ARENARIA.

II. Petals 5, but deeply cleft (often almost to the base) and sometimes appearing as 10; styles 3 or 4 ___________ 9. STELLARIA.

AA. Sepals fused into a definite calyx-tube, the 5 free calyx-teeth less than half as long as the tube, or, if longer than the tube, over 1 cm long; flowers usually over 1 cm long, showy; small or large herbs (SILENOIDEAE).

J. Flowers subtended at base or on pedicel by 2–6 appressed bracts lying flat against the calyx.

K. Calyx many-nerved; petals dentate or lacerate; flowers over 1 cm long; leaves linear to ovate _ 10. DIANTHUS.

KK. Calyx with 5 major ribs ending in teeth; petals with a shallow notch; flowers under 1 cm long; leaves linear-filiform; small, wiry herb ____________ 11. TUNICA.

JJ. Flowers on naked pedicels, or the bracts *not* immediately below the calyx and not appressed.

L. Capsule 4-toothed; styles 2; calyx strongly 5-ribbed or only obscurely many-nerved.

M. Calyx strongly 5-angled, with green, winged ribs ________________________________ 12. VACCARIA.

MM. Calyx tubular or broad-campanulate, obscurely nerved.

N. Calyx over 1.5 cm long, 2-lipped, 5-toothed; leaves ovate to ovate-lanceolate or elliptic ________________________________ 13. SAPONARIA.

NN. Calyx under 1 cm long, not lipped, but with 5 prominent teeth; leaves mostly linear ________________________________ 14. GYPSOPHILA.

LL. Capsule with 5 or more teeth; styles 3 or more; calyx 10- or 20-nerved or ribbed (this often most noticeable near the *base* of the calyx).

O. Calyx teeth 1.5–5 cm long, longer than the petals; flowers magenta purple _____ 15. AGROSTEMMA.

OO. Calyx teeth to 10 mm long, shorter than, or rarely equalling the petals.

P. Capsule normally with 5 or 10 teeth; styles (of female flowers) normally 5 (3–9); *flowers red or magenta-purple and perfect, or white and imperfect* (if white-flowered, plants never with styles or capsules as well as stamens visible on the same plant) ______________ 16. LYCHNIS.

PP. Capsule with 6 teeth; styles 3; *flowers pink or white, all perfect* (if white-flowered, plants sometimes with styles or capsules as well as stamens visible on the same plant) _17. SILENE.

1. PARONYCHIA MILL. WHITLOW-WORT.

[Core, E. L. The North American species of *Paronychia*. Amer. Midl. Nat. 26:369–397. 1941.]

Erect slender annuals, dichotomously branching, the minute flowers in the axils of branches or in cymes. Leaves opposite, often white- or black-dotted; stipules scarious, subtending the leaves and the bracts of flowers. Sepals 5, often fused slightly at base, when mature with cucullate, mucronate tip. Petals lacking. Stamens 2–5. Styles 1, 2-parted at the apex. Fruit a globose utricle containing a single, dark, shiny, round seed.

KEY TO SPECIES

A. Upper branches of inflorescence puberulent; at least some upper leaves minutely ciliate with short, antrorse hairs; sepals usually with 2 or 3 longitudinal ridges, and with obsolete or very narrow white margins -------------- 1. *P. fastigiata.*

AA. Upper branches of inflorescence glabrous; leaf margins smooth; sepals smooth or with one central ridge (this rarely with lateral ridges), and with well-defined, whitish, papery margins ------------------------------ 2. *P. canadensis.*

1. PARONYCHIA FASTIGIATA (Raf.) Fern. Forked Chickweed; Whitlow-wort. Map 1.

Anychia polygonoides Raf.

Stems 5–28 cm tall, erect or reclining, always *puberulent on the upper branches,* often throughout. Main stem-leaves oblanceolate or narrowly elliptic, mostly acute, 10–23 mm long, 2–5 mm wide; bracts always, and lower and middle stem leaves often very minutely antrorsely ciliate. Stipules lanceolate, papery, those of the bracts shorter than to several mm longer than the sepals. *Sepals linear-lanceolate,* 1.1–1.4 mm long, *with 2 or 3 prominent longitudinal ridges* (10X). Utricle shorter than the sepals.

Native, but rather rare and sporadic in Wisconsin, mainly in the "Driftless Area" in the Black, Chippewa, Wisconsin, and Mississippi River valleys, on sandstone ledges, bluffs, and in thinly wooded to open, sandy places, such as lake shores and roadsides; on top of sandstone bluffs on sterile sand under scattered *Pinus resinosa*, Long Bluff, Camp Douglas (Juneau Co.); dry sandstone ledge, upland woods on Trempealeau Mountain, Perrot State Park (Trempealeau Co.); sand bar, Dells of the Wisconsin River (Sauk Co.); and moist sandy beach, Eau Claire Lake (Eau Claire Co.). Flowering and fruiting from July to late September (October).

KEY TO VARIETIES

A. Upper stipular bracts lanceolate, equalling or shorter than the calyx; flowers much crowded on the ultimate branches; plants usually reddish or brownish when mature -- 1a. *P. fastigiata* var. *fastigiata.*

AA. Upper stipular bracts lanceolate-attenuate, equalling or longer than the calyx; flowers generally not crowded on the ultimate branches; plants usually greenish when mature ------------------------------------- 1b. *P. fastigiata* var. *paleacea.*

Although var. *paleacea* Fern. is distinguished by Fernald (1936, 1950) from var. *fastigiata* solely on the stipular bract character, the other differences listed in the key have been noted in Indiana by Deam (1940) and generally apply to the Wisconsin specimens as well. Deam also noted that in Indiana var. *paleacea* has an earlier flowering season. This is true in Wisconsin as well, where most of the collections were made from early July to mid-August, while collections of var. *fastigiata* were made from late August to October. One collection *(Peterson 152,* 25 September, Onalaska, La Crosse Co. [WIS]) contains one reddish plant of var. *fastigiata* and two greenish plants of var. *paleacea,* which were apparently growing together at the same station. On the other hand, 50 individuals from the same population, collected on a sand bar at Tower Hill State Park, Iowa Co., were all var. *fastigiata.* Although these varieties are usually distinct, several of the collections *(e.g., Schlising & Musolf 1795, Grether 6641,* and *Peterson 710)* seem to be intermediate in stipular bract length.

Paronychia fastigiata var. *paleacea* often somewhat resembles *P. canadensis* in its greener aspect and less densely-flowered branches.

2. PARONYCHIA CANADENSIS (L.) Wood. Forked Chickweed; Whitlow-wort. Map 2.

Anychia canadensis (L.) Ell.

Similar to *P. fastigiata* in size and branching, but with upper branches more delicate, leaves less acute and broader, and the inflorescence more open. *Glabrous throughout.* Main leaves obovate, oblanceolate, or elliptic, 10–21 mm long, 3–9 mm wide, entire, eciliate. Stipules of inflorescence ovate-lanceolate, shorter than the sepals. *Sepals oblong-ovate,* 0.8–1.3 mm long, with *prominent, white, scarious margins,* often with a central rib (rarely with 2 lateral ones). Utricle longer than the sepals.

Native, mainly in the "Driftless Area" of southern Wisconsin, here reaching its northern limit; in dry, bare and sterile soil, on slopes and cliffs, especially common on sandstone ledges, occasionally on limestone; in Red Oak-White Oak woods and on wooded dry sandstone ledges, top of Trempealeau Mountain (Trempealeau Co.); soil pocket on Niagara Dolomite boulders, Blue Mounds State Park (Iowa Co.); and rarely on xeric prairie. Flowering and fruiting from the first of July through September.

HERNIARIA CINERIA DC., Rupture-wort, a native of Europe somewhat resembling *Paronychia* or a creeping *Euphorbia,* is a spreading, grayish, short-hispid annual with tiny, ciliate stipules and opposite, oblong leaves, the 5-parted calyx enclosing the 1-seeded, indehiscent nutlet. The sole specimen, annotated by L. C. Wheeler in 1937, is labelled: "Green Bay, 1870, recd. May, 1871, Dr. J. M. Antoine, Brussels, Door County," and is in the Gray Herbarium, Harvard University. The collector, a Belgian botanist, wrote to Asa Gray in an undated letter *(ca.* 1871) that he collected the species in sandy terrain in the vicinity of Green Bay, and points out that the species was not included in Gray's Manual. *Herniaria* has not been recollected here, and Antoine himself (1871) did not include it in his note on the flora of Wisconsin. (Information courtesy of Carroll E. Wood).

2. SCLERANTHUS L. KNAWEL

Low herbs with forked, pubescent, wiry stems and numerous minute greenish flowers in tight cymes. Leaves minute, estipulate. Sepals fused at base to form a perigynous calyx tube, becoming thick and hard in fruit. Petals lacking. Stamens (1–) 10, inserted on calyx tube below the calyx teeth. Styles 2, distinct. Fruit a hard, one-seeded utricle, persistently enclosed by the calyx. Old World.

KEY TO SPECIES

A. Calyx teeth acute, with a narrow scarious border at the tip; subtending bracts usually equalling or longer than the flowers; annual (Fig. 1–3.) .... 1. *S. annuus.*

AA. Calyx teeth elliptic, blunt or rounded, and with a conspicuous white scarious border at the tip; subtending bracts shorter than the flowers; perennial (Fig. 1–3.) ...... 2. *S. perennis.*

1. SCLERANTHUS ANNUUS L. Annual Knawel. Map 3; Figs. 1–3.

Small annual or biennial, much branched from the base, with branches ascending or reclining, 3–14 cm long. Leaves linear-subulate, the larger 5–25 mm long, the connate bases ciliate. *Inflorescence bracts usually equalling or longer than the flowers.* Calyx mostly 2.4–4 mm long, the *teeth acute,* bordered at the tip with a narrow scarious margin. *Calyx teeth in fruit erect or slightly spreading,* free from each other most to all of their length. Stamens half as long as the calyx teeth or shorter.

Naturalized from Europe. A rare weed in Wisconsin: Manitowoc Co.: roadsides, sandy soil, Cleveland, 1907, *Goessl s.n.* (WIS). Sheboygan Co.: sand dunes, 3 miles south of Sheboygan on Lake Michigan, 1927, *Wadmond s.n.* (MINN, WIS). Barron Co.: sand delta, Prairie Lake, Cameron, 1938, *Fassett 19927* (WIS). Douglas Co.: firelane road near Stone's Bridge, 1942, *Thomson 5094* (WIS). Lincoln Co.: sandy roadside, 1950, *Seymour 11650* (WIS); and sandy shore of Lake Nokomis, 1950, *Seymour 12406* (MIL, WIS). Flowering and fruiting from July to September.

2. SCLERANTHUS PERENNIS L. Perennial Knawel.
Map 4; Figs. 1–3.

Small perennial, 3–10 cm tall, often with dead leaves at the base. Similar to *S. annuus,* but stems usually more ascending and less branched at base, with numerous, short internodes below the major branching. Larger leaves 5–12 mm long. *Bracts of inflorescence shorter than the flowers.* Calyx mostly 2.5–4 mm long, with *blunt or rounded elliptic teeth,* with wide, white, scarious border at the tip. *Calyx teeth usually bending together in fruit,* over-lapping one another and in contact for much of their length. Stamens nearly as long as the calyx teeth.

A Eurasian weed, occurring from Europe to Asia Minor, the Caucasus, Armenia, and Siberia (Hegi, 1908), established in south-

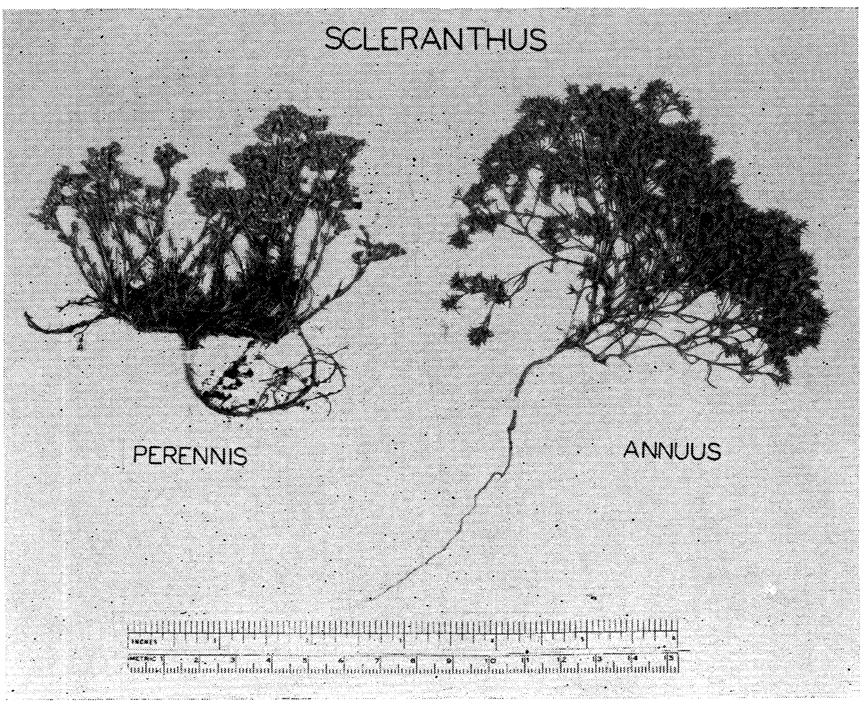


FIGURE 1. *Scleranthus perennis (Fassett 21635), S. annuus (Fassett 19927).*

FIGURE 2. *Scleranthus annuus* (top), *S. perennis* (bottom). Same plants as in Figure 1. Scale on left in mm.

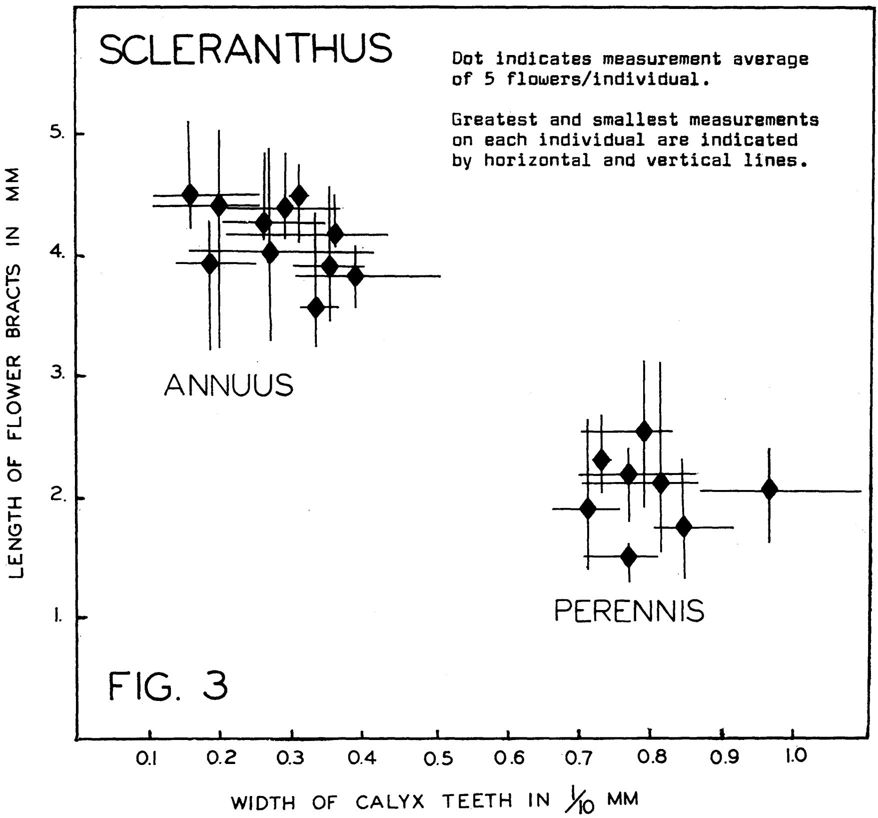


FIGURE 3.

central Wisconsin in sandy, disturbed areas: Juneau Co.: Camp Douglas, 1928, *Davis s.n.* (WIS); prairie along county trunk H, Camp Douglas, *Wills s.n.* (WIS); abundant mat-forming weed in sandy lawn, Mauston, 1958, *Curtis & Greene s.n.* (WIS). Marquette Co.: sandy pasture, Montello, 1937, *Fassett 20418* (WIS); sandy roadside, abundant in pastures, Montello, 1942, *Fassett 21635* (MIL, MINN, WIS). Sauk Co.: Lake Delton, 1941, *Schorta s.n.* (WIS). Columbia Co.: sand dunes near Fox River, Fort Winnebago, 1948, *Seymour 10313* (WIS). Flowering and fruiting from late June to September.

Scleranthus perennis is listed here for the first time as occurring in Wisconsin, and it appears, for the first time in North America as well.

All fourteen collections of Wisconsin *Scleranthus* studied were labelled *S. annuus*. Since taxonomic manuals and floras all list *S. annuus* as having very narrowly bordered calyx teeth, the broad, white, scarious borders of the calyx teeth in part of the Wisconsin collections readily indicated an unusual variant. It was not difficult to demonstrate that not only *S. annuus,* but also the Eurasian *S. perennis* listed in European floras (Hegi, 1908; Karsten, 1895; Clapham, Tutin, and Warburg, 1952) does occur in Wisconsin. Measurements were taken of 19 plants from the 14 Wisconsin collections labelled *S. annuus*. Width of calyx teeth (0.5 mm from tip of the tooth) was plotted on the horizontal axis of a scatter diagram, and length of bracts subtending upper flowers on the vertical axis. The resulting Figure 3, where averages as well as extremes of measurements for any one individual are indicated, *shows two clearly separated groupings of individuals.* The wider-toothed, shorter-bracted individuals do have all the characters listed in European floras for *S. perennis,* and compare very well with European collections such as *Mattisson 3751* from Skåne (Sweden), or *Klástersky s.n.,* 1938, from Bohemia (both WIS), except that the Wisconsin collections seem smaller. The other group on the scatter diagram contains individuals bearing all the characters listed for *S. annuus.*

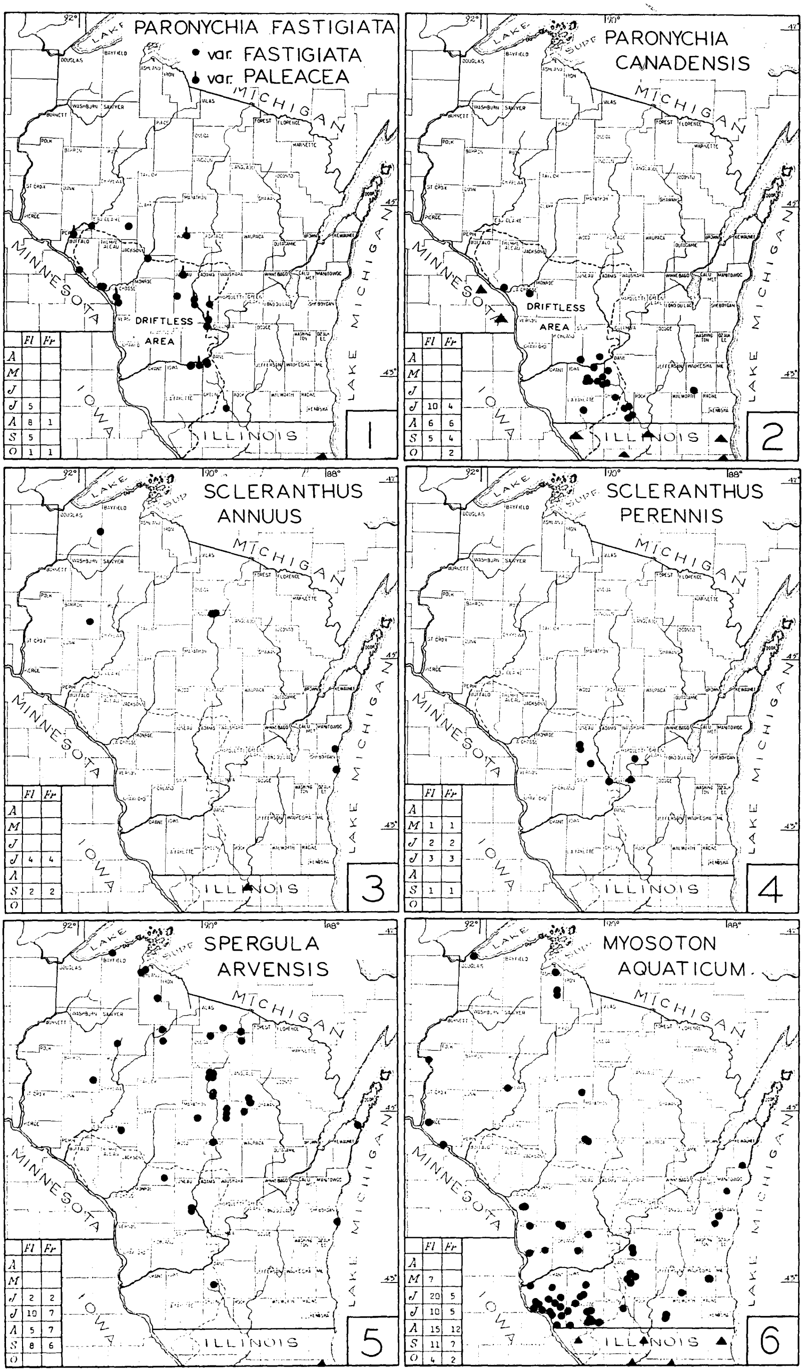
The Wisconsin collections of *S. perennis,* although made over a thirty-year period (with the first collection in 1928), all came from a comparatively small area in the central Wisconsin "sand counties." All the plants here may very probably be the progeny of one original introduction of *S. perennis.*

3. SPERGULA L. SPURREY

1. SPERGULA ARVENSIS L. Spurrey; Corn Spurrey. Map 5.

Annual with flowering stems 1–6 dm long, simple or with 2–18 weak ascending branches from the base, nearly glabrous below to glandular-hairy in the inflorescence. *Leaves filiform, in opposite clusters at the nodes,* often glandular-hairy, mainly 1–5 cm long, with tiny *scarious stipules.* Inflorescence cymose, dichotomous. Sepals 5, ovate, blunt, scarious or scarious-margined, 1.5–4 mm long, often glandular-hairy. Petals 5, white, entire, to sometimes longer than the sepals. Stamens 10 or 5. Styles 5. Capsule 5-valved, longer than the sepals. Seeds 1–1.5 mm wide, black with white papillae and with a very narrow white concentric wing-margin.

Naturalized from Europe, a weed of sandy areas in northern and central Wisconsin, mainly in cultivated or neglected fields, roadsides, and lake shores, locally abundant in Marathon County in pea and potato fields, the one collection from southern Wisconsin from a strawberry patch in Dane County, 1953, where in subsequent years it did not persist *(Thomson s.n.* [WIS]); in dry, sandy field with *Comptonia peregrina, Hieracium aurantiacum* and *Robinia*


PARONYCHIA FASTIGIATA
var. FASTIGIATA
var. PALEACEA
DRIFTLESS AREA
1
PARONYCHIA CANADENSIS
DRIFTLESS AREA
2
SCLERANTHUS ANNUUS
3
SCLERANTHUS PERENNIS
4
SPERGULA ARVENSIS
5
MYOSOTON AQUATICUM
6
LAKE SUPERIOR
MICHIGAN
LAKE MICHIGAN
MINNESOTA
IOWA
ILLINOIS

pseudo-acacia (Lincoln Co.); in sandy roadside with *Linaria canadensis* and *Paronychia fastigiata* (Juneau Co.); and in a cranberry marsh (Jackson Co.). Flowering and fruiting from mid-June until mid-September.

4. MYOSOTON MOENCH. GIANT CHICKWEED

1. MYOSOTON AQUATICUM (L.) Moench. Giant Chickweed.
Stellaria aquatica (L.) Scop. Map 6.

Reclining or upright perennial, glabrous at base to densely glandular-hairy above. Flowering stems weak, from 1–6 (–10) dm long, often much branched in the cymose inflorescence. *Larger leaves narrowly to broadly ovate or elliptic, 3–7 cm long, 1.5–3.5 cm wide,* often cordate at base, *sessile,* the lower sometimes petioled. Flowers long-pediceled, in the axils of reduced foliage leaves. Sepals ovate-lanceolate, 5–9 mm long. *Petals 5, white, deeply notched, longer than the sepals.* Stamens 10. *Styles 5.* Valves of capsule 5, often bifid. Seeds orbicular-reniform, brown, rough-acute-warty, 0.8–0.9 mm wide.

Naturalized from temperate to arctic Eurasia, occurring mainly in southwest Wisconsin but also scattered in other areas, usually in moist situations, especially on rocky, gravelly and shady streamsides, in roadside ditches, pastures, abandoned old fields, seepage bogs, alder thickets, sedge meadows, and shady wood borders, or in oak or maple woods; on damp or wet sandstone cliffs along and above streams in open sun, with *Sullivantia* and *Mimulus glabratus* (Grant Co.); in moist, lowland floodplain forest of *Acer nigrum, Quercus bicolor, Ulmus,* and *Tilia* (Vernon Co.); on steep, damp, densely wooded limestone slope with maple, basswood, and oaks (Lafayette Co.); first collected in the state in 1910, with most of the early collections from weedy habitats, since then often collected, especially in southwest Wisconsin, in native communities, where often it seems very much at home. Flowering from the last week of May to the first week of October, and fruiting from mid-June to early October.

Extreme variation occurs in this species, and small or depauperate specimens are sometimes confused with *Stellaria media.* They may be distinguished as follows:

MYOSOTON AQUATICUM	STELLARIA MEDIA
1. Upper stem pubescent with scattered hairs.	1. Upper stem pubescent in lines.
2. Petals longer than sepals.	2. Petals shorter than sepals or none.
3. Styles 5.	3. Styles 3.
4. Mature capsule 5-valved.	4. Mature capsule 6-valved.

5. CERASTIUM L. Mouse-ear Chickweed

[Fernald, M. L., and K. M. Wiegand. Studies of some boreal American Cerastiums of the section Orthodon. Rhodora 22:169–179. 1920.]

Low, generally pubescent herbs with opposite, estipulate leaves. Sepals 5, scarious-margined. Petals 5, white or pale pink, the apex notched or cleft to the middle. Stamens 10 or 5. Styles 5. Mature capsule cylindrical, usually upward-curved at the end and exceeding calyx, scarious, with 10, often twisted teeth.

Key to Species

A. Inflorescence bracts subtending pedicels green and leaflike throughout, not scarious on the margin, ciliate; teeth of opened (mature) capsule 0.5–0.9 mm long; viscid annual, often with very weak stems ________________ 1. *C. nutans.*

AA. Inflorescence bracts subtending pedicels scarious, or green with scarious margin especially near the apex (the lowermost bracts often leaflike), ciliate or eciliate; teeth of opened (mature) capsule 0.9–1.6 mm long; perennials generally with upright habit, but often with stems decumbent at the base.

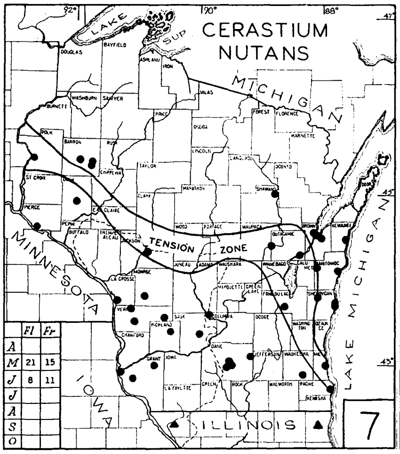
B. Petals showy, 8–12 mm long, 3–7 mm longer than the sepals; axils of stem leaves with sterile leafy short-shoots, the plants therefore very leafy; plants of sandy areas ___________________________________ 2. *C. arvense.*

BB. Petals 3–8 mm long, shorter than to rarely longer than the sepals; sterile shoots rarely present in the leaf axils; ubiquitous weed ______________________ 3. *C. vulgatum.*

1. Cerastium nutans Raf. Nodding Chickweed. Map 7.

Rather weak annual, 1–4 dm tall, often viscid with glandular hairs. Main stem leaves acute, 1.4–5.4 cm long, 0.3–1.3 cm wide, ovate to lanceolate or oblanceolate, nearly glabrous to heavily viscid-pubescent on both surfaces. *Bracts of inflorescence herbaceous, without translucent margins.* Sepals 4–6 mm long, shorter than the 5–7 mm long white petals. Capsule curved, 6–12 mm long, with teeth 0.5–0.9 mm long. Pedicels in fruit typically 1–5 cm long, usually curved downward at the tip.

Native, mostly south of the Tension Zone, occasional, most often in dry or mesic oak or maple woods, in moist areas of sand or gravel such as creek beds and tops or bases of limestone or sandstone bluffs, and sometimes weedy along railroads and roadsides. Flowering from about the second week of May through the first third of June.


CERASTIUM NUTANS
LAKE SUP
MICHIGAN
TENSION ZONE
MINNESOTA
IOWA
ILLINOIS
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M 21 15
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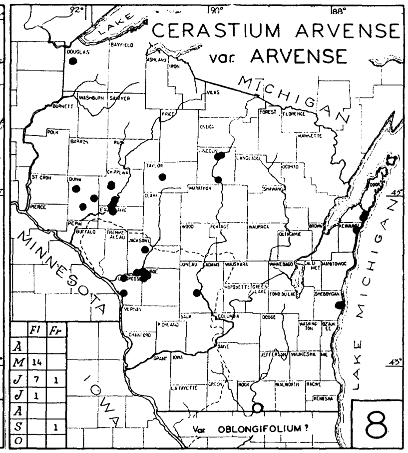
CERASTIUM ARVENSE
var. ARVENSE
LAKE SUP
MICHIGAN
MINNESOTA
IOWA
LAKE MICHIGAN
Var. OBLONGIFOLIUM ?
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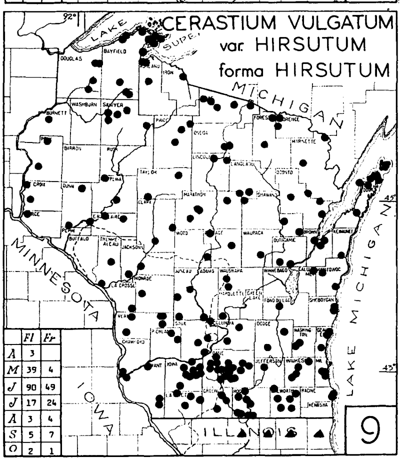
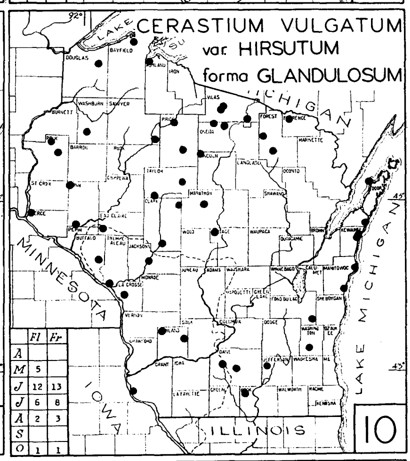

CERASTIUM VULGATUM
var. HIRSUTUM
forma HIRSUTUM
LAKE SUP
MICHIGAN
MINNESOTA
IOWA
ILLINOIS
LAKE MICHIGAN
Fl Fr
A 3
M 39 4
J 90 49
J 17 24
A 3 4
S 5 7
O 2 1
9


CERASTIUM VULGATUM
var. HIRSUTUM
forma GLANDULOSUM
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J 6 8
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O 1 1
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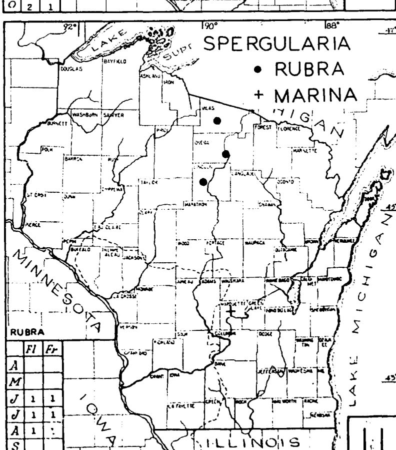
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+ MARINA
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RUBRA
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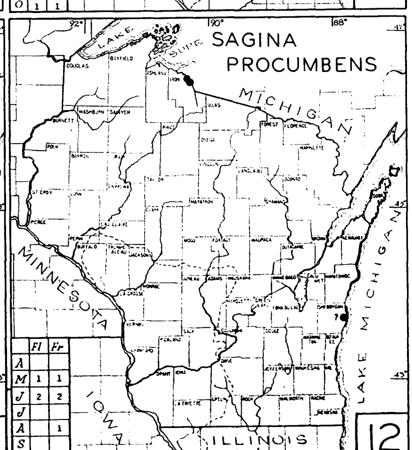
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2. CERASTIUM ARVENSE L. var. ARVENSE. Field Chickweed. Map 8.

Matted perennial with tufts of leaves (short-shoots) in axils of most stem leaves, giving plants a bushy appearance, the branch bases decumbent. Stems pubescent, 10–26 cm tall. Leaves linear to narrow-lanceolate or oblanceolate, acute, 10–33 mm long and 1–5 mm wide, sparingly to densely pubescent, sometimes glandular. Inflorescence rather stiff and erect, pubescent throughout, the *bracts* and sepals *scarious-margined,* the sepals acute, 5–7 mm long, pubescent, sometimes glandular. *Petals 8–12 mm long, white and rather showy,* with a 2–3 mm deep cleft. Capsule 6–9 mm long, 2–2.5 mm wide, the elongate teeth about 1.5 mm long.

Native, mainly in west-central Wisconsin and along the Lake Michigan shore, in dry, open, usually sandy places such as river banks, sand dunes, and open woods; sandy prairies at edge of scrubby *Pinus banksiana-Quercus velutina* woods, with *Tradescantia ohiensis, Lithospermum croceum,* and *Selaginella rupestris* (NW Monroe Co.); and rarely weedy in old fields and roadsides. Flowering from early May through mid-June, and fruiting from June to September.

All Wisconsin individuals are densely leafy, and belong to var. *arvense.* However, two old and somewhat incomplete collections from Beloit are more loosely branched, have larger leaves somewhat farther upward on the stems, and are probably referable to Var. OBLONGIFOLIUM (Torr.) Holl. & Britt.: Rock Co.: Beloit, May 22, 1875, *Swezey s.n.* (WIS), May 29, 1895, *G. B. Olds s.n.* (WIS).

3. CERASTIUM VULGATUM L. var. HIRSUTUM Fries. Common Mouse-ear Chickweed. Maps 9 & 10.

Hirsute perennial of extremely varied habit and appearance. Leafy shoots often present at the base. Stems 4–45 cm tall. Leaves 5–30 mm long, 2–12 mm wide, ovate or lance-ovate to oval or oblong, the lower often spatulate, *hirsute on both surfaces.* Inflorescence forking, with *scarious-margined bracts,* only the lowermost herbaceous. Sepals scarious-margined, 4–7 mm long, usually hirsute, sometimes glandular. *Petals slightly shorter than to rarely longer than the sepals.* Pedicels mostly 5–13 mm long in fruit, bearing *curved capsules* 7–11 mm long, 2–3 mm wide.

Naturalized from Eurasia, very abundant throughout Wisconsin in a great variety of disturbed or open habitats, such as sandy roadsides, lawns, gardens, pastures, cultivated fields, waste places, and along railroads, frequent on sandy lake shores and stream banks, the Lake Michigan sand dunes, and on bluffs; occasionally in a number of forest types: aspen-spruce-fir, oak-basswood-cherry, oak-hickory, basswood-elm-maple, and mature hemlock-sugar maple. Flowering from latest April through the first third of July (October), with a flowering peak in mid-June. Fruiting from late May through July (October).

Key to Forms

A. Upper branches of the inflorescence hirsute, with none of the hairs bearing glands ____________ 3a. *C. vulgatum* var. *hirsutum* forma *hirsutum.*

AA. Upper branches of the inflorescence hirsute, with all of the hairs bearing glands ________ 3b. *C. vulgatum* var. *hirsutum* forma *glandulosum.*

The non-glandular forma HIRSUTUM (Map 9) is more common in Wisconsin than the glandular forma GLANDULOSUM (Boenn.) Druce (Map 10), which, though widely distributed in the state, is most common in the north. Both glandular and completely non-glandular plants have been observed in the same population.

CERASTIUM VISCOSUM L., reported for Wisconsin by Fassett (1957), is a more southern species with smaller flowers. No collections have been seen from the state.

CERASTIUM TOMENTOSUM L., Snow-in-Summer, a white-tomentose, mat-forming perennial to 40 cm tall, with leaves 3–5 cm long, is frequently grown in gardens in Wisconsin, the two collections evidently representing escapes: Milwaukee Co.: spreading from garden, lake shore south of Atwater Beach, Shorewood, *Shinners s.n.* (WIS). Kewaunee Co.: weedy open sandy places, dump along Lake Michigan, *Iltis & Buckmann 10826* (WIS).

6. SPERGULARIA J. & C. PRESL. SAND SPURREY

[Rossbach, R. P. *Spergularia* in North and South America. Rhodora 42:57–70, 105–143. 1940.]

Small annuals with decumbent or erect stems, to 15 cm long. Leaves filiform, opposite, the secondary shoots at the nodes making leaves appear whorled. Stipules scarious, prominent, 1.5–4 mm long. Flowers small. Sepals 5, ovate, blunt, scarious-margined, longer than the 5 dull pink, entire petals. Stamens 2–10. Styles and valves of capsule 3. Seeds minutely papillate.

Key to Species

A. Stipules triangular-acuminate, markedly longer than broad; capsule about as long as calyx; stamens 6–10 ___ 1. *S. rubra.*

AA. Stipules triangular, almost as broad as long; capsule longer than calyx; stamens 2–5 ____________ 2. *S. marina.*

1. SPERGULARIA RUBRA (L.) J. & C. Presl. Red Sand Spurrey. Map 11.

Tissa rubra (L.) Brandegee.

Stems several to many times branched at base, decumbent. Plants nearly glabrous to densely glandular-hairy, especially in the inflorescence. Main leaves 0.6–2 cm long, 0.4–1 mm wide, mucronate. *Stipules conspicuous, triangular-acuminate, 1.5–4 mm long. Sepals* 2.5–4 mm long, longer than the petals and *about as long as the capsule.* Stamens 6 (–10). Seeds about 0.5 mm long.

Naturalized from Eurasia, in Wisconsin a rare weed of sandy areas, with only three collections (all WIS): Oneida Co.: Hugo Sauer Nursery near Rhinelander, 1958, *Weber 69*. Vilas Co.: Trout Lake State Forest Nursery, in seed bed and lawn, 1959, *Iltis 13074* (persisting and abundant in 1961!). Lincoln Co.: sand of fire lane, Town of Harding, 1952, *Seymour & Schlising 14424*. Flowering all summer.

2. SPERGULARIA MARINA (L.) Griseb. Salt-marsh Sand Spurrey Map 11.

Tissa marina (L.) Britton.

Stems simple or with 2–6 branches from base. Plants glabrous, especially in the lower portions, to densely glandular-hairy in inflorescence. Leaves mostly 1.5–3.5 cm long, about 1 mm wide, often slightly mucronate. *Stipules deltoid, mostly 2–3 mm long, clasping (sometimes encircling) node. Sepals* 2.8–3.5 mm long, *shorter than the capsule.* Stamens (2–) 3 (–5). Seeds 0.6–0.7 mm long.

Native of Europe, probably introduced in America; collected in only one locality in Wisconsin, at abandoned Soo Line Railroad station in Westfield, Marquette Co.: sand and cinders, 1941, *Shinners 4006* (WIS), and sandy roadsides and edges of vacant lots, 1960, *Schlising & Musolf 1771* (WIS).

7. SAGINA L. PEARLWORT

1. SAGINA PROCUMBENS. L. Pearlwort; Birdseye. Map 12.

Tiny matted or tufted perennial (somewhat resembling *Arenaria stricta*), to 10 cm tall, *glabrous throughout. Leaves linear, mucronate, 3–18 mm long,* often with short-shoots in their axils, estipulate. Pedicels capillary, often hooked or recurved at the summit. Sepals normally 4, sometimes 5, oval or oblong, with rounded apex, 1.8–2.5 mm long. Petals the same number as sepals, entire, shorter than sepals, or sometimes absent. Stamens 4 or 5. Styles 4 or 5, alternate with the sepals. Capsule 4-valved, equalling or longer than the sepals.

A circum-boreal species, possibly native to northern Wisconsin, but here mainly from weedy habitats, with all but one collection made in 1929 and 1930 from near Hurley, Iron County: woods and pasture, *Bobb 225* (WIS, NORTHLAND), roadside ditch, *Fassett 9541* (WIS), roadside, base of bluff near Lake Lavina, *Fassett 10761* (WIS), and 2 miles west of Hurley, *Knowlton s.n.* (WIS). *Goessl s.n.* (WIS), from "Lawn city park," *sine. loc.*, probably came from Sheboygan.

8. ARENARIA L. SANDWORT

[Maguire, B. Studies in the Caryophyllaceae V. *Arenaria* in America North of Mexico. Amer. Midl. Nat. 46:493–511. 1951]

Delicate small herbs with sessile estipulate leaves. Inflorescence 1 to many-flowered. Sepals 5. *Petals 5, white, entire* (rarely emarginate). Stamens normally 10. *Styles 3.* Capsule ovoid or conic, splitting into 3 valves, in some species each valve 2-cleft and splitting nearly to base.

KEY TO SPECIES

A. Leaves with expanded, ovate to lanceolate blades; capsule with 6 teeth; plants pubescent and leaves ciliate (pubescence reduced to minute knobs and ciliation essentially lacking in No. 3).
- B. Leaves broadly ovate, not over 6 mm long; sepals usually with minute, white, stalked glands; petals shorter than sepals; plants creeping; eastern Wisconsin -- 1. *A. serpyllifolia.*
- BB. Leaves oblong or elliptic to lance-ovate or lanceolate, over 6 mm long; sepals without glands, glabrous, pustulate, or sparsely pubescent; petals longer than or (rarely) shorter than sepals.
  - C. Leaves oblong to elliptic or lance-ovate; usually blunt, ciliate, the midrib pubescent beneath; sepals obtuse, shorter than the petals; common, southern Wisconsin------------------------------------ 2. *A. lateriflora.*
  - CC. Leaves lanceolate or lance-ovate, acute, nearly eciliate, the midrib glabrous beneath; sepals acuminate, longer than the petals; rare, northern Wisconsin -- 3. *A. macrophylla.*

AA. Leaf blades linear or linear-subulate, entire; capsule with 3 teeth; plants glabrous, mat-forming ---------- 4. *A. stricta.*

1. ARENARIA SERPYLLIFOLIA L. Thyme-leaved Sandwort. Map 13.

Pubescent annual with weak, often decumbent stems, simple or much branched, sometimes to 30 cm tall. *Leaves ovate, ciliate,* the larger 3–6 mm long, often pustulate. *Sepals with whitish pubescence (hairs usually bearing minute whitish glands)*, in fruit 2.4–3.6 mm long, longer than the petals. Capsule elongate-ovoid, with 6 teeth. Seeds black, about 0.5 mm long, tuberculate.

Naturalized from Europe, in eastern Wisconsin west to Dane County, in disturbed, rocky, sandy, mostly calcareous places, such as roadways, ridges, pastures, quarries, gravel pits, on calcareous cliffs, shores and beaches, and in thin soil pockets on Niagara Dolomite.

Some of the specimens studied *(e.g., Rogers s.n.,* from Ephraim, Door Co., [WIS]) have long internodes and a diffuse, spreading habit, and suggest the variety *tenuior* Mert. & Koch as described in Gleason (1952) and Fernald (1950). However, these plants seem more like shade forms hardly warranting varietal distinction.

2. ARENARIA LATERIFLORA L. Grove Sandwort; Side-flowering Sandwort. Map 14.

Perennial from slender creeping rhizomes, with upright, simple or branched, retrorsely puberulent stems 10–25 cm tall. *Leaves oblong or elliptic to lance-ovate or lanceolate,* mostly 1.5–3 (3.8) cm long, 0.4–1.5 cm wide, narrowed at the base, acute to obtuse or sometimes rounded at the apex, *ciliate, the midrib pubescent,* often puberulent or pustulate throughout. *Inflorescence (1–) 2–3 (–5) flowered, on long and slender terminal pedicels or from the leaf axils. Sepals* blunt, entire, glabrous, or with few hairs in lines, 2–4 mm long, *shorter than the petals.* Capsule with 3 deeply cleft valves, longer than the sepals. Seeds with an appendage (strophiole) at the hilum.

Native and common in southern, and occasional in western and central Wisconsin, in densely wooded to open, mesic to damp situations, most common in southern floodplain forest, oak, oak-hickory, oak-maple and other deciduous woods, on limestone, sandstone, loam, and sand, as well as on low moist prairies, pastures, river banks, sand bars, thickets, and roadside ditches. Flowering from the second week of May through mid-June (September).

Although *Arenaria lateriflora* is generally thought of as an arctic and boreal species, in Wisconsin it occurs mostly south of the Tension Zone, being absent from a broad region in northern Wisconsin, and from there north to Hudson Bay (Raup, 1947: plate 23)! In Wisconsin it seems to behave more like a southern than a northern species, and one wonders if not two taxa might be involved here.

3. ARENARIA MACROPHYLLA Hook. Map 14.

Similar to *A. lateriflora* but much less pubescent, the stem hairs minute and barely noticeable with a 10X lens. *Leaves* larger, *lanceo-*

late or lanceolate-elliptic, generally sharply acute and more pointed than those of *A. lateriflora; margins and midrib smooth. Sepals acuminate, longer than the petals* and longer than the 6-toothed capsule.

Native, but very rare in Wisconsin, on cliffs of the igneous Penokee Range (outlined on Map 14), with only two collections known: Ashland Co.: Mossy crevices in bluff, Voght Knob, Foster Junction, *Fassett 5794* (WIS). Iron Co.: basalt cliff west of Hurley, *Fassett 9454* (WIS).

Arenaria macrophylla is a widely disjunct species (Fernald, 1925: Map 31.) with a main range in the northwestern United States, and with localized colonies around Lake Superior, the Gulf of St. Lawrence and in Labrador.

4. ARENARIA STRICTA Michx. Rock Sandwort. Map 15.

Glabrous perennial, often much branched from basal prostrate stems, growing in *dense tufts or mats 3 or 4 cm high,* the basal shoots persistent. *Main stem leaves linear-subulate, stiff and with sharp tips, the lower mostly, bearing dense, leafy short-shoots in their axils.* Upright branches (10–) 15–20 (–30) cm tall, bearing much-forked, slender cymes of delicate white flowers.

A native species of Wisconsin, represented here by two subspecies, one a common plant of dry habitats in the southern and eastern parts, and a second, similar one, rare on a few bluffs in the western and central parts of Wisconsin.

KEY TO SUBSPECIES

A. *Petals longer than sepals,* usually from 1 mm longer to two times the length of sepals; *sepals sharply lance-ovate or acuminate,* with 3 ribs of about equal prominence; capsules mostly shorter than sepals; southern and eastern Wisconsin, common ------------------------------- 4a. *A. stricta* ssp. *stricta.*

AA. *Petals shorter than to equalling sepals; sepals blunt or acute,* but not long-acuminate, the two lateral ribs usually not as prominent as the midrib; capsules about equalling sepals or longer; western and central Wisconsin, rare ------------------------- 4b. *A. stricta* ssp. *dawsonensis.*

4a. ARENARIA STRICTA spp. STRICTA. Rock Sandwort. Map 15.

Sepals lance-acuminate or sharply lance-ovate, 3.4–5.5 mm long, *strongly 3-ribbed. Petals at least 1 mm longer, to sometimes twice as long as the sepals. Capsule about equalling or shorter than sepals,* with 3 entire valves.

Eastern and southern Wisconsin within the "Region of Limestones," mostly in dry, open, rocky or sandy places, such as tops of calcareous sandstone *(i.e.,* sandstones overlain by dolomites) or (less often) limestone bluffs, as well as on rock outcrops in the very steep, very dry prairies beneath them, on sandy and gravelly hillsides, sand prairies or open woods, sand dunes along Lake Michigan, rarely on rock outcrops in woods or in woods recently converted from prairie. Flowering and fruiting mainly from the last third of May through June (July).

4b. ARENARIA STRICTA ssp. DAWSONENSIS (Britton) Maguire
Northern Rock Sandwort. Map 15.

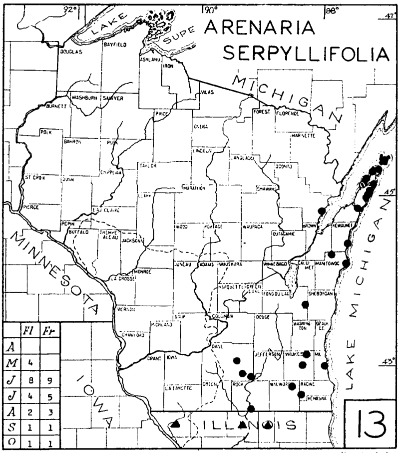
Arenaria dawsonensis Britton.

Similar to ssp. *stricta,* but somewhat smaller, with the leafy short-shoots somewhat more in the leaf axils of the lower half of the plant. *Sepals blunt to acute, but not long-acuminate,* 2.3–4.0 mm long, *the midrib often much more prominent than the lateral ribs. Petals shorter than to equalling sepals. Capsule usually longer than the sepals.*

Collected in only four localities: La Crosse Co.: cliff top, Timber Coulee, 1958, *Peterson 608* (WIS). Vernon Co.: rich "goat" prairie, Coon Valley, 1939, *Marks s.n.* (WIS). St. Croix Co.: top edge of enormous sandstone cliff along the St. Croix River, Boy Scout Camp north of Houlton, 1929, *Fassett 16929* (WIS), and 1960, *Schlising & Musolf 1835* (WIS). Waupaca Co.: dry, rocky bluff south of New London, 1961, *Rill s.n.* (WIS, Private Herbarium K. Rill). A small specimen collected late in the season, apparently from the last locality *(Seymour & Rogers 10397* [WIS]), probably belongs to this subspecies.

In the second St. Croix County collection, some sepals have lateral ribs as prominent as the midrib and are acuminate rather than obtuse; the capsule length is variable, with some capsules longer than the sepals and some shorter. However, the petals are all shorter than the sepals. The 1929 collection from the same locality more completely meets the key characters of ssp. *dawsonensis.* The La Crosse, Vernon, and Waupaca County collections are more clearly distinguishable from ssp. *stricta* on the basis of the key characters than are either of the St. Croix collections.

These four localities of ssp. *dawsonensis* are among the most southern stations of this taxon, the range extending far into the Arctic. Maguire (1951) does not list ssp. *dawsonensis* as occurring in Wisconsin. Fernald (1950) gives the range as from southern Labrador to Yukon, and south to Newfoundland, eastern Quebec, Ungava, western Ontario, Minnesota, South Dakota, and Alberta.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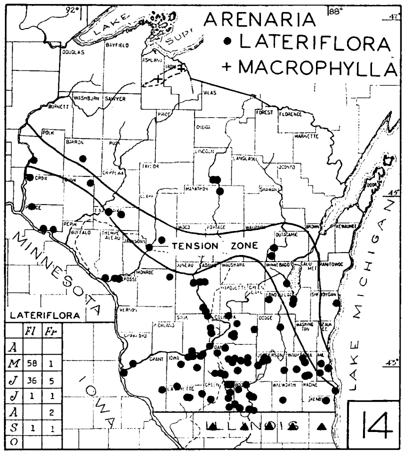
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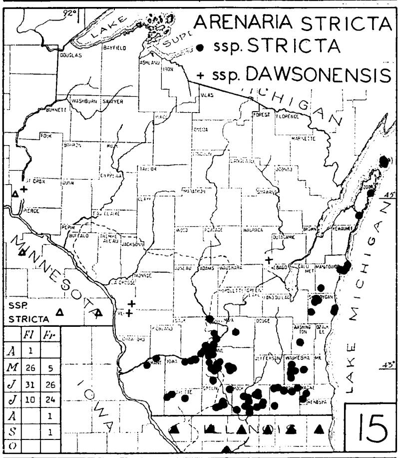
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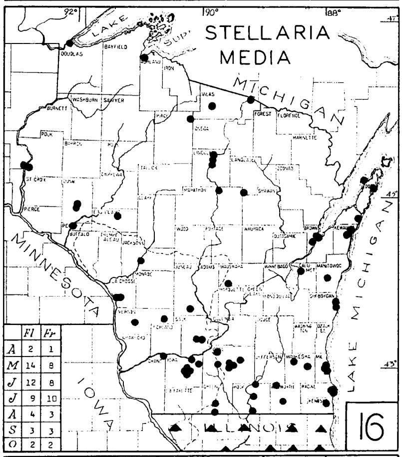
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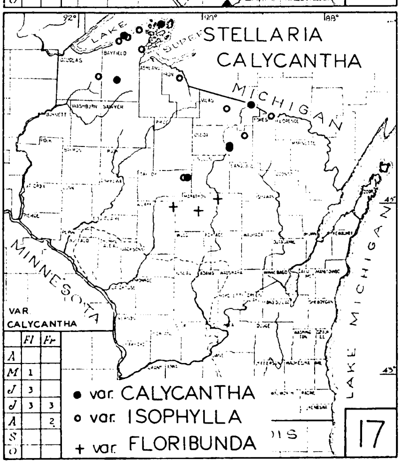
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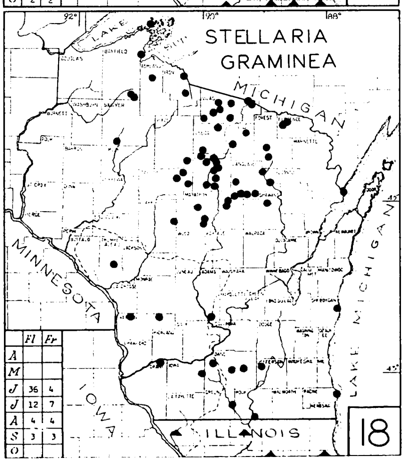
o var. ISOPHYLLA
+ var. FLORIBUNDA
17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9. STELLARIA L. Starwort; Chickweed

Usually glabrous, delicate herbs, with frequently weak and reclining stems and with estipulate leaves. Sepals (4–) 5. Petals white, usually 5, sometimes 1–4 or lacking, deeply cleft, often nearly to base, the flowers therefore appearing as if 10-petaled. Stamens 10, 8, or fewer. Styles 3 or 4. Capsule ovoid to globose, opening with as many or twice as many valves as styles.

A difficult genus, its great variability in habit often depending on season and habitat. Specimens bearing plentiful flowers or fruit are needed for determination.

Key to Species

A. Flowers solitary or in few-flowered terminal cymes, in the axils of foliage leaves or leaflike bracts; petals shorter than the sepals or lacking.

B. Stems pubescent in lines; middle stem leaves with distinct petioles; sepals pilose at base; seeds tuberculate; common weed ---------------------------------- 1. *S. media.*

BB. Stems glabrous; middle stem leaves sessile or tapered to base, without distinct petioles; sepals glabrous at base; seeds essentially smooth; uncommon, northern Wisconsin ------------------------------------- 2. *S. calycantha.*

AA. Flowers few to many in cymose inflorescences, with scarious bracts subtending the pedicels; petals mostly longer than the sepals.

C. Middle leaves lanceolate to lance-linear or oblanceolate (mostly at least 3 mm wide or wider at widest point), sessile, or narrowly elliptic and attenuated to base; inflorescence clearly terminal and much exceeding the lateral leafy shoots (if any) at its base.

D. Petals shorter than sepals or lacking; sepals 1.5–3.5 mm long; capsule straw-colored or brown to purple-black; uncommon ---------------- 2. *S. calycantha.*

DD. Petals exceeding (equalling) sepals; sepals mostly over 4 mm long.

E. Sepals acute, usually ciliate and strongly 3-ribbed; inflorescence many-flowered; capsule pale brown to straw colored; common ---------- 3. *S. graminea.*

EE. Sepals blunt or subacute, eciliate, without prominent ribs; inflorescence few-flowered or flowers solitary; capsule dark brown to black; rare, northern Wisconsin --------------------------- 4. *S. longipes.*

CC. Middle stem leaves linear (0.4–) 1–3 (–4) mm wide, often slightly tapered at both ends; inflorescence (especially with age) often appearing lateral, and shorter than to only slightly longer than the prominent leafy shoots at its base, or (in No. 5) inflorescences terminal or on few-flowered lateral branches.

F. Sepals (3.2–) 4.0–6.1 mm long, eciliate; petals usually much exceeding sepals; leaves 0.4–1.2 (–2) mm wide; slender plants, uncommon in central and western Wisconsin ---------------------------- 5. *S. palustris.*

FF. Sepals 2.3–4 (–4.4) mm long, eciliate or ciliate; petals equalling or slightly longer than the sepals; leaves 1–4 (–5) mm wide; slender or much-branched, reclining or upright plants common throughout Wisconsin ------- ---------------------------------- 6. *S. longifolia.*

1. STELLARIA MEDIA (L.) Cyrillo. Common Chickweed. Map 16.

Upright, reclining, or creeping annual or perennial, very variable, with weak *stems* 5–33 cm long, *pubescent in lines. Leaves broadly ovate to obovate or elliptic,* the *lower long-petioled,* the upper sessile, the blades 5–25 (–35) mm long, 4–20 mm wide, bearing small white blisters (pustules) on surfaces. *Flowers solitary in axils of foliage leaves or in few-flowered cymes,* the bracts leaf-like. Sepals pilose, at least at base, longer than the watery-white petals. Capsule 4.5–6.3 mm long, the 6 straw-colored valves separating to the base. *Seeds* orbicular or squarish, *tuberculate,* 0.9–1.3 mm long.

Naturalized from Eurasia, common in southern Wisconsin, but apparently occurring throughout the state, especially as a weed of lawns and gardens, railroad yards, roadsides and other open or shady disturbed areas as well as in open areas in moist, low woods and on stream banks, occasionally in oak-mixed hardwood forests, on rock outcrops, limestone cliffs, clay, or black loam. Flowering and fruiting from early May through August (October). Specimens bearing flowers are on hand from 31 January and 1 February, 1890, from Madison!

2. STELLARIA CALYCANTHA (Ledeb.) Bong. Northern Starwort.
Stellaria borealis Bigel. Map 17.

Perennial from slender rhizomes, the stems branched, upright to weak and reclining, 5–35 cm long, glabrous. *Leaves* narrowly ovate to elliptic, lanceolate or oblanceolate, or lance-linear, acute, *often slightly ciliate,* 1–5 cm long. *Flowers very small,* solitary in the leaf axils or in branched cymes, subtended by reduced foliage leaves or by minute, scarious bracts. *Sepals 1.6–3.2 mm long,* ovate or lance-ovate, blunt or acute, scarious-margined, weakly veined. *Petals 1–5, shorter than the sepals, or lacking.* Styles 3 or 4. *Capsule straw-*

colored or dark brown to purplish-black, to 5.2 mm long. *Seeds essentially smooth.*

A polymorphic and difficult, rather rare species, native of northern Wisconsin. Flowering from late May through July, and fruiting in July and August.

Three weakly defined varieties, which grade into one another, differing primarily in leaf characters, have been recognized by Fernald (key modified from Fernald, 1950). They are listed here without real understanding of whether genetic or environmental factors are primarily responsible for their slight morphological distinctions.

Key to Varieties

A. Leaves ovate, ovate-lanceolate, or elliptic-lanceolate, the primary ones 0.7–2.5 cm long; flowers often solitary, or in few-flowered cymes ---------- 2a. *S. calycantha* var. *calycantha.*

AA. Leaves lanceolate to lance-linear, the primary ones (2–) 2.5–5 cm long; flowers mostly in several- to many-flowered cymes.

  B. *Upper bracteal leaves* reduced, but *herbaceous throughout;* flowers few to many, terminal and axillary ---------------------------------- 2b. *S. calycantha* var. *isophylla.*

  BB. *Upper bracteal leaves* much reduced to *minute scarious-margined bracts;* flowers numerous in terminal cymes ------------------------- 2c. *S. calycantha* var. *floribunda.*

2a. STELLARIA CALYCANTHA var. CALYCANTHA. Map 17.

Leaves narrowly ovate to elliptic or oblanceolate, the largest *to 2.5 cm long. Flowers usually solitary in leaf axils,* sometimes in 2- to 5-flowered cymes.

Rare; in fir-white birch-aspen woods, Apostle Islands (Ashland Co.); north-facing clay bank (in shade), edge of fir-spruce-yellow birch forest, shore of Lake Superior (Bayfield Co.); shore of Lake Bellvue, Delta (Bayfield Co.); and woods, Mosinee Hills, Wausau (Marathon Co.).

Some plants keying out to var. *calycantha (e.g., Lane 2184,* North Twin Island, Ashland Co. [NORTHLAND]), could conceivably be young stages of the next two varieties.

2b. STELLARIA CALYCANTHA var. ISOPHYLLA Fern. Map 17.

Leaves lanceolate or lance-linear, the larger 2.5–5 cm long. Flowers few to many, in cymes, in axils of reduced leaves or subtended by *leaflike non-scarious bracts.*

Uncommon; *Thuja-Abies-Betula lutea* deer yard lowland (northeast Forest Co.); basalt cliff west of Hurley (Iron Co.); on mud and debris of abandoned beaver dam, in full sun, Siphon Creek

(Vilas Co.); wet *Mnium* moss cushions, with *Mitella nuda,* in open *Thuja-Sphagnum-Ledum* bog (Vilas Co.).

Duplicate collections of *Schlising & Schlising 1950* (Siphon Creek, Vilas Co. [WIS]), all from one colony of plants, contain individuals with small leaves and young, unbranched inflorescences that easily key out to var. *calycantha,* while other, older plants from the same collection, with leaves over 2.5 cm long and branched inflorescences, key to var. *isophylla.* It seems, then, that young plants of this variety (as well as of the next) may easly pass for var. *calycantha* on the basis of the listed varietal differences.

2c. STELLARIA CALYCANTHA var. FLORIBUNDA Fern. Map 17.

Leaves lanceolate or lance-linear, the larger 2.5–3.5 cm long. Flowers numerous, in cymes, subtended by minute scarious bracts.

Rare, with three collections: Clark Co.: wet places, Abbotsford, 1890, *Sandberg s.n.* (F, MINN). Marathon Co.: Granite Heights, 1894, *Cheney s.n.* (WIS); Edgar, 1915, *Goessl s.n.* (WIS).

A young individual of this variety cannot be told from var. *isophyllia* or var. *calycantha,* for the *lowermost* flowers are in the axils of foliage leaves. A mature specimen, with many-flowered inflorescences can be readily distinguished from the other varieties on leaf and bract characters, and from *S. longifolia* or from *S. graminea* by leaf, sepal, petal, and seed characters.

3. STELLARIA GRAMINEA L. Grass or Common Stitchwort. Map 18.

Perennial with a weak slender, glabrous, four-angled stem, commonly 2–4 (–6) dm tall. *Leaves narrowly lanceolate or linear-lanceolate, usually broadest a little above the base,* or sometimes (especially late in the season) narrowly elliptical or ovate and petioled. *Inflorescence large* and sometimes half the length of the plant, *terminal,* mostly *without leafy lateral branches from its base, many-flowered,* the bracts scarious, ciliate, and small. *Sepals* scarious-margined, lanceolate, acute, or acuminate, (2.5–) 4.0–6.2 mm long, often ciliate, *usually with three distinctly raised ribs. Petals longer than sepals,* the flowers rather showy. Capsule pale brown or straw-colored, exserted, its valves splitting to the base. *Seeds rugose-tuberculate with fine, sharp ridges,* orbicular-subreniform, 0.8–1.2 mm long.

Naturalized from Europe, most common in the "Northern Highlands" and occasional in southern Wisconsin, in grassy areas, such as moist fields, meadows, pastures, and roadsides, and, less commonly, in tall herbs along streams, gravelly shores of lakes, in sedge meadows, and in mesic to moist, rich Northern Hardwoods. Flowering from early June through July (September), with a flowering peak in the last third of June. Fruiting from mid-June to September.

Late specimens *(e.g., Fassett, Uhler, & McLaughlin 9638* [WIS], Dells of the Wisconsin River, Adams Co.; *Peroutky & Seymour 12971* [WIS], town of Corning, Lincoln Co.) mimic *S. calycantha* in habit and leaves, but may be distinguished by the sepal, petal and seed characters.

4. STELLARIA LONGIPES Goldie. Map 19.

Glabrous perennial from slender rhizomes, with stems (0.5–) 1.5–2 (–3) dm tall. *Leaves* narrowly lanceolate-acuminate, sessile and rounded at base, *stiff and ascending,* 15–20 (–30) mm long, 2–3 mm wide. *Inflorescence terminal,* (1–) 3–9 flowered, with scarious bracts. Sepals ovate to elliptic, acute, or sometimes blunt, eciliate, 3.5–4.5 (–5) mm long, usually weakly 3-nerved. *Petals longer than sepals. Capsule exserted, black.* Seeds oblong to oval, 0.8–1.0 mm long.

A circum-boreal species, *very rare in Wisconsin,* the two specimens from Oneida Co.: one colony, moist, gravelly bank, Rhinelander, 19 June, 1915, *Goessl 532* (MIL); east N. Log. RR, Rhinelander, 16 June, 1915, *Goessl s.n.* (WIS) [possibly the same station].

STELLARIA HOLOSTEA L., Easter-bells or Greater Stitchwort, is a cultivated Eurasian perennial with ciliate, narrowly lanceolate leaves tapered to base, and large white flowers 1.5–2 cm across, the one collection from Milwaukee County: a weed about gardens, Milwaukee, in flower March 16, 1854, *Lapham s.n.* (WIS).

S. STELLARIA PALUSTRIS Retz. Marsh Stitchwort. Map 19.
Stellaria glauca With.

Slender glabrous perennial, 2–4 dm tall, very similar to *S. longifolia,* but usually less branched. *Leaves very narrowly linear,* 1.5–3.5 cm long, *0.4–1.2 (–2) mm wide.* Inflorescences terminal and axillary (only infrequently overtopped by lateral shoots from their bases), the bracts scarious and eciliate. *Sepals lanceolate, acuminate, (3.2–) 4.0–6.1 mm long. Petals conspicuously exceeding sepals,* 5.2–8.5 mm long. Capsule pale. Seeds brownish, with low papillae.

Native to cold-temperate Europe and Asia, locally established in south-central and northwestern Wisconsin in wet places: Marquette Co.: drainage ditch in tamarack bog, Endeavor, *Iltis & Buckmann 11285* (WIS); wet *Carex-Glyceria* meadow (once a *Larix-Rhus vernix* bog), black muck soil, southwest shore of Ennis Lake, *Iltis et al. 6305* (WIS); *Cornus stolonifera* river sand flat, *White 792*

(WIS); sedge meadow, with *Campanula aparinoides, Porter, Anderson, & Post, s.n.* (WIS). Burnett Co.: Searles Cranberry Marsh, Lake Pokegama, Hertel, *Dana s.n.* (WIS). Dane Co.: *Carex filformis* society, University Bay, Madison, *Heddle 2T177* (WIS). Flowering from mid-June through July.

This taxon is tentatively listed as *S. palustris,* to which it keys out in Gleason (1952) and Fernald (1950) mainly because of its large petals and sepals. However, the several collections of European *S. palustris* in the University of Wisconsin Herbarium generally have larger flowers, as well as wider and more lanceolate leaves than do the Wisconsin collections. Extremely variable in the Old World, Ascherson and Graebner (1929) list no fewer than 14 subspecific taxa within *S. palustris.* In contrast, the Wisconsin specimens are remarkably uniform in their slender habit and *very narrow leaves* and may perhaps belong to forma *angustifolia* Marsson.

Wisconsin *S. palustris* differs from *S. graminea* mainly in the very narrowly-linear leaves, as well as generally more weakly-nerved and eciliate sepals and smaller inflorescences. *Stellaria palustris* differs from *S. longifolia* in Wisconsin by having larger flowers, with petals exceeding the sepals by several mm, narrower leaves, and fewer-flowered inflorescences.

6. STELLARIA LONGIFOLIA Muhl. Long-leaved Starwort.
Maps 20 & 21.

Perennial with weak, usually ascending, 4-angled, glabrous stems, (1–) 1.6–4 (–5.5) dm tall, the angles sometimes scabrous. Leaves linear or narrowly lance-linear to elliptic, often acute at both ends, mostly 1.5–5 cm long, 1–4 (–5) mm wide, sometimes ciliate at the base. Inflorescence few- to many-flowered, usually with leafy lateral branches from its base, these nearly equalling or overtopping it. Bracts scarious, eciliate. Sepals lanceolate, acute, scarious-margined, mostly eciliate, 2.3–4 (–4.4) mm long, often weakly 3-nerved, rarely 3-ribbed. Petals equalling or longer than the sepals. Capsule straw-colored to dark brown or black, well exserted. Seeds oblong, 0.7–1 mm long, essentially smooth.

A native circumboreal species, fairly common in Wisconsin, where strikingly variable and seemingly consisting of two entities, one found throughout the state but most common in the southern part, and the second essentially north of the Tension Zone. These, here listed as varieties, seem to have frequent intermediates which are difficult or impossible to distinguish. Further study of this taxon is certainly needed, the present treatment of this "species" to be considered tentative. It is likely that with better material and more field study the varieties will be recognized as species or geographic subspecies. When a combination of characters is used, as in the following key, most specimens, especially the mature ones, can be assigned to a variety.

KEY TO VARIETIES

A. (1) Mature capsule straw-colored to brownish; (2) plants with leaves mostly over 1.5 mm wide; (3) plants mostly dark green; (4) middle nodes frequently as long as or longer than the leaves; (5) inflorescence few- to many-flowered, but often with comparatively few flowers on long pedicels; (6) plants upright, but often frail and reclining on surrounding vegetation; (7) throughout the state, more common in southern Wisconsin ____________________ 6a. *S. longifolia* var. *longifolia.*

AA. (1) Mature capsule dark pigmented, purple brown to brownish-black; (2) leaves generally smaller and more narrow, mostly 1.5 mm wide or less; (3) plants usually yellowish-green or light green; (4) middle nodes frequently mostly shorter than the leaves; (5) inflorescence few- to many-flowered but frequently many-flowered, with flowers on short pedicels; (6) plants upright, most often rather stiff and not decidedly sprawling or reclining; (7) mostly north of the Tension Zone ________________________ 6b. *S. longifolia* var. *atrata.*

6a. STELLARIA LONGIFOLIA var. LONGIFOLIA. Map 21; Fig. 4.

This variety has been rarely collected with mature fruit, so few of the Wisconsin specimens have the pale capsules. However, it is recognized by the larger leaves and the often spreading reclining habit. On Map 21, the hollow circles represent this variety, those with short, horizontal lines being collections with pale capsules, while those without representing collections placed here on the basis of vegetative characters.

Variety *longifolia* occurs throughout the state, though most common in southern Wisconsin, in moist places such as low woods, marshes, sedge meadows, swamps, bogs, lake shores, and roadside ditches; *e.g.*, marsh on Hwy E, with *Cicuta maculata, Anemone canadensis, Thalictrum dasycarpum* (Trempealeau Co., *Schlising 1572* [WIS]); wet sand along Hwy 12–16, Lyndon Station, with *Drosera, Xyris, Spiraea tomentosa, Eleocharis, Juncus, Aletris, Viola lanceolata* (Juneau Co., *Zimmerman 3135* [WIS]; damp, grazed low prairie in valley along stream, Governor Dodge State Park, with *Lilium michiganense, Cacalia tuberosa, Crataegus,* and *Lobelia* spp. (Iowa Co., *Iltis 9691* [WIS]); open, wet sedge meadow, edge of West Salem *Larix* bog (La Crosse Co., *Iltis 5823* [WIS]); and densely wooded seepage at base of Black River bluff in bottomland forest (La Crosse Co., *Iltis 5998* [WIS]). Flowering from mid-May through July, with a flowering peak in mid-June. Fruiting from mid-June to September.

6b. STELLARIA LONGIFOLIA var. ATRATA Moore. Map 21; Fig. 4.
Stellaria atrata (Moore) Boivin.

This variety is usually more yellow-green than var. *longifolia,* more delicately branched, shorter-leaved and more upright. A

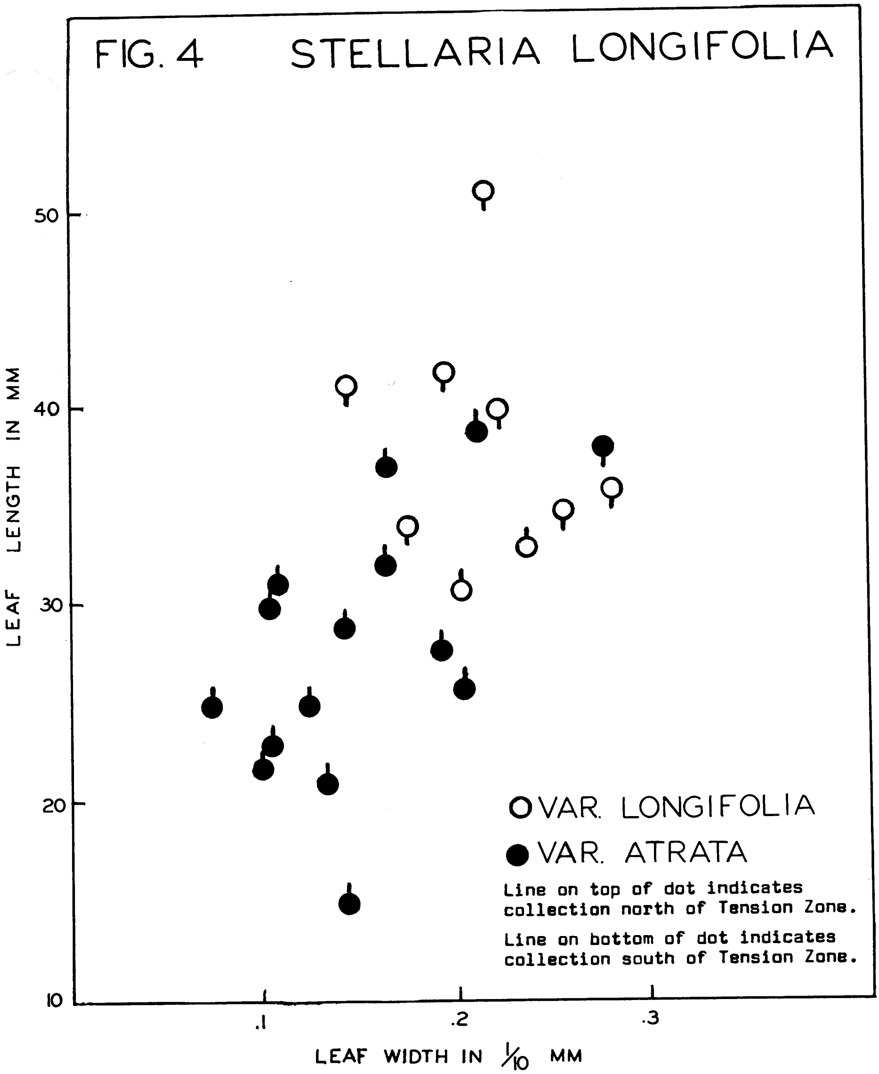
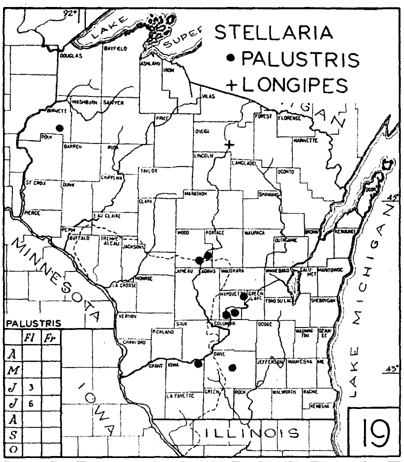


FIGURE 4.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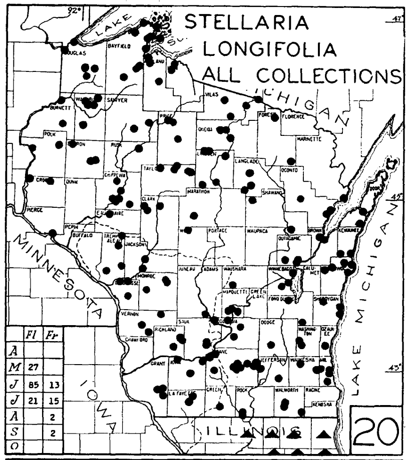
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LONGIFOLIA
ALL COLLECTIONS
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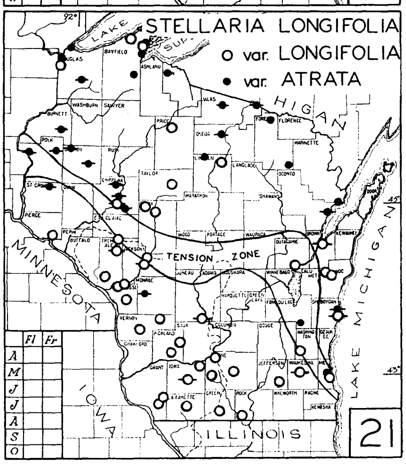
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• var. ATRATA
TENSION ZONE
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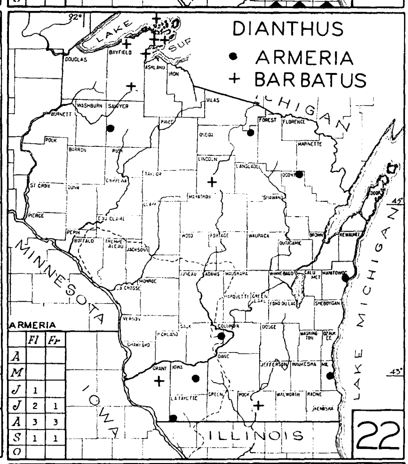
DIANTHUS
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+ BARBATUS
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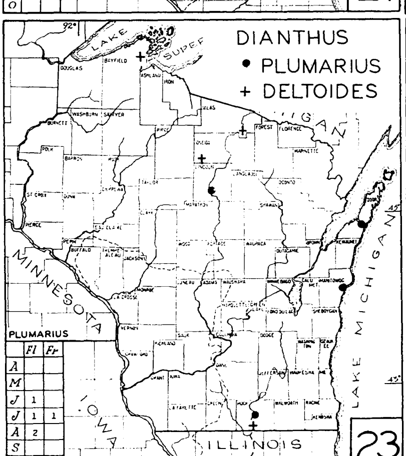
DIANTHUS
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+ DELTOIDES
MICHIGAN
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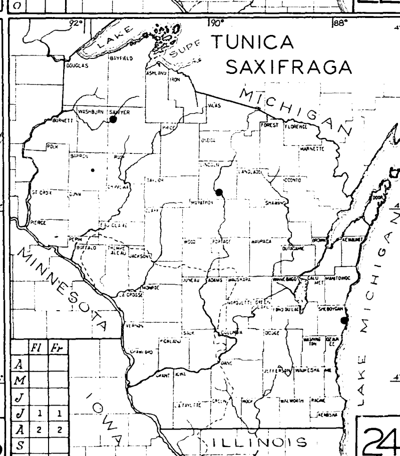
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MICHIGAN
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24

greater proportion of the collections of this variety have dark capsules. On Map 21 dark circles with short horizontal lines represent collections bearing dark capsules, while dark circles without lines are collections without capsules. In Wisconsin, this variety seems to come south only as far as the Tension Zone.

The habitats for var. *atrata* seem to be similar to those of var. *longifolia,* occurring mainly in moist places, though perhaps more commonly in Sphagnum bogs; e.g. roadsides in open sedge marsh southwest of Oconto (Oconto Co., *Iltis & Buckmann 10984* [WIS]); wet cedar bog, with birch and alder, southeast Forest County, *(Patman, Noller, Christensen s.n.* [WIS]); moist, shady hummocks, High Lake Bog (Vilas Co., *Potzger 8629a* [WIS]); wet sedge meadow on La Crosse River, Sparta (Monroe Co., *Iltis & Neess 8951* [WIS]); and sandy, grassy roadside near Lake Evelyn (Polk Co., *Schlising & Musolf 1630* [WIS]). Flowering and fruiting seasons are similar to those of var. *longifolia.*

The dark capsuled, northern plants *(atrata)* were first recognized as a variety by Moore (1950) and later elevated to the species level by Boivin (1953). However, most characters that Boivin lists to distinguish *S. longifolia* from *S. atrata* are practically useless when applied to the Wisconsin specimens. Boivin *(loc. cit.)* furthermore distinguished two varieties: var. *atrata,* with ciliate sepals, and var. *eciliata,* with eciliate sepals. In Wisconsin, however, while both the northern *atrata* and southern *longifolia sensu stricto* usually *do have eciliate sepals,* there are a good many plants of *both taxa* that have ciliate sepals! Boivin's varieties do not seem tenable here.

All collections of *S. longifolia* are included on Map 20, those that could be assigned to varieties on Map 21. The dots on Map 21 with horizontal lines represent the fruiting specimens plotted on the scatter diagram in Figure 4. The horizontal axis gives the leaf width (in 1/10 mm) of the largest stem leaf of the 2nd or 3rd node below the inflorescence, while the vertical axis plots the measurement of the same leaf's length. Solid circles represent plants bearing dark-colored capsules, and hollow circles, plants with straw-colored capsules. A short vertical line on the top of the dot indicates a collection from north of the Tension Zone, and a vertical line on the lower side of the dot indicates a collection from south of the Tension Zone. While the diagram does separate the varieties, the overlap is considerable. Immature specimens, in most instances, can not be assigned to a variety.

10. DIANTHUS L. PINK; CARNATION

Showy Old World herbs. Calyx cylindrical, 5-toothed, many-nerved, subtended by 2–6 appressed bracts. Petals dentate to lacerate, longer than the calyx. Stamens 10. Styles 2. Capsule dehiscent by 4 teeth. A very large genus with many cultivated species, including *D. caryophyllus*, the Carnation, and *D. chinense*, the Rainbow Pink.

KEY TO SPECIES

A. Bracts at base of calyx lanceolate, over half as long as to exceeding calyx; flowers solitary and short-pedicelled or sessile and in clusters.

  B. Bracts and calyx pubescent throughout; leaves linear to lance-linear .... 1. *D. armeria.*

  BB. Bracts and calyx glabrous, with ciliate margins; leaves ovate to lanceolate or oblanceolate .... 2. *D. barbatus.*

AA. Bracts at base of calyx ovate, less than half as long as calyx; flowers usually solitary and long-stalked.

  C. Main leaves 3–9 cm long; bracts abruptly acuminate, ¼–⅓ as long as calyx .... 3. *D. plumarius.*

  CC. Main leaves 1.5–2.5 cm long; bracts long-tipped, about half as long as calyx .... 4. *D. deltoides.*

1. DIANTHUS ARMERIA L. Deptford Pink. Map 22.

Simple-stemmed or branched biennial, 3–5 (–8) dm tall, pubescent in the inflorescence. *Leaves linear to lance-linear, 3–10 cm long. Flowers sessile,* borne *in tight clusters* of 2–10, *or* the lower ones solitary. *Bracts subtending calyx lanceolate, pilose, over half as long as calyx. Calyx* 12–20 cm long, *pilose.* Petals purple-red, white-dotted, dentate, exceeding calyx by 2–5 mm, the flowers about 1 cm in diameter. Capsule about equalling calyx.

Naturalized from Europe, sporadic in Wisconsin, mainly along roadsides, with one collection each from the edge of a cranberry marsh and a woods, with all the collections made since 1951, excepting those from Manitowoc of 1913 and 1916 (these cultivated in a garden?), more common south and southeastward of Wisconsin. Flowering from late June to earliest September.

2. DIANTHUS BARBATUS L. Sweet William. Map 22.

Perennial with unbranched, essentially *glabrous stems* 3–7 dm tall. *Leaves ovate to lanceolate,* those at base sometimes oblanceolate, 4–10 cm long. *Inflorescence a dense, terminal cyme of short-stalked or sessile flowers. Bracts lanceolate, ciliate,* with scarious margins at base, usually *exceeding calyx.* Calyx 15–20 mm long. Petals very showy, red, pink, or white, dentate, longer than the calyx, the flowers 2–3 cm in diameter. Capsule included.

Introduced from southern Europe. Commonly cultivated and occasionally escaped from gardens, becoming established, especially in the Apostle Islands and vicinity, in old logging roads and clearings in woods (Ashland Co.), on conglomerate ledges (Bayfield Co.), and along a railroad (Grant Co.). Flowering from mid-June through August.

3. DIANTHUS PLUMARIUS L. Grass, Garden, or Cottage Pink. Map 23.

Perennial forming large loose mats, with *linear* glaucous *leaves 3–9 cm long. Flowers single or in groups up to 5,* the pedicel about 1 cm long or longer. Calyx about 2 cm long, subtended by scarious-margined *abruptly pointed bracts up to ⅓ as long as the calyx.* Petals fringed, very showy, red, pink, or white, often with darker transverse bands, longer than the calyx, the flowers 3–4 cm across. Capsule exserted.

A garden flower from southeast Europe, often grown in rock gardens, adventive in vacant lots and roadsides in Door, Lincoln, and Rock counties. Flowering from late June to August.

4. DIANTHUS DELTOIDES L. Maiden Pink. Map 23.

Perennial with basal leafy shoots forming low mats. Similar to *D. plumarius,* but with stem *leaves less than 2.3 cm long,* the smaller flowers 1–1.5 cm across. Calyx about 1.5 cm long, with *acuminate bracts to ½ as long.* Petals dentate, purple-red, lavender, or rarely white.

A European rock garden flower, escaped in Bayfield, Oneida, Rock, and Vilas Counties. Flowering from June to October.

11. TUNICA SCOP.

1. TUNICA SAXIFRAGA (L.) Scop. Tunic Flower; Coat Flower. Map 24.

Much-branched, loosely *mat-forming low perennial,* with narrowly lance-linear, connate leaves. Flowers borne singly or in diffuse, open cymes. *Calyx 5-ribbed and 5-toothed, 4–5 mm long, subtended by 4–6 scarious-margined bracts.* Petals pink, 1 or 2 mm longer than the calyx. Stamens 10. Styles 2. Capsule longer than the calyx and dehiscent by 4 teeth.

Introduced as a garden plant from Europe, commonly cultivated, and occasionally escaped: Sheboygan Co.: roadside, Sheboygan, 1912, *Goessl s.n.* (WIS). Sawyer Co.: Hayward, 1924, *Davis s.n.* (WIS). Lincoln Co.: roadside, Hwy. 107, along Wisconsin River, 1954, *Seymour 15811* (WIS). Flowering in July and August.

12. VACCARIA MEDIC. COW-HERB

1. VACCARIA SEGETALIS (L.) Garcke. Cow-Herb; Cow-cockle.
Saponaria vaccaria L. Map 25.

Glabrous annual 2–7 dm tall. Stem simple to a much-forked cymose inflorescence. *Leaves lance-ovate, clasping* at base, the larger ones 4–8 (–12) cm long, reduced upwards in the inflorescence. *Calyx inflated, 1–1.6 cm long, with 5 prominent, usually green, winged ribs.* Petals showy, rose, 1.8–2.5 cm long and exceeding calyx, the flower 1.5–2 cm across. Stamens 10. Styles 2. Capsule included in the inflated calyx, dehiscent by 4 teeth.

A native of southern Europe and Asia, apparently once a common weed of dry, sandy waste places, railroad embankments and grain fields in scattered locations in Wisconsin, now rare or absent, the last collection in 1947, and all others either from the 1880's or 1890's or from 1907 to 1922. Flowering and fruiting from late June to early September.

13. SAPONARIA L. BOUNCING BET; SOAPWORT

1. SAPONARIA OFFICINALIS L. Bouncing Bet; Soapwort. Map 26.

Showy perennial, with simple, upright stems from rhizomes, to 9 cm long, glabrous or minutely pubescent above. *Leaves* 5–9 cm long, *ovate to ovate-lanceolate or elliptic,* tapered to base, prominently 3-veined, often brown-spotted, bearing axillary shoots. Flowers in tight cymes or in open cymose clusters. *Calyx cylindrical,* weakly 20-nerved, 1.6–2.4 cm long, *5-toothed and 2-lipped. Petals pale rose to pink or whitish,* with definite claw and blade, the flowers 2–3 cm across (sometimes double in var. CAUCASICA Hort.). Stamens 10, exserted. Styles 2. Capsule 4-toothed, about length of calyx or shorter.

Naturalized from Eurasia and found throughout Wisconsin, especially common in the southern part in open disturbed habitats, such as sandy roadsides, stream banks, beaches, railroad embankments, and waste places. Flowering from the last week of June to mid-October, and fruiting from mid-July through October.

14. GYPSOPHILA L.

Glabrous and glaucous much-branched herbs with numerous minute flowers on filiform pedicels in cymose inflorescences. Calyx 5-toothed, weakly nerved. Stamens 10. Styles 2 .Capsule 4-toothed, longer than sepals.

KEY TO SPECIES

A. Annual, much branched from base, about 2 dm or less tall; stem-leaves linear-filiform, under 3 mm wide -- 1. *G. muralis.*

AA. Perennial, with stout base and tall stems; stem leaves linear-lanceolate, tapered at both base and apex, at least some 3–10 mm wide ---------------------------------- 2. *G. paniculata.*

1. GYPSOPHILA MURALIS L. Map 27.

Frail, finely and diffusely branched annuals to 2 dm tall. *Leaves linear-filiform,* 1–2 cm long. Sepals mostly 2–3 mm long, shorter than the pink-purple petals.

A garden plant naturalized from Europe, adventive in two locations in Wisconsin, in one evidently persisting for the past 11 years: Marathon Co.: sandy soil on top of a bank along Wisconsin River, edge of Country Club grounds, in Schofield 1949, *Wilson s.n.* (WIS), and Schofield, 1960, *Kennedy s.n.* (WIS). Sheboygan Co.: old house site, 1903, *Goessl s.n.* (WIS). Flowering from June to earliest Oct.

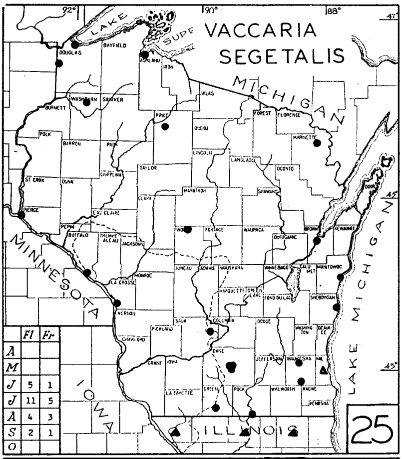
2. GYPSOPHILA PANICULATA L. Baby's Breath. Map 27.

Robust perennial to 1 m tall, *abundantly and finely branched* from a stout central stem, commonly forming dense "bushes," with showy many-flowered, beautifully cymose inflorescences; *leaves linear-lanceolate. Sepals* mostly 1.5–2 mm long, *with prominent white margins.* Petals white, about 4 mm long, longer than the sepals.

Native of arid Eurasia, much planted in gardens, recently becoming naturalized in a few places, where now well established and locally very abundant; Adams Co.: with prairie species, abundant for 500 yards in fields, pastures, and roadsides, 1959, *Iltis 13355* (WIS). Marinette Co.: large colonies in sand along Hwy 141 and in sandy, grassy fields with goldenrods, 1960, *Schlising 1690* (WIS). Sauk Co.: rocky exposed situations, Devil's Lake, 1944, *Swink s.n.* (F). Waupaca Co.: observed 2 miles SSW of Rural, abundant on roadsides and in fields *(fide Iltis,* 1960). Flowering from early July and probably throughout the summer.

GYPSOPHILA ACUTIFOLIA Fisch., resembling *G. paniculata,* but with broader leaves, longer sepals, and glandular-pubescent pedicels, was collected in 1941 along the C & NW railroad tracks, at North Fond du Lac (Fond du Lac Co., *Shinners 3778* [WIS, MINN]). This garden escape is native to the Caucasus.

GYPSOPHILA ELEGANS Bieb., a glaucous flower-garden annual from the Caucasus, has open corymbiform panicles, the longer pedicels 1.2–3.5 cm long, and showy petals twice to thrice as long as the calyx. The one collection was made in 1915 in a vacant lot in Rhinelander (Oneida Co., *Goessl s.n.* [WIS]).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SEGETALIS
MICHIGAN
MINNESOTA
IOWA
ILLINOIS
LAKE MICHIGAN
Fl Fr
A
M
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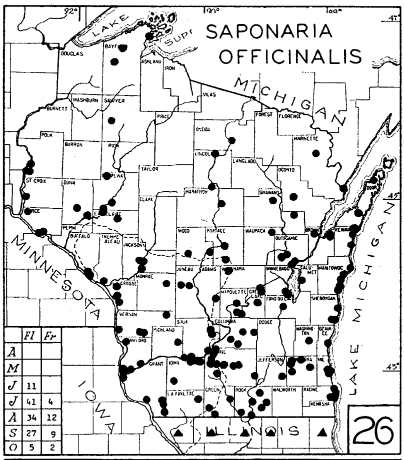
J 11 5
A 4 3
S 2 1
O
25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OFFICINALIS
MICHIGAN
MINNESOTA
IOWA
ILLINOIS
LAKE MICHIGAN
Fl Fr
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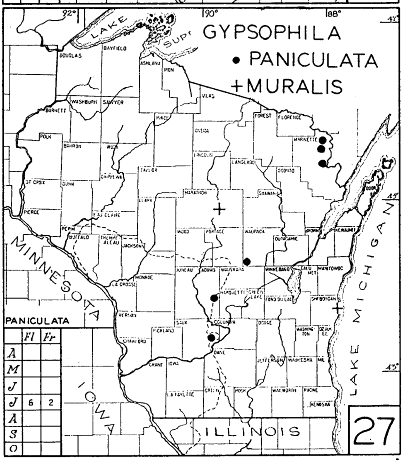
S 27 9
O 5 2
26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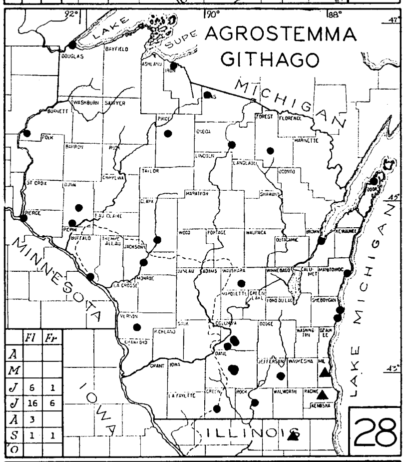
+MURALIS
MINNESOTA
IOWA
ILLINOIS
LAKE MICHIGAN
PANICULATA
Fl Fr
A
M
J
J 6 2
A
S
O
27


AGROSTEMMA
GITHAGO
MICHIGAN
MINNESOTA
IOWA
ILLINOIS
LAKE MICHIGAN
Fl Fr
A
M
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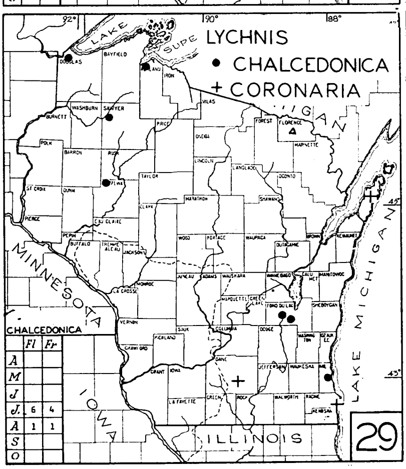
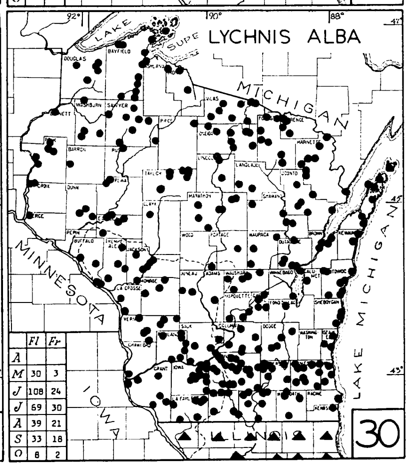
A 3
S 1 1
O
28


LYCHNIS
• CHALCEDONICA
+ CORONARIA
MINNESOTA
IOWA
ILLINOIS
LAKE MICHIGAN
CHALCEDONICA
Fl Fr
A
M
J
J. 6 4
A 1 1
S
O
29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MICHIGAN
MINNESOTA
IOWA
LAKE MICHIGAN
Fl Fr
A
M 30 3
J 108 24
J 69 30
A 39 21
S 33 18
O 8 2
30

15. AGROSTEMMA L. CORN COCKLE

1. AGROSTEMMA GITHAGO L. Corn Cockle; Purple Cockle. Map 28.

Pilose, few-branched, strictly erect annual, to 8 dm tall. Leaves linear or lanceolate, 8–12 cm long, 1 cm wide. Flowers showy, single on simple stems, or to 11 in branched plants. *Calyx-tube 10-ribbed, with linear-lanceolate teeth 1.5–5 cm long, surpassing the showy, red-purple, oblanceolate, emarginate petals.* Stamens 10. Styles 5. Capsule 5-toothed.

Naturalized from Europe, now very rare, or perhaps absent from Wisconsin, though once common in disturbed or waste places, fields, roadsides, and railroad embankments; Superior dock (Douglas Co.); Menominee tramway (Dunn Co.); in a wheatfield (Vernon Co.); in a grainfield, Ephraim (Door Co.); and at Lake Mendota marshes (Dane Co.). Flowering mainly from the middle of June through July (September) and fruiting from early July to early September.

This species has been collected in scattered localities over most of Wisconsin, but most collections are from the southern half of the state. The earliest collections date from 1885, at Madison (Dane Co.) and Two Rivers (Manitowoc Co.), while the last date from 1929 and 1944, with 26 additional collections between 1885 and 1929. It has been suggested that this species was associated as a weed with agricultural rye, for the acreage of rye grown in Wisconsin was greatly increased and expanded in the period 1880–1924, and much decreased by the 1940's (Packard, 1958), the rye acreage roughly corresponding with the occurrence, or at least the collections, of corn cockle. Hegi (1908) lists this species as a weed of grain fields in Europe.

16. LYCHNIS L. CAMPION

Robust herbs with slightly to strongly clasping, entire leaves. Inflorescence cymose, forking or densely compacted. Flowers showy, perfect or unisexual. Calyx-tube hairy, well-ribbed. Petals exceeding calyx, with claw and blade, and usually with auricles and with appendages at base of blade. Stamens 10. Styles normally 5, less often 3–9.

KEY TO SPECIES

A. Plants densely white-wooly; petals magenta-purple -- 1. *L. coronaria.*

AA. Plants green, glandular-pubescent to hirsute or pilose, not white-wooly; petals white or red.

B. Flowers white, unisexual, solitary in a forking inflorescence; calyx tubular, cylindrical, or ovoid, inflated; very common weed ______________________________ 2. *L. alba.*

BB. Flowers red, perfect; densely aggregated in a terminal inflorescence; calyx clavate (especially in fruit), not inflated; rare escape ________________________ 3. *L. chalcedonica.*

1. LYCHNIS CORONARIA (L.) Desr. Map 29.
Rose Campion; Mullein Pink; Dusty Miller.

Tall, *densely white-wooly* perennial, with stiffly forked inflorescence bearing large, *showy, magenta-purple, perfect flowers.*

A native of southern Europe, this commonly-grown garden flower has escaped from cultivation in Dane, Door, and Racine Counties.

2. LYCHNIS ALBA Mill. White Campion; White Cockle; Evening Lychnis. Map 30.

Melandrium album (Mill.) Garcke.

Dioecious pubescent biennial or perennial 2–11 dm tall. Leaves oblanceolate or lanceolate to oval or elliptic, 5–12 (–14) cm long, acute, narrowed at base, the lower petioled, the upper sessile. Inflorescence forking, usually glandular-pubescent. *Flowers unisexual,* opening in the evening, bracteate. *Calyx 1.5–2.6 cm long, cylindrical, inflated,* especially in fruit, *the narrowly-lanceolate teeth 2–6 mm long,* pilose and usually with some glandular hairs, 20-nerved in pistillate flowers, 10-nerved in staminate, the nerves often purple (especially in the staminate flowers). *Petals showy, white,* bilobed, 1.5–3 cm across. Styles usually 5, often 3–9, or even 0–13 (see discussion below). Capsule ovoid, about length of calyx. When flower has 5 styles, capsule opening with 10 (sometimes with only 5) erect or slightly spreading teeth. (Easily confused with the rarer *Silene noctiflora* [which see], which has 3 styles, 6 capsule teeth and *perfect flowers.)*

Naturalized from Eurasia and exceedingly abundant through Wisconsin in any disturbed or open habitat, one of the most pernicious weeds of cultivated fields, pastures, and gardens, less often in woods (especially at the edges, and in portions grazed by cattle or deer), in prairies, meadows, swamps, marshes, and at edges of bogs. Flowering from (early) late May through early October, with a flowering peak the last week of June. Fruiting from late May through October.

Variations in style number has been studied in Iowa and Minnesota plants (Dean, 1959). Of 21,669 *Lychnis alba* flowers studied, Dean found 66.9% bearing the typical 5 styles and 33.1% bearing from 0 to 4 or from 6 to 10 styles. Dean (personal communication,

1961) has since found flowers bearing as many as 13 styles. He indicates that he believes some of these style variations perhaps are "not as abnormal as some regard them but may be actually typical."

Although hermaphrodite (bisexual) flowers do rarely occur, *Lychnis alba,* as well as the red-flowered *L. dioica* of gardens, is noted for its strict separation of the sexes. Both are diploid, with 2N—24. Male plants have 22 autosomes and X and Y sex chromosomes, while female plants have 22 autosomes and XX sex chromosomes (a mechanism similar to that found in man).

3. LYCHNIS CHALCEDONICA L. Map 29.
Scarlet Lychnis; Maltese Cross; London Pride.

Perennial with erect *pilose stems* to 8 dm tall. Leaves ovate or lance-ovate, acute, the larger 6–9 cm long. *Inflorescence terminal, compact, and many-flowered. Flowers perfect. Calyx clavate,* 11–18 mm long, with 10 pilose ribs, and 5 acute teeth about 3 mm long. *Petals brick-red,* bilobed. Capsule 5-toothed, included in calyx.

Native to Russia and Siberia, commonly cultivated in Wisconsin, and rarely escaped, mainly in sandy roadsides, along streams, and in fields. Flowering and fruiting from early July to early August.

17. SILENE L. CATCHFLY; CAMPION

[Hitchcock, C. L., and Bassett Maguire. A revision of the North American species of *Silene.* Univ. Wash. Pub. Biol. 13:1–73. 1947.]

Annuals to perennials with opposite or whorled leaves. Flowers perfect. Petals with narrow claw, expanded blade, auricles, and a pair of appendages at the junction of claw and blade, longer than (or rarely equalling) the calyx, emarginate to bilobed or fringed. Stamens 10. Styles 3. Ovary usually stipitate (with a stalk between its base and base of the calyx). Capsule dehiscent by 6 teeth.

KEY TO SPECIES

A. Middle cauline leaves in whorls of 4; petals fringed with several deep cuts; prairies and woods, southeast and western Wisconsin ---------------------------------- 1. *S. stellata.*

AA. Middle cauline leaves opposite; petals once cut, bilobed, or emarginate.

B. Flowers in very leafy cymes, *i.e.,* solitary in the axils of large leaves; native of woodlands and thickets, southern Wisconsin ---------------------------------- 2. *S. nivea.*

BB. Inflorescences bracteate, cymose or racemose, few- to many-flowered, congested to open; garden escapes and weeds, disturbed habitats throughout Wisconsin.

C. Stems hairy throughout; calyx hairy, at least on the nerves.

D. Calyx with glandless hairs; inflorescence a one-sided raceme; flowers sessile or short stalked, each subtended by two bracts ---------- 3. *S. dichotoma.*

DD. Calyx with glandular hairs; inflorescence not one-sided; flowers pedicelled, in forking cymes (uncommon. See also *Lychnis alba.)* ----- 4. *S. noctiflora.*

CC. Stems, or at least branches of inflorescence, glabrous; calyx glabrous (sometimes calyx teeth pubescent).

E. Calyx with 10 prominent nerves; petals emarginate, pink or lavender, or petals lacking; annuals or biennials, often with glutinous bands on the upper internodes.

F. Calyx ovoid, green-nerved, often with purple teeth; stalk of capsule (within calyx) about 1 mm long; petals minute and inconspicuous, rose or pink, or lacking ---------- 5. *S. antirrhina.*

FF. Calyx strongly clavate, often purplish; stalk of capsule (within calyx) 6–8 mm long; petals showy, lavender-purple, the flowers about 1 cm in diameter ------------------ 6. *S. armeria.*

EE. Calyx with 10 or 20 nerves, branching or inconspicuous; petals deeply notched, white; perennials, without glutinous bands on the internodes.

G. Calyx subspherical to ovoid (in pressed specimens campanulate, widest at the summit), rounded or umbilicate (invaginate) at base, in fruit papery and inflated, not appressed to the included capsule; uppermost bracts of inflorescence usually entire ---------- 7. *S. cucubalus.*

GG. Calyx oblong-ovoid or ellipsoid, widest at or near the middle, narrowed to the base or attenuate to the pedicel (not umbilicate), in fruit firm and appressed to the slightly exserted capsule; uppermost bracts of inflorescence minutely ciliate ------------------------------ 8. *S. cserei.*

1. SILENE STELLATA (L.) Ait. f. var. SCABRELLA (Nieuw.) Palm. & Stey. Starry Campion; Widow's-frill. Map 31.

Puberulent perennial with several *stiff stems 6–13 dm tall. Leaves* lanceolate or lance-ovate, *long acuminate,* the major ones 4–10 cm long and *in whorls of 4.* Inflorescence a stiff paniculate cyme, with branches and pedicels puberulent. Calyx campanulate, inflated, 9–14 mm long, at summit often about as wide as long, with triangular teeth, 2–5 mm long. *Petals white, prominently fringed.* Capsule shorter than the calyx. All our plants are of the pubescent more western variety.

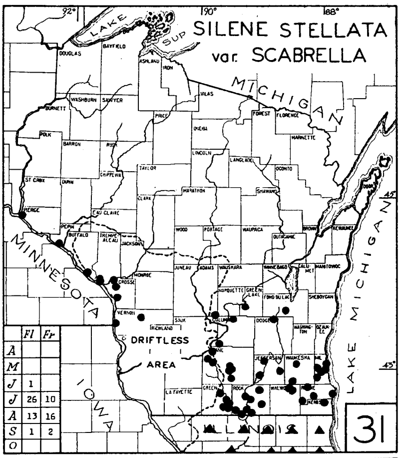
Native, locally frequent in southeastern Wisconsin and occasional in western Wisconsin, but essentially lacking from the "Driftless Area" except in the river valleys of the western part, in open upland oak woods, mesophytic or sandy woods, and wood borders, river banks and sand terraces (Pepin Co.), occasionally along roadsides and railroads, fence rows, grassy ditches and moist meadows; prairie borders and deep-soil prairies, *e.g.*, near Albany and Brodhead (Green Co.), with *Liatris pycnostacha, Cacalia tuberosa, Eryngium yuccaefolium, Silphium, Helianthus, Solidago* and *Aster* spp., *Dodecatheon meadia, Sporobolus heterolepis, Amorpha canescens,* and *Carex* spp. Flowering and fruiting from (June 8?) early July to mid-August (September).

2. SILENE NIVEA (Nutt.) Otth. Snowy Campion; White Campion. Map 32.

Tall perennial with glabrous or pubescent, simple or sparingly branched stems from 6–9 dm tall. Leaves opposite throughout, lanceolate to lance-elliptic, densely puberulent to glabrous, 4–11 (–13) cm long, and mostly 1–2 (–2.5) cm wide. *Flowers in very leafy cymes, appearing axillary, or sometimes solitary.* Calyx tubular, somewhat inflated, weakly green-nerved, glabrous to densely hirsute, 12–18 mm long. Petals white, notched. Capsule about length of calyx.

Occasional in southwestern Wisconsin, from Rock to Pierce Counties, typically a woodland species, in Wisconsin collected in alluvial woods ("Southern Floodplain Forest"), roadside thickets, grassy places along roadsides and rivers, sedge meadows, and rarely on wet cliffs, *e.g.*, on sunny, very steep seepage slope on Grant River with *Sullivantia renifolia* and *Mimulus glabratus* (Grant Co.). Flowering and fruiting the last third of June through July (August).

SILENE VIRGINICA L., the Fire Pink, a perennial with large, crimson-red flowers, is shown by Hitchcock and Maguire (1947; Plate 1, Map 2) to occur in southern Wisconsin (Madison?). However, the species is unknown here, no specimen of it has been seen, and the collection upon which the report was based has not been relocated *(fide* Hitchcock, personal communication, 1961–WIS). This species does come to within about 80 miles of Wis. in NE Illinois (Jones & Fuller, 1955).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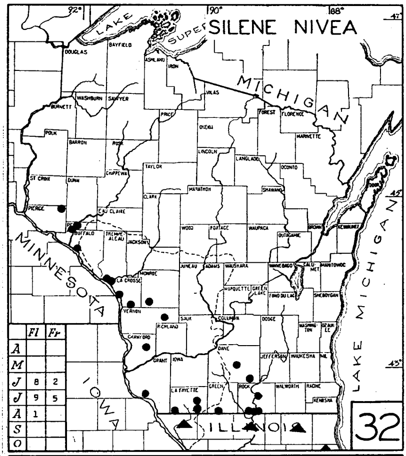
LAKE SUP
MICHIGAN
MINNESOTA
IOWA
ILLINOIS
LAKE MICHIGAN
DRIFTLESS AREA
Fl Fr
A
M
J 1
J 26 10
A 13 16
S 1 2
O
31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MICHIGAN
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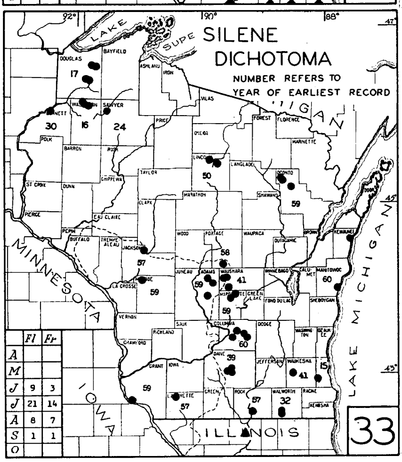
A 1
S
O
32


SILENE DICHOTOMA
NUMBER REFERS TO YEAR OF EARLIEST RECORD
LAKE SUPE
MINNESOTA
IOWA
ILLINOIS
LAKE MICHIGAN
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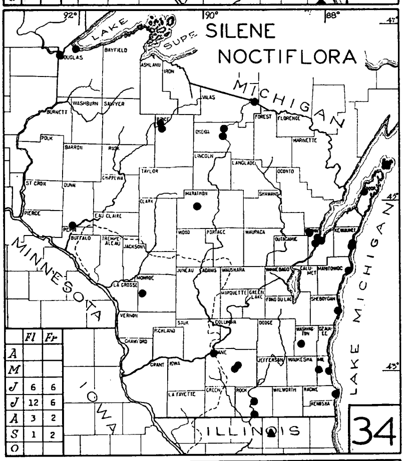
A
M
J 9 3
J 21 14
A 8 7
S 1 1
O
33


SILENE NOCTIFLORA
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MINNESOTA
IOWA
ILLINOIS
LAKE MICHIGAN
Fl Fr
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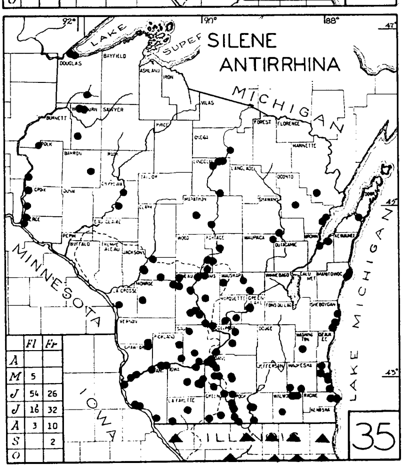
A 3 2
S 1 2
O
34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S 2
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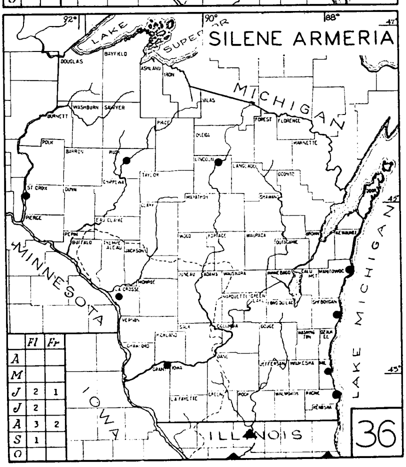
SILENE ARMERIA
LAKE SUPER
MICHIGAN
MINNESOTA
IOWA
ILLINOIS
LAKE MICHIGAN
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J 2 1
J 2
A 3 2
S 1
O
36

3. SILENE DICHOTOMA Ehrh. Forking Catchfly. Map 33.

Hirsute, often *robust biennial,* 3–10 dm tall. Leaves oblanceolate to elliptic or lanceolate, the lower petioled, the upper sessile, 3–11 (–13) cm long. Inflorescence dichotomously forked, with one to several *elongate, one-sided, strict racemes of sessile or short-stalked white flowers, each flower subtended by two narrow bracts.* Calyx oblongoid, 10–15 mm long, thin and slightly inflated, with 10 prominent rib-like, hirsute nerves. Petals deeply bilobed. Capsule about 9–11 mm long, 4–5 mm thick.

Naturalized from Europe, in Wisconsin locally abundant in sandy, open situations such as roadsides (where collected with *Comandra richardsiana, Lychnis alba, Melilotus* and *Trifolium* spp.), road cuts, railroads, in old fields, and as a weed in fields of sweet and red clover. Flowering from the last week of June (occasionally earlier) to about mid-August (earliest September), with the flowering peak in mid-July. Fruiting from late June through September.

It seems that this species is becoming more common in Wisconsin. The first collection was made in 1915, along a railroad track, town of Greenfield, Milwaukee County, *Heddle 32586* (MIL). Subsequently several collections were made between 1916 and 1930, all in the four northwesternmost Wisconsin counties, where the species still seems to persist. In southern Wisconsin this species did not become well established until the 1940's and 1950's.

SILENE GALLICA L., an adventive from Europe and very similar to *S. dichotoma,* has smaller leaves, glandular hairs on upper portions of the plant and on the smaller, 8 mm long calyces, and reddish petals. The one collection, *Goessl s.n.,* August, 1919, Sheboygan (WIS), could well represent a cultivated plant.

4. SILENE NOCTIFLORA L. Night-flowering Catchfly; Sticky Cockle.
Melandrium noctiflorum (L.) Fr. Map 34.

Somewhat viscid annual, 2–8 dm tall. Stems villous-pubescent, at least the upper portions glandular. Lower leaves spatulate, obovate, or broadly oblanceolate, 4–10 cm long, pubescent on both surfaces, pustulate, the upper elliptic, ovate, lanceolate or lance-linear. Inflorescence cymose, forking, usually few-flowered. *Calyx* 19–26 mm long, *ellipsoid-tubular, narrowed at base and apex, with 10 green, clearly-defined, villous and glandular-hairy nerves,* 5 thick and prominent ones alternating with the 5 thinner ones, these anastomosing up near the apex. *Calyx teeth 5–10 mm long, lance-linear or linear, up to about 1 mm wide in the middle.* Petals white, bilobed, the *flowers perfect,* opening in the evening. *Capsule with 6 strongly recurved teeth,* shorter than calyx.

Naturalized from Europe, occasional in Wisconsin in weedy habitats, as in yards, fields, gardens, along roads and railroads, and in other disturbed areas, including edges of woods, *e.g.*, near Fifield (Price Co.), in disturbed *Pinus strobus-Picea-Acer spicatum* grove with *Aster macrophyllus* and *Oryzopsis asperifolia*. Flowering and fruiting from about the last third of June through early September, and fruiting to late September.

Silene noctiflora, now rare in Wisconsin, with only 7 of the 31 Wisconsin specimens collected since 1919, was formerly common as a weed, mainly in grainfields, especially in eastern Wisconsin (Wadmond, 1909; Russell, 1907). It is a species easily confused with the ubiquitous *Lychnis alba.* The following key will help separate the two species:

A. Flowers perfect (rarely unisexual); styles usually 3; calyx with 10 prominent, green nerves and 10 prominent white interstices; calyx ellipsoid, pointed at both ends, widest in the middle, only slightly inflated in fruit, the calyx teeth lance-linear, 5–10 mm long, less than 1 mm wide at the middle; capsule with 6 strongly recurved teeth ---- *Silene noctiflora.*

AA. Flowers unisexual; styles usually 5 (3–9); calyx irregularly 10-nerved in staminate flowers, irregularly 20-nerved in pistillate; calyx widest at or near base, ovoid in the female flower, tubular in the male, inflated in fruit (female flowers), with narrow triangular-lanceolate calyx teeth 2–6 mm wide or wider at the middle; capsule with (usually) 5 or 10 erect or slightly spreading teeth -------------------- *Lychnis alba.*

5. SILENE ANTIRRHINA L. Sleepy Catchfly; Sticky Catchfly. Map 35.

Annual or biennial (1–) 2–8 dm tall, polymorphic, the plants simple-stemmed and upright, or with numerous stiffly-ascending branches from the base, or lax and divaricately branched, puberulent below to scabrous or glabrous above. *Upper internodes often with dark,* glutinous bands. Leaves linear or lanceolate to oblanceolate, 2–8 cm long, ciliate-margined near base, often with tufts of smaller leaves in their axils. Inflorescence usually paniculately branched and many flowered. *Calyx 4–9 mm long, ribbed with green nerves,* the often *purple-tipped triangular teeth about 1 mm long. Petals pink or rosy, inconspicuous,* equalling to barely exceeding calyx, or petals lacking. Capsule 4–9 mm long, 2–5 mm thick.

Native, though somewhat weedy, occurring over most of the state, especially in southern Wisconsin and the central sand plains, and along rivers and the Lake Michigan shore, generally in open, sandy or gravelly habitats, such as fields, roadsides, railroads, sandstone and limestone cliffs, on Lake Michigan sand dunes, and in dry prairies; in dry, steep shallow-soil prairie near Cassville (Grant Co.), with *Bouteloua curtipendula, B. hirsuta, Silphium laciniatum, Scutellaria leonardii, Andropogon gerardi* and *Castilleja sessiliflora;* dry prairie on railroad near Black River Falls (Jackson Co.), with *Tradescantia ohiensis, Rhus radicans, Coreopsis palmata,* and *Asclepias tuberosa;* and thin soil on granite near Grantsburg (Burnett Co.) with *Campanula rotundifolia, Opuntia fragilis, Rhus radicans, Xanthoxylum,* and *Selaginella rupestris.* Flowering from latest May through July (August) and fruiting from the third week of June to September.

This species seems to respond readily in its growth habit to environmental differences. Thus many of the most robust individuals come from open, sandy situations, while those from cliffs are very lax and frail, with smaller leaves and capsules.

Three minor forms have been reported from Wisconsin. Since some of their characters are ephemeral, their occurrence is based on information supplied by the collector:

SILENE ANTIRRHINA forma DEANEANA Fern. has no glutinous bands on the internodal areas *(e.g.,* Lafayette Co., Red Rock Quarry, Darlington, *Nelson s.n.* [WIS]). In the specimens studied the prominence of the glutinous bands on the upper internodes varies greatly. The bands range from dark, viscid areas around the stem that are several cm long to barely noticeable areas a few mm long, or, in the form, are completely lacking. Blowing debris and seeds from the plants' own capsules are often found adhering to the sticky bands.

SILENE ANTIRRHINA forma BICOLOR Farw. has petals ventrally white and dorsally pink. It has been collected in Waupaca County near Clintonville *(Rill s.n.* [WIS]).

SILENE ANTIRRHINA forma APETALA Farw. has the petals lacking. It has been collected in Lincoln County on a river bluff in the town of Pine River *(Seymour 15955* [WIS]).

6. SILENE ARMERIA L. Garden- or Sweet William-catchfly; None-so pretty. Map 36.

Annual with *glabrous stems,* simple or branched above, with or without glutinous internodal bands, 6–45 cm tall. Leaves oblong, ovate or obovate, glabrous, 1–8 cm long, (0.3–) 1–2 (–4) cm wide, clasping. *Flowers solitary* on small plants or *2–20 or more in congested cymes. Calyx slender, cylindrical-clavate, purplish,* 12–16 mm long, 2–4 mm wide, the teeth minute. *Flowers pink or purple,* 9–13 mm in diameter, the *petals* with wavy margin or emarginate, *with 2 linear appendages at base of blade.* Capsule on a 6–8 mm stalk (carpophore), the two about length of calyx.

Introduced from Eurasia, common in cultivation, and perhaps locally established in Wisconsin; driveway, Point Beach State Forest (Manitowoc Co.); vacant lot, Milwaukee, with *Datura, Kochia* (Milwaukee Co.) spontaneous in a lawn, Tomahawk (Lincoln Co.); the earliest collections dated 1861 from Milwaukee and St. Croix (both *Hale, s.n.* [F, WIS]). Flowering the last week of June through mid-September.

7. SILENE CUCUBALUS Wibel. Bladder Campion; Maiden's Tears.
Silent latifolia (Mill.) Britt. & Rendle. Map 37.

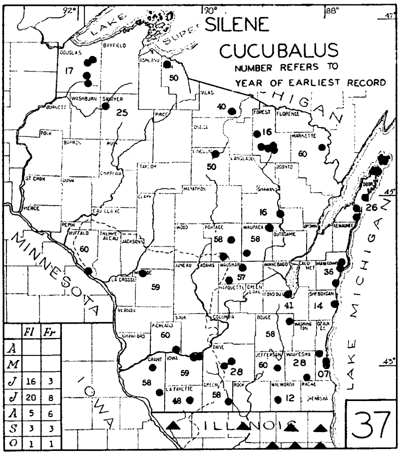
Glabrous and glaucous weedy perennial similar to *S. cserei* (which see) 3–8 (–10) dm tall. Leaves usually lanceolate to ovate or elliptic, sometimes oblong or oblanceolate, acute, mostly 3–8 cm long. *Cymes loose and paniculate;* uppermost inflorescence bracts scarious, usually glabrous. *Calyx subspherical to ovoid, rounded to umbilicate (invaginate) at base,* 9–17 mm long, with branching and anastomosing nerves, *greenish, or often purplish, in fruit papery and much inflated, not appressed to the much smaller capsule.* (Calyx, *when pressed,* often campanulate, with wide open apex.) Petals white, deeply bilobed.

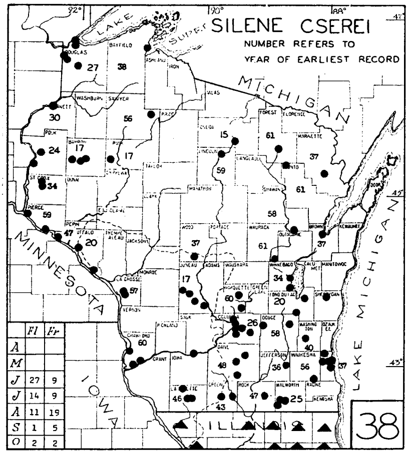
Naturalized from Eurasia, locally common, but largely missing from western and central Wisconsin, in disturbed, open habitats, mainly on roadsides, roadcuts, old fields, waste places, and along railroads; near Cleveland (Manitowoc Co.) in a grassy field with *Chrysanthemum leucanthemum,* and *Linaria vulgaris;* near Custer (Portage Co.) weedy along roadside and in thickets of *Prunus* and *Quercus macrocarpa.* Flowering from mid-June through August (mid-October) and fruiting from late June through mid-September (October).

It seems that this species is becoming more common in Wisconsin. The first published record (as *S. vulgaris)* is from Milwaukee County (Russell, 1907), while the first collection was made in 1912 in Delavan, Walworth County *(Wadmond s.n.* [MINN]). Only sporadic collections were made through the 1940's, with more collections since 1949 than during all the years before. The great increase in the number of herbarium specimens of *Silene cucubalus* in the past decade, while no doubt partly due to the more intensive collecting activity, may be best explained by an increase in abundance and range of this weedy species.

8. SILENE CSEREI Baumg. Bladder Campion. Map 38.

Very similar to *Silene cucubalus,* but commonly taller (to 1 meter tall), and often with larger leaves (to 11.5 cm long). *Cymes* more





narrow and racemose, with the uppermost inflorescence bracts minutely ciliate. *Calyx narrowly ovoid-oblong to ellipsoid, constricted at summit, often narrowed at base and attenuate to the pedicel* (not umbilicate), 8–13 mm long, with nerves not evidently anastomosing, *glaucous, greenish,* slightly inflated and papery in flower, becoming firmer *in fruit* and *appressed to capsule. Capsule ovoid, slightly exserted,* longer than in *S. cucubalus* (the calyx however, smaller). Petals white.

Naturalized from the Balkans and Asia Minor and found throughout most of Wisconsin, though not as common in central and northern parts, in disturbed habitats, mainly on roadsides and roadcuts, in ballast, cinders, sand, or gravel of railroad tracks; in Shorewood (Milwaukee Co.), in cinders and gravel along railroad tracks, with *Plantago major, P. indica, Chaenorrhinum minus, Oenothera biennis, Saponaria,* and *Linaria;* west of Doylestown (Columbia Co.) on grassy banks and in gravel along railroad tracks, with *Lychhis alba, Mirabilis nyctaginea, Descurainia pinnata,* and *Erysimum inconspicuum.*

Silene cserei, like *S. cucubalus* with which it may grow, seems to be increasing its range in Wisconsin. Infrequent collections were made following 1915, the year the first collection was made (Rhinelander, Oneida Co., *Goessl 2497* [MIL]). More frequent collections have been made in the 1930's and 1940's, and over 40% of the total number of specimens date from after 1955. Spreading very freely along railroad tracks, large colonies of *S. cserei*—often extending for miles—can be found in many places in Wisconsin. Apparently *S. cserei* is much more "at home" on railroad ballast than *S. cucubalus,* the latter preferring roadsides and fields.

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NOTES ON WISCONSIN PARASITIC FUNGI. XXVII

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The collections referred to in this series of notes were, unless indicated otherwise, made during the season of 1960.

Undetermined powdery mildews in the OIDIUM stage have been collected on 1) *Cornus rugosa.* Columbia Co., Gibraltar Rock County Park, June 20; 2) on the inflorescence of *Cornus femina,* with various collections in the Madison area from 1946 to the present, a very striking early season manifestation which it seems quite certain cannot be *Phyllactinia corylea* (Pers.) Karst., the only determined species reported on this host from Wisconsin; 3) on *Valeriana edulis.* Jefferson Co., near Waterloo, July 28; 4) on *Aronia melanocarpa* and 5) on *Amelanchier laevis.* Sauk Co., Devils Lake State Park, September 15; and 6) on *Chrysanthemum coccineum* (cult.), Dane Co., near Cross Plains, August 26. In general, the development of powdery mildews was very limited in southern Wisconsin in 1960.

PERISPORIUM WRIGHTII B. & C. collected on *Opuntia macrorhiza* near Pine Bluff, Dane Co., by D. Ugent, July 17, is immature, as are most specimens I have seen of this fungus, but the perithecia here contain large numbers of hyaline, rod-shaped microconidia.

LEPTOSPHAERIA sp., on the dead tips of otherwise green and vigorously growing leaves of *Carex vulpinoidea,* was collected at Madison, July 6. The falcate, olivaceous, triseptate ascospores, 22–25 x 5–6 μ, have, as is often the case in this genus, one of the central cells slightly enlarged. This would seem close *L. caricicola* Fautr. (ascospores triseptate, 18–21 x 4 μ) or to *L. caricina* Schroet. (ascospores triseptate, 20 x 5 μ) which for their part would seem to be probably identical.

LEPTOSPHAERULINA sp. appears parasitic on dark brown lesions on leaves of *Lactuca biennis,* collected at Madison, June 28. The thin-walled, pale brown perithecia are gregarious, subglobose, about 150 μ diam. The asci are broadly ovoid to almost subglobose, approx. 40–45 x 50 μ. There is no evidence of paraphyses or paraphysoids. Ascospores are subhyaline to yellowish, broadly clavate, 28–30 x 9.5–11 μ, indistinctly muriform, perhaps slightly immature. This might almost as well be referred to the hyaline-spored *Pleosphaerulina* Pass. which, according to v. Hoehnel, should be replaced by *Pringsheimia* Schulzer.

ASTERINA RUBICOLA Ell. & Ev. is fairly common on leaves of *Rubus strigosus* in the fall in southern Wisconsin. As a general thing, the small shining-black ascomata, usually clustered in groups on small but well-defined spots, contain no spores of any sort at this season, but in a collection made near Verona, Dane Co., September 28, a small percentage of the fruiting bodies contain numerous *Coniothyrium*-type conidia which are brownish-olivaceous, globoid, subgloboid, or broadly ellipsoid, 2–3 x 2.5–3.5 μ. The ascomata with the spores differ in no external respect from their sterile neighbors, so their detection is a hit or miss affair.

PHYLLACHORA GRAMINIS (P.) Fckl. fruiting bodies (presumptive) on *Elymus canadensis,* collected at Madison, October 12, contain very large numbers of laxly curved, slender, hyaline scolecospores, about 12–17 x .8–1 μ. There is some evidence of an accompanying incipient ascigerous stage.

CHRYSOMYXA PIROLATA *Wint. (C. pyrolae* (DC.) Rostr.) is represented by a number of uredial specimens in the University of Wisconsin Herbarium, but telia have been unreported until now. Re-examination of duplicate material of a specimen on *Pyrola elliptica,* collected near Verona, Dane Co., May 3, 1948, shows germinated telia in some abundance, which were, inexplicably, overlooked at the time.

MELAMPSORA ABIETIS-CANADENSIS (Farl.) Ludw. I on *Tsuga canadensis,* so far as Wisconsin material is concerned, has been represented up to now by three scanty specimens on leaves, all from the far northern part of the state. In June at a station near LaValle, Sauk Co., there was observed a massive infection of large, old trees with the rust strictly confined to the cones, so far as noted. Perhaps as many as a fifth of the large crop of young cones were a bright orange-yellow hue from the exposed caeomoid spore masses, a most striking sight.

UROMYCES sp., on a phanerogamic specimen of *Carex richardsoni* in the University of Wisconsin Herbarium, was submitted to G. B. Cummins who states that he is unable to identify it and that it is not the usual sort of rust encountered on North American Carices. Since the specimen was collected in 1879 in the environs of Green Bay, Wis. it seems quite certain the habitat has long since been destroyed. The urediospores are light cinnamon-brown, globoid, broadly ellipsoid, or obovoid, with wall about 1.5–2 μ thick, finely echinulate, pores 2–3(–4), approx. equatorial. (15–)18–20(–23) x 22–25(–28) μ. The pallid olivaceous teliospores are ellipsoid to broadly ellipsoid, with wall about 3–5 μ thick above by 1.5 μ at sides, 17–20 x 22–26(–30) μ, pedicel very short. Many of the teliospores had germinated and Cummins thinks it probable that they are of the current season and thus germinated without dormancy.

PHYLLOSTICTA MINUTISSIMA Ell. & Ev., common on leaves of *Acer saccharum* in Wisconsin, is not ordinarily very destructive, being prominent usually only toward season's end. However, in early August, sizeable planted specimens of sugar maple in the University of Wisconsin Arboretum at Madison suffered near total defoliation, following a massive infection with *P. minutissima.* The attack proceeded from the leaf tips inward, causing reddish discoloration, drying, and very strong curling.

PHYLLOSTICA APOCYNI Trel. on *Apocynum androsaemifolium,* collected at Parfrey's Glen, Sauk Co., September 16, 1959, has some pycnidia, associated with the normal *Phyllostica*-type and macroscopically indistinguishable, which contain very large numbers of hyaline microspores, approx. 3–4 x 1–1.5 μ.

PHLLOSTICAE of uncertain affinities, and sometimes of questionable parasitism, are found in the course of every collecting season. It seems worthwhile to continue recording descriptive notes of these and to file them in the Wisconsin Cryptogamic Herbarium, in the hope that some if not all may eventually be identified. (In the past certain small and inadequate collections have ultimately served to supplement later large specimens on which descriptions of new species of *Phyllosticta* have been based.) Ten undetermined *Phyllostictae* are listed here:

1) On *Carex sartwellii* at Madison, October 10. Lesions are small, angled, and reddish-brown, the pycnidia blackish, small and flattened, about 75–100 μ diam. The conidia are slender, rod-shaped microspores. Associated with and perhaps connected with *Cercospora caricis* Oud.

2) On *Carex blanda* at Gov. Dodge State Park, Iowa Co., June 24. This appears parasitic on indeterminate brownish areas on the leafy bracts of the inflorescence. The small, blackish, thick-walled, sublenticular pycnidia are hypophyllous, multiseriate and substomatal, mostly about 35–40 μ in short diameter, but up to 50 μ or a little more. They are rather widely open, tending to conform with the stomatal aperture, and verge upon the melanconiaceous. The hyaline conidia are of the microtype, about 4–5 x 1–1.3 μ.

3) On *Carya ovata* at Perrot State Park, Trempealeau Co., June 17, 1959. The lesions are broadly subfusoid or suborbicular, medium brown with a narrow darker border, about .3–.5 cm. diam., and usually oriented along the principal lateral veins of the leaflet. The epiphyllous pycnidia are sooty brown, gregarious to clustered

centrally on the spot, subglobose, imperfectly developed apically, about 50–80 μ diam. The hyaline conidia appear to fall into two classes, 1) 2.5–3 x .7–1 μ, short rod-shaped, and frequently biguttulate, very numerous, and 2) 5–6 x 1.5–1.7(–2) μ, subfusoid, and comparatively few. The larger conidia are quite similar to those of *Phyllosticta caryae* Peck, as represented in a specimen collected by Peck at Piffard, N. Y. and labeled "ex type". *P. caryae* has been reported from Wisconsin, but there is no verifying specimen at present in the Wisconsin Herbarium.

4) On *Rubus occidentalis* at Madison, August 1. The conspicuous lesions are dull brown with yellowish halo, orbicular to variously elongate. The pallid-brownish pycnidia are scattered, subglobose, approx. 125–140 μ diam.; conidia hyaline, cylindric, faintly biguttulate, (5–)7–10 x (2–)2.5–3 μ. These conidia are longer and larger than those of other species I find reported on *Rubus*. They appear well matured and show no evidence of incipient septation.

5) On *Cornus obliqua* near Jefferson, Jefferson Co., July 28. The hyaline, broadly ellipsoid conidia, 5–7 x 2.5–3 μ, are somewhat smaller than those of *Phyllosticta cornicola* (DC.) Rabh., and the subglobose, blackish pycnidia, approx. 60–75 μ diam., much smaller.

6) On *Asclepias phytolaccoides* near Verona, Dane Co., September 28. The spots are greenish-black and angled, approx. 2–7 mm. diam. The pycnidia are scattered to gregarious, globose, black, appearing non-ostiolate, small, about 50–65 μ diam. Hyaline microconidia, 3–4 x 1–1.3 μ are present in some profusion.

7) On *Solidago gigantea* in close association with *Ramularia serotina* Ell. & Ev., Gov. Dodge State Park, Iowa Co., July 21, 1959. The epiphyllous pycnidia occur usually near the margins of the small, rounded, brownish-ashen spots, which are assumed to have been produced primarily by action of the *Ramularia*. Pycnidia are dark grayish, subglobose, approx. 100–150 μ diam., while the conidia are hyaline, short-cylindric to broadly ellipsoid, or occasionally subfusoid, 4–6(–7) x 2–2.5 μ. The conidia are of about the same dimensions as those of *Phyllosticta madisonensis,* described on this host from Wisconsin, but the fungus does not seem similar in other respects.

8) On *Aster macrophyllus* at Wildcat Mt. State park, Vernon Co., September 9, 1959. Held out-of-doors in a wire cage at Madison until early May 1960. At the time of collection the pycnidia were scattered or clustered on large, conspicuous purple-brown spots. They were black, composed of dark, thick-walled pseudoparenchymatous cells, globose and somewhat erumpent, approx. 200–250 μ diam., with contents undifferentiated. Following the caging, and

produced presumably after overwintering, numerous hyaline, rod-shaped conidia, 4–7 x 1.5–2 μ, were observed in the pycnidia. It seems possible that, in some instances, the caging of leaves may have influence in favoring the production of an imperfect as over a perfect stage, since the latter may sometimes depend on a very delicate balance of conditions, not realized in a cage, where the leaves tend to become appressed to one another.

9) On *Aster pilosus* at Madison, August 21. The pycnidia are closely clustered on dead upper stem leaves, or scattered singly on the adjacent stem. They are clear brown, subglobose, uniformly about 100 μ diam. The conidia are hyaline, ellipsoid, 4–5 x 2–2.5 μ.

10) On *Inula helenium,* Gov. Dodge State Park, Iowa Co., July 21, 1959. The lesions are brownish, orbicular, about 1 cm. diam. Pycnidia globose, thin-walled, brownish, about 75–100 μ diam., the conidia hyaline, broadly ellipsoid, frequently biguttulate, (2–) 2.5–3 x 4–6.5 μ. This may be identical with *Phyllosticta Inulae* Allesch., which has conidia of the same dimensions, but material for comparison is not available.

CONIOTHYRIUM (?) sp. parasitized thalli of the lichen *Dermatocarpon miniatum* (L.) Mann, collected by J. Looman at Nelson Dewey Memorial Park at Cassville, Grant Co., July 21, 1959. The brownish elevated mass of the parasite is deeply imbedded in the host medulla, and the algal layer has been forced aside, as is shown in sections. The imbedded, subrostrate, dark brown pycnidia are scattered in the uppermost layer of the elevated mycelial mass, but they are easily seen under a hand lens. They are subglobose, or somewhat flattened below and irregular in outline, approx. 60–75 μ diam. The conidia are clear greenish-olivaceous, thin-walled, broadly ellipsoid, 3–4.3 x 2.5–3.5 μ. Keissler's "Die Flechtenparasiten" was consulted, but no certain conclusion as to identity could be reached.

CONIOTHYRIUM sp. is epiphyllous on rounded ashen spots, approx. 2–4 mm. diam., on leaves of *Ribes missouriense,* collected in the New Glarus Woods Roadside Park, Green Co., September 21, 1959. The gregarious black pycnidia are subglobose to globose, approx. 150–175 μ diam., the conidia smoky gray, ellipsoid or subfusoid, 4.5–6 x 2.5–3 μ. Questionably parasitic.

CONIOTHYRIUM sp. occurs on leaves of two specimens *Ribes missouriense,* and on one of what appears to be *Ribes cynosbati,* the former from Cross Plains and Madison, Dane Co., respectively, collected in June and July, the latter from Ferry Bluff, Sauk Co., in June. The small, but conspicuous, ashen spots are rounded to elongate, mostly very irregular in outline. The pycnidia are epiphyllous, scattered to gregarious, blackish, subglobose, about 115–140 μ diam. The numerous conidia are of a clear grayish shade, thin-walled, broadly ellipsoid or short-cylindric, approx. 4–6 x 2–3 μ. There is no evidence of insect action in connection with the spotting and it seems quite likely the fungus is parasitic. So far as appearance of spots is concerned, as well as in size of pycnidia, these specimens appear quite different from the 1959 collection on *R. missouriense* mentioned in the preceding note. Except for one obscure report which I have been unable to check adequately, all mention of *Coniothyrium* on *Ribes* appears to be based on specimens on stems and branches.

DARLUCA FILUM (Biv.) Cast. occurs on telia of *Puccinia asteris* Duby on *Aster pilosus,* collected at Madison, October 10. Development of this hyperparasite on a microcyclic rust is rare, although one earlier Wisconsin specimen on *P. asteris* is in the Wisconsin Herbarium.

STAGONOSPORA ATRIPLICIS (West.) Lind. on *Chenopodium album* from Madison, July 4, has some pycnidia which contain small, rod-shaped microconidia instead of the characteristic phragmospores.

STAGONOSPORA sp. is present in profusion on the leaves of a phanerogamic specimen of *Carex leptonervia* Fern., collected by J. J. Jones, August 16, 1954, near Winegar, Vilas Co. The blackish subglobose pycnidia are about 150 μ diam. The subhyaline spores are cylindric to subcylindric, or subfusoid, straight or slightly curved, (25–)30–35(–40) x (4–)5–6 μ, 4–6 septate, often with slight constrictions at the septa.

STAGONOSPORA sp. heavily infected *Carex pennsylvanica* near Cross Plains, Dane Co., September 7. The elongate, indeterminate spots are yellowish- to reddish-brown, usually involving the narrow leaves from margin to margin. The affected areas are not necessarily distal, but often occur within the still green areas of the leaves. The pycnidia are scattered, mostly pallid brownish, occasionally somewhat darker, rather thin-walled and translucent, subglobose, approx. 90–150 μ diam. The conidia are hyaline, often guttulate or granulose, obtuse and cylindric, straight or slightly curved, 2–3 septate, 23–30(–33) x 7–8(8.5) μ. Where 3 septate, it sometimes appears as though division had occurred in a terminal cell without accompanying divisions in the other two. This fungus appears truly parasitic, in contrast to the sometimes doubtful specimens where pycnidia are confined to dead leaf tips.

STAGONOSPORA sp. occurs on tiny, white, translucent spots about 1 mm. diam. on *Circaea latifolia,* collected June 27 near Pine Bluff, Dane Co. The thin-walled, pale brown, subglobose pycnidia are epiphyllous, two or three per spot, approx. 75 μ diam. The spores are cylindric or subfusoid, straight or slightly curved, 13–18 x 2.5–3.5 μ, 1–3 septate. There seem to be no reports of any Sphaeropsidales on *Circaea,* other than an undetermined species of *Septoria* mentioned in my Notes XXVI.

STAGONOSPORA sp. collected on *Fraxinus pennsylvanica* var. *lanceolata* at Gov. Dodge State Park, Iowa Co., June 24, seems distinct from any other sphaeropsidaceous species with phragmospores or scolecospores reported on *Fraxinus* from Wisconsin. The conspicuous spots are tan colored, one or two per infected leaflet, suborbicular, with narrow, irregular, darker margins, about .5–1 cm. diam. The pycnidia are epiphyllous, light brown, subglobose, tending to collapse, deeply seated in the host tissue, approx. 75–125 μ diam., scattered to gregarious. The conidia are hyaline, straight to lax, or slightly sinuous, often more obtuse at one end than at the other, 23–32 x 3–3.5 μ, (2–)3 septate. Admittedly, this might be classed as a *Septoria,* various species of which have been reported on *Fraxinus,* but it is certainly not *S. besseyi* Peck, of which there are numerous specimens in the Wisconsin Herbarium.

SEPTORIA sp. on dead leaves of *Agrostis alba* at Devils Lake State Park, Sauk Co., September 15, has spores which in their dimensions seem to correspond fairly closely to the macrospores of *S. passerinii* Sacc., as described and figured by Sprague. This species, however, has been reported only on Hordeae. In the specimen on *A. alba* the scattered brown pycnidia are somewhat flattened, thin-walled and translucent, mostly about 125 μ diam. The spores are from almost straight to lax or strongly curved, approx. 23–28 x 2–2.5 μ, appearing obscurely 2 septate.

SEPTORIA sp. on dead areas on leaves of *Calamagrostis canadensis,* collected at Gibraltar Rock County Park, Columbia Co., June 20, in microscopic characters corresponds quite closely with *Septoria secalis* Prill & Delacr., as described and figured by Sprague in his "Diseases of Cereals and Grasses in North America", p. 253. For conclusive determination, however, more and better material would be desirable.

SEPTORIA sp. (or RHABDOSPORA?) occurs on flowering stems of *Zigadenus elegans,* collected near Eagle, Waukesha Co., July 22, 1959. The black, globose pycnidia are approx. 65–100 μ diam., scattered on elongate, light-colored areas on the stem. The conidia are hyaline, flexuous, tapering at one, or sometimes both apices, rather obscurely 1–3 septate, 20–33 x 1–1.5 μ. A *Septoria* was collected on leaves of this host at the same station in 1951, and reported on in my Notes XVII. It had continuous spores which were definitely thicker in relation to length, and pycnidia which averaged about 100 μ diam.

SEPTORIA sp. developed on leaves of *Viburnum acerifolium*, collected at Devils Lake State Park, Sauk Co., October 10, 1959, and held out-of-doors over winter in a wire cage at Madison until May 1960. The freshly collected leaves were still green, with conspicuous, angled, sordid-brownish spots. The pycnidia were inconspicuous, scattered to gregarious, deeply sunk in the host tissue, but with rather thin, translucent walls and with contents undifferentiated. The overwintered pycnidia showed a surprising further development of the wall which had become black and is composed of dark, thick-walled mostly isodiametric cells. These mature pycnidia are subglobose, approx. 125–160 μ diam., with a prominent ostiole, and with spores which are hyaline, slender and acicular, straight or slightly curved, 23–38 x 1–1.3 μ, appearing continuous. This is not *Septoria viburni* West., reported on *Viburnum opulus* (cult.) in Wisconsin, as that species has cylindric guttulate spores. I have found no record of other *Septorias* on *Viburnum*. It seems possible that the October collection constituted an overwintering stage of a *Septoria* which had developed normally earlier in the season.

SEPTORIA sp. occurs on dead tips of leaves of *Chrysanthemum coccineum* (cult.), collected near Cross Plains, Dane Co., August 28. The tiny pycnidia, approx. 60–75 μ diam., are thin-walled and fragile and closely crowded. The hyaline spores appear continuous, are slightly curved, and are about 15–20 x 1.2–1.7 μ. Most of the species reported on *Chrysanthemum* and allied hosts have spores which are much longer than these.

LEPTOTHYRIUM (?) sp. occurs on leaves of *Viburnum acerifolium* (cult.), collected at Madison, September 26. The fruiting structures are subcuticular in origin, lifting the cuticle as they develop under it. The spots are orbicular, reddish-brown with narrow purplish borders, approx. .5–1 cm. diam. The fruiting bodies are convex above and flattened below, non-ostiolate, black, approx. 100–125 μ diam., and scattered on the spots. Conidiophores are hyaline, basal and rudimentary, about 6–7 x 2 μ, the conidia pallid greenish, broadly ellipsoid, 5–6 x 3–3.5 μ. Perhaps parasitic.

GLOEOSPORIUM CANADENSE Ell. & Ev. *(Discula quercina* (West.) v. Arx) is common on *Quercus alba* and *Q. macrocarpa* in Wisconsin, and has spores about as described by Ellis and Everhart, 10–14 x 3.5–4.5 μ, narrowly ellipsoid or fusoid. In a specimen on *Q. macrocarpa,* collected August 26 near Cross Plains, Dane Co., the conidia are 12–14 x 7–8.5 μ, broadly oval in outline. Fruiting is essentially hypophyllous and is confined to segments of the principal veins, producing yellowing on the upper leaf surface along the infected veins, but without the reddish-brown and extensive dead areas commonly seen in *G. canadense* infections. At the time of collection the leaves affected were being prematurely shed. It seems doubtful that the Cross Plains specimen represents merely a variant manifestation in view of the much greater spore width and the quite different lesions produced.

DISCULA sp. (following the treatment of von Arx in his revision of *Gloeosporium)* is present in small amount on leaves of *Quercus bicolor,* collected near Avon, Rock Co., September 3, 1959. The lesions are pale reddish, rounded, about .5 cm. diam. The acervuli are gregarious, subepidermal, epiphyllous but deeply sunken to a point about midway between upper and lower epidermis, and hemispherical in outline, approx. 100–125 μ diam. Conidiophores are subcylindric, appearing somewhat grayish in mass, very closely ranked over the entire surface of the acervulus, 10–12 μ long. The conidia are hyaline, continuous, fusoid or occasionally narrowly subcylindric, 5–8 x (1–)1.5(–2) μ. Quite similar to *Discula quercina* (West.) v. Arx *(Gloeosporium quercinum* West.) in general characteristics. The latter, however, is hypophyllous and has conidia which are longer and somewhat wider than those of the specimen under consideration.

DISCULA sp. occurred on reddish-brown, wedge-shaped apical portions of leaves of *Ribes diacantha* (cult.) at Madison, August 22. The fruiting body superficially resembles a pycnidium, but in section is seen to be a somewhat elevated acervulus, approx. 150 μ wide by 60 μ high, subepidermal with a well-developed blackish mycelial covering above, but with a wide central aperture. The base and sides of the acervulus are lined with closely ranked, slender, hyaline conidiophores about 12–15 x 2 μ, while the conidia are hyaline, broadly ellipsoid, subfusoid, or fusoid, about 5–7 x 2–3 μ.

PHLYCTAENA (?) sp. occurs on leaves of *Desmodium nudiflorum,* collected near Browntown, Green Co., July 19. The acervuli appear subepidermal in origin and in fact verge upon a pycnidial structure. The conspicuous, orbicular, dull reddish-brown spots are mostly about .5 cm. diam. In accommodation to the very thin leaf the acervuli are noticeably flattened, and are mostly about 60–75 μ in broad diameter, pallid brownish, very inconspicuous and few and scattered on the spots. The conidiophores are more or less bottle-shaped, approx. 9–12 x 2 μ, rather loosely ranked. The conidia are hyaline, from almost straight to mostly curved and falcate, usually broadest in the middle and tapering toward the ends, appearing continuous, 22–25 x 1.5–2 μ. Certainly not far from *Septoria.* The tentative assignment to *Phlyctaena* attempts to follow the treatment of von Arx in his revision of *Gloeosporium.*

PHLEOSPORA ANEMONES Ell. & Kell. has been found several times on *Anemone cylindrica* in Wisconsin. That the large, black, closely grouped fruiting structures are close to *Septoria* cannot be denied and the fungus has in fact been so designated by some workers. In the fall host plants are sometimes found bearing black fruiting structures which externally correspond closely to those of *Phleospora anemones,* but whose contents are not differentiated and do not become so prior to the onset of winter. Host leaves bearing these structures were collected near Cross Plains, Dane Co., in September 1959, placed in a wire cage, and overwintered out-of-doors at Madison until early May 1960. It had been thought that a perfect stage might develop, but examination showed profuse production of typical *Phleospora* spores, indicating that this fungus, like a number of others observed by the writer, may live from year to year without production of a perfect stage.

INULA HELENIUM, collected at Gov. Dodge State Park, Iowa Co., July 21, 1959, bears an unidentified monilaceous fungus which seems perhaps to fall within the range of what has been called *Ovularia.* The tufted fascicles are epiphyllous on more or less extensive, sordid brownish areas. The hyaline, clustered conidiophores, more or less widely divergent from a small, brownish, elevated stroma, are approx. 15–20 x 2.5–3 μ, simple, with a single scar at the narrowed tip, or subgeniculate and denticulate at the tip. The conidia appear to have been catenulate and are hyaline, fusoid, or sometimes narrowly subcylindric in the longer conidia, which may be narrowed at one end and irregularly obtuse at the other, 8–22 x 2–3 μ and continuous so far as observed.

BOTRYTIS sp. appears parasitic on upper portions of leaves—not necessarily the tips—of *Hemerocallis fulva,* the common day-lily, collected at Madison, July 6. The fungus is amphigenous, the conidia smooth, thin-walled, subhyaline, broadly oval, 12–16 x 9–10 μ, produced in clusters from very short, stubby branches in the apical region of the medium-long, sparingly septate, grayish-olivaceous conidiophores. The hardy host plant is extensively naturalized in Wisconsin, but the present instance is the first in many years of collecting where an apparent parasite has been noted on it. There seem to be no literature references recording *Botrytis* on *Hemerocallis.*

CLADOSPORIUM sp., possibly parasitic, occurs in minute gregarious tufts on long, narrow, brownish lesions on the adaxial sides of leaves of *Bromus purgans,* collected at the New Glarus Woods Roadside Park, Green Co., October 4. The conidiophores are closely fascicled in small groups, clear brown, multiseptate, sparingly geniculate and somewhat paler toward tip, approx. 60–75 x 3–3.5 μ. The few conidia observed ran about 10–12 x 4.5–5 μ, short-cylindric, rather deep brown with wall minutely roughened. The leaves also bear *Puccinia recondita* Rob. ex Desm.

CERCOSPORELLA (?) sp. occurs on leaves of *Dioscorea villosa,* collected at Gov. Dodge State Park, Iowa Co., July 21, 1959. The fungus is amphigenous on small, translucent, orbicular or angled, brownish, darker bordered spots approx. 1–3 mm. diam. The hyaline, multigeniculate conidiophores are scattered, mostly singly or in pairs, on the spots, but many of them appear to be compound, being considerably enlarged and somewhat amorphous in aspect basally. They are about 3 μ wide in the narrower upper portion and approx. 15–40 μ long, very inconspicuous and revealed only in sections. The conidia are hyaline, subacicular, straight or slightly curved, base narrowly obconic, 2–3 septate, approx. 30–45 x (1.5–) 2–2.5 μ.

CERCOSPORELLA CELTIDIS (E. & K.) J. J. Davis *(Ramularia celtidis* Ell. & Kell.) was collected on *Celtis occidentalis* by Davis in Crawford Co., Wis. in 1921. In his specimen most of the spores are lax and filiform, about 50 x 2.5 μ, or longer, but there are a considerable number which are not more than 20–25 x 2.5 μ. At a station near Cross Plains, Dane Co., October 7, on leaves of the same host, a fungus was found which it seems likely may be a reduced late-season development of *Cercosporella celtidis.* The spots are grayish and less sharply defined than in the 1921 specimen. The conidia are hyaline, slender-cylindric, about 12–14 x 2.5 μ, and there is considerable production of superficial, creeping, slender thread-like mycelium on the surface of the spots.

CERCOSPORA FILIFORMIS (Davis) Chupp is fairly common on *Anemone patens* var. *wolfgangiana* in Wisconsin. After the *Cercospora* has passed its peak, small pycnidium-like bodies are regularly produced on the old lesions. In past years these have been examined from time to time, but no spores have been found in them. In a collection made near Cross Plains, Dane Co., July 14, however, these structures are filled with hyaline, rod-shaped microconidia, possibly indicative of a perfect stage to be developed, although when similar leaves were overwintered out-of-doors in 1954–55, the "pycnidia" produced only *Cercospora* conidia from their surfaces and no perfect stage ensued.

CERCOSPORA sp. is hypophyllous on sordid brownish areas on leaves of *Callistephus chinensis* (cult.), collected September 7 near Cross Plains, Dane Co. The conidiophores are from almost straight to slightly curved or angled, widely and loosely 1–3 geniculate, clear pale brown below, pallid and slightly wider at the truncate tips, basally 2–3 septate, approx. 125–135 x 4.5–6 μ, fascicled from a more or less well-developed blackish stroma. The conidia are hyaline, slightly curved, narrowly obclavate, multiseptate, truncate at base, approx. 100–140 x 3.5–4.5 μ. Chupp, in his monograph, does not list any species of *Cercospora* on *Callistephus.*

CERCOSPORA sp. on *Centaurea macrocephala* (cult.), collected near Cross Plains, Dane Co., September 7, does not correspond to *Cercospora centaureae* Died., the only species mentioned by Chupp as on *Centaurea.* In the Wisconsin specimen the spots are small, rounded, and sharply defined, about 2–5 mm. diam., with wide dark brown borders and cinereous centers. The conidiophores are epiphyllous, clear gray brown, multiseptate, mildly geniculate, with widely spaced but nevertheless rather prominent geniculations, obtuse and truncate at tip, with prominent scar, approx. 225–275 x 4–6 μ in small, loose fascicles of about 3–10 phores, from a small stroma. The conidia are hyaline, obscurely multiseptate, more or less curved, essentially acicular, truncate at base, with prominent scar, approx. 90–120 x 3–3.5(–4) μ.

SCLEROTIOMYCES COLCHICUS Woronichin occurs on leaves of *Acer saccharinum,* collected September 9, 1959 and of *Zanthoxylum americanum,* September 13, 1960, both at Wildcat Mt. State Park, Vernon Co. Epiphyllous, as in the case of all other specimens of this photosynthesis-reducing fungus collected so far in Wisconsin. This seems not to be a typical "honey-dew" organism, since there is, so far as I have observed, no evidence that it develops on insect excretions.

ADDITIONAL HOSTS

The following hosts have not been previously recorded as bearing the fungi mentioned in Wisconsin.

SYNCHYTRIUM FULGENS Schroet. on *Oenothera rhombipetala.* Sauk Co., near Spring Green, September 11, 1959. Karling (Mycologia 50:373. 1958) discusses American collections of this species.

ALBUGO CANDIDA (Pers.) O. Ktze. on *Erysimum cheiranthoides.* Dodge Co., near Horicon, July 12.

ALBUGO TRAGOPOGONIS (Pers.) S. F. Gray on *Antennaria plantaginifolia.* Iowa Co., Blue Mounds State Park, August 11.

PLASMOPARA HALSTEDII (Farl.) Berl. & DeToni on *Silphium terebinthinaceum* x *laciniatum.* Dane Co., Madison, September 20. In my notes XXII I stated that *P. halstedii* had not been found on *Silphium laciniatum* in Wisconsin, which remains true, but I speculated that, since at that time the fungus had not yet been found on the hybrid either, the hybrid might have resistance imparted by *S. laciniatum,* which is evidently not the case.

CRYTOSPORELLA ANOMALA (Peck) Sacc. on *Corylus americana* x *avellana*. Pierce Co., River Falls, November 12, 1959. Coll. & det. A. H. Epstein. This species, only very occasionally seen on native hazelnut, was causing serious and extensive damage in a commercial plantation of the European filbert crossed with the American species. It is reported as occurring on filbert in Europe, along with two other species of *Cryptosporella.*

VENTURIA INAEQUALIS Wint. *Fusicladium dendriticum* stage on leaves and young fruit of *Pyrus arnoldiana* (cult.). Dane Co., Madison, June 6.

TICHOTHECIUM sp. occurred as an obvious parasite on the lichen *Caloplaca flavovirescens,* collected by K. G. Foote near Ridgeway, Iowa Co., April 19. The many-spored asci of the parasite are broadly clavate, about 35 x 12 μ, the uniseptate, dark brown, broadly spindle-shaped ascospores are approx. 5–7 x 3–3.5 μ. These spore dimensions do not fit those of either of the two species listed by Keissler in his monograph on lichen parasites, although they are not far from those of *Tichothecium nanellum* Arn.

OPHIODOTHIS HAYDENI (B. & C.) Sacc. on *Aster pilosus*. Dane Co., Madison, August 21. This growth, although usually sterile in my experience, is characteristic and obviously parasitic, causing much distortion of the host.

ELSINOE VENETA (Burkh.) Jenkins. *Sphaceloma* stage on *Rubus parviflorus* (cult.). Dane Co., Madison, July 20.

MELAMPSORA ABIETI-CAPREARUM Tub. ii, III on *Salix glaucophylloides* Fern. Columbia Co., near Swan Lake, Pacific Twp., September 18, 1959.

PUCCINIA DIOICAE P. Magn. II, III on *Carex normalis*. Dane Co., near Verona, June 29. On *C. brevior*. Dane Co., near Pine Bluff, August 4.

PUCCINIA DIOICAE P. Magn. on *Carex concinna*. Door Co., Ridges Sanctuary at Bailey's Harbor, June 12, 1954. Coll. J. H. Zimmerman. On *C. disperma*. Winnebago Co., Menasha, May 18, 1889. Collector unknown. On *C. foenea*. Dane Co., Madison, June 23, 1950. Coll. J. H. Zimmerman. On *C. houghtonii*. Ashland Co., Ironwood Island, June 27, 1956. Coll. F. C. Lane (2682). On *C. pauciflora*. Oneida Co., near Minocqua, August 11, 1953. Coll. J. J. Jones. On *C. projecta,* Green Co., near Albany, August 3, 1956. Coll. H. H. Iltis (6726). On *C. sterilis*. Dane Co., Madison, June 14, 1950. Coll. J. H. Zimmerman. These were all noted on phanerogamic specimens in the University of Wisconsin Herbarium.

PUCCINIA CARICINA DC. on *Carex atherodes*. Sauk Co., Devils Lake State Park, July 24, 1947. Coll. J. H. Zimmerman. On *C. pedunculata*. Sauk Co., Parfrey's Glen, June 14, 1937. Coll. F. J. Hermann (8764). On *C. pseudocyperus*. Lincoln Co., Tomahawk, September 16, 1952. Coll. F. C. Seymour. All on phanerogamic specimens in the University of Wisconsin Herbarium.

PUCCINIA CARICINA DC. var. LIMOSAE (Magn.) Jorstad II, III on *Carex limosa*. Vilas Co., Sayner, July 27, 1902. Coll. S. C. Wadmond. On a phanerogamic specimen in the University of Wisconsin Herbarium. The urediospore pores are scattered, which would seem to throw the specimen into what was formerly designated *Puccinia karelica* Tranz., rather than into *P. limosae* Magn., both of which are placed by Jorstad in *P. caricina* var. *limosae*.

PUCCINIA ASTERIS Duby on *Aster pilosus*. Dane Co., Madison, October 10.

GYMNOSPORANGIUM GLOBOSUM Farl. I on *Sorbus americana* (cult.). Dane Co., Madison, August 13.

GYMNOSPORANGIUM JUVENESCENS Kern I on *Amelanchier interior* Nielsen. Columbia Co., Gibraltar Rock County Park, June 20.

SCHIZONELLA MELANOGRAMMA (DC.) Schroet. on *Carex blanda*. Sauk Co., Devils Lake State Park, June 20, 1946. Coll. J. H. Zimmerman. On a phanerogamic specimen in the University of Wisconsin Herbarium. This is the first broad-leaved species of *Carex* on which this smut has been noted in Wisconsin.

ENTYLOMA COMPOSITARUM Farl. on *Aster pilosus*. Dane Co., Madison, October 10.

CERATOBASIDIUM ANCEPS (Bres. & Syd.) Jacks. *(Sclerotium deciduum* J. J. Davis) appears strongly parasitic, but not at all specific, as one observes it on various hosts in the field. At a single station in Wildcat Mt. State Park, Vernon Co., June 9, this fungus was collected on eight hosts not previously recorded for Wisconsin, as follows: *Cryptotaenia canadensis, Monarda fistulosa, Veronicastrum virginicum, Triosteum perfoliatum, Aster paniculatus, Aster prenanthoides, Rudbeckia laciniata,* and *Senecio aureus*. In addition, it occurred on *Sanguinaria canadensis, Verbena urticifolia,* and *Solidago gigantea,* previously reported as hosts. Near LaValle, Sauk Co., June 15, the fungus was collected on *Urtica dioica,* and on young shoots of *Rumex* (probably *R. britannica)*.

PELLICULARIA FILAMENTOSA (Pat.) Rogers on *Plantago lanceolata*. Dane Co., Madison, July 20.

PHYLLOSTICTA DEARNESSII Sacc. on *Rubus* sp. (dewberry). Dane Co., near Pine Bluff, August 30. Although it is scarcely possible to state the host species, it is obviously neither *R. strigosus* nor *R. parviflorus,* the only previously reported hosts for this fungus in Wisconsin.

PHYLLOSTICTA FRAGARICOLA Desm. & Rob. on *Potentilla norvegica* var. *hirsuta.* Jefferson Co., near Waterloo, July 28. This specimen corresponds closely to like-named collections on *Potentilla arguta* and *P. recta.*

PHYLLOSTICTA ANTENNARIAE Ell. & Ev. on *Antennaria plantaginifolia.* Iowa Co., Blue Mounds State Park, August 11. The conidia are slightly longer, up to 10 μ, than in other specimens on *Antennaria fallax,* but are of the same general type.

NEOTTIOSPORA ARENARIA Syd. on *Carex grayii.* Outagamie Co., near Stephensville, June 19, 1951. Coll. R. T. Brown and R. Bray. On *C. scoparia.* Burnett Co., near Webster, September 6, 1929. Coll. W. T. McLaughlin (1846). On phanerogamic specimens in the University of Wisconsin Herbarium.

ASCOCHYTA GRAMINICOLA Sacc. on *Oryzopsis asperifolia.* Price Co., Camp Merrill near Phillips, September 13, 1911. Coll. J. J. Davis. On a leaf bearing *Puccinia pygmaea* Erikss., for which the specimen was originally collected. On *Muhlenbergia racemosa.* Sauk Co., Ferry Bluff, Town of Prairie du Sac, June 24.

ASCOCHYTA AQUILEGIAE (Rabh.) Hoehn. on *Aquilegia buergeriana* Sieb. & Zucc. (cult.). Dane Co., Madison, July 4, 1959.

ASCOCHYTA PISI Lib. on *Lathyrus ochroleucus.* Iowa Co., Blue Mounds State Park, August 11.

ASCOCHYTA CUCUMIS Fautr. & Roum. on *Cucurbita maxima* (cult.). Dane Co., Madison, September 26.

ASCOCHYTA COMPOSITARUM J. J. Davis on *Senecio aureus.* Vernon Co., Wildcat Mt. State Park, June 9. This is the small-spored variety, originally designated by Davis as var. *parva,* but later considered as better included with the species. In the present specimen most of the spores are about 8–10 x 3 μ, and are possibly somewhat immature, as only a minority show a septum.

DARLUCA FILUM (Biv.) Cast. on *Pucciniastrum pyrolae* (Pers.) Schroet. II on *Pyrola elliptica.* Dane Co., near Verona, September 28. The first Wisconsin collection on a species of *Pucciniastrum.* On *Melampsora abietis-canadensis* (Farl.) Ludw. II on *Populus grandidentata.* Vernon Co., Wildcat Mt. State Park, September 13. On *Tranzschelia pruni-spinosae* (Pers.) Diet. III on *Prunus nigra.* Chippewa Co., near Cadott, September 20, 1922. Coll. J. J. Davis. The first Wisconsin report of *Darluca* on *Tranzschelia.* On *Puccinia* *puritanica* Cumm. II on *Carex pennsylvanica*. Dane Co., near Cross Plains, August 17.

STAGONOSPORA ARENARIA Sacc. on *Lolium multiflorum*. Dane Co., Madison, October 12. The straight to laxly curved spores are mostly about 35–40 x 3–3.5(–4) μ and mostly 3, but occasionally 4 septate.

STAGONOSPORA CARICINELLA Brun. on *Carex normalis*. Dane Co., near Cross Plains, July 14. On *C. brevior*. Dane Co., Madison, July 6.

STAGONOSPORA ALBESCENS J. J. Davis on *Carex conoidea*. Dane Co., Madison, June 20. Mostly on the upper leaves (or bracts) subtending the pistillate spikes, but also on the scales of the staminate inflorescence.

STAGONOSPORA CYPERICOLA H. C. Greene on *Cyperus schweinitzii*. Iowa Co., near Arena, August 11. The spores in this specimen are mostly about 22–25 x 5–6.5 μ, slightly smaller than in the type. The leaves also bear *Puccinia cyperi* Arth.

SEPTORIA NODORUM Berk. on *Alopecurus aequalis*. Waukesha Co., Big Bend, June 26, 1930. Coll. J. J. Davis. Associated with *Uromyces dactylidis* Otth *(U. alopecuri* Seym.).

SEPTORIA RIBIS Desm. on *Ribes alpinum* (cult.). Jefferson Co., McKay Nursery at Waterloo, October 10. Comm. E. K. Wade.

SEPTORIA CORNICOLA Desm. var. AMPLA H. C. Greene on *Cornus obliqua*. Dane Co., Madison, September 26.

SEPTORIA ASTERICOLA Ell. & Ev. on *Aster sericeus*. Sauk Co., near Spring Green, May 26. That *S. astericola* and *Septoria fumosa* Peck, the latter commonly reported on species of *Solidago*, are really distinct may be doubted.

SEPTORIA ATROPURPUREA Peck on *Aster junciformis*. Dane Co., near Deerfield, July 28.

SEPTORIA LANARIA Fairman on *Antennaria petaloidea* Fern. (host det. E. W. Beals). St. Croix Co., near New Richmond, May 29. Coll. H. H. Iltis. Although the fungus is on the previous year's leaves it seems certain it was parasitic.

HAINESIA LYTHRI (Desm.) Hoehn. on *Rubus allegheniensis*. Vernon Co., Wildcat Mt. State Park, September 13. The *Sclerotiopsis* stage is also present in this specimen. At the same station, September 9, 1959, a specimen with *Sclerotiopsis* only was collected on *Carya cordiformis*. Both are stages of *Pezizella lythri* (Desm.) Shear & Dodge.

LEPTOTHYRIUM SIMILISPORUM (Ell. & Davis) Davis on *Aster macrophyllus*. Sauk Co., Devil's Lake State Park, September 15. All previous collections in Wisconsin have been on species of *Solidago*.

MELASMIA ULMICOLA B. & C. on *Zelkova carpinifolia* (cult.). Dane Co., Madison, August 6. Referred here with some doubt. There are many slender rod-shaped or slender-ellipsoid conidia, about 5 x 1.5 μ, which are very similar to those on specimens on *Ulmus* but there is also a second class of subfusoid conidia, about 7 x 2.5–3 μ, which seem to be a constant feature.

COLLETOTRICHUM GRAMINICOLA (Ces.) Wils. on *Avena sativa* (var State Pride). Dane Co., Madison, June 11, 1958. Coll. D. C. Arny. Also on *Poa annua* at Madison, August 14.

ELLISIELLA CAUDATA (Peck) Sacc. on *Koeleria cristata*. Dane Co., Madison, July 17, 1959.

CYLINDROSPORUM BETULAE J. J. Davis on *Betula populifolia* (cult.). Dane Co., Madison, October 12. The lesions, although entirely characteristic, are somewhat old and only a few typical *Cylindrosporium* conidia were observed. There are present, however, many hyaline, bacilliform microspores, approx. 4–6 x 1 μ.

CYLINDROSPORIUM FILIPENDULAE Thum. on *Spiraea "rosebella"* (cult. and said to be a hybrid of *S. alba* DuRoi and *S. salicifolia* L.). Dane Co., Madison, August 22.

CERCOSPORELLA DEARNESSII Bub. & Sacc. on *Solidago hispida*. Vilas Co., Trout Lake, September 7, 1959. Coll. J. D. Sauer. The conidiophores are from 60–85 μ long in this specimen.

CERCOSPORA FUSIMACULANS Atk. on *Panicum wilcoxianum*. Dane Co., near Cross Plains, September 1, 1959.

CERCOSPORA CARICIS Oud. on *Carex normalis*. Dane Co., near Verona, June 29, and near Cross Plains, July 14.

ADDITIONAL SPECIES

The fungi mentioned have not been previously reported as occurring in the State of Wisconsin.

SYNCHYTRIUM DAVISII Karling on *Rubus hispidus* and *R. triflorus (R. pubescens)*. Jackson Co., near Millston, September 26, 1912. Davis originally labeled these collections (and others) as *Synchytrium aureum* Schroet., but Karling (Mycologia 49:744. 1957), after critical study, has erected this species, with the specimen on *R. hispidus* designated as the type. Certain other Wisconsin specimens on these hosts remain under *S. aureum*.

PSEUDOPERONOSPORA CELTIDIS (Waite) G. W. Wils. on *Celtis occidentalis*. Vernon Co., Wildcat Mt. State Park, September 13. On the basis of inoculation experiments, it has been suggested that this species may be identical with *Pseudoperonospora humuli* (Miyabe & Takah.) Wils.

CERATOSTOMA PARASITICUM Ell. & Ev. on *Fomes applanatus*. Dane Co., Madison, June 15. Coll. & det. D. J. Rossouw.

OPHIOBOLUS GNAPHALII (Sacc. & Br.) Fairm. var. *lanaria* Fairm. on *Antennaria petaloides* Fern. (host det. E. W. Beals). St. Croix Co., near New Richmond, May 29. Coll. H. H. Iltis. This very interesting fungus, developing on the hairy under surface of the previous year's more or less evergreen leaves, seems possibly, although not certainly parasitic. Described by Fairman (Ann. Mycol. 9:149. 1911) on *Antennaria plantaginifolia* from Lyndonville, New York.

SCUTULA TUBERCULOSA Rehm on *Peltigera canina* var. *spuria*. Marinette Co., Dunbar, April 27, 1945. Coll. J. W. Thomson. On a specimen in the University of Wisconsin Herbarium.

PUCCINIA POLYSORA Underw. II, III on *Zea mays* (cult.). Dane Co., near Madison, September 1959. Coll. & det. M. S. Pavgi. It is believed that this rust, although undetected until recently, has long been present in Wisconsin and neighboring states.

PUCCINIA PURITANICA Cummins II, III on *Carex pennsylvanica*. Dane Co., near Cross Plains, August 17. Det. G. B. Cummins. The second collection of this species. The type was collected on the same host at Waltham, Mass. in 1910. The teliospores are pallid-olivaceous and germinate in the current season without dormancy.

PHYLLOSTICTA CELTIDIS Ell. & Kell. on *Celtis occidentalis*. Grant Co., Wyalusing State Park, September 24, 1959.

PHYLLOSTICTA ARMERIAE Allesch. on *Limonium* sp. (cult.). Outagamie Co., Kaukauna, July 18. Coll. N. Esler. Comm. E. K. Wade.

Phyllosticta heliopsidis sp. nov.

Maculis orbicularibus, centris albidis, marginibus fusco-purpureis, 2–5 mm. diam.; pycnidiis epiphyllis, paucis et sparsis, fumoso-olivaceis, subglobosis, ca. 150–200 μ diam., ostiolis prominentibus cum marginibus nigris; conidiis numerosis, hyalinis, rectis, tenuo-cylindraceis vel raro curvis leniter et subfusoideis, 5–7.5 x 1.5–2 μ.

Spots orbicular with whitish centers and rather wide dark purplish margins, 2–5 mm. diam.; pycnidia epiphyllous, few and scattered, smoky-olivaceous, subglobose, approx. 150–200 μ diam., ostiole outlined by prominent band of blackish cells; conidia numerous, hyaline, straight, slender-cylindric, or rarely slightly curved and subfusoid, 5–7.5 x 1.5–2 μ.

On living leaves of *Heliopsis helianthoides* (L.) Sweet, along the Milwaukee Railroad right-of-way, Iowa County, 1½ miles east of

Arena, Wisconsin, U. S. A., September 9, 1959. The host has often been referred to previously as *Heliopsis scabra* Dunal.

Many of the spots have only a single pycnidium, and most not more than two or three, scattered and more or less remote from one another.

PHOMA POLYGRAMMA (Fr.) Sacc. var. PLANTAGINIS Sacc. on scapes of *Plantago lanceolata*. Dane Co., Madison, August 22. There is reason to believe that this is really a species of *Phomopsis*. A specimen in the University of Wisconsin Herbarium collected by L. R. Jones in 1920 at Winchester, Va. has both alpha and beta type spores in abundance, but other specimens from Maryland, New Jersey, New York and Wisconsin have only the fusoid *Phoma*-type conidia. However, the development and general appearance of the fungus also suggests *Phomopsis* as I have seen it in other representatives of the genus.

Ascochyta lonicerae-canadensis sp. nov.

Maculis conspicuis, orbicularibus vel irregularibus, sordido-brunneis, marginibus obscuro-purpureis, angustis, ca. (1–) 1.5–2 (–2.5) cm. diam.; pycnidiis epiphyllis, sparsis, flavido-brunneis, subglobosis, ca. 100–125 μ diam.; conidiis hyalinis, cylindraceis vel late subfusoideis, granulosis aliquanto, septis mediis, (13–) 15–17 (–18) x 6–7.5 μ.

Lesions conspicuous, orbicular or irregular, sordid brownish with narrow dull purplish border, approx. (1–) 1.5–2 (–2.5) cm. diam.; pycnidia epiphyllous, scattered, yellowish-brown, subglobose, approx. 100–125 μ diam.; conidia hyaline, cylindric or broadly subfusoid, contents somewhat granular, septa median, (13–) 15–17 (–18) x 6–7.5 μ.

On living leaves of *Lonicera canadensis*. University of Wisconsin Arboretum, Madison, Dane County, Wisconsin, U. S. A., August 13, 1960. The host plant was transpanted from Bayfield Co., Wis. in 1958, so it seems possible the parasite was brought along with it.

The conidia here are decidedly wider than those of other species of *Ascochyta* which are reported as occurring on Caprifoliaceae. There is occasionally slight constriction at the septum, but usually none.

DIPLODINA CHENOPODII Karst. on *Coriospermum hyssopifolium*. Ozaukee Co., Lake Michigan beach 5 miles north of Port Washington, October 15. Coll. J. D. Sauer. This corresponds quite closely to Petrak's Fl. Bohem. et Morav. Exsicc. Ser. II, No. 1132, distributed as this species on *Chenopodium glaucum*. Hollos described *Diplodina coriospermi*, but the principal difference seems to be in slightly wider spores, so it seems likely that *D. coriospermi* is synonymous with *D. chenopodii*, although Petrak (Ann. Mycol. 23:57. 1925) states *D. coriospermi* should be referred to *Ascochytella,* a genus most authorities seem to regard as of dubious standing.

Stagonospora biseptata sp. nov.

Maculis variabilis, pallido-brunneis, in bracteis foliatis; pycnidiis amphigenis, nigro-fuscis, sparsis, subglobose, ca. 100–125 μ diam.; conidiis hyalinis, cylindraceis, subcylindraceis, vel subfusoideis, rectis vel curvis leniter, granulosis et guttulatis, biseptatis, (8–) 10–11(–13) x (35–)40–50(–55) μ.

Spots variable, brownish straw-colored with mottled darker areas, mostly on the leafy bracts subtending the inflorescence, and often, but not always, involving the entire bract; pycnidia amphigenous, blackish, scattered, subglobose, approx. 100–125 μ diam.; conidia hyaline, cylindric, subcylindric, or subfusoid, straight or slightly curved, granular and guttulate, biseptate, (2–)10–11(–13) x (35–)40–50(–55) μ.

On *Carex lanuginosa.* University of Wisconsin Arboretum, Madison, Dane County, Wisconsin, U. S. A., July 6, 1960.

In 1952 in the same general area a small specimen of this fungus was collected and commented on in my Notes XVIII.

Stagonosporia astericola (Davis) H. C. Greene comb. nov.
(Davis, J. J.—Trans. Wis. Acad. Sci. Arts Lett. 21:281. 1924)

Davis described *Asteromella astericola* as occurring on *Aster lateriflorus* in Wisconsin and I have since found the same organism on *Aster ericoides* on several occasions. The elongate, subcylindric spores, including those in Davis' specimen, often have a median septum, and in a specimen on *A. ericoides,* collected June 18, 1959 in Perrot State Park, Trempealeau Co., the spores are frequently 2 septate.

SEPTORIA QUERCICOLA Sacc. on *Quercus macrocarpa.* Trempealeau Co., Whitehall, August 19. Coll. E. P. Jensen. The pycnidia occur individually, or only two or three together, on tiny, rounded, reddish-tan spots which are very numerous on the infected leaves. The spores are strongly curved, 3 septate, not constricted at the septa, hyaline and obtuse at both ends, mostly about 35–40 x 3.5–4.5 μ. Said to have been very prevalent on bur oak in Trempealeau Co. in 1960.

CHAETOSTICTA PERFORATA (Ell. & Ev.) Petr. & Syd. on *Cirsium discolor.* Dane Co., Madison, August 13, 1959. Det. S. J. Hughes. This fungus simulates *Acanthostigma occidentale* (Ell. & Ev.) Sacc. in macroscopic appearance, but is an imperfect form producing hyaline phragmospores. Also on *Cirsium muticum,* collected at Madison, September 3, 1951, and discussed in my Notes XVII, but without a determination at that time.

GLOEOSPORIDIELLA VARIABILE (Laub.) v. Arx *(Gloeosporium variabile* Laub.) on *Ribes alpinum* (cult.). Barron Co., Rice Lake, August 6. Coll. Mrs. J. Brecka. Comm. E. K. Wade. This seems quite distinct from *Gloeosporium ribis,* common on native currants in Wisconsin, as the conidia of *G. variabile* are narrower, longer, and mostly strongly curved than those of *G. ribis.*

Leptothyrium salicicola sp. nov.

Maculis orbicularibus, 2–8 mm. diam., saepe confluentibus, brunneis, zonatis plus minusve, marginibus angustis, fuscis; fructificationibus epiphyllis, sparsis, nigris, pseudoparenchymaticis, rotundatis supra, applanatis infra, fissilibis stellatis supra, subepidermidibus, erumpentibus, ca. 135–175 μ latis; conidiophoris subhyalinis, tenuibus, inconspicuis, basiliaribus plerumque; conidiis hyalinis, subfusoideis vel fusoideis, subcylindraceis interdum, (9–) 12–14 (–17) x 3.5–4.5 μ.

Lesions orbicular, 2–8 mm. diam., often confluent, grayish-brown, more or less zonate with narrow darker margin; fruiting bodies epiphyllous, scattered, black, pseudoparenchymatous, rounded above, flattened below, the upper covering tending to split stellately, subepidermal in origin, but strongly erumpent, approx. 135–175 μ wide; conidiophores subhyaline, slender, inconspicuous, mostly basal; conidia hyaline, subfusoid to fusoid, or occasionally subcylindric, (9–) 12–14 (–17) x 3.5–4.5 μ.

On living leaves of *Salix petiolaris.* University of Wisconsin Arboretum, Madison, Dane County, Wisconsin, U. S. A., October 3, 1960.

The rounded fruiting bodies are about half as high as wide and not numerous, usually only one or two per lesion.

PIROSTOMA CIRCINANS Fr. on *Sorghastrum nutans.* Dane Co., Madison, September 28. Vast numbers of the shining-black, flattened, punctate, fruiting bodies, approx. 25–50 μ diam. are crowded on the abaxial surfaces of the still green basal leaves. Despite the crowding, the circinate nature of the arrangement is plainly to be seen. Sections show the fungus to be evidently parasitic within the epidermis, with some of the larger bodies appearing even more deeply seated. Although no conidia were observed, the fungus is identical in aspect with exsiccati specimens on *Phragmites communis* and is so characteristic and well-marked that a report seems fully justified. An undetermined fungus on *Danthonia spicata,* mentioned in my Notes XXIV (Trans. Wis. Acad. Sci. Arts Lett. 47: 108. 1958) obviously also is referable to *P. circinans.*

DIPLOCLADIUM MINUS Bon. on *Polyporus gilvus.* Dane Co., Madison, October 18. Coll. & det. D. J. Rossouw.

A FIVE-YEAR SURVEY OF OAT SEED QUALITY IN WISCONSIN

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In 1959 there were 2,562,000 acres of oats grown in Wisconsin (1) making this the most important small grain, and second only to field corn among cereals in general. Oats are planted in the spring on Wisconsin farms as a companion or nurse crop when seeding a hay crop. The oat crop furnishes grain for feeding and straw for bedding livestock. Seed oats is also an important cash crop in the state for some specialized seed producers.

There are many people interested in the production of seed oats besides the farmers of the state. The Wisconsin Agricultural Experiment Station carries on an oat breeding program to furnish improved varieties for the state's agriculture. The Wisconsin Crop Improvement Association, an organization of seed producers, promotes the use of improved varieties by providing the organization for certifying the trueness of varieties which involves maintaining necessary records and seed testing facilities and making field inspections. The State Seed Laboratory of the Wisconsin Department of Agriculture has been interested in the use of high quality seed on Wisconsin farms.

In order to obtain information on the quality of seed oats being used in the state, a series of surveys was conducted in five areas from 1955 through 1959 by the State Seed Laboratory. It is hoped that this information will stimulate the use of better quality seed, promote seed testing and further better weed control.

METHODS AND MATERIALS

The samples of oat seed used in these surveys were obtained through the cooperation of county agricultural agents and vocational agricultural teachers in the counties being surveyed (Figure 1). The teachers had their students bring in samples of the oats which were to be used for seed on their families' farms. The 1959 survey was an exception in that the samples were collected by the 4-H clubs of Walworth County as part of a county-wide project on weeds and weed control. The State Seed Laboratory supplied paper bags for the samples, directions for drawing the samples, and a questionnaire to accompany each sample giving the sender's name, address and school and pertinent information on the sample submitted. The samples received were from three sources (Table

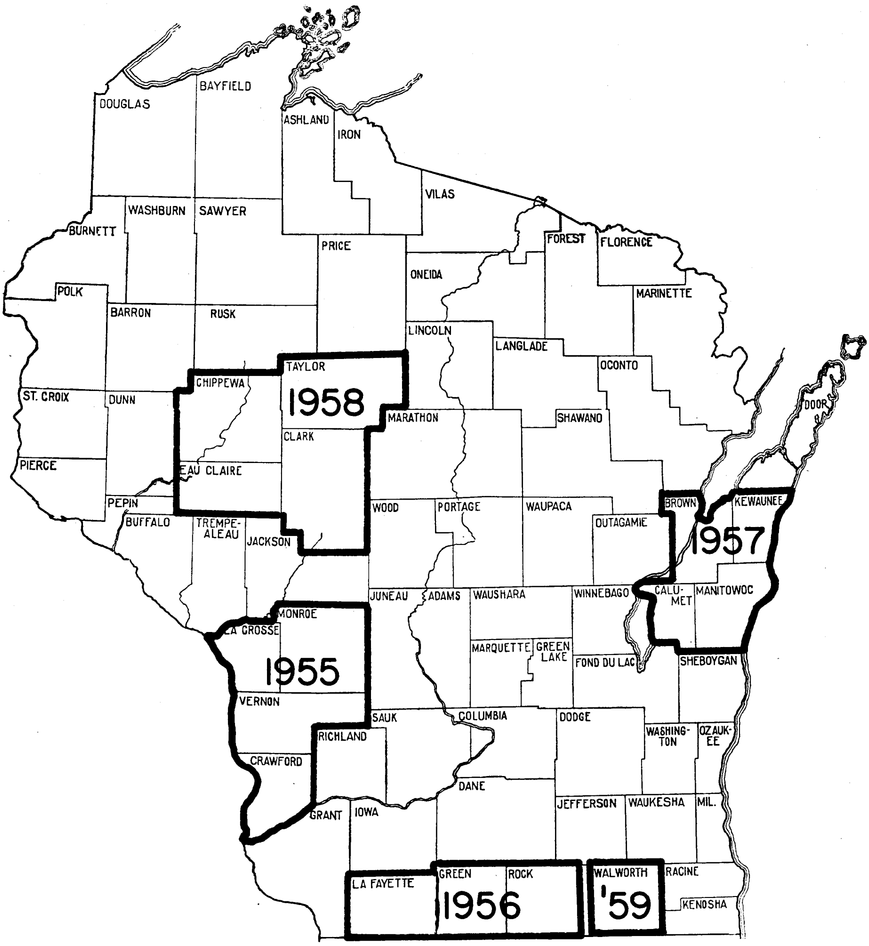

FIGURE 1. Five survey areas and year each was surveyed.

1): home-grown, purchased from neighbors, or purchased from seed dealers. During the five years samples were submitted by 954 persons from 54 schools and 15 clubs.

The samples were assembled and delivered to the State Seed Laboratory at Madison where they were tested during the summer as time permitted. Each sample was tested for purity, germination and noxious weed seed content according to standard seed testing procedures with the exception that the amount of seed tested was half of that specified in the "Rules for Testing Seed, adopted by the Association of Official Seed Analysts" (2). This reduction in sample size appeared justified because the number of samples was large for the number of analysts available and because the results would not be used for labeling purposes.

The information on the samples after testing was summarized and reported to the cooperating vocational agricultural teachers and county agricultural agents.

TABLE 1. SAMPLES OF OAT SEED RECEIVED EACH YEAR AND SOURCES ACCORDING TO INFORMATION SUPPLIED BY INDIVIDUALS SUBMITTING SAMPLES

Year	Number of Samples	Percentage of Samples from Each Source		
		Home-grown	Purchased	
			Neighbor	Seed dealer
1955	248	78	....	..
1956	103	56	11	33
1957	382	62	19	19
1958	300	75	15	10
1959	87	61	17	22
Total	1120			
Average		63*	16	21

*1955 excluded from average.

RESULTS AND DISCUSSION

Oat Varieties

There were 42 variety names given for the samples submitted (Table 2). The four varieties—Beedee, Branch, Fayette and Sauk—which were bred and developed by the Wisconsin Agricultural Experiment Station and released after 1950, accounted for 36.3 per cent of the samples. Fourteen varieties in the survey were on the approved list for certification by the Wisconsin Crop Improvement Association during the years of the surveys, and accounted for 74.5 per cent of the samples. However, only one-fifth of all the samples were declared to be certified.

There were 28 additional varieties for which one or more samples were obtained, accounting for 20.1 per cent of the samples. These were mainly older varieties which had been superseded by newer ones. No variety names were given for 5.4 per cent of the samples.

The examination of all samples showed that 10.6 per cent had in excess of four per cent contamination with other varieties. The variety names on 1.6 per cent of the samples were totally incorrect. These determinations of the correctness of variety names were made by visual examination of the color of the oat kernels. Many varieties cannot be separated on color, so that the varietal contamination in all of the samples might be higher than the above figures indicate.

Those samples which were from home-grown seed showed the most varietal contamination with 12.9 per cent of the samples having over four per cent other varieties present, while 8.4 per cent of the samples from seed purchased from neighbors and 5.1 per cent from seed dealers showed a similar rate of contamination.

TABLE 2. NUMBER OF SAMPLES OF EACH OAT VARIETY RECEIVED DURING 1955 TO 1959

Varieties	No. of Samples	Varieties	No. of Samples
Abegweit	1	Kherson	1
Ajax**	181	Larain	2
American Beauty	1	Mindo**	2
Andrew	2	Minhafer**	4
Beaver	8	Missouri 0–205	12
Beedee*	54	Mohawk	2
Benton	1	Nemaha	72
Bonda**	58	Newton	3
Bonham	18	Rodney	47
Branch*	168	Sauk*	166
Cherokee	16	Shelby**	1
Clarion	4	Silver King	1
Clintafe**	1	Simcoe	7
Clintland**	96	Sioux	1
Clinton**	64	Swedish White	1
Craig	1	Valor	1
Exeter	1	Vanguard	4
Fayette*	14	Vicland**	2
Garry**	22	White Cross	1
Gopher	6	White Kherson	1
Iogold	1	Yellow Kherson	4

*Varieties developed by the Wisconsin Agricultural Experiment Station and released after 1950.

**Additional varieties approved for certification by the Wisconsin Crop Improvement Association during one or more of the five years of the survey.

Farmers generally are eager to accept new varieties of oats and do a very commendable job of maintaining the purity of these varieties for seed purposes. Fifty years ago the farmers of the state had difficulty maintaining pure varieties. New varieties of grain produced by the Wisconsin Agricultural Experiment Station were contaminated with other varieties within several years after being released to farmers. This prompted members of the Agronomy Department of the Wisconsin College of Agriculture at Madison to establish a seed inspection program (3), later to become the seed certification program, as a means for training farmers to protect seed from contamination. The results of these surveys indicate that the farmers of Wisconsin learned this lesson and are putting it into practice.

Germination

A satisfactory germination of seed oats is usually considered to be 90 per cent. During the five years of these surveys 83.3 per cent of all the samples were equal to or better than this standard (Table 3). Eighty samples, or 7.1 per cent, had germinations less than 80 per cent. The results of these surveys correspond to the results of germination tests on oat samples submitted to the State Seed Laboratory by farmers and seed dealers. In a year when there is no particular problem with germination, it is customary to expect that at least 5 per cent of the samples will germinate less than 80 per cent. The results of these surveys from 1955 to 1959 indicate that the persons preparing these lots for seed did not have many of the samples tested for germination.

The samples from home-grown seed contained 7.7 per cent which germinated less than 80 per cent while the samples purchased from

TABLE 3. VARIATION IN GERMINATION PERCENTAGES OF OAT SAMPLES FROM 1955 TO 1959

YEAR	PERCENTAGE OF SAMPLES IN GERMINATION CLASSES				
	100–95	94–90	89–60	79–50	49–0
1955	65.7	20.2	8.9	4.4	.8
1956	81.5	10.7	2.9	2.9	2.0
1957	50.2	24.6	13.6	7.4	4.2
1958	69.6	17.3	7.7	4.3	1.0
1959	74.7	16.1	6.9	2.3	0.0
Average	63.6	19.7	9.6	5.1	2.0

neighbors showed 5.6 per cent and from seed dealers 5.1 per cent. Although seed which was purchased has a slightly better record than home-grown seed, it appears that some farmers were paying for seed which would not produce plants in the field.

Purity

Impurities in seed consist of (a) other crop seeds; (b) weed seeds and (c) inert matter, such as, chaff, dirt or broken and damaged seeds half the original size or less. There were many samples in these surveys with considerable quantities of the above impurities (Table 4). Seed oats submitted to the Wisconsin Seed Certification Service must have a minimum pure seed content of 99.56 per cent. The average pure seed content of those samples drawn by the seed inspectors of the Wisconsin Department of Agriculture from seed oats offered for sale by retail seed dealers in the spring of 1959 was 99.87 per cent. A comparison of the quality of seed oats being offered for sale in the state and the quality of the oats found in these surveys would point to the conclusion that farmers should pay more attention to the pure seed content of the seed they intend to plant.

Weed Seeds

There were 54 different kinds of weed seeds (4) found in the oat samples in these surveys (Table 5). Eight weed seeds were found in the five survey areas indicating that they are generally found in oat fields throughout the state.

There are other weed seeds which occurred predominantly in one area, such as wild oats, night flowering catchfly and common ragweed in 1957 in the northeast area, and hempnettle, wild radish, Pennsylvania smartweed and water smartweed in 1958 in the northwest area.

TABLE 4. VARIATION IN PURE SEED PERCENTAGES OF OAT SAMPLES FROM 1955 TO 1959

YEAR	PERCENTAGE OF SAMPLES IN PURE SEED CLASSES				
	100.00 99.50	99.49 99.00	98.99 98.00	97.99 97.00	96.99 below
1955	51.7	19.3	19.3	6.5	3.2
1956	68.0	12.6	8.7	3.9	6.8
1957	42.5	19.6	19.1	8.1	10.7
1958	60.3	19.3	15.0	2.7	2.7
1959	59.7	23.0	9.2	3.5	4.6
Average	53.0	19.1	16.3	5.5	6.1

A few weed seeds are not only common but are difficult to remove from oat seed because they are nearly the same size as the oat kernels. Examples of such weed seeds are wild buckwheat, quackgrass, yellow foxtail, and wild mustard. Extra care must be taken in seed cleaning to remove them from the oats.

A number of very small weed seeds, such as, white cockle, Virginia peppergrass, wormseed mustard and red sorrel, were present in some samples. With a minimum of care in cleaning these weed seeds should have been removed.

TABLE 5. WEED SEEDS CONTAMINATING OAT SAMPLES FROM 1955 TO 1959. (BASED ON 50 GRAMS OF OATS.)

COMMON AND BOTANICAL NAMES	OCCURRENCE	
	No. of Samples	Years
Wild buckwheat, *Polygonum convolvulus*	713	5
Quackgrass, *Agropyron repens*	554	5*
Yellow foxtail, *Setaria glauca*	244	4
Ladysthumb, *Polygonum persicaria*	145	5
Lambsquarters, *Chenopodium album*	131	5
Green foxtail, *Setaria viridis*	89	5
Curly dock, *Rumex crispus*	75	5
Pennsylvania smartweed, *Polygonum pensylvanicum*	51	4
Water smartweed, *Polygunum hydropiper*	50	3
Barnyard grass, *Echinochloa crus-galli*	42	3
Wild mustard, *Brassica kaber*	39	3**
Hempnettle, *Galeopsis tetrahit*	36	2
White cockle, *Lychnis alba*	26	5
Wild radish, *Raphinus raphanistrum*	25	4**
Canada thistle, *Cirsium arvense*	23	4*
Night flowering catchfly, *Silene noctiflora*	23	2
Wild oats, *Avena fatua*	22	3
Common ragweed, *Ambrosia artemisiifolia*	19	2
Virginia peppergrass, *Lepidium virginicum*	17	3
Wormseed mustard, *Erysimum cheiranthoides*	10	4
Red sorrel, *Rumex acetosella*	9	3
Broadleaf plantain, *Plantago major*	7	2
Blackseed plantain, *Plantago rugelii*	6	2
Corn spurry, *Spergula arvensis*	6	2
Vetch, *Vicia spp.*	5	2
Perennial sowthistle, *Sonchus arvensis*	5	1**
Redroot pigweed, *Amaranthus retroflexus*	4	4
Marsh cress, *Rorippa islandica*	4	3
Velvetleaf, *Abutilon theophrasti*	4	2
Field pennycress, *Thlaspi arvense*	4	3
Common mallow, *Malva neglecta*	4	2
Ball mustard, *Neslia paniculata*	4	1
Hoary alyssum, *Berteroa incana*	3	2
Smallseed falseflax, *Camelina microcarpa*	3	1
Spiny sowthistle, *Sonchus asper*	3	1
Hedge mustard, *Sisymbrium officinale*	3	1
Chicory, *Cichorium intybus*	2	1
Prickly sida, *Sida spinosa*	2	1
Mayweed, *Anthemis cotula*	2	2
Indian mustard, *Brassica juncea*	1	1**
Field pepperweed, *Lepidium campestre*	1	1
Hairy catchfly, *Silene dichotoma*	1	1
Flowering spurge, *Euphorbia corollata*	1	1
Field sandbur, *Cenchrus pauciflorus*	1	1
Sulphur cinquefoil, *Potentilla recta*	1	1
Yellow rocket, *Barbarea vulgaris*	1	1**
Meadow salsify, *Tragopogon pratensis*	1	1
Cinquefoil, *Potentilla sp.*	1	1
Russian pigweed, *Axyris amaranthoides*	1	1
Prostrate knotweed, *Polygonum aviculare*	1	1
Giant ragweed, *Ambrosia trifida*	1	1
Haresear mustard, *Conringia orientalis*	1	1
Foxtail barley, *Hordeum jubatum*	1	1
Houndstongue, *Cynoglossum officinale*	1	1

*Primary noxious weed seeds.
**Secondary noxious weed seeds.

Approximately one sample in every ten contained more than 0.5 per cent weed seeds (Table 6). The samples of home-grown seed contained slightly more than the average with 12.2 per cent and the seed purchased from neighbors, 11.3 per cent, and seed purchased from seed dealers, 4.5 per cent.

Along with the evidence of considerable weed seed contamination of the samples in these surveys, there is equally good evidence that weed seeds are not a necessary evil. There were 230 samples in the five years, or 20 per cent, which were found to be free of weed seeds (Table 6). Weed free seed is not obtained by chance, but through careful seed production methods which require, among other things, careful cleaning based on a knowledge of the weed seeds which are present in the seed. Seed testing is a means of obtaining such information.

Noxious Weed Seeds

There are 12 weed seeds which are listed as noxious in the Wisconsin State Seed Law. The seven noxious weed seeds found in the samples during this series of surveys were determined along with the other weed seeds in the separation of the 50 grams of oats for the purity analysis (Table 5). A larger quantity of oats consisting of 250 grams from each sample was examined expressly for noxious weed seeds. By examination of the larger quantity of seed, a larger number of samples were found to be contaminated with noxious weed seeds (Table 7), and Canada thistle and wild radish seeds were found to be present in all five years.

TABLE 6. OAT SAMPLES CONTAINING OVER 0.5 PER CENT WEED SEEDS BY WEIGHT AND NO WEED SEEDS IN 50 GRAM SAMPLES, AND NO NOXIOUS WEED SEEDS IN 250 GRAM SAMPLES FROM 1955 TO 1959

YEARS	SAMPLES CONTAINING					
	Over 0.5% Weed Seeds		No Weed Seeds		No Noxious Weed Seeds	
	No.	%	No.	%	No.	%
1955	11	4.4	82	33.1	48	19.3
1956	2	1.9	40	38.8	47	45.6
1957	83	21.7	58	15.2	167	43.7
1958	18	6.0	30	10.0	68	22.7
1959	3	3.4	20	23.0	54	62.1
Totals	111		230		384	
5-year average		9.9		20.5		34.4

There were considerably more noxious weed seeds in seed that was home-grown than in seed that was purchased. The percentage of the samples from the three sources which contained noxious weed seeds was as follows: home-grown, 55.4 per cent; purchased from neighbor, 8.1 per cent; and purchased from seed dealer, 4.2 per cent.

There were 34.4 per cent of the samples which contained no noxious weed seeds in the 250 gram sample examined (Table 6) indicating that the presence of noxious weed seeds contributed more to lowering the quality of seed oats than varietal purity, germination, pure seed or weed seeds.

Noxious weed seeds are so designated because the plants increase the difficulties and cost of agricultural production in a number of ways. One of these is through the difficulty of removing them from crop seed in the cleaning process.

Samples Satisfactory for Seed

The value of these samples as seed can now be judged on the basis of all five factors which have been discussed previously. The following criteria have been used: varietal purity, four per cent other varieties, maximum; germination, 80 per cent, minimum; pure seed, 99 per cent, minimum; weed seed, 0.5 per cent, maximum; and noxious weed seed, none. The percentage of samples found to be satisfactory for seeding purposes was 25.8 per cent for the five years (Figure 2). The samples complying with the above standards for each of the qualify factors were: germination, 92.9 per cent; weed seed, 90.1 per cent; varietal purity, 89.4 per cent; pure seed, 72.1 per cent; and noxious weed seeds, 34.4 per cent.

TABLE 7. NUMBER AND PER CENT OF SAMPLES CONTAINING EACH OF SEVEN NOXIOUS WEED SEEDS AND THE NUMBER OF SURVEY YEARS PRESENT. (BASED ON 50 GRAMS OF OATS.)

Kinds of Noxious Weed Seeds	Samples		Years
	Number	Per Cent	
Primary			
Quackgrass	714	64	5
Canada thistle	35	3	5
Secondary			
Wild mustard	59	5	5
Wild radish	34	3	5
Perennial sowthistle	11	1	1
Indian mustard	1	....	1
Yellow rocket	1	....	1

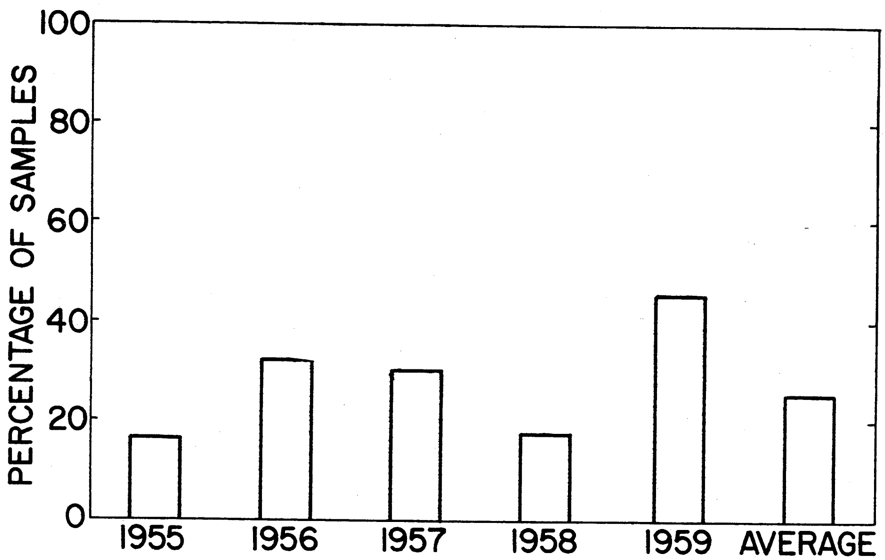

FIGURE 2. Percentage of samples satisfactory for seeding purposes based on varietal purity, germination, pure seed, weed seed, and noxious weed seeds from 1955 to 1959.

Some farmers would object to these standards, since they would not fill their needs. For instance, the farmer who wanted to produce seed oats for sale commercially would not be satisfied to have any mixture of varieties or as much as 0.5 per cent weed seeds because this might lower the quality and value of his crop. Another farmer might be willing to accept oats which germinated 75 per cent, if he wanted a variety in short supply. He would justify the purchase of such oats by increasing the seeding rate. The proposed standards are suggested for use in this survey, as standards which would meet the needs of the average farmer who is growing oats for grain.

Surveys of seed quality have been made in a number of states during the past ten years with similar results in general (5). Agricultural leaders in Wisconsin have been recommending the testing of seed since the first seed testing laboratory was established in the College of Agriculture in 1907. It is obvious from the records of these surveys that many farmers still plant seed oats without testing.

Seed Cleaning

The persons submitting the oat samples were asked whether or not the seed had been cleaned. There were 965 samples, or 86.0 per cent, which were declared to be cleaned. On examination of the records of these samples, it was evident that some had not been cleaned, or, if they had been, the cleaning job was woefully inadequate in removing the contamination. As a result, standards were adopted for those quality factors which can adversely affect seeding value and which can be improved by cleaning. These factors and their respective standards were: pure seed, 99 per cent minimum; weed seed, 0.5 per cent maximum; noxious weed seeds, none; and inert matter, 1 per cent maximum.

The cleaning was satisfactory in a small percentage of the samples (Table 8). A great deal of significance should not be attached to the differences between the years, because of the lack of uniformity in the method of obtaining the samples. The general conclusion that there is still ample room for improvement in the cleaning of seed oats is well illustrated, however.

TABLE 8. COMPARISON BY SOURCE OF THE EFFECTIVENESS OF CLEANING OAT SEED FROM 1955 TO 1959

YEAR	Percentage of Samples Claimed (C) and Found* (F) to be Cleaned							
	Home-grown		Purchased				Average, All Samples	
			Neighbor		Seed Dealer			
	C	F	C	F	C	F	C	F
1955....	79.3	8.8	98.0**	63.0	....	....	83.4	20.3
1956....	77.5	27.2	91.0	63.6	97.0	79.4	86.5	48.5
1957....	81.8	30.0	93.0	40.3	93.3	77.0	86.2	40.6
1958....	89.5	19.5	88.5	15.5	96.6	43.3	90.0	21.3
1959....	73.6	43.4	100.0	66.7	89.5	84.1	81.5	56.3
Average	82.5	22.3	92.3	37.3	94.4	72.8	86.0	32.1

*Standards used: pure seed, 99 per cent minimum; weed seed, 0.5 per cent min.; noxious weed seeds, none; and inert matter, 1 per cent max.

**Samples listed as "purchased" in 1955, and omitted from average of columns under "purchased".

The fact that many samples had been treated with fungicide material bears out the claims of the individuals submitting the samples that the seed had been cleaned. In 1955 it was found that among those samples of home-grown seed which were claimed to be cleaned, 138 were poorly cleaned. Of these there were 81, or 59 per cent, which had been treated. The fungicides used on the oats generally contained mercury which is highly poisonous, making the grain unfit for any use other than for seeding purposes. From this information we can assume that the farmers must have thought their seed was cleaned and in shape for seeding or they would not have gone to the expense of treating it.

The chances of getting properly cleaned seed are best when purchasing seed oats from seed dealers (Table 8), and seed oats purchased from neighbors are likely to be more adequately cleaned than when home-grown oats are used for seed.

SUMMARY

A series of surveys of seed oat quality was conducted in five areas of Wisconsin from 1955 to 1959 by obtaining samples through the cooperation of the high school vocational agricultural teachers. The samples were tested for purity, germination and noxious weed seed content.

There were five quality factors reported on as being the ones influencing the seeding value of oats. These were noxious weed seeds, pure seed, varietal purity, weed seeds, and germination arranged in order of decreasing influence. During the five years, 25.8 per cent of the samples were found to be satisfactory for seed.

The results show that seed oats are not being cleaned adequately and that the seed is not being tested to determine its suitability for seeding purposes.

The seed oats were from three sources—home-grown, purchased from neighbors or purchased from seed dealers. That purchased from seed dealers proved to be best on all counts, while home-grown seed was the poorest.

ACKNOWLEDGMENT

The writer is indebted to Howard T. Richards, who organized the collection of samples and the reporting of results to participants, and to the seed analysts at the State Seed Laboratory who made the surveys possible.

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HEMLOCK REPRODUCTION AND SURVIVAL ON ITS BORDER IN WISCONSIN

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Eastern hemlock *(Tsuga canadensis)* grows throughout the greater part of eastern United States and extends into Wisconsin where the border abruptly stops in the western part of the state (Fig. 1). Within the range of hemlock in Wisconsin phytosociologi-

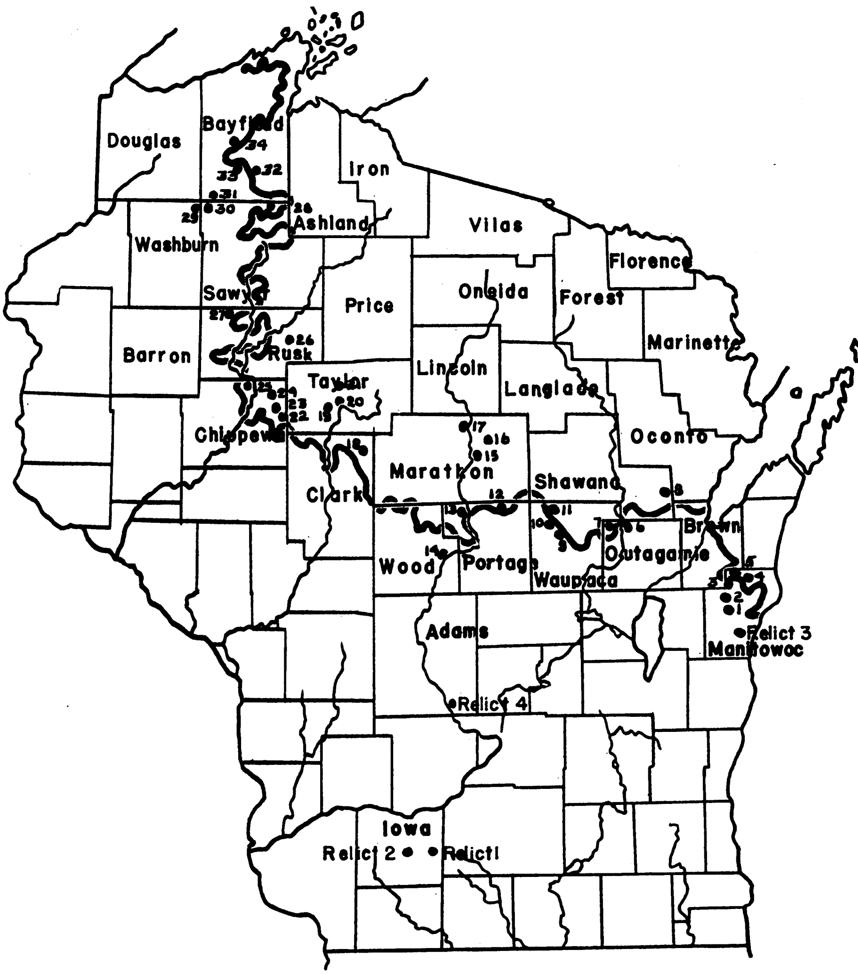

FIGURE 1. *Tsuga canadensis* border as drawn from location of present day stands and state political divisions (in part).

cal aspects under which the species reproduces and survives were recorded for this paper from 34 southern and western stands without severe disturbances.

Using the quarter method (Cottam and Curtis, 1956)[1] the location of germinated seedlings (current year's reproduction), seedlings (less than 1 year old and less than 1 foot tall), saplings (less 12dbh)[2], and trees were checked on a form sheet according to their location (logs, stumps, mounds, intervening area between mounds, and pits) to determine which sites were most favorable for germination and successful survival. One hundred and forty-eight quadrants were studied in each stand. Fallen coniferous logs and stumps were examined and measured as reproductive sites. Measurements included area, zone of decay, and circumference of solid core. An estimated per cent moss cover and residual bark was recorded along with a general description of each log and stump.

To determine the substratum necessary for successful germination and survival, Indices of Decay Classes based upon the characteristics of 61 hemlock logs and 37 stumps were constructed. Five stages of decay were designated for both logs and stumps with particular emphasis given to the part logs play in the reproduction and survival of hemlock.

Index for Logs:

D1. Fallen tree with needles, cones, and twigs present; branches and bark intact.

D2. Fallen tree with no needles, cones, or twigs present; distal ends of large branches present; bark intact without evidence of sloughing.

D3. Fallen tree with proximal end of large branches present; bark sloughing but intact patches present; decay of wood may be initiated.

D4. Fallen tree with proximal ends of large branches present; presence *or* absence of patches of bark; decay of wood well advanced; solid core present inside rotten shell; wood moist to touch, fracturing into small pieces.

D5. Fallen tree incompletely outlined in ground humus; no indication of branch positions, decay of wood complete; no solid core present; wood residue dry and crumbly.

Index for Stumps:

D1. Stump with freshly exposed surface; bark intact.

D2. Stump with more than 50 per cent bark present; outer core of wood solid on exposed surface.

[1] Cottam, G. & Curtis, J., 1956. The use of distance measures in phytosociological sampling. Ecology 37:451.

[2] dhb: diameter breast height.

D3. Stump with more than 50 per cent bark present; outer core of wood not solid on exposed surface.
D4. Stump with less than 50 per cent bark present; outer core of wood solid on exposed surface.
D5. Stump with less than 50 per cent bark present; outer core of wood not solid on exposed surface.

The density of *Tsuga* seedlings on logs parallels the per cent moss cover through Decay Class 4 in which maximum germination occurs. On stumps, the density of seedlings is highest in Class 5. Decay Classes 3, 4 and 5 exhibit increasing decay and exposure of greater surface area for germination in both logs and stumps.

Mosses are rarely present in Decay Class 1. The number of moss species reaches a maximum of 13 in D4 and diminishes to six in Class 5. Decay Class 4 represents the highest hydrophytic environment (Figs. 2 and 3) in both logs and stumps.

Herbacious plants were not found on logs in Decay Classes 1, 2 or 3. Those noted as the most abundant species in Class 4 were *Mianthemum canadensis, Trientalis borealis, Coptis trifolia, Cornus canadensis, Clintonia borealis,* and *Oxalis montana.*

The degree of wood decay varies according to species and location in relation to ground surface. It is not uncommon for yellow birch *(Betula lutea)* to remain standing long after death. Once such a tree falls, it takes only a short period for the wood residue to disappear leaving the desiccated shell of xeric bark. Hemlock seldom decays in a standing position, but starts to decompose only after it has remained on the ground for a long period of time. Once decomposition by weathering and fungal action is initiated, the length of time for a log to be transformed from one decay class to another is greatly shortened.

Germination cannot occur on decaying logs unless there is a moist depression in the bark in which seed and humus can lodge. Germination percentage is low on the relatively smooth bark of birch but high in fissures and exposed wood commonly located at the butt end of the fallen tree. The fractured bark of hemlock presents a greater area for retention and subsequent germination of seeds.

In considering logs and stumps as favorable germination habitats, density of germinated seedlings varies according to the different micro-areas on these substrata. In descending order the most favored are: (1) mats of moss, (2) moist exposed wood, and (3) bark free of moss. Moss growth is indicative of a mesic microenvironment. Wood, which has a high water holding capacity, benefits germination. Residual bark, which has a lower water holding capacity is least favorable.

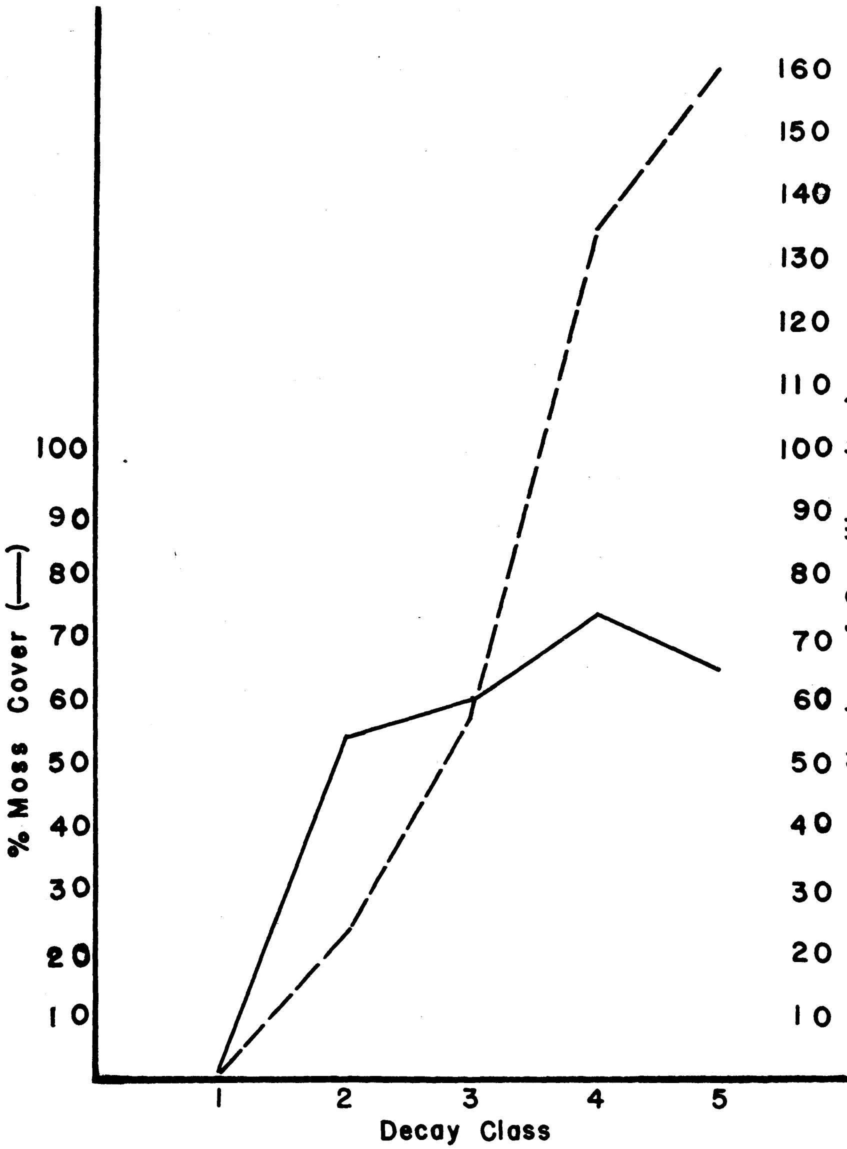

FIGURE 2. Mean Number of germinated *Tsuga canadensis* seedlings in each Decay Class per 21 feet of stump area and mean per cent moss cover.

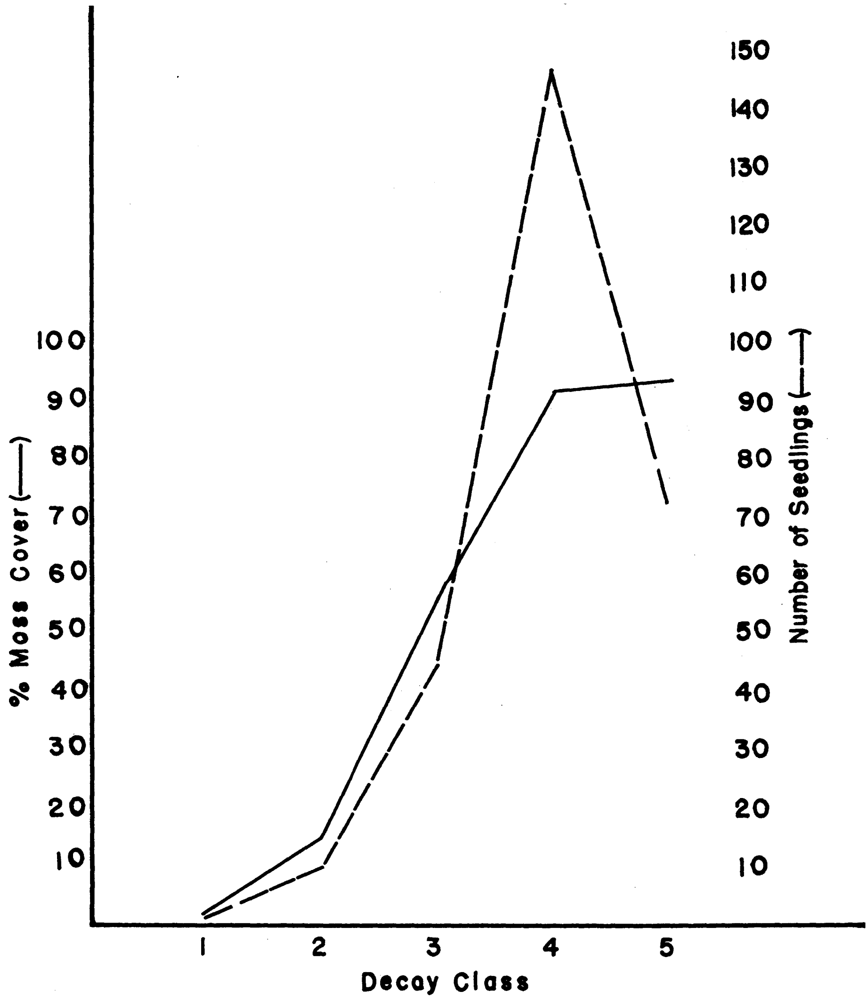

FIGURE 3. Mean Number of germinated *Tsuga canadensis* seedlings in each Decay Class per 50 feet of fallen tree trunk and mean per cent moss cover.

Infrequently, large areas of hemlock are windthrown to create favorable germination habitats, but more commonly only a few trees in a stand are windthrown each year. In the blowdown of a shallow rooted hemlock the extent of the root system determines the amount of earth upturned. A pit is formed by the extraction of roots and adhering soil and rocks. Decay of roots and weathering loosens the clinging upturned soil which falls to form a mound on the side of the pit toward which the tree fell. Because of the over-turn of soil the upper layers of the mound contain more nutrients than the underlying layers.

Various names have been given to these mounds which contribute to the micro-relief of a forest: Indian-graves, clay-mounds and tip-ups. In any stand there are mounds of all ages and heights. Mounds which have a high content of rock material resist erosion for longer periods than mounds composed of finer soil so that mound height does not necessarily indicate mound age.

Lesser numbers of germinated seedlings were recorded from the pits and intervening areas than from other germination habitats. Etiolated Tsuga seedlings were observed between layers of deciduous leaf mold which accumulates in pits. The deeper organic layers of leaf mold are meshed with mycelia of saprophytic fungi. Apparently these fungi also limit the life of a seedling in the duff.

In addition to providing an effective barrier of litter and fungi the pits often act as a water reservoir for the duration of the germination period.

Like the pits, litter also accumulates in the intervening areas. The depth of the organic matter would limit Tsuga germination and successful survival in these areas.

Mounds, which are exposed to ground winds because of their height, have a thinner organic layer enabling seeds to germinate more readily. Nutrients brought to the surface in the upheaval of soil in the formation of the mound contribute to successful establishment.

Although many thousands of seedlings germinate on the available substrata in the forest, few germinate on a substrata where successful establishment occurs. Hemlock seeds which germinate on mounds, logs or stumps are those most likely to survive (Table 1). Rarely are trees, saplings or seedlings found in the pit region. From 83.6 to 100 per cent of the seed bearing trees occur on mounds. Even though seed germination is high in intervening areas successful survival does not occur regularly as indicated in the seedling column of Table 1. It can be inferred from the tree data that conditions of the substrata were favorable for successful establishment in the intervening areas of several stands. Germination probably took place on small mounds which have since eroded or on logs which have completely disintegrated.

Unless a drastic environmental change occurs, it appears that Tsuga canadensis will perpetuate itself by continuing to create its own reproductive environment. The species has the reproductive capacity to remain a component of the northern hardwood forest with slight fluctuations in the geographical location of the border if not disturbed.

TABLE 1. TABULATION OF SUCCESSFUL GERMINATION PER CENT OF *Tsuga canadensis* ACCORDING TO MOUND, PIT, INTERVENING LOG OR STUMP AREA

STAND NUMBER	TREES					SAPLINGS					SEEDLINGS				
	M	P	I	L	S*	M	P	I	L	S	M	P	I	L	S
7	94.0	0.0	2.0	4.0	0.0	57.4	0 0	5.7	13.2	23.7	29.0	0.0	0.0	39.5	30.6
11	83.6	0.7	9.8	0.0	5.9	100.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
12	90.9	0.0	3.9	3.9	1.3	85.1	0.0	0.0	14.9	0.0	0.0	0.0	0.0	0.0	0.0
13	97.1	0.0	2.9	0.0	0.0	99.6	0.0	0.0	0.0	0.4	100.0	0.0	0.0	0.0	0.0
14	100.0	0.0	0.0	0.0	0.0	98.4	0.4	0.0	0.0	1.2	98.4	0.0	0.0	0.0	0.0
23	96.0	0.0	0.0	4.0	0.0	88.7	0.0	0.0	7.0	10.6	56.2	0.0	0.0	12.5	31.3
25	100.0	0.0	0.0	0.0	0.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
28	93.0	0.0	3.0	4.0	0.0	100.0	0.0	0.0	0.0	0.0	1.8	0.0	0.0	0.6	97.6

*M = Mound.
P = Pit.
I = Intervening.
L = Log.
S = Stump.

CHARACTERISTICS AND GENESIS OF A PODZOL SOIL IN FLORENCE COUNTY, WISCONSIN*

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A classic Podzol soil, called the Au Train loamy sand, was studied, both under forest cover and in an adjacent field, in Florence County, in northeastern Wisconsin, about 3 miles from the Michigan state line and 8 miles southwest of Iron Mountain, Michigan. The study was part of the soil survey of Florence County by the Soil Survey Division, Wisconsin Geological and Natural History Survey, in co-operation with the U. S. Soil Conservation Service and the Soils Department, College of Agriculture, University of Wisconsin (Gaikawad, 1961).

Processes of soil formation since the continental glacier disappeared from the county, possibly about 14,000 years ago, have produced: 1) on the forest floor an organic layer 2.25 inches (5.6 cm.) thick, 2) an underlying bleached sandy layer of "A_2 horizon" 8.75 inches (22 cm.) thick, and 3) a rock-like, cemented, dark-brown subsoil layer called the iron-humus Ortstein or hardpan (B_{irh_2}). Under cultivation by man over a period of about 65 years the organic layer of the forest floor has been removed, lime and organic matter have been added to the second layer, which has been compacted, and the third layer, the "Ortstein" hardpan, has apparently been somewhat weakened.

In the upper left-hand corner of Figure 1 is a diagram of the site. To the right of this diagram is a sketch of "cradle-knoll" or tree-throw micro-relief, characteristic of the soil under forest cover. Although the soil layers or horizons are irregular in thickness and exhibit lateral discontinuities, as shown in Figure 1, average depths to top and bottom of each horizon are given in the table. The "H" or humus layer, one-fourth inch thick on top of the bleached "A_2 horizon" in the forest soil, contained 11 grams of oven-dry roots in one square foot (not reported in column 4 of the figure).

Soil profile descriptions follow:

1. Au Train loamy medium sand

N.W. Corner Sec. 17, T.38 N., R.19 E., Florence Co., Wis.

(Soil profile under forest of balsam fir, white pine, white cedar, hard maple, yellow birch, aspen)

* Paper read at the 91st annual meeting of the Wisconsin Academy of Sciences, Arts, and Letters.

2.25″–1.25″	L	Dark reddish-brown (5YR 3/2, moist Munsell color notation) needles and leaves; pH 5.2, by Truog field test; very few roots; abrupt, smooth lower boundary.
1.25″–0.25″	F	Dark reddish-brown (5YR 3/2–3/1) somewhat decomposed needles and leaves; pH 5.0; very few roots; abrupt, smooth lower boundary.
0.25″–0″	H	Black (5YR 2/1) humus with small fragments of charcoal; pH 5.1; many roots; abrupt, smooth lower boundary.
0″ –1.25″	A_{21}	Very dark gray (5YR 3/1–4/1) loamy medium sand; very weak medium granular to single grain; loose; pH 4.1; some charcoal present; very many roots; gradual, irregular boundary.
1.25″–8″	A_{22}	Reddish-gray (5YR 5/2) medium sand; single grain; loose; many roots; pH 5.2; gradual, irregular boundary.
8″ –8.75″	A_{23}	Dark reddish-gray (5YR 4/2–5/2) medium sand; single grain; loose; many roots; pH 5.1; abrupt, irregular boundary.
8.75″–12″	B_{irh_1}	Dusky red (2.5YR 3/2–2/2) loamy medium sand; massive to weak angular fine blocky; soft to very friable "Orterde"; pH 5.3; many roots; abrupt, irregular boundary.
12″ –21″	B_{irh_2}	Dark reddish-brown (2.5YR 2/4) loamy medium sand; massive; cemented "Ortstein"; crushes to irregular fragments; clear, irregular boundary; very few roots, confined to surfaces of fractures in this "pan"; pH 5.5; abrupt, irregular boundary.
21″ –25″	B_{irh_3}	Reddish-brown (5YR–2.5YR 4/3) loamy medium sand; massive; soft and loose to somewhat cemented; very few roots; pH 5.4; clear, irregular boundary.
25″ –46″	B_f	Reddish-brown (5YR 4/3) with some irregular banding (4/2–4/4) loamy medium sand; single grain; slightly cemented "incipient fragipan", which shatters under pressure between the fingers; very few roots; pH 5.6; gradual, irregular boundary.

46″ –78″	C_1	Brown (7.5YR 5/4) medium sand glacial drift; single grain; loose to slightly cemented; roots rare; pH 5.4 at the top to 4.8 at the bottom; sampled with hollow auger below bottom of pit.
78″ –108″	C_{2g}	Similar material, saturated with water on June 8, 1960.

2. Au Train loamy medium sand

(Soil profile in newly planted corn field, about 300 feet west of the profile described above)

0″– 8″	A_p	Dark gray (5YR 4/1–3/1) loamy sand with scattered stones; plow layer; granular; loose; pH 6.2; roots abundant; abrupt, smooth boundary.
8″– 14″	A_2	Reddish-gray (5YR 5/1–5/2) medium sand; single grain; loose; pH 6.2; few roots; abrupt, irregular boundary.
14″– 23″	B_{irh_1}	Dark reddish-gray (5YR 3/2–4/2) medium sand; massive to angular medium blocky; soft to loose "Orterde"; pH 5.2; few roots; irregular, abrupt boundary.
23″– 30″	B_{irh_2}	Dusky red (2.5YR 3/2) loamy medium sand; cemented "Ortstein"; hard; pH 5.1; few roots, largely confined to surfaces of cracks; abrupt, irregular boundary.
30″– 40″	B_{irh_3}	Reddish-brown (5YR 4/4–4/6) loamy medium sand; massive; loose; pH 4.8; clear, irregular boundary.
40″– 46″	B_f	Reddish-brown (5YR 4/3) loamy medium sand; massive; somewhat cemented; pH 5.1; irregular, clear boundary.
46″– 98″	C_1	Light brown (7.5YR 6/4), above, to reddish-brown (5YR 5/3–4/3), below, medium fine sand with some gravel and bands of very fine sandy loam; massive to single grain; slightly cemented to loose.
98″–108″	C_2	Brown (7.5YR 5/4) mottled yellowish-red (5YR 4/8) medium sand; reddish black (10R 3/1–2/1) iron-rich concretions ⅛ inch in diameter; single grain; loose glacial drift.

Definitions of Kinds of Data Reported in Figure 1 and Report on Methods and Procedures

This information will be reported by column numbers, as given at the heads of columns in Figure 1. Analyses were made of soil passed through a 2 mm sieve.

pH or Soil Reaction (Column 1): Measurements were made by means of the Beckman pH meter. The pH of the organic layers (L, F, H) on top of the mineral soil in the forest was 5.0, by the Hellige-Truog quick test used in the field. The upper 1¼ inches of the A_2 horizon had a pH of 4.1 as measured by Beckman pH meter.

Bulk Density (B. D., Column 2) was determined by driving a steel cylinder into each soil horizon in such a way as to take a 200 cc sample. The oven dry weight of the soil in grams was divided by the volume of the soil to obtain bulk density. Careful estimates yielded the average figure of 0.14 gm per cu cm of the organic layer (L, F, H).

Organic Matter (O. M., Column 3): The Walkley-Black method (Jackson, 1958) was used.

Dry Weight of Roots (Column 4): A 1-foot-square steel box, with lower cutting edge, was driven through each horizon; and roots were carefully removed from the soil in the field, and were gently washed in the laboratory before drying and weighing. Weight of roots from the humus horizon (H) is given above.

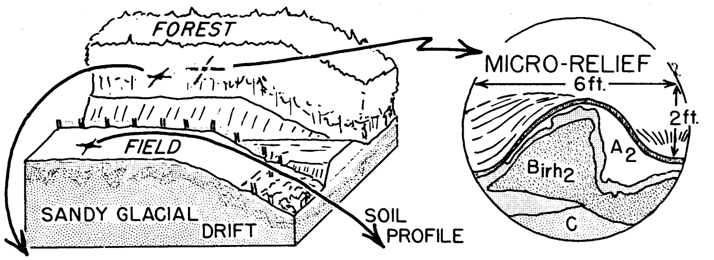
Carbon-nitrogen Ratio (Column 5): Percent carbon by the Walkley-Black method and percent nitrogen by the Kjeldahl method (Jackson, 1958) were used in obtaining this ratio for each horizon.

Clay, silt, and sand contents (Columns 6, 7, 8): Clay (mineral particles less than .002 mm in dia.), silt (.05–.002 mm in dia.), and sand (2.00–.05 mm in dia.) contents were determined by a hydrometer method described by Day (1956).

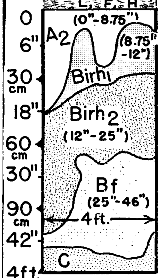
Available phosphorus in pounds per acre (Column 9) was determined by a Wisconsin State Soil Testing Laboratory procedure, using 4 cc of soil, 15 ml of 0.3 N HCl, with activated charcoal to remove soluble organic matter. To 3 ml of colorless extract, 3 ml vanadate solution were added, and calculations made on the basis of light transmission readings on a B. and L. spectrometer.

Available potassium, in pounds per acre (Column 10): The separate determinations for available K in soil moist from the field, and in oven-dried soil were made by flame photometer procedures of the Wisconsin State Soil Testing Laboratory (Jackson, 1958).

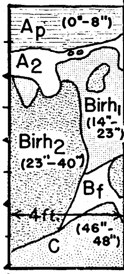
Cation exchange capacity in millequivalents per 100 g of soil (Column 11) was determined by the E.D.T.A. titration method, using Mg^{++} as the saturating cation and Na^{+} as the displacing cation, and titrating Mg^{++} in the displaced solution with E.D.T.A. standard solution.



VIRGIN SOIL	1 pH	2 B.D.	3 O.M.	4 Roots	5 C/N
L, F, H; A2 (0"-8.75")	5.2	1.27	0.9	38.3	19
Birh1 (8.75"-12")	5.3	1.23	2.1	6.6	20
Birh2 (12"-25")	5.5	1.51	1.6	2.2	25
			0.7	—	22
Bf (25"-46")	5.6	1.57	0.3	—	17
C	5.4	1.56	0.3	—	16



CULT'D SOIL	1 pH	2 B.D.	3 O.M.	4 Roots	5 C/N
Ap (0"-8")	6.2	1.37	1.8	31.2	15
A2	6.2	1.51	0.2	0.2	12
Birh1 (14"-23")	5.2	1.29	1.7	1.4	21
Birh2 (23"-40")				—	
Bf	5.0	1.43	1.4	—	23
	5.1	1.44	0.4	—	19
C (46"-48")	5.3	1.38	0.2	—	15



	Depth	6 Clay %	7 Silt %	8 Sd. %	9 Avl.P # a.	10 Avl. K "wet"	10 Avl. K "dry"	Depth	6 Clay %	7 Silt %	8 Sd. %	9 Avl.P # a.	10 Avl. K "wet"	10 Avl. K "dry"
Ap	—	—	—	—	—	—	—	0"-8"	6	7	87	8.5	382	126
A2	0"-8¾"	5	10	85	0.7	34	27	8"-14"	3	4	93	2.0	75	24
Birh1	8¾"-12"	12	10	78	1.5	48	54	14"-23"	8	3	89	2.5	52	54
Birh2	12"-25"	8	6	86	19.1	26	26	23"-40"	6	4	90	7.0	23	20
Bf	25"-46"	5	4	91	24.0	15	15	40"-46"	3	2	95	52.5	12	15
C	46"-48"	3	1	96	82.0	16	18	46"-48"	1	1	98	69.0	16	12

	Depth	11 C.E.C.	12 Ba.St.	13 Ca,X	14 Na,X	15 ca/mg	16 Fe	Depth	11 C.E.C.	12 Ba.St.	13 Ca,X	14 Na,X	15 ca/mg	16 Fe
Ap	—	—	—	—	—	—	—	0"-8"	4.5	69.8	2.4	0.03	6.4	**0.2**
A2	0"-8¾"	4.4	24.1	0.8	0.01	7.1	**0.1**	8"-14"	1.5	52.0	0.5	0.01	3.4	**0.1**
Birh1	8¾"-12	12.2	27.5	2.9	0.03	13.5	**0.6**	14"-23"	8.0	20.2	1.1	0.04	4.4	**0.6**
Birh2	12"-25"	6.7	14.2	0.8	0.05	19.2	**0.5**	23"-40"	6.9	12.5	0.5	0.02	6.8	**0.3**
Bf	25"-46"	2.3	31.7	0.7	0.01	32.5	**0.2**	40"-46"	2.4	13.4	0.2	0.08	12.1	**0.1**
C	46"-48"	2.1	36.6	0.7	0.01	20.4	**0.1**	46"-48"	1.2	29.6	0.2	0.08	8.0	**0.1**

FIGURE 1. Some field and laboratory data for a virgin profile and a cultivated profile of the maximal Podzol soil, Au Train loamy sand, near the N.W. corner of Sec. 17 and the N.E. corner of Sec. 18, T.38 N., R.19 E., Florence County, Wisconsin, respectively. Note that the horizontal scale is compressed in the soil profile diagrams, which represent four feet in width, as well as in depth, for each of the two rectilinear soil sections. A key to the abbreviations in the figure is as follows:

Abbreviations in the diagrams: A_p, plowed dark surface soil in the field; A_2, reddish-gray light colored soil layer or horizon; B_{irh}, soft upper subsoil layer or "B" horizon containing iron (ir) and humus (h) deposits; B_{irh}, cemented lower subsoil layers containing iron and humus deposits; B_f, weakly developed, pale, coherent subsoil layer or horizon, called "incipient fragipan"; C, loose sand or "parent material" of the soil; L, surficial litter layer of recently fallen leaves, needles and wood on the forest floor; F, fermented or partially decomposed organic material lying beneath the L layer; H, humus layer or well decomposed organic material forming the bottom part of the natural organic blanket on the forest floor.

Abbreviations at the heads of columns in the tables: 1—pH, measure of soil reaction; 2—B.D., bulk density in gm/cm^3; 3—O.M., organic matter in per cent; 4—Roots, dry weight in gm of plant roots found in a column of soil 1 ft^2 in horizontal cross-section; 5—C/N, carbon/nitrogen ratio; 6—Clay, content on an oven-dry weight basis of mineral particles less than .002 mm in dia.; 7—Silt, content of mineral particles .002 to .05 mm in dia.; 8—Sand, content of mineral particles .05 to 2.0 mm in dia.; 9—Avl.P, pounds per acre of phosphorus "available to plants"; 10—Avl.K, pounds per acre of "available" potassium in undried soil as taken in the field ("wet"), and in oven-dried soil ("dry"); 11—C.E.C., cation exchange capacity in meq per 100 g of soil; 12—Ba.St., percent base saturation; 13—$Ca^{++}X$, meq exchangeable calcium per 100 g of soil; 14—$Na^{+}X$, exchangeable sodium; 15—Ca/Mg, ratio between exchangeable calcium and exchangeable magnesium; 16—Fe, percent reductant-soluble or "free" iron on a dry wt. basis.

Percent base saturation (Column 12) was calculated on the basis of exchangeable cation determinations and cation exchange capacity determinations.

Exchangeable cations (Columns 13, 14, 15) were determined by extractions with 1 *N* NH_4OAC solution at pH 7, and by flame photometry. Data are reported in millequivalents per 100 g of soil.

Reductant soluble iron content (Column 16) was determined by the dithionite-citrate-bicarbonate method (Jackson, 1956).

Discussion

During an undetermined portion of the period of approximately 14,000 years since the Cary (middle Wisconsin) glaciation in Florence County, an organic mat on the forest floor has been maintained at a steady state on the Au Train loamy sand. Bits of charcoal in the humus (H) horizon of the organic mat attest to interruptions of this steady state by forest fires. The presence of large white pine trees indicates, however, that the forest at the study site was not clear-cut and destroyed during lumbering operations of 1850–1920. Tree-fall has caused disturbance of the soil horizons, as indicated in Figure 1. However, the virgin soil was sampled as far away as possible from "cradle-knolls" or tree-tip mounds. This soil is a well developed or "maximal" Podzol and the study site is situated in a well drained position fairly close to the water table (78 inches in June, 1960). The proximity to the water table may account for the extreme cementation of the iron-humus subsoil (B_{irh}), because a relatively high water table favors tree growth (Wilde, 1958). The latter provides for the volumes of organic matter necessary for podzolization (Stobbe and Wright, 1959) which involves the translocation of iron and organic matter through leached sandy parent material from the surface soil (A_2 horizon) to the subsoil (B_{irh}).

Tree roots are most abundant in the humus horizon, in the A_2 and upper B_{irh} horizons, to a depth of a foot below the surface of the mineral soil. In this zone a notable depletion of available phosphorus has occurred, presumably by plant root feeding. Weathering of the relatively small amount of weatherable minerals in the upper 2 feet of soil, and base cycling by trees and deposition of small amounts of aeolian silt would explain the relative accumulation of available potassium in upper horizons of the soil. The fixation of available potassium by drying of the soil may be explained as the action of a small amount of vermiculite clay. Iron and organic matter have accumulated in the subsoil (B_{irh}), particularly in the upper portion, the dark reddish-brown to dusky red soft "Orterde". The latter overlies the cemented portion, the dark reddish-brown "Ortstein" hardpan. Apparently considerable clay has been translocated from the pale (reddish-gray) A_2 horizon into the B_{irh} horizon, presumably independently of iron and organic matter (Flach, 1960). The carbon/nitrogen ratio is high in this soil, and base saturation is low, as is the case in many Podzol soils (Soil Survey Staff, U.S.D.A., 1960; Hole and Schmude, 1959). The exchangeable Ca/Mg ratio is high and increases with depth.

Clearing of the forest from this soil 65 years ago, and ensuing cultivation in the field across the road from the forest site has apparently made the following changes in the Au Train loamy sand:

1) The cradle-knoll micro-relief of the forest soil has been erased.
2) Mixing by plow and other agricultural tools has replaced the organic mat and upper A_2 horizon with a plow layer (A_p).
3) Some disturbance of the soil profile was very possibly produced by stump pulling and burning during land clearing.
4) The A_p and A_2 horizons have been compacted, particularly just below the plow layer (A_p), by loss of organic matter and pressure from farm machinery.
5) Despite additions of manure and crop residues by the farmer, organic matter has been lost, presumably as a result of increased aeration and summer temperatures in the A_p horizon as compared to the upper soil horizons in the forest, as a result of excess of translocation of organic matter from the B horizon over additions to it, and as a result of artificial increase in pH which favors microbial activity.
6) Slight reduction in contents of N, exchangeable calcium (except in the plow layer), cation exchange capacity, and

reductant soluble iron may be the results of removal of plant nutrients by crops in excess of additions by the farmer, and the results of accelerated leaching.

7) The upper 14 inches of soil have higher pH, contents of exchangeable calcium and magnesium, and base saturation values, as a result of liming and fertilization by the farmer.
8) The C/N ratio of organic matter in the upper 14 inches of soil has been lowered, presumably by loss of carbon as CO_2 to the air, with accelerated microbial activity and aeration.
9) The average specific gravity of plant roots has dropped from 0.3 to 0.2, with the replacement of forest by crop and pasture plants.

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THE GEOLOGIC MATERIAL: ITS IMPACT ON SOIL PROFILE CHARACTERISTICS IN WEST CENTRAL WISCONSIN

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For several years, soil investigations in West Central Wisconsin have included, among other things, an attempt to correlate more closely soil profile characteristics with the geologic material in which they develop. The following is but a brief summary of some of the knowledge gained during that period. The theories proposed and the ensuing conclusions are those of the author only, and not necessarily reflecting those of the many people involved in the gathering of the information.

The author is especially indebted to Mr. Paul Carroll[1] for permission to reproduce substantial parts of the field data gathered by him, and to Dr. Francis D. Hole of the Wisconsin Geological and Natural History Survey, University of Wisconsin, for encouraging preparation of the article.

The exposed part of the lithosphere and included portions of the biosphere reflect the interaction of local factors such as underlying material,[2] topography, climate, and organic agencies (flora, fauna, man). Soil scientists regard the "soil environment" as a product of the interaction of these four factors acting through time (3), which is considered to be a fifth factor of soil formation. This approach enables the researcher to understand the mode of formation of the various kinds of soil and helps in predicting soil-type distributions. In short, measuring the environment (qualitative and quantitative), is a major step toward understanding why particular soils occur in specific localities.

Bear (1) and Jenny (3) in their respective treatises on soil chemistry and soil formation give an excellent bibliography of the extent to which soil characteristics can be attributed to the initial geologic materials. In many instances, the extent to which parent material properties influence soil characteristics is controversial, and a generalization may often be misleading.

West Central Wisconsin, with its combination of glaciated and driftless areas, offers many opportunities to study the relationships between soil characteristics and associated geologic materials. The area in which observations were made and from which samples were collected includes the following counties: Pierce, St. Croix, Pepin, Dunn, Eau Claire, Chippewa, and Taylor.

[1] Soil investigator, Soil Conservation Service, River Falls, Wis.

[2] Term used to denote both consolidated and unconsolidated material, often referred to by soil-scientists as "parent-material".

Methods

Field examination of soils in selected areas were initiated in 1956 by Mr. Paul Carroll, as a part of the coöperative soil-survey program of the U. S. Soil Conservation Service and the University of Wisconsin. Each observation included a detailed description of the soil profile to a minimum depth of 5 feet and often deeper so as to reveal the various types of strata underlying the soil solum. Bulk samples of the soil horizons, including one or more of the underlying geologic materials, were collected for further laboratory studies. Samples were taken to the laboratory, air dried and sieved to pass a 2 mm. screen. Duplicate 50 gm. samples were treated with hydrogen-peroxide to destroy organic matter, and dispersed in Na-hexametaphosphate. Particle size distribution was determined by hydrometer, except in the case of silt fractionation, where a pipette was used to determine coarse and fine fractions. Chemical analyses on the 2 mm. material included a pH measurement using a glass electrode and a 1:1 soil: water mixture; cation exchange capacity with buffered (pH 7.0) NH_4-acetate; free iron-oxide using Na-hydrosulfite as extracting agent, Coleman Junior spectrophotometer and orthophenanthroline.

Results and Discussions

In areas where different geologic materials, e.g. limestone, sandstone, glacial till and loess, occur in a single stratigraphic column or form a continuous surface on level or sloping land, an assemblage of different soils usually results. In West Central Wisconsin, a common landscape association consists of plateau-like remnants (mesas) with gently sloping to level intervening lowlands. The presence of the tabular highland remnants is due mostly to the protective capping of the dolomitic limestone. This dolomitic layer is one unit in the sequence of sandstones and limestones (usually dolomitic) which make up the stratigraphic column in this part of the state. Often a thin shale layer can be found interbedded or separating the two main types of material making up the stratigraphic section. The fluvial dissection in conjunction with the general dip of the beds determines the age and type of bedrock exposed. More often than not, a variable thickness of wind deposited silty (loess) material overlies the bedrock. In the northern part of the area, glacial till of Wisconsin age overlies the bedrock the till being in turn capped by a variable thickness of eolian material. The following are selected instances which clearly illustrate the relationship between soil profiles and their respective underlying geologic materials.

A. *Stratigraphy, a factor in soil profile characteristics.*

The "Colluvial Hixton"[3] soils of St. Croix County are found most frequently on valley slopes below limestone-capped ridges underlain by sandstone. During the process of geologic and accelerated erosion, movement down the slopes created a heterogenous mixture of limestone slabs and loess, which together with the sand became the parent material for the Hixton like soils of the county. In selective places, the great quantities of weathering limestone fragments provide clay size material in quantities large enough to impart a sandy clay loam to clay loam texture to the middle and lower solum (see description below).

In one area where the limestone capping was missing completely a sandy Gray-Brown Podzolic Boone soil developed on the slope. However, at a depth of five feet a loamy material was located. This finer textured material remained as evidence of earlier colluvial movement, when a limestone capping was still in existence. The following are a few examples of the types of soil profile encountered on the slopes of the mesas.

B. *Soil development in coarse silt dominated loess,*[7] (Pepin and Dunn Counties).

Loess of variable thickness overlies bedrock and glacial deposits in relatively extensive areas of Dunn, Pepin, and other counties in western and southwestern Wisconsin. The larger body of loess extends well into Minnesota, Iowa, Illinois, and Missouri. Loess of this larger area is characteristically thickest on the bluffs adjoining the Mississippi River and other glacial drainage channels, thinning away from the river valleys. Usually the loess in Dunn and Pepin counties is from one to six feet thick and is found primarily on the uplands, upland valley slopes and occasionally in the valley bottoms. Much thicker loess deposits, however, may be found further to the west and south nearer the Mississippi River.

Within this loess belt, are found significant areas of coarse-textured loess.[8] In parts of these two counties the loess is underlain by till.

Mechanical analysis of soils from the four selected sites indicated a very high percentage of total silts (table 1). The amount ranges from approximately 76 percent in the surface horizons to approximately 70 percent in the B_2 horizons, and from 72 to 75 percent in the parent material. The ratio of coarse silt to fine silt

[3] Quotation marks used to distinguish these soils from central concept of the series.

[7] Loess is a geological deposit of relatively uniform calcareous silt with some very fine sand and clay, presumably transported by wind from alluvium or disintegrated siltstone during periods of aridity.

[8] Wind-blown materials consisting primarily of coarse silts e.g. 50 to 20 microns in diameter.

I. Minimal-Podzol Developed in St. Peter Sandstone, Ordovician System (Boone Fine Sand)

Horizon	Depth	Color (moist) [4]	Texture	Reaction (pH) [5]
Ap	0–2″	10YR 3/1(1)	Organic Matter	4.5
A_{21}	2–10″	10YR 5/1	Fine sand	4.5
A_{22}	10–15″	10YR 7/1	Fine sand	4.5
Birh	15–42″	10YR 5/4	Fine sand	4.5
C	42–60″	10YR 6/4	Fine sand	6.0

II. "Colluvial Hixton", a Gray-Brown Podzolic Developed From Mixed Sandstone, Limestone, and Calcareous Sandstone

Profile II-a

Horizon	Depth	Color (moist)	Texture	Reaction (pH)
A_1	0–4″	10YR 3/1	Fine sandy loam [6]	7.0
AB	4–13″	10YR 4/2–4/3	Fine sandy loam [6]	6.5
B_1	13–20″	10YR 4/3	Loam	6.5
B_{21}	20–26″	7.5YR 3/4	Loam	6.5
B_{22}	26–33″	7.5YR 4/4	Loam	6.5
B_3	33–40″	10YR 4/4	Loam	6.5
Dr	40–60″	10YR 8/4	Sandstone	6.0

Profile II-b

Horizon	Depth	Color (moist)	Texture	Reaction (pH)
A_1	0–2″	10YR 2/2	Sandy loam	6.6
A_2	2–6″	10YR 4/3	Sandy loam	6.0
B_1	6–14″	7.5YR 4/4	Sandy loam	6.0

[4]Moist, Munsell Color Notations.
[5]By Truog–Hellige field kit.
[6]Possible loess influence here.

III. "Colluvial Hixton", Profile II-b Continued

Horizon	Depth	Color (moist)	Texture	Reaction (pH)
B_{21}	14–20″	7.5YR 4/4	Loam	5.5
B_{22}	20–30″	7.5YR 4/4	Sandy clay loam	4.7
B_{23}	30–42″	5YR 3/4	Clay loam	5.0
B_3	42–48″	7.5 4/4	Clay loam	5.5
C	48–58″	7.5 4/4	Loam	6.0
Dr	58+″	10YR 7/4–5/8	Sandstone	6.0

ranges from 1.83 to 2.97. The clay percentages in the B horizon varied quite widely.

A structural characteristic of these soils is the general macroplatiness of the profile, which is quite distinct in the parent loess and weakly to moderately expressed in the solum. Compound structural forms of subangular blocky and platy were observed in the B horizon of all sampling sites. The macroplaty characteristics of these soils is probably "inherited" from the parent loess. Alternating light (10YR 5/3) and darker-colored (10YR 4/3) horizontal silty bands extend deep into the parent loess. These layerings in the parent loess result in abrupt and smooth boundaries and provide lateral lines of weakness in an otherwise massive structural form. A combination of vertical zonation induced by roots and freezing and thawing, coupled with an "inherited" horizontal layering result in the observable macroplatiness of the soil solum.

C. *Soil development in Glauconitic sandstone*

During 1958, while a detailed soil survey of Pepin County was in progress, a series of field observations were made on the Norden and other associated series developing, at least in part, in glauconitic sandstone (Franconia formation, Cambrian system), described in detail by Berg (2) and Nelson (4). The interest was primarily in the weathering sequence of the glauconitic parent rock. For this reason, the red variant of the Norden series was selected for study. The red variant is a highly ferruginous soil of very limited extent in Wisconsin, but one of significance because of the advanced glauconite weathering in it. Generally, the red variant of the Norden has been defined as a Gray-Brown Podzolic soil. However, because of high iron content in the upper part of the solum (table 2), it may be more properly regarded as a Gray-Brown Podzolic soil intergrading to Podzol. All profiles exhibited moderate to strong brown colors in the solum with additional brown "earthy" streaks extending horizontally and vertically through the lower part of the soil profile. Clay skins were observed along the cleavage planes of the disintegrated sandstone in the lower profile, the skins becoming thicker and more continuous with increased depth.

The Franconia sandstone formation often consists of alternating bands of white and green (glauconitic) material. The brown streaks usually develop in the originally green glauconitic material. Table 2 shows the extremely high iron content of the upper part of the solum. Lower horizons showed a marked decrease in that particular constituent. Although omitted from table 1, mechanical analysis of the profile indicated the presence of two clay-enriched layers. These layers may have formed by a differential weathering in certain parts of the soil profile due to the presence of a series of

TABLE 1. PARTICLE SIZE DISTRIBUTION OF SELECTED SOIL HORIZONS DEVELOPING IN RESPECTIVE GEOLOGIC MATERIALS

SOIL TYPE	HORIZON	GEOLOGIC MATERIALS	TOTAL SAND 2–0.05mm %	TOTAL SILT 0.05–0.002mm %	TOTAL CLAY 0.002mm %	COARSE SILT 0.05–0.02 mm / FINE SILT 0.02–0.002mm
Norden sandy loam	Ap	Glauconitic s.s.	62	24	14	....
Norden sandy loam	B_{22}	Glauconitic s.s.	51	17	32	....
Norden sandy loam	Dr	Glauconitic s.s.	90	3	7	....
El Paso, shallow variant	Ap	Acid shale	11	47	42	....
El Paso, shallow variant	B_{22}	Acid shale	20	21	59	0.3
El Paso, shallow variant	Dr	Acid shale	15	16	71	....
El Paso silt loam*	Ap**	Silt loam loess	14	67	19	1.1
El Paso silt loam*	B_{22}**	Silt loam loess	18	50	32	1.8
El Paso silt loam*	Dr	Acid shale	12	18	70	0.1
Brill silt loam	Ap	Silt loam loess	11	69	20	0.87
Brill silt loam	B_{22}	Silt loam loess	11	56	33	1.33
Brill silt loam	C	Silt loam loess	17	57	26	1.38
Seaton silt loam***	Ap	Silt loam loess	12	77	11	1.59
Seaton silt loam***	B_2	Silt loam loess	10	72	18	2.46
Seaton silt loam***	C	Silt loam loess	13	72	15	2.44
Milaca silt loam	A_1****	Silt loam loess	16	73	11	....
Milaca silt loam	B_2	Red till	52.2	29	19	....
Milaca silt loam	C_2	Red till	69	21	10	....

*Tentative series name.

**Developed in overlying silt.

***"Fayette", an average of 6 profiles, three analyzed locally and three from data of the soil survey laboratories, S.C.S., Lincoln, Nebraska.

****This horizon is formed in the thin loess cover overlying the till, and characteristic of this particular series.

TABLE 2. CHEMICAL PROPERTIES OF SELECTED SOIL HORIZONS DEVELOPING IN RESPECTIVE GEOLOGIC MATERIALS

Soil Type	Horizon	Geologic Material	pH	Cation Exchange Capacity m.e./100 gm.	Free Iron Oxide Fe_2O_3 %
Norden sandy loam	A_1	Glauconitic s.s.	5.5	...	50.0
Norden sandy loam	B_{22}	Glauconitic s.s.	5.2	...	11.4
Norden sandy loam	Dr	Glauconitic s.s.	...	...	1.0
El Paso silty clay	Ap	Acid shale	6.5	7.7	0.9
El Paso silty clay	B_{22}	Acid shale	4.6	16.0	2.0
El Paso silty clay	Dr	Acid shale	3.7	16.4	4.3
El Paso silt loam	Ap*	Silt loam loess	6.0	6.5	0.9
El Paso silt loam	B_{22}*	Silt loam loess	4.3	13.3	1.4
El Paso silt loam	Dr	Acid shale	3.7	15.8	2.7
Brill silt loam	Ap	Silt loam loess	5.5	5.1	0.9
Brill silt loam	B_{22}	Silt loam loess	5.0	17.1	1.5
Brill silt loam	C	Silt loam loess	6.0	14.8	1.3
Milaca silt loam	A_1*	Silt loam loess	5.2	...	...
Milaca silt loam	B_2	Red till	4.7	25.5	...
Milaca silt loam	C_2	Red till	5.3	15.3	...

*See table 1 for notation on this horizon.

perched water tables, in addition to the movement of clay size material from overlying horizons as evidenced by vertical clay skins. Perched water tables have been observed in road cuts, and when exposed to atmospheric conditions, form red, weathered streaks, parallel to the bedding planes. The two major changes taking place during the development of a soil profile from glauconitic sandstone therefore are: (a) the formation of a highly-

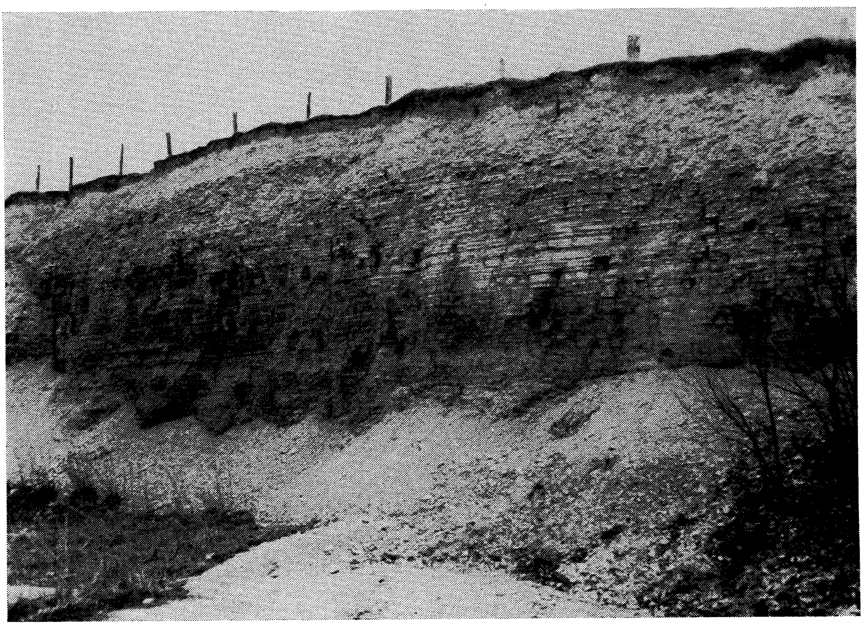

FIGURE 1. Road cut showing acid shale with overlying siltstone and capped by eolian material. (Pierce County, Wisconsin)

ferruginous upper solum and (b) the development of one or more textural layers in the subsoil.

D. *Soil development in acid shale*

The particular area investigated occupies a nine-square-mile valley in the southwest quarter of Rock Elm Township, Pierce County, Wisconsin. The valley is formed at the confluence of two first order streams[9] and has been eroded in its deepest part to a level about 140 feet below the surrounding landscape. Geologic erosion has cut through a stratum of St. Peter sandstone, including an underlying thin layer of basal siltstone and shale.

The valley consists of undulating to rolling uplands, gently to strongly-sloping upland valley slopes, where only a relatively thin

[9] Unbroken, fingertip streams in the headwaters of the drainage basin.

silt mantle exists, and where, most or all of the B horizon of the soil profile is developing in the underlying shale. On gentler gradients, however, the soils are considerably deeper, with only the lower part of the B horizon extending into the underlying shale. The deep silt mantles are derived either from wind deposited silts or from siltstone that outcrops in the higher surrounding areas.

Table 1 shows the influence of the parent rock on the relative amounts of silt and clay in the two respective profiles. The El Paso silt loam[10] has its solum developing in silty material underlain by a clayey shale. The coarse silt/fine silt ratios reaffirm the sharp break in the geologic materials between the solum (20 inches in this case) and the underlying material. The El Paso, shallow variant, almost totally developed in the shale, has a solum which reflects the clayey nature of this material. In both soils those layers developing in the shale exhibited a stronger compound structure of large plates in turn subdivided into smaller subangular to angular blocks. A short description is given herewith for purposes of illustration:

EL PASO SILT LOAM PROFILE (SHOWING HORIZONS FROM THE LOWER PART OF THE SOLUM AND DIRECTLY UNDERLYING SHALEY MATERIAL)

Horizon	*Depth*	*Description*
B_{22}	14–17″	Dark brown (10YR 4/3, moist) silty clay loam with compound structure of strong fine to medium angular blocky and weak to moderate medium macroplaty; many thick, patchy, high-contrast clay skins (10YR 3/2, moist) and light silt coats on vertical and some horizontal faces of structural peds; very firm; pH 4.3; gradual and wavy lower horizon boundary. 3 to 4″ thick.
B_{23}	17–20″	Dark brown (10YR 4/3, moist) silty clay loam with compound structure of moderate medium angular blocky (having stronger vertical than horizontal cleavage planes) and moderate medium platy; continuous, thick high-contrast clay skins on vertical faces of structural peds; very firm; very few fine prominent mottles (5YR 4/5, moist) in the lower part of the horizon, pH 4.2; diffuse and irregular lower horizon boundary. 3 to 5″ thick.
D	20–27″	Olive gray (5Y 5/2, moist) clay with moderate fine to very fine platy structure. Has occasional but weak vertical cleavage planes; very firm; very few fine prominent mottles (10YR 5/8, moist); pH 3.9; diffuse and smooth lower horizon boundary. 7 to 36″ thick.
Dr	27+″	Olive gray to light olive gray (5Y 5/2 to 6/2, moist) shale having very thinly-laminated, rather loosely-bedded structure; many iron-oxide streaks (10YR 5/8, moist) on the horizontal structural planes; individual shale flakes are very firm when moist and very hard to extremely hard when dry; pH 3.7. Many feet thick.

[10] Tentative series name.

Field examination of the acid shale revealed the presence of pyritized fossils. The pyrite crystals present were in various stages of decomposition i.e. ranging from fresh yellow perfect cubes to a dark gray powder. Chemical analysis of the powder showed it to be mostly $FeSO_4$. The decomposition of the pyrite crystals may be taking place in the following manner:

$$2FeS_2 + 7O_2 + 2H_2O \longrightarrow 2FeSO_4 + 2H_2SO_4$$

Such a reaction would lead to extreme acid conditions. Table 2 shows the very low pH (high acidity) in the underlying shale as well as the possible influence this acidity has on overlying materials. The siltstone overlying the shale, inherently, has a much lower acidity (higher pH).

The above study illustrates the impact a geologic material can have on soil properties even if only as an "underlying layer". The extent of that influence depends on the make up of the geologic material, especially those constituents which exhibit a "dynamic-aspect" i.e. active-acidity produced continuously by a mineral or chemical compound present in it.

E. *Soils of Taylor County: a preliminary study of "Acid Gray-Wooded" soils in Central Wisconsin*

Taylor County is covered by reddish-brown, acid till and glaciofluvium of late Wisconsin age and Patrician source (Part of the Chippewa Lobe of the continental glacier). With the possible exception of the terminal moraine that extends across the county from north-east to south-west, the drift is overlain by a deep to moderately deep blanket of loess. The loess, in many depressed sites, has assumed the characteristics of lacustrine silts.

The silt mantled zonal soils of Taylor County represent varying stages of "Gray-Wooded" solum development, under varying drainage and microclimatic conditions. Most, if not all of the "Acid Gray-Wooded" soils in Taylor and the adjacent counties developed in deep to moderately deep silts on level to gently rolling topography. Unlike the true Gray-Wooded soils of Canada that have calcareous parent materials, the soils of Taylor County developed in acid silts and underlain by slightly to moderately acid deposits of sandy clay loam to clay loam glacial till, sandy gravelly outwash or lacustrine silts and clays. The following abbreviated descriptions illustrate the range of soil profile characteristics found in the area.

Laboratory analysis showed a two-fold increase in clay content from A_2 to B_{21} horizon (15 vs. 29 percent respectively). Abundance of clay skins in the lower B horizon and many continuous silt coatings on ped surfaces in the upper B point to a clay movement along vertical surfaces resulting in a methodic degradation of the upper B horizon.

BRILL SILT LOAM (A MONOSEQUAL "ACID GRAY-WOODED" SOIL)

HORIZON	DEPTH	COLOR (MOIST)	TEXTURE	pH
Ap	0–4″	10YR 4/2	Silt loam	5.5
A_2	4–13″	10YR 5/2	Silt loam	5.0
B&A	13–15″	7.5YR 4/4	Silty clay loam	5.0
B_{22}	15–21″	7.5YR 4/4	Silty clay loam	5.0
B_{23}	21–27″	10YR 4/3	Silty clay loam	5.0
B_3	27–30″	10YR 4/3	Silty clay loam	5.3
C	30–40″	10YR 4/3	Silt loam	6.0
D	40+″	....	Sand and gravel	6.0

NOTE: Although initially described as a Gray-Brown Podzolic, this soil shows strong evidence of an "Acid Gray-Wooded" type of profile e.g. deep tonguing, degradation (destruction) of the B horizon (B&A or A&B layers), absence of A_3 or B_1 horizons, thickness and whitish color of A_2 horizon.

STAMBAUGH SILT LOAM (PODZOL SOIL)

HORIZON	DEPTH	COLOR (MOIST)	TEXTURE	pH
Ao	1–0″	10YR 2/2–2/1	Organic matter	6.0
A_2	0–4″	10YR 5/2	Silt loam	5.5
Bir	4–10″	7.5YR 4/4	Silt loam	5.3
Bm_1	10–18″	10YR 4/3	Silt loam	5.5
Bm_2	18–28″	10YR 6/2	Very fine sandy loam	5.0
Dm	28–29″	7.5YR 4/4	Sand and gravel	5.5
D	29+″	7.5YR 4/4	Sand and gravel	6.0

NOTE: The profile shows a relatively thin A_2 with little tonguing and an iron-enriched layer (Bir) underlain by a series of strongly cemented horizons (Bm_1, Bm_2, Dm). Note the complete absence of a "degraded-layer" (B&A) in the upper B.

BOHEMIAN SILT LOAM (ACID VARIANT), A BISEQUAL "ACID GRAY-WOODED SOIL"

HORIZON	DEPTH	COLOR (MOIST)	TEXTURE	pH
Ap	0–6″	10YR 4/2	Silt loam	6.0
Bir	6–9″	10YR 4/4	Silt loam	5.5
A_2	9–12″	10YR 6/2	Silt loam	5.3
A&B	12–15″	5YR 4/3	Silt loam	4.8
B_{22}	15–27″	5YR 4/4	Silty clay loam	4.5
B_3	27–37″	5YR 4/4	Silt loam	4.8
C	37+″	5YR 4/4–4/6	Silt/very fine sand	5.2

NOTE: This soil has a bisequal profile i.e. a repeated succession of eluvial (leached)—illuvial (accumulation) horizons, the upper sequence usually being an A_2–Bir (iron and/or organic matter enriched layer) combination, underlain by an A_2–B_2 (textural layer) sequence.

The textures in the various horizons reflected the silty nature of the parent loess and/or lacustrine silt. The A_1 and A_2 horizons generally are silt loam. The transitional (A&B or B&A) zone of degradation and the underlying B_2 are a heavy silt loam to silty clay loam. In some few instances the A_2 appears to grade abruptly into a clayey B. In no instance did an "Acid Gray-Wooded" profile display either A_3 or B_1. Both were entirely lacking or were replaced by an A&B (or B&A) horizon.

A fragipan-type cementation was found in several of the observed "Acid Gray-Wooded" soils. Among the monosequal "Acid Gray-Wooded" soils (lacking the A_2-Bir or A_2-Bhir sequence), fragipans are most prominently expressed in the B_3 and upper C horizons. The structure of the B horizon in the "Acid Gray-Wooded" soils usually is compound; moderate, medium to coarse prisms that break under pressure to moderate medium subangular to angular blocky peds. A general macro- to microplatiness is also evident. The prismatic structural form is obvious even more in the undisturbed profile, where tongues of A_2 and prominent silt coats extend along the prisms' vertical faces. Toward the lower B, the prismatic structural form becomes weaker and, generally coarser. The subangular to angular blocky structural form is most strongly developed in the middle B and becomes weaker and coarser in the lower parts of the solum.

Conclusions

In the preceding pages selected instances are cited which establish a definite relationship between soil profile characteristics and the type of geologic material in which the profile develops. An attempt was made to describe as fully as possible those properties observable in the field, and in addition, conduct specific laboratory analyses.

The extent to which a soil profile displays inherent geologic characteristics depends on: (a) the degree of uniformity ("stratification") of the parent-material, its texture and mineralogy, (b) position of the soil in the landscape, especially relative to other types of rock materials, (c) the intensity and duration of surface exposure.

The degree of certainty with which a particular soil profile characteristic can be attributed to the geologic substructure rather than to climate, organisms and/or time, will depend on accuracy and extent of field observation and of course on laboratory analyses. Each case has to be judged on an individual basis and generalizations avoided unless enough data, field and laboratory, are available.

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THE BASE OF THE ST. PETER SANDSTONE IN SOUTHWESTERN WISCONSIN*

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The problem of the base of the St. Peter sandstone formation in southwestern Wisconsin has been debated for many years. The paucity of exposures of this contact hampered investigation greatly and it awaited the collection of logs of wells based on samples of the cuttings to understand much of the phenomena. From this data the existence of considerable amounts of chert pebble conglomerate, chert rubble, sandstone, in part quartzitic, and non-calcareous shale together with some dolomite or dolomite conglomerate was established. These strata are here termed the "basal beds" and are very little exposed in either natural or artificial exposures. Problems which arise consist of: (1) whether or not the basal beds are part of the original St. Peter sandstone formation or belong in the older Prairie du Chien group, (2) whether an unconformity is present at the top of these beds or at their bottom, and (3) determination of the true bottom of the basal beds, for there may be some non-dolomitic shale layers in the Prairie du Chien strata. The nature of the basal beds which strongly indicate reworked weathered material and the fact that they rest upon various older formations down to the Cambrian Franconia sandstone, as well as their difference from known Prairie du Chien strata convince the writer that there is a pronounced unconformity at the bottom of this downward extension of the St. Peter sandstone. It is possible, however, that there are some non-calcareous shales in the Prairie du Chien group. A. E. Flint (1956) deals almost entirely with the upper contact of the basal beds although he discusses some exploration drill holes which penetrated the basal strata. The present paper is confined to the same area that was discussed by Flint.

Previous Investigations. Although study of the problem of the base of the St. Peter has been carried on for many years (Heller 1956, Powers 1935, Trowbridge and Atwater 1934), few geologists have had access to subsurface information derived from sample-controlled logs of water wells. Such information is vital to a correct interpretation of the evidence which bears on this problem. Flint (1956) reviewed the opinions of almost all of the students of the

* Paper read at the 90th annual meeting of the Wisconsin Academy of Sciences, Arts, and Letters. Mr. Thwaites died June 7, 1961.

area so thoroughly that little can be added. He omits, however, a paper by Twenhofel and Thwaites (1919) which was based on a report on the Sparta and Tomah quadrangles, Wisconsin, which was refused publication by the U. S. Geological Survey. In this paper a surface exposure of St. Peter sandstone where it lies on Cambrian strata was discussed.

Nature of Subsurface Data. The following factors must be evaluated in order to use subsurface data from cable tool cuttings. In surface exposures all the strata above a given outcrop are either covered or removed by erosion, and everything below the base of the exposure is concealed. Lateral relations between exposures is confused by both dip of the strata and lenticular deposition. The great advantage of drill records is that they are vertical, or near vertical, sections which are subject only to the hazards of obtaining good cuttings or cores if a core drill is used. The basal beds at the base of the outcrops of St.Peter sandstone are concealed because the outcrops are so friable that sand weathered from them conceals the outcrop of the less resistant basal beds. Cable tool drilling through the basal beds is generally accomplished with considerable difficulty from caving particularly of the shales. With core tools recovery is poor. In many wells the initial drilling is not too difficult, but safe completion demands casing. In some wells this casing must be under-reamed. The caved fragments are normally much larger than are actual cuttings, but some are broken up by the drill and others are rounded by mixture with drill cuttings which are agitated by the action of the tools. This process of admixture may give a false color to some of the cuttings. It is very difficult to distinguish thin layers of interbedded shale in sandstone and to separate cemented conglomerate of broken dolomite from true solid dolomite. Correlation of the material is very difficult unless the hole is carried down into recognizable formations below. This applies particularly to the exploratory holes of the U. S. Geological Survey, many of which were not drilled enough to identify the formation at the bottom. Although some of the difficulties described above make interpretations of cable tool cuttings somewhat difficult, it is clear the attitude of many old-time geologists that cable tool cuttings are valueless is not just. It may be remarked that had caving been so bad as they claimed, it would have been almost impossible to complete a hole. When a record of casing is available, the order in which each string of pipe was installed can generally be found which is a great advantage in interpreting cuttings. Another source of data is from fresh highway cuts. An enormous amount of information was lost because the geologists of the Wisconsin Survey were not encouraged to examine highway grading while it was fresh. At the present time this involves walking over the project, for cuts even in firm bedrock are slanted back, covered with black earth, and seeded so that by the time the road is opened to traffic nothing whatever can be seen.

Underlying Formations. In the normal stratigraphic succession the St. Peter sandstone is underlain by the dolomites of the Prairie du Chien group (Powers 1956, Heller 1935, Trowbridge and Atwater 1934). If localities where the basal beds are thick are considered, it is found that the next underlying formation ranges down to the Franconia sandstone of Cambrian age. Such localities where there is no recognizable Prairie du Chien are not as common in southwestern Wisconsin as farther to the east. In some places the converse is true and there is no St. Peter sandstone between Prairie du Chien dolomite and basal Platteville strata. This discrimination is rendered difficult by reason of the sandy Glenwood member of the Platteville and sandstone which is properly included in the Prairie du Chien. In many well records, particularly drillers logs, the sandstones of the Prairie du Chien have been erroneously correlated as St. Peter. Although the official usage of the U. S. and some other geological surveys is to subdivide the Prairie du Chien group into three distinct formations, the writer is far from convinced that this procedure is practicable in Wisconsin. The formations in descending order are: Shakopee (Willow River) dolomite, New Richmond (Root Valley) sandstone, and Oneota dolomite. The relative stratigraphic positions of some of the type localities of these formations is not clear. The well logs examined by the writer show definitely that instead of a single New Richmond sandstone, there are in some places several sandstone beds interbedded with dolomite and in other places no sandstone at all. It seems probable that the sandstone beds within the Prairie du Chien are lenticular. The mixture of sandstone and dolomite strongly suggests conditions like the east coast of Florida where sand brought by waves and currents from the north is interbedded with local calcareous deposits. The writer has never been able to make any definite subdivision of the entire group of dolomites in Wisconsin and decidedly prefers to use the name Prairie du Chien as a formation rather than as a group; in fact until recently Owen's ancient name "Lower Magnesian" was still used by the Wisconsin Geological Survey. In many sections it is difficult to determine the exact top of the Prairie du Chien. The writer has fixed it by presence of non-dolomitic shale and chert conglomerate in the overlying beds but some noncalcareous green-gray shale is present throughout the entire Prairie du Chien sequence for the most part as mere thin laminae or small specks. Just how this noncalcareous nature is reconciled with the adjacent dolomite has not been determined. A confusing feature of the contact with the basal beds is the presence of organic reefs or bioherms throughout the Prairie du Chien dolomite. Although oolitic chert and dolomite are most abundant in the recognized Prairie du Chien, it is by no means certain that either is entirely confined to it. Fragmental oolitic chert is certainly present in the overlying basal St. Peter beds and it may be indigenous to the dolomite layers of those strata although this has not been definitely proved. The supposed dolomites of the basal beds may possibly be cemented conglomerate or cemented talus. Attempts to subdivide the Prairie du Chien by use of insoluble residues were not successful. The arithmetical average of insoluble material in 55 analyses collected by Steidtmann (Steitdmann, 1924, pp. 185–187) is 8.5% but the range is from 1.37% to 26.26% which is too much of a scatter to permit an accurate average. The clays formed from weathering of the Prairie du Chien under modern climatic conditions are decidedly more brown than are the clays of the basal shales, some of which are very pale pink. It is impossible to make an isopach map of the Prairie du Chien because not only of the uncertainty of its top but chiefly because of rapid changes of thickness whose distribution is at present entirely unpredictable. It is found, however, that a map can be made of the combined St. Peter-Prairie du Chien thickness. This ranges from 300 feet along the Mississippi River to less than 100 feet west of Milwaukee. No Prairie du Chien is reported in any well within a considerable area in southeastern Wisconsin although it has been recognized in some well logs in the southern part of Michigan.

Basal St. Peter Beds Below the Original St. Peter Sandstone. When the St. Peter was named by Owen (Wilmarth, 1938, pp. 1884–1885) over a century ago, the term applied only to the "soft white sandstone" which is exposed along what is now called Minnesota River. Since exposures of the basal contact are naturally confined to localities where the formation is abnormally thin, nothing was known of the strata which are confined to areas where the entire St. Peter is abnormally thick. In preparing geological maps it was presumed that the underlying Prairie du Chien dolomite was present in many areas where subsequent drilling failed to demonstrate this fact. These localities of thick St. Peter naturally offer few outcrops, for the lower strata are covered by sand from the disintegration of the higher beds. Only one outcrop has been described where the St. Peter rests upon Cambrian strata. Twenhofel and Thwaites (1919, p. 638) describe the outcrop at Middle Ridge in the Sparta quadrangle of western Wisconsin, where St. Peter sandstone rests "on a residuum of red clay and chert which is altogether without stratification." They concluded: "This residuum was derived from 'the weathering of' older formations." The underlying formation at this locality is the Jordan member of the Trempealeau formation of the Upper Cambrian. In 1914 the writer visited several exposures in the Sugar River Valley near Albany, Wisconsin which displayed at that time the lower beds of the St. Peter without any of the underlying formation. At that time there were large pits in the chert rubble, for it was used to surface sandy roads in that vicinity. Since then its unsuitability with automobile tires has caused these pits to be abandoned and it is very unlikely that any are now worked. Similar material is often encountered in drilling and does not appear to cave extensivly. It was called "cotton rock" in some of the exploration drill holes of southwestern Wisconsin. Field notes on and photographs of these exposures are still extant in the office of the Wisconsin Geological Survey. The following quotations are from the writer's notes of 1914.

> "Center sec. 8, T. 3 N., R. 10 E. Gully west of school house on south side of Allen Creek shows poor exposure of ordinary yellowish to very ferruginous St. Peter. Bedding locally steeply tilted and is interbedded with red sandy to clay shale and oolitic chert. At one point near the north end is a bed of broken weathered chert passing into chert sandstone conglomerate with small rounded cherts about ⅛th inch diameter. Above this is usual St. Peter sandstone. Chert bed is clearly regolith and not reworked much.
>
> "NE. ¼ SE. ¼ sec. 16, T. 3 N., R. 9 E. West of here visited several chert pits. The largest was about 1½ miles north of Albany. This is a large excavation in irregularly broken white to yellowish-red chert which varies from very hard to chalky and is extensively used on roads in the vicinity. In the chert there is occasional bedding but most is loose or without bedding. There are also layers of yellowish-brown sandstone and chert-sandstone conglomerate. At the very bottom of pit was found very fine-grained calcareous buff and red streaked sandstone and red shale much like that seen in gully to east. At top of pit main part of sandstone is like usual St. Peter but shows layers of red shale."

Fig. 1 is a photograph of this pit by W. O. Hotchkiss.

Alden (1918, pp. 81–82) briefly described some of the above exposures saying:

> "In a street cut just north of the Schoolhouse at Albany, 3 to 5 feet of this loose chert was seen overlying a rounded and weathered surface of the limestone (dolomite) and underlying the undulating basal layers of sandstone, in whose lowest layer fragments of chert are included."

Alden mentions the red to white shale but concludes that most of the exposures were so poor that the true relations could not be found. A section is given of a cut on the Illinois Central Railroad (NW. ¼ sec. 29, T. 4 N., R. 8 E.) where he describes thin layers of white sandstone, in part shaly, which grade laterally into partly brecciated dolomite. Alden suggested that the dolomite was a reef

FIGURE 1. Exposure of chert rubble near Albany, Wisconsin.

formed at the same time as the adjacent sandstone. It is probably part of the basal beds and hence none of the true Prairie du Chien was exposed. Alden also described quartzitized sandstone in these beds.

A road cut on U. S. 14 about 5.4 miles west of Readstown was not visited by the writer until several years after its completion. The location is NW. 1/4 NW. 1/4 sec. 22, T. 12 N., R. 4 W. One end of the cut is in dolomite which overhangs for a few feet above red shale beneath and is overlain by normal St. Peter sandstone. In the present condition of the cut, it is difficult to determine if the overhanging contact is erosional or due to folding of the strata while still soft. It is possible that the dolomite is really a part of the basal St. Peter beds. No exposure is known to the writer in which the bedding of the Prairie du Chien is demonstrably truncated by either the upper St. Peter or these basal beds. Several localities have been observed in which St. Peter sandstone appears to fill narrow channels in the older dolomite. Fig. 2 shows one of these which was discovered in the Steil exploration of the U. S. Geological Survey near Highland, Wisconsin. The shale just above the dolomite appears to follow the irregular contact. Another exposure in the abandoned railroad cut at Dill, west of Monroe, was visited by the writer in 1907 while working as assistant to Alden. The cut was undoubtedly much fresher at that time than when it was visited by Flint more than 40 years later. Flint described this as a filling of a depression between two adjacent domes of dolomite, but there was no suggestion of such a structure at the time it was visited by the writer.

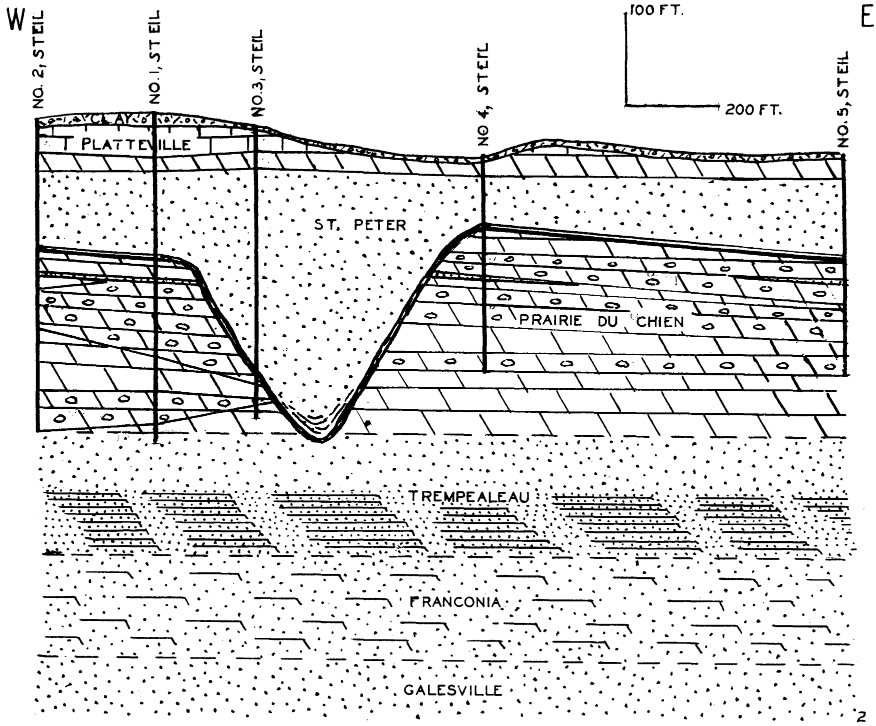

FIGURE 2. Cross section of Steil exploration drill holes, near Highland, Wisconsin, redrawn by the writer. It is suggested that the St. Peter sandstone fills an erosion valley in the top of the Prairie du Chien dolomite instead of a depression between organic reefs. A layer of deoxidized shale follows the contact. Old formations added from records of nearby water wells.

Another similar occurrence was visited by the writer while he was a student at the University of Wisconsin. At that time our instructor, C. K. Leith, accounted for the narrow wedge of sandstone in the dolomite as a graben. When visited years later weathering had destroyed the entire exposure.

Well Records. The following well records are all located in or near southwestern Wisconsin and are based on samples of the cuttings which were examined by the writer. The strata extend downward from the highest St. Peter sandstone, excluding the sandy base of the Platteville, to the highest recognizable Cambrian strata. They give a much better knowledge of the basal beds than can be obtained from outcrops.

PARTIAL LOG OF VILLAGE WELL, NO. 2, LINDEN, WISCONSIN

	Thickness feet	Depth feet
Sandstone, medium to fine-grained, light gray to white	90	300
Sandstone, medium to fine-grained, coarse-grained to silty	10	310
Shale, gray, red, and green-gray	35	345
Dolomite, slightly sandy, light gray	40	385
Dolomite, light gray; shale, red and green-gray	10	395
Shale, red and green-gray	30	425
Sandstone, medium to fine-grained, light gray, dolomitic	5	430
Dolomite, light gray; sandstone, fine-grained, gray, dolomitic	15	445
Sandstone, fine to medium-grained, light gray; no sample 450–455	25	470
Shale, red and green-gray; chert, white	10	480
Conglomerate, chert pebbles, white, in sandstone, coarse to fine-grained; shale, red caved(?)	25	505
Shale, red and green-gray	10	515
Sandstone, medium to fine-grained, pink; shale, red, probably caved	20	535
Shale, dark red, mottled with green-gray	60	595
Total St. Peter 385 feet		
Shale, very sandy, pink, very dolomitic, glauconitic. This is part of Cambrian Franconia formation		

Casing was inserted from 284 to 351 before drilling deeper. It was then thought that Prairie du Chien dolomite had been reached. Later pipe was set from 342 to 434. After drilling to 776 pipe was hung from the top of the last pipe to depth 638. The cuttings from 434 to 776 may have been contaminated by cavings.

PARTIAL LOG OF VILLAGE WELL NO. 2, HAZEL GREEN, WISCONSIN

	Thickness feet	Depth feet
Sandstone, coarse to fine-grained, light gray to pink	115	475
Shale, medium-gray and pale red; sandstone, pink-gray	5	480
Sandstone, medium to fine-grained, pale pink-gray	50	530
Shale, pale red, some green-gray, base dolomitic	15	545
Dolomite, oolitic at base, light gray and pink; shale red, green-gray, some sand	35	580
Shale, red, green-gray; chert and dolomite oolites	10	590
Sandstone, medium to fine-grained; shale, red and green-gray	10	600
Shale, red and green-gray; some sand, mica and oolitic chert	35	635
Chert rubble, light gray, not caving; some shale like above; some sandstone, light gray quartzitic	50	685
Sandstone, medium to coarse-grained, light gray to pink; much chert and red shale; no samples 690–695, 700–705	40	725
Shale, sandy, red	5	730
Total St. Peter 379 feet		
Dolomite of Trempealeau formation		

The well was cased to 554.5 feet before drilling deeper. At 760 caving became so bad that progress was stopped until casing was installed from 711 to 760. Samples below 760 examined by J. B. Steuerwald.

PARTIAL LOG OF CITY WELL NO. 1, SHULLSBURG, WISCONSIN

	Thickness feet	Depth feet
Sandstone, medium to coarse-grained, light gray and light pink	202	395
Sandstone, coarse-grained, red; shale, red	2	397
Shale, dark red mottled with green-gray; pebbles white chert	38	435
Chert rubble, white; shale, red	18	453
Shale, dark red; chert, white	9	462
Shale, red and green-gray; sandstone and chert caved	20	482
Sandstone, fine-grained, gray, very dolomitic	20	502
Sandstone, fine-grained, gray, pink and green-gray; some shale and chert, caved(?)	18	520
Total St. Peter 327 feet		
Dolomite of Trempealeau formation		

The well was drilled to 444. Strata below caved so badly that a liner was inserted to 520. This well is shown in Fig. 3.

PARTIAL LOG OF CITY WELL NO. 3, DE WITT, IOWA

	Thickness feet	Depth feet
Sandstone, medium to fine-grained, light gray to white	215	1065
Sandstone, fine to medium-grained, light pink to yellow-gray, pebbles of chert and dolomite	15	1080
Shale, dark purple-red, some green-gray; pebbles of chert up to 1 cm. diameter	55	1135
Dolomite, gray, may be conglomerate; shale and chert, caved	26	1161
Shale, light green-gray, some sand and chert	12	1173
Chert, white and gray, part oolitic; some sand; some shale; some dolomite	87	1260
Sandstone, fine to medium-grained, light gray to white; some chert, dolomite and shale, caved(?)	40	1300
Dolomite, light purple, possibly conglomerate; some sandstone	10	1310
Sandstone, fine-grained, light gray, dolomite, pyritic	10	1320
Dolomite, sandy, light purple, possibly conglomerate	40	1360
Total St. Peter 510 feet		
Dolomite of Trempealeau formation		

Samples were also examined by W. H. Norton, Iowa Geological Survey. Casing was underreamed from 1100 feet to 1256.

Interpretation of the Basal Beds. The presence of these basal beds below the original St. Peter sandstone raises several questions. Are they conformable below the sandstone of outcrops? Are they unconformable on older formations? Are they a downward continuation of the St. Peter? Should they be made a separate formation not previously recognized? Are they a part of the underlying Shakopee formation of the Prairie du Chien group? Norton (pp. 37–42) desired to make them a separate formation although he regarded them as a downward continuation of the St. Peter. He knew of no surface exposure from which to obtain a formational name so suggested a type locality in a well. The writer advised against this and the project was dropped. The chief difficulty in interpretation is the apparent presence of dolomite which seems inconsistent with the non-dolomitic nature of all of the shale. It has been suggested that these beds are not true dolomite but a conglomerate of cemented dolomite pebbles. Alden noted a brecciated structure in one outcrop. Some of the sandstone layers are dolo-

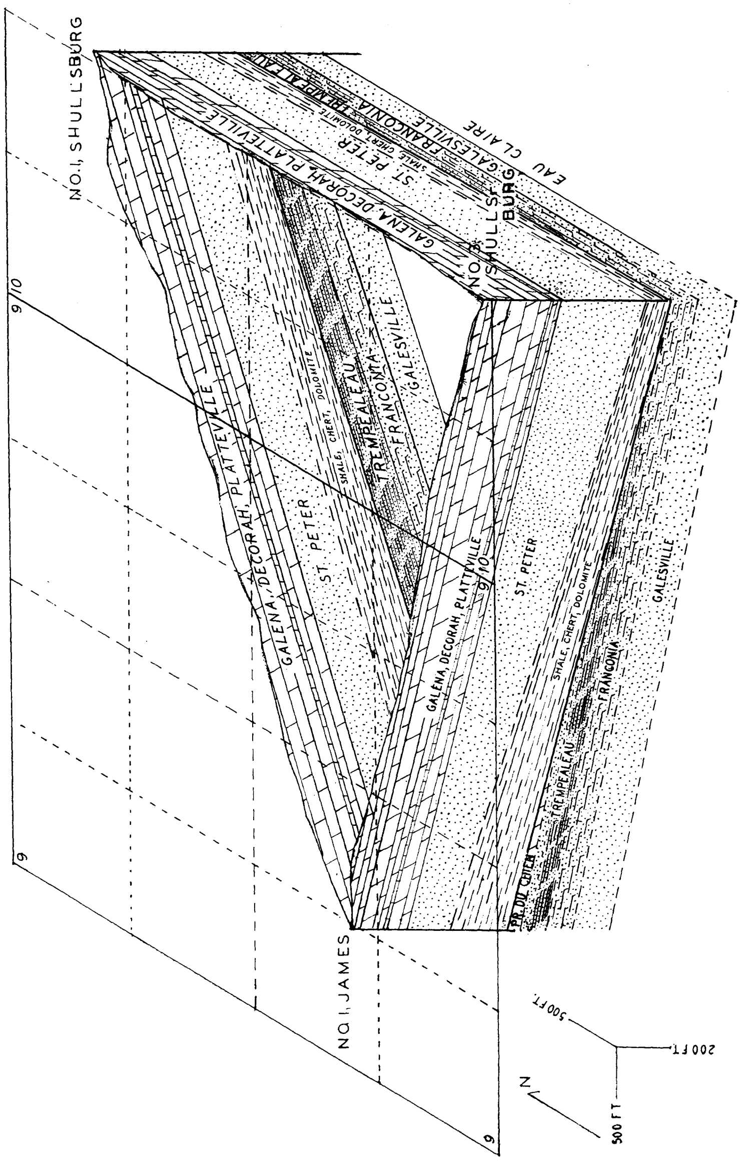

FIGURE 3. Fence diagram of subsurface geology at Shullsburg, Wisconsin. No. 1 James was an exploration drill hole of the U. S. Geological Survey. The other holes are water wells of which only No. 1 penetrates the Cambrian formations. A slight bevel of pre-St. Peter formations is shown.

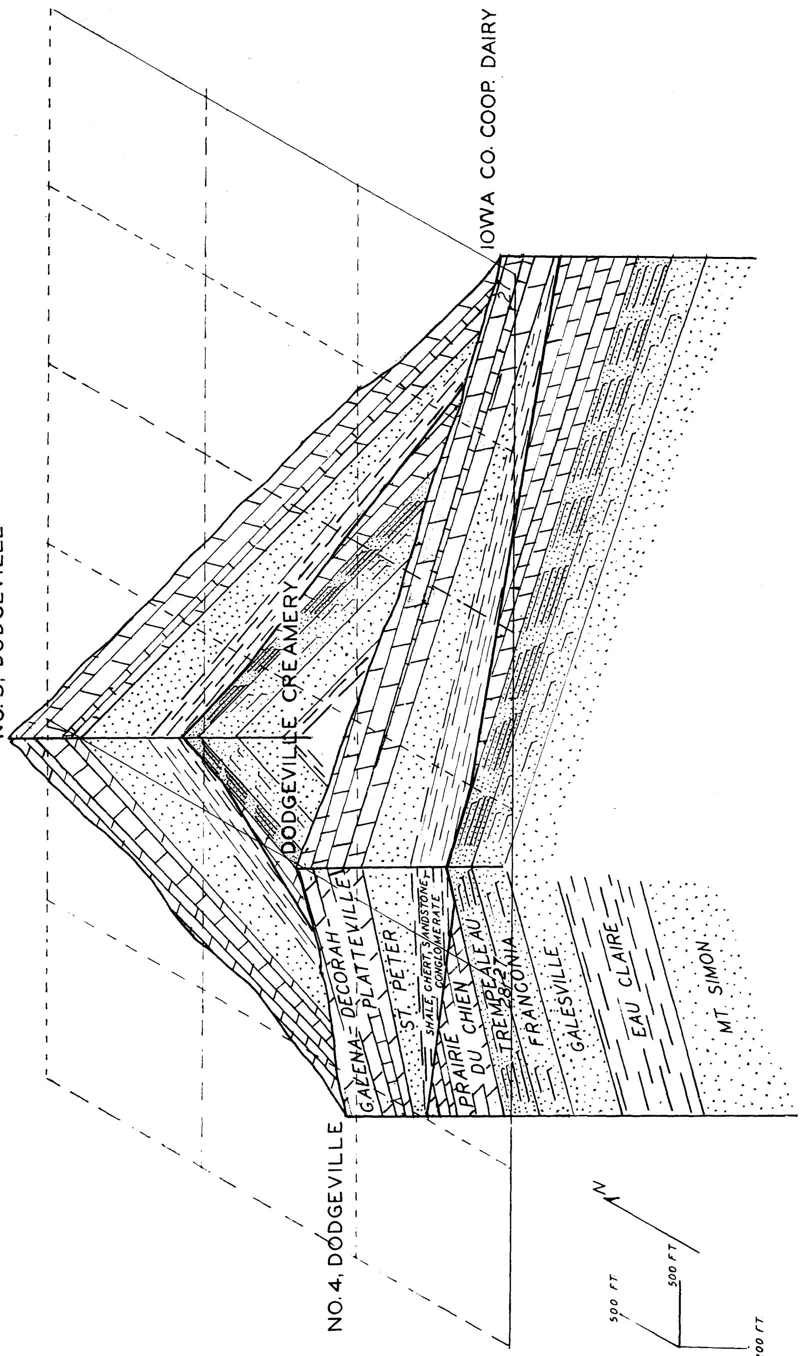

FIGURE 4. Fence diagram of subsurface geology at Dodgeville, Wisconsin.

mitic. Some of the sandstone is quartzitic and breaks into chips under the drill. The red and pink colors of some sandstone layers may be due to drilling up of caved fragments of red shale. The mottling of green-gray color in the red is explicable by deoxidation from organic matter. The red color of the shale does not agree with the color of modern residual clays from the Prairie du Chien dolomite but might have been formed under a different climate. The chert rubble (Fig. 1) is too free of clay to be regarded as a residual soil but is explicable as a reworked deposit. The chert pebbles are not well rounded, but many seem to display the results of weathering prior to deposition. Some sand layers were laid down in the rubble. It is possible that the supposed dolomite layers are cemented conglomerate or talus from dolomite hills not far distant. It is far from clear that any oolitic dolomite or oolitic chert is present in primary dolomite of these beds. All such occurrences are probably

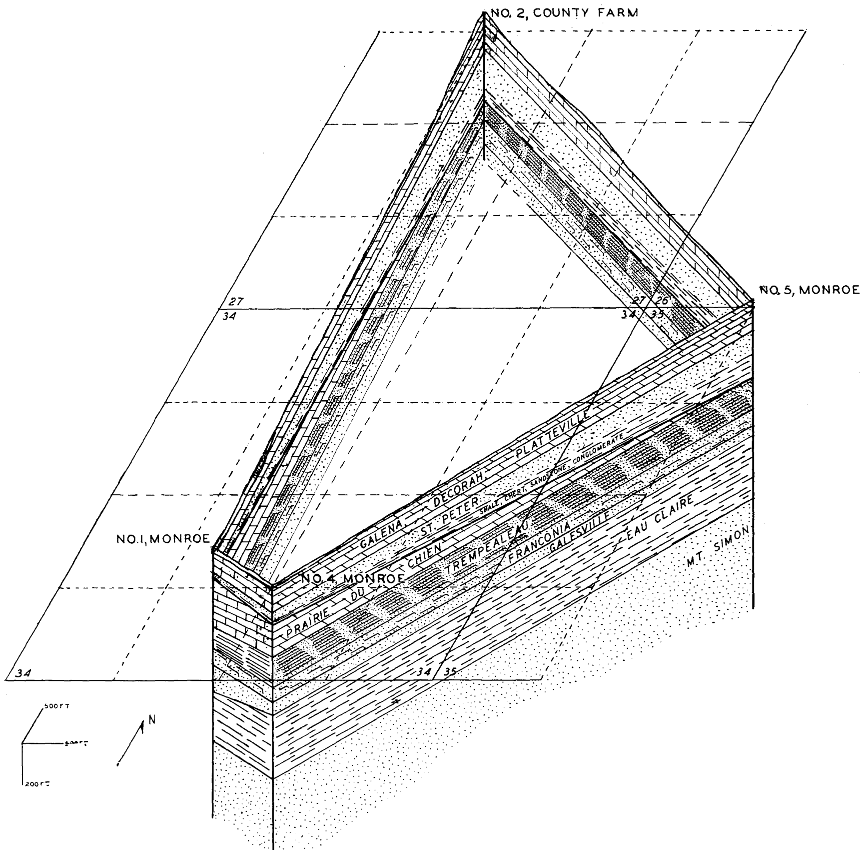

FIGURE 5. Fence diagram of subsurface geology at Monroe, Wisconsin.

fragmental. The chert-sandstone conglomerate positively indicates reworking of a chert residuum. It is possible that dolomite accumulated in sheltered localities within the hills of Prairie du Chien dolomite without adding enough to the adjacent shales to make them effervesce with acid. The very irregular sequence of the basal beds where it is almost, if not quite, impossible to correlate beds between adjacent holes is a natural result of waves and currents of an advancing sea which was interspersed by many islands. The main evidence that the basal beds are conformable with the overlying St. Peter sandstone is the occurrence of many layers of sandstone clear down to their base. Furthermore Figs. 3, 4, 5, 6, and 7 indicate clearly that the base of the basal beds truncates older formations down to the Cambrian Franconia formation. None of the basal beds, with the possible exception of the green-gray shale layers, is at all like any known Shakopee strata which has ever been observed in outcrop (Powers, Trowbridge, and Atwater). The basal beds served to level up the irregular surface of positively known Prairie du Chien strata. The irregularity of the Prairie du Chien surface is due in part to reefs or bioherms of organic origin. Their presence is no indication that there is conformity, for such accumu-

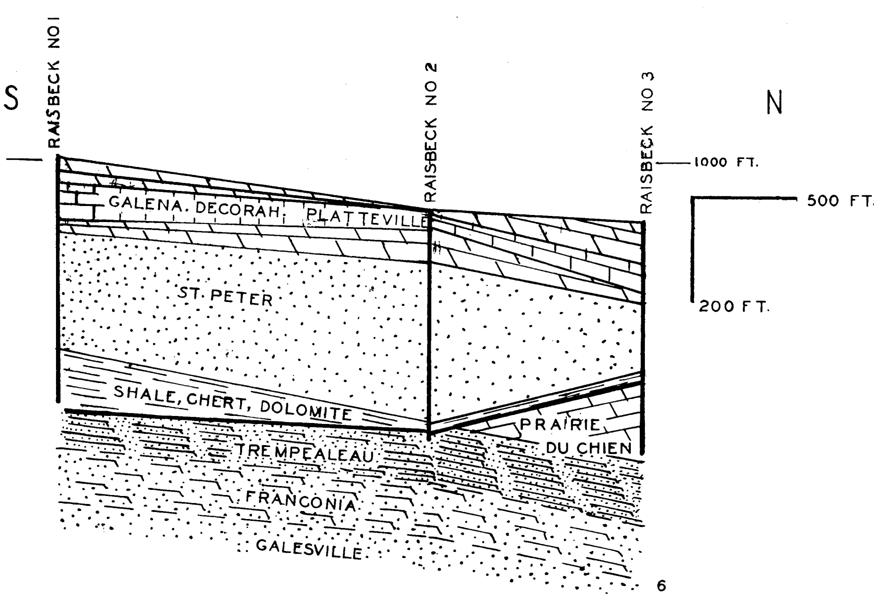

FIGURE 6. Geologic section of Raisbeck exploration of U. S. Geological Survey near Meekers Grove, Wisconsin. Although the abrupt border of the Prairie du Chien dolomite might be accounted for by original deposition the relation of the basal St. Peter beds strongly suggests an unconformity. The older formations were added from records of nearby water wells.

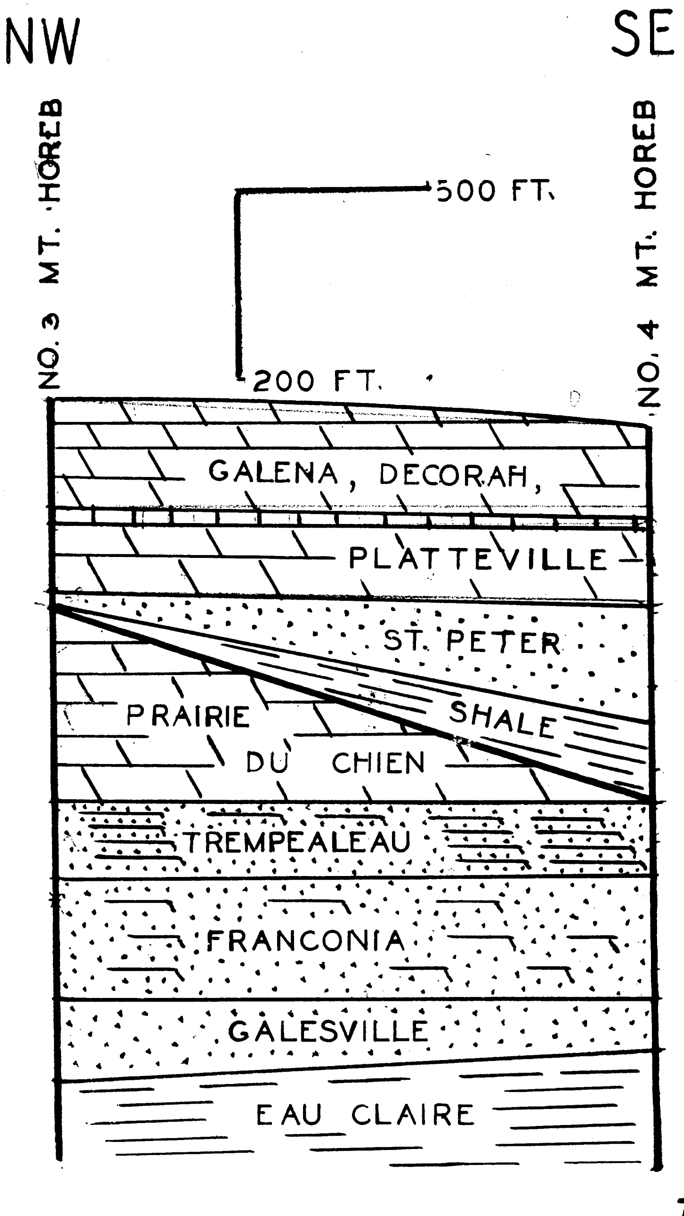

FIGURE 7. Cross section between two water wells in Mt. Horeb, Wisconsin. The non-dolomitic nature of the shale, which is present in one well and not in the other suggests an unconformity with reworking of residual clays.

lations in the Silurian dolomite of northeastern Wisconsin form hills on the present erosion surface (Thwaites and Bertrand, 1957, pp. 836–838). That the bedding in the bedrock is parallel to the slope of these hills is no indication that the Pleistocene is conformable on the Silurian. Much more important evidence is that shown in Fig. 8, the fact that the basal beds locally rest on formations

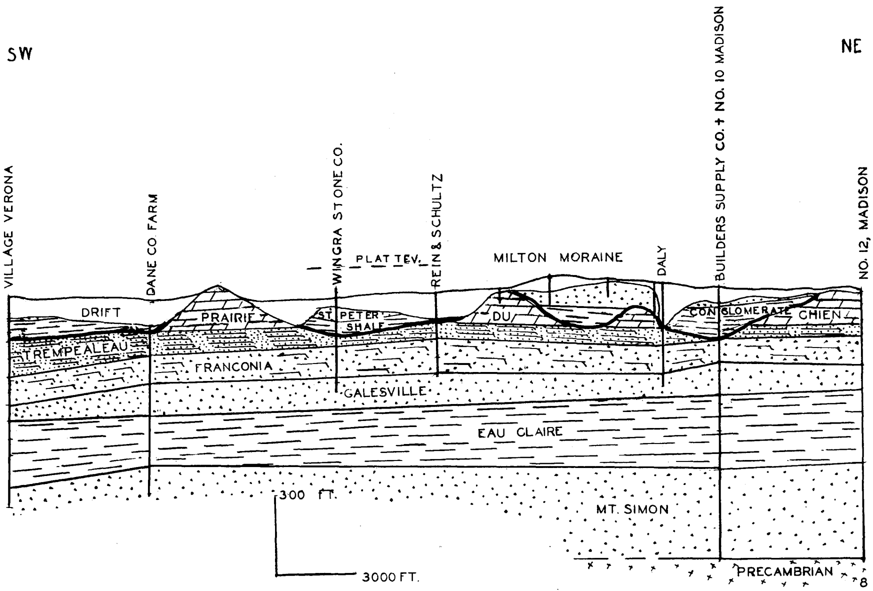

FIGURE 8. Geologic section from Verona to Madison, Wisconsin. Some well logs reported by W. C. Alden were included. Other records were based on examination of samples. A striking unconformity is indicated at the base of the St. Peter.

as old as the Cambrian Franconia sandstone. This fact makes it very difficult to regard them as a lateral replacement of the adjacent Prairie du Chien dolomite. The unconformity is at their base, not at their top next to the sandstone of the outcrops. Flint did not seem to be familiar with the basal beds, for he states:

> ". . . separating the impure dolomite and dolomitic limestone from the overlying St. Peter is a contact zone, which in places is more than 10 feet thick and consists of intercalated shale, sandstone, and admixtures of these locally cemented by dolomitic material. This interval is considered by some geologists as a basal phase of the St. Peter sandstone, but others have interpreted it as a weathered residuum on the upper Shakopee surface."

The writer concludes that these basal beds are not strictly residuum but reworked weathered material. It is possible that in some wells layers of sandstone within the Prairie du Chien have been confused with these basal St. Peter beds just as the sandstone at the base of the overlying Platteville is often mistakenly included in the St. Peter. Such an error would be minor, for such sandstones are rarely more than a few feet thick in Wisconsin.

Hypothesis of Subsurface Solution and Slump. The basal beds below the St. Peter sandstone proper show much evidence of slump and sliding. There are minor folds and faults, the surfaces of which are marked by slickensides. Samples of such slickensided surfaces are often recovered from caved fragments in cable tool holes. The writer was shown a core from a diamond drill hole in southwestern Wisconsin which displayed a joint in dolomite filled with red shale. Intrusion into broken dolomite is strongly suggested but whether the dolomite belongs to the Prairie du Chien or to the basal beds is not clear. The overhang of dolomite above shale which is exposed on U. S. Highway 14 may not be erosional but instead due to sliding of the strata while still soft. Such sliding would be expected on the irregular surface of the underlying Prairie du Chien regardless of the origin of the slope at that place. An overhang is not a normal erosional feature but could have been due either to wave erosion or lateral stream erosion. A possible origin through solution has also been suggested, but its association with the top of a shale bed strongly suggests sliding as the most probable origin. Flint suggests subsurface solution as the cause of some of these phenomena, but it seems unlikely that it is the same as that which caused, or was associated with, the sulphide mineralization of younger strata in southwestern Wisconsin. The features of sliding with minor faulting extend far outside the mineralized district and are not associated with any substantial amount of sulphide deposition. Solution due to normal ground waters seems unlikely, if not impossible, because the waters of the St. Peter almost wholly entered that formation through the overlying dolomites and limestones and thus became saturated with carbonate. It seems very improbable that solution was due to escaping ground water. The solution and slump phenomena extend far from the outcrop of this contact as shown in the figures here included.

Conclusions

(1) Flint (1956) is correct in concluding that the horizon which he considered the base of the St. Peter is conformable on underlying beds of shale which are here ascribed to the basal beds. (2) The basal beds below the normal St. Peter sandstone of outcrops vary greatly in thickness and level up the irregular top of the Prairie du Chien dolomite. (3) The shale is all non-calcareous and is associated with chert rubble, chert-pebble conglomerate, and quartzitized sandstone which are best accounted for as reworked residuum of the weathering of the Prairie du Chien. (4) No unaltered pre-St. Peter

soil profiles are known, for the waters of the St. Peter sea advanced through many narrow channels between islands and ridges of dolomite. (5) The basal beds almost certainly contain local patches of dolomite although there is a possibility that these could be cemented conglomerate or cemented talus formed from the older Prairie du Chien. (6) The shales of the basal beds are the probable cause of sliding with associated minor faulting and folding because they lie on sloping surfaces of dolomite. (7) The origin of the sloping surfaces varies and although no clear-cut examples of truncation of the Prairie du Chien strata have been discovered, subsurface exploration strongly suggests that such must occur. (8) Hills due to reef structure are common in the present day erosion surface of parts of Wisconsin and are abundant in the top of the Prairie du Chien. (9) The disturbances of the basal St. Peter beds clearly antedate the deposition of the overlying St. Peter sandstone. (10) The basal beds show no evidence of unconformity at the top but their base cuts across older strata down to the Cambrian Franconia formation in a way which cannot be explained by non-deposition of the Prairie du Chien but only by an erosion interval at its top.

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WATER TEMPERATURES IN A WELL NEAR WILD ROSE, WISCONSIN*

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Temperature measurements made in a well near Wild Rose, Wis., show that ground-water temperatures, which are generally assumed to be almost constant, fluctuate seasonally, and vary with depth. The measurements, made by the U. S. Geological Survey in cooperation with the Wisconsin Geological and Natural History Survey, are discussed because an understanding of ground-water temperatures is becoming increasingly important in Wisconsin. Many industries in the State depend upon the relatively uniform temperature of water from wells, and the attraction of Wisconsin's streams to thousands of sportsmen is the direct result of ground water discharging at temperatures favorable for cold-water game fish, especially trout. Moreover, the movement (Wenzel, 1942, p. 7) and the chemical character of ground water (Hem, 1959, p. 4) are related to its temperature. The knowledge gained by a study of ground-water temperatures in Wisconsin can aid in the development and conservation of the State's ground-water resources.

The temperature of ground water is usually determined by measuring the temperature of the water as it is pumped from a well or as it flows from a well or spring. Sometimes the temperature is measured by lowering a thermometer or other device directly into a well and measuring the temperature of the water at various depths in the well. In Wisconsin experience indicates that temperatures obtained in these ways usually cannot be used to describe the manner in which temperatures are distributed within the aquifer, because, in practice, the observed temperatures are related to the geology and the hydrology of the aquifer plus such other factors as well construction, discharge rate, and housing that are unrelated to the distribution of temperature in the aquifer. For reasons which will be discussed in detail in the ensuing pages, the temperatures observed in the well near Wild Rose are assumed to approximate closely the temperature of the ground water at various depths in the aquifer, and, as such, they are used to interpret the movement of heat within the aquifer and to illustrate the role of ground-water movement in the thermal regimen of the area.

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* Paper read at the 90th annual meeting of the Wisconsin Academy of Sciences, Arts, and Letters. Publication authorized by the Director, U. S. Geological Survey.

Ground-water temperatures have been measured since 1869 when Lord Kelvin first began making systematic observations of the earth's temperature (Darton, 1920). Particular attention has been given to "thermal" areas, geothermal gradients, heat flow, hot springs, and geysers (Jakowsky, 1950, p. 966–986). The occurrence of ground water in areas of extreme cold or permafrost also has been studied (Cederstrom and others, 1953; and Hopkins and others, 1955). Temperatures of soil also have received considerable attention (Chang, 1958). By contrast, little attention has been given to the causes and variations of ground-water temperatures in "nonthermal" areas. However, the temperature of discharging ground water is nearly always measured as part of a ground-water study. For example, in Wisconsin, Foley and others (1953, p. 88) measured the temperature of ground water sampled for chemical analyses from the "dolomite" and "sandstone" aquifers of the Milwaukee-Waukesha area. Other investigators have considered: (1) The temperature of water pumped from wells (Harder, 1960, p. 24–25, Rasmussen and Andreasen, 1959, p. 54–56); (2) the areal distribution of temperature in an aquifer (Darton, 1898; and Suter and others, 1959, p. 74–75); (3) the temperature of ground water in the United States at depths of 30 to 60 feet (Collins, 1925, p. 97–98); (4) the effect of artificial recharge on ground-water temperature (Leggette and Brashears, 1938, p. 414–418; Brashears, 1941, and 1946, p. 504, 511, 513–515; and Jennings, 1950); and (5) the effect of infiltration of water from a nearby stream on ground-water temperature (Kazman, 1948, p. 840–844; Rorabough, 1951, p. 169, and 1956, p. 162–164; and Simpson, 1952, p. 68–72).

METHODS

All the temperatures presented in this paper were measured by the U. S. Geological Survey with a single underwater thermometer. The thermometer consists of a thermister or temperature sensitive element, a constant-resistance insulated cable, a power supply, a Wheatstone bridge, and a microammeter. The water temperatures were measured by lowering the thermister into the well, stationing it at progressively greater depths, and reading the meter, which is calibrated in degrees Fahrenheit. The temperatures were read to 0.1 degree.

Although ground-water temperature at depths of 70 feet or more probably did not vary during this study, temperature measured at these depths at different times varied as much as 0.4°F. These differences are attributed to errors in calibration of the instrument. However, for a given set of measurements the deviation from the true temperature is constant.

Other sources of error have been recognized. These include: mixing of water from different depths by the cable; temperature changes due to heat exchange between the cable and the water in the well; and variations in the techniques of the different operators. In general, the quality of the measurements improved as the operators gained experience.

ACKNOWLEDGMENTS

The underwater thermometer is the property of the Division of Well Drilling, Wisconsin State Board of Health, and thanks are given for its use. The Wisconsin Conservation Department owns the well in which the measurements were made and the use of this well is gratefully acknowledged.

LOCATION OF THE WELL

The well in which the measurements were made is in central Wisconsin, in Waushara County, about 90 miles north of Madison. It is in the SE¼ sec. 24, T. 20 N., R. 10 E., about 0.5 mile north of the village of Wild Rose at the trout hatchery of the Wisconsin Conservation Department. Specifically, it is 300 feet west of Wisconsin State Highway 22, 50 feet north of the north raceway of the hatchery and 5 feet west of the rearing shed.

GEOLOGIC SETTING

Glacial deposits of Cary age (Thwaites, 1943), more than 200 feet thick, conceal an irregular bedrock surface in the Wild Rose area. The glacial drift consists of a mixture of sand and gravel, some silt, and very little clay (Whitson and others, 1913). At the well the deposits include poorly sorted silty sand, silty clay, and sandy gravel. A log of a well about 200 feet north of the well in which the temperatures were measured is given in table 1.

Less than 50 feet of sandstone of Cambrian age underlie the glacial drift at the well site. Both the glacial drift and sandstone are permeable, porous, and water-bearing. The total saturated thickness of the glacial drift and sandstone is estimated to be 250 feet.

Granite of Precambrian age underlies the sandstone. The granite is, for practical purposes, impermeable.

HYDROLOGIC SETTING[3]

The water table in the Wild Rose area slopes eastward about 30 feet per mile, except near streams where the slope is greater and toward the streams. The streams flow to the east. Recharge of the

[3] The ground-water hydrology of Portage, Waupaca, and Waushara Counties was studied by the U. S. Geological Survey in cooperation with the Wisconsin Geological and Natural History Survey. Results of these studies are being prepared for publication.

TABLE 1. LOG OF A WELL AT THE FISH HATCHERY, WILD ROSE, WIS. (PREPARED BY THE WISCONSIN GEOLOGICAL AND NATURAL HISTORY SURVEY FROM EXAMINATION OF SAMPLES)

DESCRIPTION	THICKNESS (FEET)	DEPTH (FEET)
No samples	10	10
Sand, very fine, light-pink-gray, dolomitic, silty	15	25
Clay, light-pink, dolomitic, silty	20	45
Sand, very fine, light-pink-gray, silty	40	85
Sand, fine to very fine, light-yellow-gray	10	95
Sand, fine, light-gray, silty	25	120
Sand, fine to very fine, pink-gray, silty	10	130
Sand, very fine, pebbly, pink-gray, silty	5	135
Sand, very fine to medium, light-gray, silty	40	175
Sand, medium to coarse, light-gray	5	180
Gravel, sandy	3	183

ground-water reservoir results when precipitation in the area percolates to the water table, and discharge occurs when the water in the reservoir moves into a local stream, is used by vegetation, or is pumped from wells.

At the well site, the ground water moves toward and discharges into the hatcher's raceways. The water flows from the raceways into the Pine River. Ground water also is discharged by springs and wells on the hatchery grounds and conducted into the raceways. The total discharge through the raceways was 2,200 gpm (gallons per minute) on September 1, 1956, and averaged about 2,200 gpm during 1957 (John Ockerman, Wisconsin Conservation Department, personal communication).

The water table in the shallower part of the aquifer at the well stays at an almost constant level about 3 feet below the land surface because the water level in the nearby raceway is artificially maintained. The well taps the deeper part of the aquifer, however, and water rises about 8 feet above the land surface, because permeability differences within the glacial drift create artesian conditions at depths below 10 feet.

The total depth of the well is 187 feet, but, during the period when the temperature measurements were made, it was filled with gravel to a depth of 141 feet. The 4-inch diameter steel casing extended from 0.4 foot above the land surface to the bottom of the well, so that all the water entered the well through an area of about 13 square inches at the bottom. Because the well was partly plugged, the flow during the period of the temperature measurements was about 4 gallons per hour. Differences in water levels and flow rates in the well were not measured.

The Observed Temperatures

Temperatures were measured on six occasions during the period February 1957 to February 1958. The temperature measured in May, August, October, and November 1957 and February 1958 were plotted against depth (fig. 1). Although only a few measurements

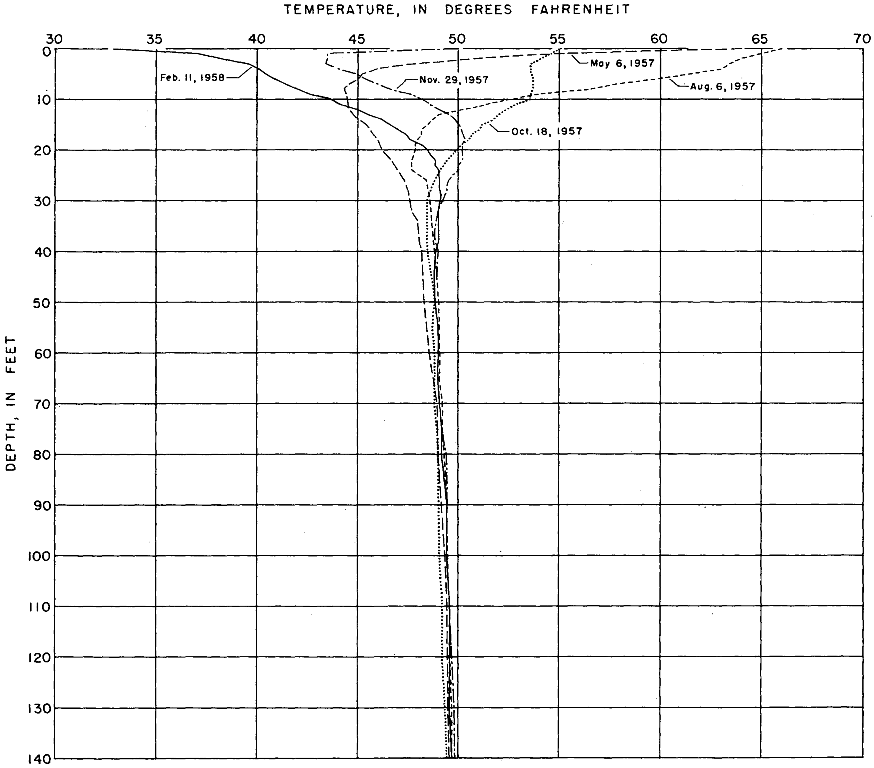

FIGURE 1. Graphs of water temperature in a well near Wild Rose, Wis.

were made in February 1957, the data are sufficient to show that the temperatures were probably identical with the temperatures measured in February 1958. Figure 1 shows that from the land surface to a depth of about 60 feet the temperatures fluctuated with time, the magnitude of the fluctuation decreasing with depth.

The maximum observed range of water temperature at different depths, determined by subtracting the observed minimum from the observed maximum, was plotted against depth in figure 2. At a depth of 1 foot, the temperature range was 30.5°F, at 10 feet it was 9.9°F, and at 36 feet it was less than 1°F. For depths below 60 feet the temperature increased uniformly with depth (fig. 1) and did not fluctuate significantly with time (fig. 2).

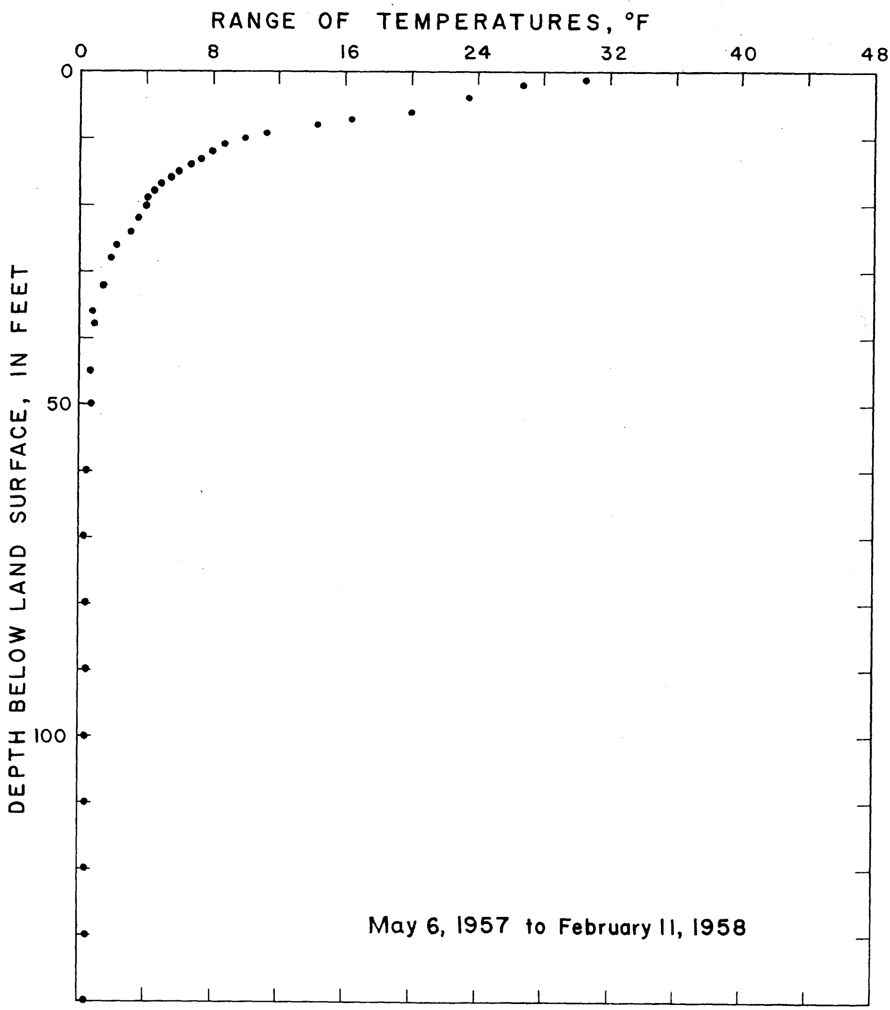

FIGURE 2. Maximum observed range of water temperatures in a well near Wild Rose, Wis.

RELATION OF THE OBSERVED TEMPERATURES TO AQUIFER TEMPERATURES

The relation of the observed temperature of water in the well to the temperature of ground water in the aquifer may be derived from the following argument. First, consider the effect of water flowing through a well cased in unsaturated rock. Boldizsar (1958) has shown that for large flows of water, heat is exchanged between the water in the well and the rock penetrated by the well if a temperature difference exists, and usually the rock becomes warmer.

He points out that for small flows, from depths of less than 100 meters, the exchange of heat is negligible, and the temperature of the rock does not change. Therefore, at the well near Wild Rose, the temperature of the rock of the ground-water reservoir probably would not be measurably affected by the heat in the small volume of water flowing through the well.

Next, consider the effect of the heat in the water flowing through a well cased in a ground-water reservoir. For large flows, heat will be exchanged if a temperature difference exists between the aquifer and the water in the well. The warming or cooling of the aquifer will be less than if the rock were unsaturated, because more heat is required to warm saturated rock than is required to warm unsaturated rock, and some of the heat is carried away by the ground water moving past the well. Obviously, as the flow of water in the well approach zero, the exchange of heat between the well and the ground-water reservoir becomes more complete, and the difference in temperature between the water in the well and th ground-water reservoir approaches zero. Therefore, the temperature in the subject well and the temperature of the ground-water reservoir should be nearly identical, because the water in the well is flowing very slowly to the surface.

From the preceding discussion a condition of zero flow would appear to be ideal. This, however, is not always true, because other factors operate to disturb the temperature in a nonflowing well. These factors include convection within the well (Van der Merme, 1951), circulation from one part of the aquifer to another or from one aquifer to another through the well (Foley and others, 1953, p. 75), and external sources of heat.

External sources of heat are those that affect the water in the well but not those in the aquifer. In Wisconsin common external sources of heat are solar radiation and heated pump houses. Convection of air within the well causes warm or cold air to be brought in contact with the water, and as a result the temperature of the water standing in the well is not necessarily representative of the temperature of the water in the aquifer. During periods when the ground was frozen, the temperatures observed in the subject well were probably somewhat higher than those near the top of the aquifer.

The effect of the casing upon water temperature in a well may be significant also. For example, steel casing is an excellent conductor of heat so that the transfer of heat between the well and the atmosphere, or between the water in the well and the aquifer immediately outside the well, may be facilitated.

SIGNIFICANCE OF THE OBSERVED TEMPERATURES

If the observed temperatures (fig. 1) are representative of the aquifer, they are significant. They show the distribution of temperatures in the aquifer with depth and time, and the movement of heat in the aquifer can be inferred. In the following discussion, the observed temperatures are assumed to be representative of the aquifer at the site of the well, so that the fact that the temperatures were measured in a well becomes immaterial to the argument.

Seasonal fluctuations. The temperature of the ground water at shallow depths responded to seasonal changes in air temperature. Similar responses in earth or soil temperatures to depths of as much as 100 feet have been observed and reported by many investigators (Carslaw and Jaeger, 1947, p. 62). The effect of seasonal air temperature of the ground water is reflected in the data of figure 1. As the air temperature changed, the temperature of ground water to a depth of about 60 feet changed with a lag in time. The temperature fluctuations of ground-water decreased with depth (fig. 2), and the time required for the air temperature to affect the ground-water temperature increased with depth (fig. 3). Thus, the maxi-

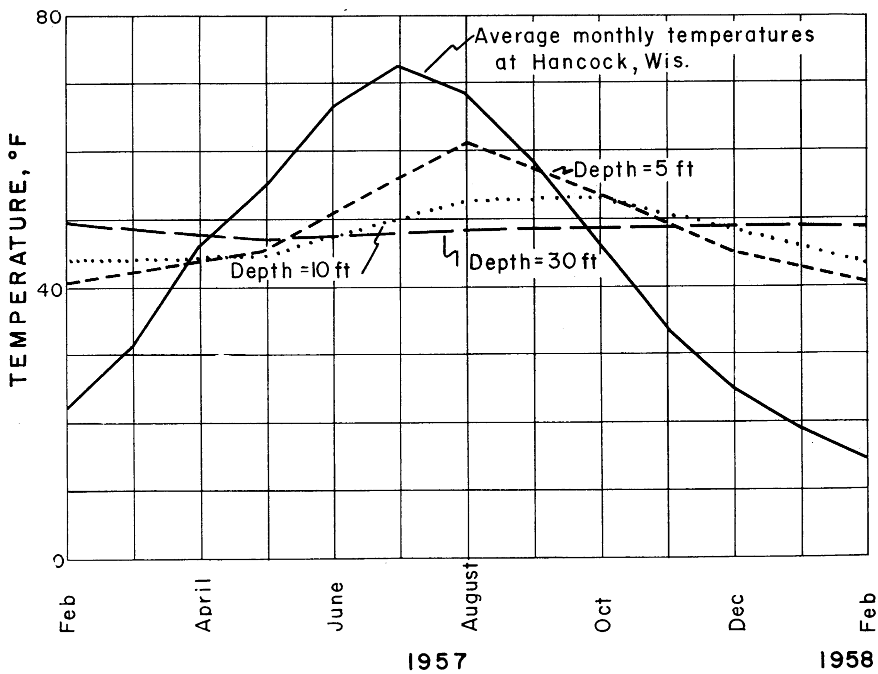

FIGURE 3. Average monthly air temperature at Hancock, Wis., and water temperatures at depths of 5, 10, and 30 feet in a well near Wild Rose, Wis.

mum temperature difference below 36 feet is less than 1°F, and the water temperature reaches a maximum after air temperature.

Temperatures below 60 feet. Below a depth of about 60 feet, the water temperature increased gradually with depth (fig. 1). From 60 to 140 feet, the average rate of increase is about 0.9°F per 100 feet. In addition to the observations in the subject well, temperatures were measured in four other wells in central Wisconsin. In these wells, which ranged in depth from 184 to 349 feet, the temperature increase with depth below 60 feet was less than 1°F per 100 feet.

Movement of heat in the ground-water reservoir. Heat moves through the ground-water reservoir by conduction and convection (R. W. Stallman, written communication, January 1960). The movement of heat by conduction is governed by the thermal conductivity of the media (k) and the temperature gradient (T/Z). The movement is along a path of diminishing temperature and is expressed quantitatively by the expression $Q = KT/Z$, where (Q) is the heat flux through a unit area in unit time (Chang, 1958, p. 28). The movement of heat by convection is controlled by the properties of the water—specific heat, density, temperature, and velocity (R. W. Stallman, written communication, January 1960, p. 7). In general, the lateral movement of heat in an aquifer is by convection, whereas the vertical movement of heat is by conduction. The data shown on figure 1 are sufficient to determine a thermal gradient (T/Z) and, therefore, to show whether heat is being conducted upward or downward and to measure relative differences in the amount of heat moving through a vertical column of rock in the area. Two generalizations about the conduction of heat may be made immediately from inspection. First, heat is moving steadily through the aquifer from below; and, second, heat moves into and from the aquifer seasonally.[4]

Heat moves laterally by convection, and, although measurements were made in only one well, the effect of convection also can be inferred from the observed temperature gradients. Earth temperatures usually increase steadily with depth below the zone of seasonal variation, because heat is flowing to the surface from the interior of the earth (Evans and others, 1942, p. 268–269). The average increase in temperature below a depth of 100 feet at eight sites in Michigan, Illinois, and Iowa is about 1.3°F per 100 feet (Spicer, 1942, p. 280–282). The temperature gradient in a well drilled more than 300 feet into crystalline rock of Precambrian age near Sextonville, Wis., about 80 miles southwest of Wild Rose,

[4] The exchange of heat between the well and the aquifer is negligible and is not considered here.

is 1.1°F per 100 feet. Therefore, the temperature gradient in the granite of the Wild Rose area also might be about 1.1°F per 100 feet. At the subject site, the average observed temperature gradient for the interval between 60 and 140 feet is about 0.9°F per 100 feet. Inasmuch as the thermal conductivity of granitic rocks is usually greater than the thermal conductivity of saturated sand and clay (Birch, 1942, p. 251–252 and 259; Ingersoll and others, 1948, p. 244; Chang, 1958, p. 30–32), and the temperature gradient in the granite is greater than that measured in the subject well, more heat is moving through the granite than is being conducted through the ground-water reservoir. Convection of heat can account for this difference. As the water moves through the aquifer, some of the heat received from the granite is convected by the moving ground water and is released from the aquifer, as the ground water is discharged.

In addition to the heat moving upward through the ground-water reservoir from below, heat is added from above to the ground-water reservoir in the summer and removed in the winter due to variations in solar radiation.[5] Thus, on February 11, 1958, the temperature [of ground water in the subject well] increased with depth from the surface to 30 feet (fig. 1), indicating that in this zone heat was moving toward the surface. Between 30 and 50 feet the temperature decreased slightly, showing that heat was moving downward. Heat from a depth of 30 feet was either being conducted upward to be radiated at the surface or was being conducted downward to warm the water in the interval between 30 and 50 feet.

By a similar analysis, the data of May 6, 1957, show that although heat was flowing into the aquifer from the land surface and warming of the water had begun, not enough heat had moved into the aquifer to warm the water below a depth of 8 feet. Warming of the water continued as heat flowed downward from the surface, and by August 6, 1957, all the water to a depth of 60 feet had received some heat. By October 18, 1957, heat had ceased to flow into the aquifer from the surface, and the water in the top 10 feet had begun to cool. However, the water between 30 and 40 feet was still receiving heat. On November 29, 1957, heat was flowing toward the surface from a depth of about 18 feet, and the water in this interval was cooling. The water between 18 and 35 feet was still receiving heat.

[5] On a smaller scale, heat is added to and taken from the soil as a result of diurnal and day-to-day air-temperature variations (Langbein, 1949, p. 543). Each of the curves of figure 1 have the effect of small short-term air-temperature variations "built in". This effect is most obvious in the curves of August 6, and October 18, 1957. In the following discussion, the effect of these short-term variations have been disregarded.

Conclusions

Several generalizations have been drawn from the data obtained: (1) The temperature measured in the well closely approximates the actual temperature of the water at various depths in the aquifer; (2) in the Wild Rose area, Wisconsin, the temperature of water in the zone of saturation increases about 0.9°F per 100 feet below a depth of 60 feet, and, therefore, heat is flowing upward through the ground-water reservoir from a greater depth; (3) some of the heat that moves through the aquifer is released at the land surface as latent heat in discharging ground water; (4) water in the interval from a depth of 60 feet to the surface is subject to seasonal temperature fluctuations that are related to seasonal variation in air temperature.

If these generalizations are valid, then the temperature of ground water in the Wild Rose area is due primarily to two factors (1) the temperature of the water as it recharges the aquifer and (2) the change in temperature due to the gain or loss of heat as the water moves through the aquifer. The amount of heat gained or lost by the water (hence, the temperature of the ground water) is dependent upon the length of time the water is in the aquifer and the path the water takes as it passes through the zone of saturation from the point of recharge to the point of discharge.

Temperature relations similar to those described for the Wild Rose area probably occur in other areas where the hydrologic conditions are similar.

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NITIDULIDAE COLLECTED FROM BANANA BAIT TRAPS IN WISCONSIN[1]

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During the summer of 1954 a series of four bait traps were placed in three locations in Wisconsin to study the occurrence and seasonal incidence of Nitidulidae associated with the mycelial mats of the oak wilt fungus *(Ceratocystis fagacearum* (Bretz) Hunt). Preliminary work had shown that many of these species associated with the fungus were also found in banana bait traps.

Each trap consisted of: a tin can 5 inches high by 4 inches in diameter; a cylinder of 4-mesh screen, 7 inches high and slightly less than 4 inches in diameter, closed at one end by screen; a metal cone; soil; leaves; and one half of a banana. The can was placed to its own depth in soil and filled approximately 7/8 full with soil. The soil was covered with a small layer of leaves and the half banana was squashed down on top of the leaves. The screen cylinder, which prevented rodents from removing the bait, was fitted just inside the top of the can and finally the cone was placed on top of the screen.

At the time of each collection the remains of the banana, the leaves and about one quarter of the soil were transferred to pint bottles and examined in the laboratory. The remainder of the soil was examined in the field and returned to the traps before replenishing them with fresh soil, leaves and banana.

Four traps were placed in each of three locations, namely: on the University of Wisconsin Campus in Dane County, near Griffith State Nursery in Wood County, and in Rib Mountain State Park in Marathon County. The traps were set out in late April or early May and were examined at weekly intervals thereafter until early November.

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Many insects, including several families of Diptera, Staphylinidae, Histeridae, Scarabaeidae and Nitidulidae were taken in the traps. Records were kept of the Nitidulids collected. Those species that were known to the authors were recorded and discarded at the time of examination. Unknown species were pinned and coded for later identification. When the numbers of a species taken were so great as to make pinning impractical, a small series of ten to twenty specimens was prepared. If a coded series contained more than one species when identified, as was often the case, particularly with the genus *Epuraea*, the ratio obtained from the prepared specimens was applied to the whole series.

The seasonal abundance of the fourteen most common species is indicated in the graphs in Figures 1 and 2. The graphs represent the totals for all twelve traps. For certain species there were considerable differences between the three locations in the numbers collected. These differences are indicated in Table 1 which also lists those species taken in small numbers.

The graphs indicate peaks of abundance which presumably are associated with the life history of the insects and represent the period of the adult stage. Many of the species exhibited a relatively high population in May and another in September or October. These species probably overwinter as adults. *Epuraea* and *Stelidota* spp. appeared later in the year, late May or June, *(E. alternata* in July) and again in August, although *S. geminata* was relatively common in late September. There was no indication of a second peak for *S. strigosa*. *C. adustus* exhibited two peaks, one in late June and early July and the other in late September. *Glischrochilus* spp. tended to show a third period of abundance in midsummer, indicating, perhaps, two generations.

Different environmental conditions possibly explain the differences in the numbers of individual species collected in the three locations. If this is so, it points out differences in closely related species. For example, the largest numbers of *Stelidota strigosa, S. geminata,* and *S. octomaculata* were taken in Wood, Dane, and Marathon Counties, respectively. A similar situation occurred in respect to the three common species of *Glischrochilus*.

In conclusion, the authors wish to draw attention to the fact that, although the collections described here indicate certain trends, the causes of the differences are not known, nor is the reliability of the trapping method as an indicator of absolute populations known. The response of insects to an attractant may be influenced by other materials in the neighborhood. For example, although no specimens of *Colopterus truncatus* were taken in the traps between the first week of June and the first week of September in Wood

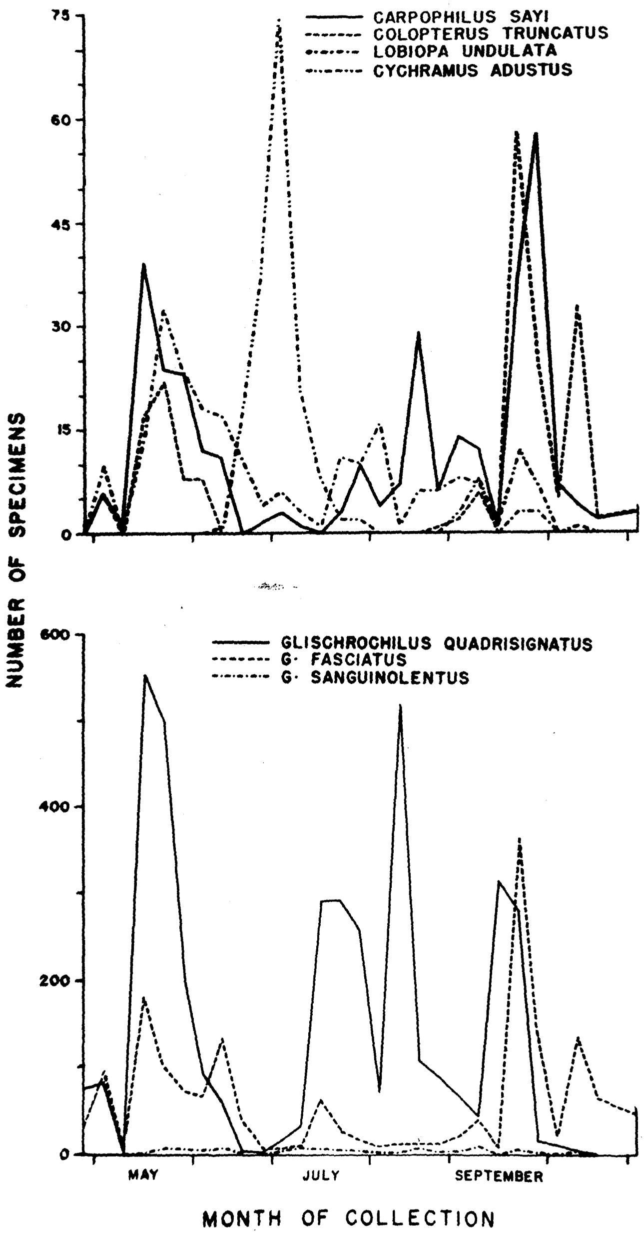

FIGURE 1. Seasonal trends in population of Nitidulidae as determined by collections from banana bait traps.

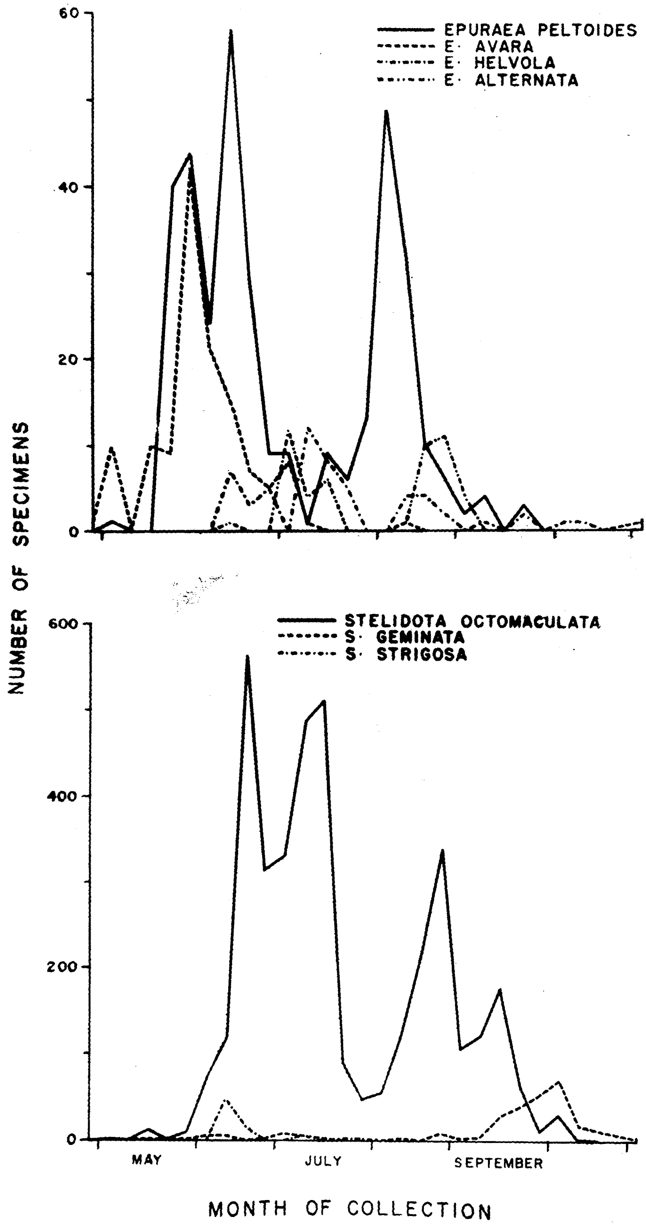

FIGURE 2. Seasonal trends in population of Nitidulidae as determined by collections from banana bait traps.

County, they were found nearby in relatively large numbers in hatchet wounds on *Quercus ellipsoidalis* Hill throughout June and July (McMullen *et al,* 1960). However, the work does show that adults of many species are abundant in May and June and again in September, the time of year at which mycelial mats of the oak wilt fungus are most abundant in Wisconsin.

TABLE 1. LIST OF NITIDULIDAE COLLECTED IN BANANA BAIT TRAPS WITH NUMBERS TAKEN AT THREE LOCATIONS, WISCONSIN, 1954

SPECIES	COUNTY		
	Dane	Wood	Marathon
Colopterus truncatus (Rand.)	15	171	14
C. maculatus (Erichs.)	0	5	0
Carpophilus hemipterus (Linn.)	14	1	0
C. sayi Parsons	229	18	45
Epuraea helvola Erichs.	3	41	12
E. rufa (Say)	10	0	0
E. corticina Reitter	0	0	2
E. avara (Rand.)	0	65	67
E. peltoides Horn	7	304	51
E. labilis Erichs.	0	2	0
E. alternata Parsons	47	0	2
E. planulata Erichs.	0	1	0
Stelidota strigosa (Gyll.)	0	73	3
S. geminata (Say)	271	1	0
S. octomaculata (Say)	5	25	3816
Omosita colon (Linn.)	16	12	0
Lobiopa undulata (Say)	79	127	5
Phenolia grossa (Fab.)	0	0	6
Cychramus adustus Erichs.	2	43	152
Oxycnemus histrina (Lec.)	0	7	1
Cryptarcha ampla Erichs.	6	16	4
C. concinna Melsh.	0	5	0
Glischrochilus obtusus (Say)	0	2	0
G. sanguinolentus (Oliv.)	0	33	57
G. fasciatus (Oliv.)	185	332	1286
G. quadrisignatus (Say)	3320	115	393
Totals	4209	1399	5917

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FADING FINS*

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Beneath the surface of the gray-yellow water flowing past the homes and factories of Everywhere, U.S.A., gyrates a phantom of Death. The principal character of this danse macabre flips to one side, then to the other, twists in futile loops and wrenches in jerks. Splayed fins extend awkwardly and stiffly from its sides. Its white belly arches agonizingly, curving and recurving. A hot noonday sun can scarcely illuminate the floor of this murky arena. Here the fish struggles from corner to corner. Warm sticky tongues of silt grasp at his fins, clays entwine themselves about his lips and gills, and organic wastes enfeeble his heart and disorient muscles and nerves. Wildly our dancer lunges to escape from the altar but the river gathers the sacrifice in her lap and carries it away. The last of his kind, *Piscis perdidus* is lost forever, a statistic in the logbook of time.

This drama is nothing new. Yearly it is being enacted from one end of our country to the other. If man's hand has fallen heavily upon the face of the land, even more devastating is his impact on our waters. Man often cannot evaluate this change with eye, nose, or ear. He must rely upon laboratory refinements to make such measurements. Changes, however, have occurred—enough to strike off species after species. Ranges have shrunk in many instances to individual streams, frequently widely separated by hundreds of miles from the next body of water harboring another remnant of the same form.

Nor is this entirely a mystery. Fish biologists are quite aware of the fact that the distribution of our fishes varies yearly, that species which are taken in a particular water today may diminish in number or disappear before the same time next year. In every state the number of species apparently is on the decline. Still state lists include fish which have not been collected since the turn of the century. Why? First, extensive collections were seldom made, and even today little collecting is done. Many important streams and lakes have not been sampled at all because of lack of equipment, money and personnel. Ignorance clouds our knowledge. Moreover there is but rarely an attempt anywhere to assess, synthesize, evaluate and study critically fish species other than those which are

* I wish to thank my colleagues Profs. J. W. Barnes and R. E. Simpson, and Prof. Milton Trautman of Ohio State University for their suggestions and critical reading of the manuscript.

of sporting or commercial value, or which, due to parasitic or competitive habits, interfere with the well-being of those fish man considers of value. For instance, although 150 species exist within the state of Wisconsin, only two dozen appeal in some way to the tastes of fishermen and fisheries. Many of the forgotten are in serious trouble—some are hanging on the brink of extinction.

We must keep in mind that all species of fish were not found in unlimited numbers even under primeval conditions. Many species have held their existence by a thin thread, tolerated as neighbors by the common forms, but never allowed to burgeon. The subtle changes wrought by man have in a few cases provided a boon, and some dimly-regarded members have catapulted into respectable standing in the piscine community. More frequently the pendulum has swung the other way, with species being cut down one by one.

In my study of several Central Wisconsin rivers in recent years, I found no traces of at least seven species of fish which had been recovered in the very same waters three decades previously. Repeated careful samplings with improved techniques over those used by Greene thirty years before failed to "restore" these forms. Moreover, several species which I was able to report gained their inclusion on the presence list by a handful of individuals despite the fact that over 17,000 fish were captured and examined. The lawyer *(Lota maculosa)* appeared on the basis of one individual; the least darter *(Etheostoma microperca)*, on the basis of two individuals; the northern mimic shiner *(Notropis v. volucellus)*, seven individuals. It was significant that relatively few species made up the bulk of fish found within a given body of water. In the 1958 survey the ten most common species on each of the streams surveyed represented 80 to 90 percent of the total number of fish captured; the 43 remaining species comprised only 10 to 20 percent of the catch.

The following factors have had a profound impact on fish distribution over the nation: impoundments, canals, dredging operations, sewage and industrial wastes (e.g., coal mines, canneries, creameries, paper mills), irrigation, highway construction, insecticides, and agricultural practices under which can be enumerated grazing, siltation, deforestation, fertilizers. Frequently life-giving springs have gone dry and water tables have dropped. Many communities have felt the pinch when the well runs dry. The fish is among the first to perish with the impact of the drought.

Unfortunately the fish is a victim of his surroundings. Should conditions change within the stream, he either becomes accustomed to these changes or those mutants capable of enduring such changes assume the responsibility of perpetuating that species. If neither physiological ability nor genetic variability exist, he can move either downstream or upstream until he meets conditions which satisfy his needs. However, the answer isn't as simple as all this. Although fish can move freely, many species are shackled by rather narrow ecological requirements. Critical water temperatures, bottom siltation, turbidity, fish associates, vegetation, nature of the bottom, and rate of water flow are just some of the factors which must be met, not singly nor generally, but often in toto. A particular species like the pugnose shiner *(Notropis anogenus)* can't afford to move, let us say, either upstream or downstream because one, two, or more factors necessary for its continued existence cannot be met. Therefore the pugnose shiner, unable to stand up against a changing environment, has sacrificed range and number within the past quarter century. The spotty map of old collection records looks like a forgotten graveyard.

Dams of concrete and steel have provided an impasse for certain fish species. The river herring or "golden shad" *(Alosa chrysochloris)*, one of the most beautiful and lively fishes of the Mississippi basin, ran into trouble with the dam breeching the river at Keokuk, Iowa. Just after the structure was placed in 1913, enormous numbers of herring gathered below it with the approach of spawning. During the first few years after the construction of the dam, the herring in the upper part of the river rapidly declined in abundance until a relatively low point was reached. Evidence points to the fact that the dam was primarily responsible for this decrease. Also the American eel *(Anguilla rostrata)*, a highly prized delicacy in some parts of the country, is stopped in its upward migration from the sea by dams at Keokuk and other places and has virtually disappeared from Minnesota and Wisconsin waters. Aside from the fact that dams pose an obstacle to spawning migration, changes are wrought on the streambed and in rate of flow. These factors combined or singly have contributed to the decrease of the following species on the Ohio River: blue catfish *(Ictalurus furcatus)*, white bass *(Roccus chrysops)*, rock bass *(Amboplites rupestris)*, smallmouth bass *(Micropterus dolomieu)*, yellow walleye *(Stizostedion vitreum)*, and Ohio logperch *(Percina caprodes)*.

Turbidity reigns as the most influential reaper of all. Virtually all of man's activity converts crystal-clear waters to colloidal films of varying intensities. Milk pollution, lignin wastes, coal and iron ore wastes, raw sewage, errant topsoil, bovine hooves biting away at helpless river banks, all contribute to the load suspended in ocean-bound waters. The blue or Missouri sucker *(Cycleptus elongatus)*, esteemed by many as a valuable food fish, is rarely found in such highly turbid streams as the Missouri River and is more frequently taken in the clearer, cleaner sections of the Ohio and Mississippi Rivers. Even in these rivers it has decreased to only a fraction of its former numbers, is considered very rare in Minnesota and Wisconsin waters of the Mississippi and in precarious numbers for that section of the Mississippi bounding the states of Illinois and Iowa. Sharp reductions in abundance in the Illinois River and in the Ohio further suggest its intolerance to turbidity and other pollutants.

Unfortunately many species of fish which are wedded ecologically to large bodies of water tolerate turbidity with difficulty. An important corollary declares: the larger the stream, the greater the turbidity. The silver chub *(Hybopsis storeriana)* requires waters with plenty of fin room and waters that are clear. In Iowa it was found that the population diminishes after years when successive floods cause the water to remain turbid over considerable periods of time. A close relative, the gravel chub *(Hybopsis x-punctata)* which only recently gained specific status, is so intolerant of high turbidity, that it is fast disappearing over its rather restricted range in Central United States. Another species, the harelip sucker *(Lagochila lacera)* which ranged from Ohio to Arkansas to Georgia, has not been taken anywhere in the last 50 years and is believed extinct. It possessed a small, specialized mouth and closely-bound gill covers. This, coupled with conversion of the typical clear-water prairie stream type into muddy streams of the western-plains type probably caused its disappearance. The harelip must have been particularly susceptible to asphyxiation through impacting of colloidal clay about the gills.

No fish illustrates intolerance to turbidity better than the bigeye shiner *(Notropis boops)*, found in a narrow belt lying along the southern edge of the North Central States. This minnow originally was well distributed over the entire western half of the state of Ohio. As early as 1897 it had become uncommon in Central Ohio. The more than 2000 collections made since 1925 in Ohio show that between 1930–41 a relict population was still present in the Auglaize River, but that since 1941 none have been found there, or elsewhere, in Western Ohio. Today it remains only in a few tributaries of the Scioto River in a tiny area of southcentral Ohio. According to Trautman (1957):

> The Bigeye was present in streams as long as these were essentially of the clear-water type, disappearing when the waters became silt-laden and the stream bottoms became covered with silt. As an example: In 1928, Morgan's Fork, in Pike County, contained a large population of Bigeye Shiners. One of its tributaries became turbid because of silt which entered from a newly made hill cornfield. Before the tributary became turbid it contained a large population of shiners; these disappeared as soon as the stream became turbid. A few years later erosion was stopped, after the cornfield had been allowed to revert to a brush field, whereupon the waters became clear, the gravel of the stream bottom became free of silt, and the Bigeye again became abundant."

No state in the country has had a more thorough evaluation of its fish life than has the state of Ohio. We know best the history of fish and fishing from the intensive yearly collections made in all corners of that state from 1920 to 1950. Collections prior to that time, although not extensive, have furnished a valuable springboard for comparison. Species incapable of withstanding turbidity and culled to extinction since the turn of the century are many. Between 1900 and 1930 the blackchin shiner *(Notropis heterodon)* was numerous in East, Middle, and West Harbors, at the mouth of the Portage River, about South and Middle Bass Islands and in some of the Portage Lakes. After 1930 the blackchin decreased rapidly in abundance. Since 1940 none have been taken in Ohio waters although many attempts were made to capture it. Trautman reports that it disappeared almost immediately when waters became turbid, the bottoms silt-covered, and the aquatic vegetation vanished. Other extinct species and possible dates of their extinction are: gilt darter *(Percina evides)* and Western silvery minnow *(Hybognathus nuchalis)*, before 1900; pugnose shiner *(Notropis anogenus)*, 1931; crystal darter *(Ammocrypta asprella)*, 1925.

Turbidity and siltation are blamed for the decrease of a large percentage of the 160 species and 12 subspecies of fishes in Ohio and a listing of these reads like the "Who's Who in Ohio Fishes". Some of the families represented in this decrease in abundance and distribution are: fresh-water lamprey, paddlefish, sturgeon, gar, bowfin, mooneye, herring, whitefish, trout, sucker, minnow, North American catfish, mudminnow, pike, eel, killifish, pirate-perch, perch, darter, sunfish and silverside. This leaves a weak minority of families whose members have retained the status quo or increased in abundance.

This does not mean that the families listed above are entirely decimated, nor that there was no increase in certain species of these families. The carp *(Cyprinus carpio)*, a minnow, has proved that it can establish itself under a wide variety of conditions. No species of fish in the past century can match its extension in range and numbers. The fathead minnow *(Pimephales promelas)* and suckermouth minnow *(Phenacobius mirabilis)* have filled the niches vacated by the withdrawal of other minnow species. Amazing hordes of sea lamprey *(Petromyzon marinus)*, alewife *(Pomolobus pseudoharengus)*, and smelt *(Osmerus mordax)* have moved into waters of the Great Lakes. Extensions of range and abundance in Ohio are demonstrated by the goldeneye *(Hiodon alosoides)*, the black bullhead *(Ameiurus melas)*, white crappie *(Pomoxis nigromaculatus)*, warmouth *(Chaenobryttus gulosus)*, green sunfish *(Lepomis cyanellus)*, and orangespotted sunfish *(Lepomis humilis)*.

Some of these fill a welcome spot in a fisherman's minnow bucket and creel. Still, for every species showing an increase, at least five show a corresponding decrease.

Would the species composition have remained unchanged had man's destiny kept him from this continent? The answer, of course, is no. Change inevitably takes place under the press of natural phenomena. There are the cyclic weather patterns measured in centuries and millenia, the successful hatches of predatory or competitive species, the evolution of new species due to isolation. It may well have been that the pugnose shiner was going to extinction before man tampered with land and water. Now, however, it will take only a nudge or two to push it over the brink. The harelip sucker was never abundant anywhere and as pointed out above may now in all probability be extinct. The pallid sturgeon *(Scaphirhynchus album)* has had such a tenuous history that practically nothing is known about its habits. Rarely has one been found containing visible eggs. Here is a species which has persisted at extremely low levels for as long as man has known it.

Another species which apparently is on its way out due to factors beyond man's control is the redside dace *(Clinostomus elongatus)*. Populations have persisted in isolated, widely separated streams. It has disappeared from Iowa waters and is exceedingly rare in the extreme southeastern corner of Michigan's southern peninsula and in the southeastern part of Minnesota. In Ohio many redside populations decreased drastically in abundance with wastes from coal mines and heavy siltation. In Wisconsin hybridization has been found between this species, the abundant northern creek chub *(Semotilus atromaculatus)* and the northern common shiner *(Notropis cornutus frontalis)*. Hybridization, it is felt, often results when a species is in trouble and is a last-ditch mechanism for perpetuation of that species. I have noted one instance in a Central Wisconsin stream where the redside has been able to endure heavy siltation. Such evolution of a strain resistant to previously unfavorable conditions may assist in the continuance of this species in certain areas.

During the past summer I made several trips within the state of Wisconsin with the express purpose of capturing the finescale dace *(Chrosomus neogaeus)*, a beautiful golden-bronze minnow found only in the uppermost reaches of quiet, bog streams. In one trip after the other in streams where it had been taken only a quarter century ago we drew a blank—*with one exception!* After three hours of intensive shocking in the headwaters of the Tomorrow River, we finally captured a single individual. The prize was hard-won and greatly appreciated. It brings the number of individuals in our school collection to a grand total of five. There are streams in the state, I'm sure, where more could be found. But the fact remains that no published data less than thirty years old is available and financial assistance to workers for current studies is scarce. Emphasis has been placed too strongly on those fish of sporting and commercial interest and it is difficult to bend thinking in another direction.

Lists of priorities in many conservation departments do not include surveys embracing all the fishes found within their boundaries. Such surveys, if done at all, are frequently the work of one or two individuals who devote time and energy in a labor of love. Due to lack of personnel and funds, the coverage has often been scanty.

The blame should not be directed against the fish biologist and his superiors alone since they are responsive to the plaintive wails of the taxed public. One would expect that the academic ichthyologist, freed from the same squeeze, would even out the balance. But here too the survey type of research appears to have fallen into disrepute. Noses among the piscine hierarchy are thumbed at collecting studies since it is felt that anyone, even the man-with-the-shovel, can do this "simple" kind of work. On the other hand they gloat over high-powered research techniques shrouded in statistics, refined laboratory equipment, unusual chemical compounds, off-beat fish with crooked spines and the effect of predation on such anomalies. Many ichthyologists condemn any research that smacks of immediate utility. "Science for science's sake" has been thrown around until many have lost sight of the fish for all the water.

I have no quarrel with this viewpoint. There is no question that such knowledge too is important, and each pearl, however unusual it may be, contributes to the necklace of integrated knowledge. At the same time the fact remains that basic life history material is utterly lacking for altogether too many species, that the salvation of many species is entirely dependent upon our knowledge of their spawning and mating requirements, that our knowledge of these requirements and of fish movements is sketchy to say the least. There is little doubt that the greatest overall contributions to our knowledge of life histories has come from the pens of survey men whose well-conceived, year-around collections of all species piece in what little we now know. We have barely scratched the surface. Some species have only recently acquired a name and already dangle on the thread of extinction. So reduced are they in numbers that a study in their behalf may well function in opposite fashion and rub out the last of their kind in the final effort to save.

The question arises: Who is to be blamed for this loss? Should condemnation fall upon the sewage system, outmoded and outdated before its time in the face of a mushrooming population? Should industry which feeds, clothes, and houses this population suffer ignominy because its effluent has changed the character of the fish and fishing downstream? Must the farmer grovel under the foot of society because, in his effort to earn a fair share, his cattle and agricultural practices changed the trout brook into a haven for suckers and chubs? Must the public service commission with its control over water rights be held responsible because it trades a trout stream for a dam in a destitute corner of the state which can then show more meat and butter on the tables, warm clothes on the backs of its men and women and better schools and homes for all?

Must the sportsmen's organizations, sacrificing time and money to erect fences and seal down banks with ripprap, deflectors and the like, endure censure because their interest channels in the salvation and perpetuation of only a special segment of fish life? Must we criticize the fish biologist who under the thumb of an expanding fishing fraternity struggles year after year to reduce mortality and produce more from a select list of fish? Should we complain about the conservation department that enters into a watershed purchase program so that good trout streams may still be with us for the next two centuries or more? Can we grumble at the pure scientist whose esoteric research today may be the atomic salvation of fish tomorrow? Should we condemn the trapper whose nets and traps provide millions of minnows for fishermen's buckets? Should we condemn the fisherman for disseminating the seeds of competitive forms in new waters, for catching more than he can eat or give away, for returning stunted fish to waters already overpopulated, when this same fisherman spends millions of dollars yearly, dollars to be shared by many segments of our economy?

What complaints should we level against the manufacturers of fishing equipment, gadgets and lures which are sportier, catch more, catch bigger, make-it-easier? Must the conservation ethic perish in the welter of economic reasons without end? Is not the *raison d'etre* enough to justify at least a few fist-shakings and another few dollars to abet a program of salvation? Did we have to erect our mute monuments to the passenger pigeon after its death or could we have provided a living monument for eternity?

These questions, perplexing as they are, fall squarely on the shoulders of man in whose care rest the creatures of the world. The obligation, therefore, is everyone's, nor are we unaware of this. The last few whooping cranes winging between Arkansas, Texas, and Canada have received the love and attention which only a doting public can give. In Wisconsin thousands of dollars, contributed by foundations and private individuals, are being thrown into the purchase of marshes so that the remaining scatterings of prairie chickens may persist in perpetuity. Even the fading timber wolf has evoked at least lip service in his behalf. Are the paddlefish, pallid sturgeon, blue sucker, gravel chub, and silver shiner any less valuable than those? Need the appreciation of these forms rest with what we can see, smell, or taste? For it stands to reason that the great American public will seldom see a whooping crane, smell the scent tree of a wolf or taste the breast of a prairie chicken, but the knowledge of a wild animal still with us raises within our souls the primeval joy of survival against all odds. So too will we be richer in the knowledge that rare aquatic forms have been preserved in suitable waters as living models for coming generations.

Speckling the eastern states like errant ink spots are species like the Ohio spotted chub *(Hybopsis dissimilis)*, western tonguetied chub *(Parexoglossum laurae hubbsi)*, variegated darter *(Etheostoma variatum)*, spotted darter *(E. maculatum)*, bluebreast darter *(E. camurum)*, Tippecanoe darter *(E. tippecanoe)*. Though not rare, yet because of their very restricted ranges, these species share the threat of extinction. What preparations are we making for their preservation? Has a stream, out of the score or so in which it is still found, been set aside as a preserve for the Tippecanoe darter, even as we have set aside a remnant marsh in the state of Wisconsin, as a living laboratory for unborn generations of prairie chickens?

Recently one of my students showed me fish which he was clearing for skeletal staining. They were mostly minnows obtained from a local bait station. Near the top of the jar I spotted a redside dace, one of the rarest minnows in the state. We can only conjecture as to how many of these had been seined in the past, perished in minnow buckets or succumbed on a fisherman's hook. Could this single specimen have been the last of its kind from some unknown stream? We tried to get the necessary data on this unusual fish, a beautiful male with typical red slashes on the sides. We met with little success because the dealer feared that we and others would seine in the same stream, and, as he put it, "Minnows are hard to find in winter."

The upshot is that seining of all minnow species is permitted anywhere in all but trout waters, and even here they may be taken in glass and wire traps. Not a single regulation in the Wisconsin statutes provides for these failing forms. The redside dace, exploited to the end, appears to be doomed unless proper authorities and a sympathetic public can be brought into a compromising attitude. We are already too late to do much about some species. But with vigilance some rare forms may continue finning crystal waters under deep-rooted banks, tomorrow, next year, throughout this century and onward.

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ARTS AND LETTERS

HAWTHORNE'S LITERARY AND AESTHETIC DOCTRINES AS EMBODIED IN HIS TALES†

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In discussing Shelley (in "P's Correspondence," 1845) Hawthorne emphasized the importance of the genetic or chronological approach to an author's work. In viewing all Shelley's "successive productions," the reader should be conscious, Hawthorne says, that, seen as a whole "there is a harmony, an order, a regular procession. . . . They are like the successive steps of a staircase. . . as Shelley really climbed, as it seems he has, from a lower region to a loftier one," developing from the early "faults into which a too exclusive use of fancy and [a cold] intellect are wont to betray him" toward his later works which are "warmer with human love" (Standard Library Edition of Hawthorne's *Works,* 1883, II, 419–20. Unless otherwise noted, citations to follow are from this edition.) Following Hawthorne's own advocacy of the genetic approach, let us then try to summarize his own successive stories chronologically as they embody or relate to writers or artists.

Some of the more interesting particular ideas we should watch for are the following. Since in his third-person preface to "Rappaccini's Daughter" (1844) Hawthorne said "he seems to occupy an unfortunate position between the Transcendentalists (who, under one name or another have their share in all the current literature of the world) and the great body of pen-and-ink men who address the intellect and sympathies of the multitude,"* what was Hawthorne's position as regards Platonic archetypes or idealizations versus earthy imagery? Partly a moralist who also resented his era's obsession with utility as opposed to beauty, precisely what did beauty and the artist's concern with it mean to Hawthorne? Is aesthetics in the main subordinated to religion in the broad sense? If Hawthorne was intensely democratic and generally of the opinion that the individual's effort gains significance only when it is in accord with the "uninstructed multitude" and in sympathy with

† Grateful acknowledgement is made of the fact that I have been aided in getting this study into its present form by Miss Mary Pitlick, a Research Assistant employed for this purpose by the Graduate School of the University of Wisconsin.

* He goes on to say of himself, "If not too refined, at all events too remote, too shadowy, and unsubstantial in his modes of development to suit the taste of the latter class (the multitude), and yet too popular to satisfy the spiritual or metaphysical requisitions of the former (the transcendentalists), he must necessarily find himself without an audience, except here and there an individual" who, not repulsed by the lack of "human warmth" in allegory, can appreciate his "fancy and originality." (II, 107).

their welfare, how does he fit this over-arching view in with his frequent defence of the artist as a gifted individual out of accord with the utilitarian populace? He had an unusual fear of invading the privacy of others, yet how did he justify the artist's omniscient probing into the secret motives and thoughts of his individual subjects in his quest of "psychological romance"? Precisely what did Hawthorne have to say of the technical or pictorial questions of the craft of fiction, such as Poe concerned himself with, and precisely where did he stand on the much disputed question of the mechanical versus the organic? What is his view of imagination and its relation to a truthful view of realities, to what one might call kodak literalism? Let us now explicate his successive stories and sketches relevant to artists.

Hawthorne satirizes the poet in "The Canterbury Pilgrims" (1833) as "the chief spokesman"[1] of a small group seeking the "cold and passionless security" (N.P., p. 1203) of a celibate Shaker village in retreat from worldly disappointment. After the frustrated poet rails against an unappreciative public, Hawthorne comments, "During this harangue, the speaker gesticulated with great energy, and as poetry is the natural language of passion, there appeared reason to apprehend his final explosion into an ode extempore" (N.P., p. 1199).

In response to the young Shaker man who refers to the poet in utilitarian terms as a "varse-maker" (N.P., p. 1198), the poet explains the infusion of ideal insight into poetic form: " 'True, I am a verse-maker,' he resumed, 'but my verse is no more than the material body into which I breathe the celestial soul of thought' " (N.P., p. 1199).

As he abstracts himself after his harangue, the poet is inspired to creation by nature which inspires "reverie, which he called thought" (N.P., pp. 1199–1200). The poet in his harangue points out the opposition (satirized by Hawthorne) between an unappreciative society and himself as artist who confuses an escapist's reverie with thought:

> "Alas! how many a pang has it cost me, this same insensibility to the ethereal essence of poetry, with which you have here tortured me again, at the moment when I am to relinquish my profession forever! O Fate! why hast thou warred with Nature, turning all her higher and more perfect gifts to the ruin of me, their possessor? What is the voice of song, when the world lacks the ear of taste? How can I rejoice in my strength and delicacy of feeling, when they have but made great sorrows out of little ones? Have I dreaded scorn like death, and yearned for fame as

[1] Nathaniel Hawthorne, *The Complete Novels and Selected Tales of Nathaniel Hawthorne,* ed. Norman Holmes Pearson (New York, 1937), p. 1198. Subsequent references to this text will be indicated by the initials N.P. Other text references are indicated by "H.H.," *The Complete Short Stories of Nathaniel Hawthorne* (Garden City, New York: Hanover House, 1959).

> others pant for vital air, only to find myself in a middle state between obscurity and infamy? But I have my revenge! I could have given existence to a thousand bright creations. I crush them into my heart, and there let them putrefy! I shake off the dust of my feet against my countrymen! But posterity, tracing my footsteps up this weary hill, will cry shame upon the unworthy age that drove one of the fathers of American song to end his days in a Shaker village!" (N.P., p. 1199).

The qualitative difference between the poet possessing imaginative insight and the common man without this gift is pointed up elsewhere in the story. For example, Hawthorne says, "The reader must understand that, for all these bitter words, he was a kind, gentle, harmless, poor fellow enough, whom Nature, tossing her ingredients together without looking at her recipe, had sent into the world with too much of one sort of brain, and hardly any of another" (N.P., p. 1199). Again, in commenting on the disillusioned, bankrupt merchant in the retreating group, Hawthorne refers to him as "one so different from the poet that the delicate fancy of the latter could hardly have conceived of him . . ." (N.P., p. 1200). While Hawthorne was elsewhere tender toward the artist victimized by society's indifference, this particular poet is satirized because of his attire, which showed "a peculiar sort of foppery, unworthy of a mature man," contrasted with the "plain good sense and unworldly feelings" (N.P., pp. 1198, 1202) of the people, especially the young Shaker couple, strengthened by mutual love, who are turning toward the world "to mingle in an untried life" (N.P., p. 1203).

"The Village Uncle" (1835) expresses the same Hawthornian preference for the humble reality of the folk artist-craftsman over the unreality resulting when "fancy [frequently referred to by Hawthorne as the creative imaginative faculty] can create so bright a dream of happiness . . ." (HH, p. 160). Like the preceding artist aroused to imaginative creativity by moonlight, the old man, who is the first-person narrator of "The Village Uncle," kindles his imagination with firelight: "And now, come, Susan, come my children, draw your chairs around me, all of you. There is a dimness over your figures! You sit quivering indistinctly with each motion of the blaze, which eddies about you like a flood, so that you all have the look of visions, or people that dwell only in the firelight, and will vanish from existence as completely as your own shadows when the flame shall sink among the embers" (HH., p. 154).

The narrator reminisces back to his bachelor days when he was an artist, a writer whom he pictures in his study as a "solitary figure in a looking-glass." Comparing the isolation of this life with his happy participation in family life, the narrator thinks, "Oh, I should be loath to lose my treasure of past happiness, and become once more what I was then; a hermit in the depths of my own mind; sometimes yawning over drowsy volumes, and anon a scribbler of wearier trash than what I read; a man who had wandered out of the real world and got into its shadow, where his troubles, joys, and vicissitudes were of such slight stuff that he hardly knew whether he lived, or only dreamed of living. Thank Heaven, I am an old man now, and have done with all such vanities" (H.H., p. 154).

Through the catalystic agency of his "frank, simple, kind-hearted, sensible, and mirthful" (H.H., p. 157) wife, the narrator rejected art for domestic bliss with Susan, for the humble community-service occupation of fisherman, and for the role of folk-artist or "spinner of long yarns" (H.H., p. 158). During his courtship of Susan, art to the narrator was not the shadowy world of the Platonic ideal but was associated with nature's myriad forms by the seashore where he saw Susan's "own slender beauty in so stern a scene . . . all combined into a strain of poetry" (H.H., p. 157). After his marriage, the literary tastes of the writer-turned-fisherman became anti-intellectual and almost primitive: "All that I heard of books was when an Indian history, or tale of shipwreck, was sold by a pedlar or wandering subscription man, to some one in the village, and read through its owner's nose to a slumberous auditory." When his children were growing up, he "feared to trust them even with the alphabet; it was the key to a fatal treasure" (H.H., pp. 157–158).

As the reminiscence continues, the narrator speaks tenderly of his present venerable position of folk artist, "the patriarch, the Uncle of the village." He is "a spinner of long yarns"

> . . . seated on the gunwale of a dory, or on the sunny side of a boat-house. . . . Such, Heaven be praised! is the vigor of my faculties, that many a forgotten usage, and traditions ancient in my youth, and early adventures of myself or others, hitherto effaced by things more recent, acquire new distinctness in my memory. I remember the happy days when the haddock were more numerous on all the fishing grounds than sculpins in the surf; when the deep-water cod swam close in shore, and the dog-fish, with his poisonous horn, had not learned to take the hook. I can number every equinoctial storm in which the sea has overwhelmed the street, flooded the cellars of the village, and hissed upon our kitchen hearth. I give the history of the great whale that was landed on Whale Beach, and whose jaws, being now my gateway, will last for ages after my coffin shall have passed beneath them.
>
> If melancholy accidents be the theme of conversation, I tell how a friend of mine was taken out of his boat by an enormous shark; and the sad, true tale of a young man on the eve of marriage, who had been nine days missing, when his drowned body floated into the very pathway, on Marblehead Neck, that had often led him to the dwelling of his bride,—as if the dripping corpse would have come where the mourner was. With such awful fidelity did that lover return to fulfil his vows! Another favorite story is of a crazy maiden who conversed with angels and had

> the gift of prophecy. . . . I speak of pilots who knew the wind by its scent and the wave by its taste, and could have steered blindfold to any port between Boston and Mount Desert, guided only by the rote of the shore,—the peculiar sound of the surf on each island, beach, and line of rocks, along the coast. Thus do I talk, and all my auditors grow wise while they deem it pastime (H.H., pp. 158–159).

The Village Uncle concludes his story with an Hawthornian moral which by implication appears to deprecate serious art because of its non-utilitarianism: "In chaste and warm affections, humble wishes, and honest toil for some useful end, there is health for the mind, and quiet for the heart, the prospect of a happy life, and the fairest hope of heaven" (H.H., p. 160).

In "Passages From a Relinquished Work" (1834) the first-person narrator of the story, who as a wandering story-teller is a folk-artist like the Village Uncle, illustrates the animosity even to folk-art of a puritan, utilitarian, New England culture, represented by Parson Thumpcushion. Abandoning his foster home and his guardian (Parson Thumpcushion) for his vagabond-folk-artist existence, the narrator says, ". . . my chief motives were, discontent with home and a bitter grudge against Parson Thumpcushion, who would rather have laid me in my father's tomb than seen me either a novelist or an actor, two characters which I thus hit upon a method of uniting. After all it was not half so foolish as if I had written romances instead of reciting them" (H.H., p. 414). Hawthorne emphasizes the "grossness" of the antipathy of New Englanders to non-utilitarian pursuits (H.H., pp. 413–414).

Even the story-teller seems partially imbued with this negative attitude toward his occupation, directing at himself humorous satire. He half-facetiously compares his obscure person with Goldsmith, Childe Harold, and Don Quixote; he remembers being made an "absurdity" by a practical joker (H.H., p. 420). However, the story-teller's attitude at the end is extreme enough, like the attitude of his countrymen, for the reader to consider his literary occupation as one of "guilt and madness" (H.H., p. 421), unless this, too, is tongue-in-cheek satire. That this story is autobiographically-directed satire is reinforced by the inclusion in the story-teller's repertoire of "Mr. Higginbotham's Catastrophe," another Hawthorne tale.

Although the emphasis of the story is on the cleavage between the artist and a practical society, there is one situation which explores rapport between the artist and society and by implication reveals Hawthorne's democratic egalitarianism. The story-teller speaks of the creation of his tales: "Besides the occasions when I sought a pecuniary reward, I was accustomed to exercise my narrative faculty wherever chance had collected a little audience idle enough to listen. These rehearsals were useful in testing the strong points of my stories; and, indeed, the flow of fancy soon came upon me so abundantly that its indulgence was its own reward, though the hope of praise also became a powerful incitement" (H.H., p. 414).

"The Devil in Manuscript" (1835) is significant in having the narrator agree with Oberon in his aversion to the kind of topic or framework Hawthorne was to deal with in stories of witchcraft such as "Young Goodman Brown." Oberon finally burns the manuscript of all his rejected stories in which, he says, " '. . . I endeavored to embody the character of a fiend as represented in our traditions and written records of witchcraft. Oh, I have a horror of what was created in my own brain, and shudder at the manuscripts in which I gave that dark idea a sort of material existence!' " (III, 575). Oberon admits, " 'I am surrounding myself with shadows, which bewilder me, by aping the realities of life. They have drawn me aside from the beaten path of the world." (p. 576). As an author, Oberon has "recollections" of his throes of creativity—of how he used various scenes and dreams, and became " 'feverish, the victim of my own enchantments . . . !' but he concludes that the different moods in which he created the tales resulted in no 'corresponding difference' in the 'worthless' finished product. (pp. 578–579.

Another theme in this story (which accords with Hawthorne's view in the preface of the 1851 edition of *Twice-Told Tales)* is that of the indifference of the American reading public to authors and to literature. Seventeen booksellers had rejected Oberon's manuscripts and he wants to escape being a "damned author," to avoid having " 'to undergo sneers, taunts, abuse, and cold neglect, and faint praise, bestowed for pity's sake, against the giver's conscience!' " (p. 580). In contrast to this "cold neglect," the author cries, "my brain has set the town on fire," as he burns his manuscripts in a windstorm.

The painter in "The Prophetic Pictures"[2] *(Token,* 1837) illustrates how the true artist " 'must look beneath the exterior" ' to " 'see the inmost soul' " of his subjects.[3] However, the story is essentially a warning against the artist who allows himself in his *pride* to be "insulated from the mass of human kind" and to have "no sympathies" beyond his art (AWS, pp. 259–260). In this story, the "proud" painter "failed to see the disorder" of his own character; and in painting the portraits of Walter and Elinor, a young couple about to be married, portraits which prophesied that Walter as a

[2] Hawthorne, *Works* I, Lathrop Edition, 192. "This story was suggested by an anecdote of Stuart, related in Dunlap's *History of the Arts of Design*—a most entertaining book to the general reader, and a deeply interesting one, we should think, to the artist."

[3] Hawthorne in the American Writers Series, p. 257, hereafter referred to as AWS.

husband would become dangerously insane, the proud painter regarded Walter and Elinor virtually "as creations of his own," rivaling the work of the Creator. Eventually, repenting of his pride in his prophetic art, the painter returns just in time to prevent the husband from stabbing his sorrowful wife, a rescue which shows that a prophetic "Fate [can] impede its own decree" (AWS, p. 262), that the artist *has* a free-willed responsibility.

In "The Great Carbuncle" (1837), as in other tales and stories, Hawthorne criticizes the serious artist for his obsession with fame. Here, a poet and five other self-centered people are goaded by "selfish and solitary longing for this wondrous gem" (N.P., p. 927), the Great Carbuncle. Hawthorne laughs at this artist just as much as at Oberon in "The Devil in Manuscript": "The fifth adventurer likewise lacked a name, which was the greater pity, as he appeared to be a poet. He was a bright-eyed man, but woefully pined away, which was no more than natural, if, as some people affirmed, his ordinary diet was fog, morning mist, and a slice of the densest cloud within his reach, sauced with moonshine, whenever he could get it. Certain it is, that the poetry which flowed from him had a smack of all these dainties" (N.P., p. 928). Here, the moonlight used elsewhere as the atmosphere for serious artistic creation is used for satiric purposes.

The poet's egocentricity makes him vulnerable to the thrust of Hawthorne's satire, as in the following passage where the Great Carbuncle facetiously represents the world of ideality which the serious artist perceives through his imagination:

> "For myself, hiding the jewel under my cloak, I shall hie me back to my attic chamber, in one of the darksome alleys of London. There, night and day, will I gaze upon it; my soul shall drink its radiance; it shall be diffused throughout my intellectual powers, and gleam brightly in every line of poesy that I indite. Thus, long ages after I am gone, the splendor of the Great Carbuncle will blaze around my name!"
>
> "Well said, Master Poet!" cried he of the spectacles. "Hide it under thy cloak, sayest thou? Why, it will gleam through the holes, and make thee look like a jack-o'-lantern!" (N.P., p. 931).

But the poet settles willingly for a substitute, "a great piece of ice." And Hawthorne chuckles: "The critics say, that, if his poetry lacked the splendor of the gem, it retained all the coldness of the ice" (N.P., p. 936). Selfishness, then, is incompatible with serious artistic creation. And Hawthorne's sympathies lie again with the simple, the young couple Hannah and Matthew, who find the gem but have the wisdom to reject it and return to the humble cottage which they had hoped to light with the gleam from the Great Carbuncle.

In "Edward Randolph's Portrait" *(Democratic Review,* 1838) Hawthorne returned to vary the theme of "The Prophetic Pictures," suggesting that when the artist's slanting (in this case adaptation) is done in a defensible cause (in this case to try to dissuade a political tyrant from a sin against colonial liberties), then the artist's slanting is justifiable. Alice Vane, the "favorite niece" of Lieutenant-Governor Hutchinson who has to decide whether to quarter a British fleet at Boston's Castle William, uses her artistry gained by study in Italy, to alter the fading portrait of Edward Randolph so as to make it symbolic of the agony of an earlier colonial ruler who opposed liberty and therefore "the inward misery of that curse worked itself outward, and was visible on the wretched man's countenance, making it too horrible to be looked upon." (N.P., p. 966) As Alice says to her uncle about to profane American liberties, ". . . if ever mortal man received a warning from a tormented soul, your Honor is that man." (p. 969) Hutchinson was not deterred by the portentous portrait, however, and years later when he died, he resembled Randolph.

"Sylph Etherege" *(Token,* 1838) belongs to the group of stories involving beauty and art because of the fact that the story hinges upon the role of a "miniature" picture purportedly of Sylph's betrothed, Edgar Vaughan, whom she had never seen, a picture which nourishes her romantic wishful thinking. Actually, the picture is a fabricated one, given her by Edgar, posing as Edward Hamilton, Edgar being actually of "ill-omened shape," "the reverse of attractive," (III, 511) and motivated by "wounded vanity" (p. 515) and "mockery and malice." Hamilton, with his "evil smile," appears and tells the romantic Sylph he is Vaughan. When she dropped the misleading miniature he "set his foot upon it, and crushed the ivory counterfeit to fragments." " 'There, my sweet Sylph,' he exclaimed. 'It was I that created your phantom-lover, and now I annihilate him! Your dream is rudely broken. Awake, Sylph Etherege, awake to truth!' " Such was his unfeeling way of "curing Sylvia of romantic notions, and reconciling her to truths and realities of life." (p. 515) Although her patroness, Mrs. Grosvenor, thinks that if Vaughan succeeds in winning her love, "she will be the better, her whole life long, for the lesson we have given her," the "fragile Sylph," made vulnerable by her imagination unbalanced by understanding or the acceptance of the fact that "the beauty of the pictured countenance was almost too perfect to represent a human creature, that had been born of a fallen and world-worn race," (p. 512) dies, seeming to "fade into the moonlight." The story may be briefly summarized as meaning that, while a person such as Sylph may need curing of the "fantastic nonsense" (p. 508) of mistaking the "fanciful" for the imperfections of the real and the true, of mistaking illusions for reality, if the cure is motivated by "wounded vanity" or other evil impulses (the union of the young people had in this case been greedily arranged as a means of "uniting two rich estates") (p. 509) and the transition is too abrupt, it may cause death. Quick disillusionment kills, and "counterfeit" art is thus very dangerous. The broad implications of this story are especially interesting, considering that Hawthorne has often been regarded as the crusader for romance and the idealizing function of the imagination. Misled by the "counterfeit" picture, Sylph "had communed with a creature of imagination, till her own loveliness seemed but the creation of a delicate and dreamy fancy." (p. 514) This "picture was but the masculine counterpart of Sylph Etherege's sylph-like beauty. There was that resemblance between her own face and the miniature which is said often to exist between lovers whom Heaven has destined for each other, and which, in this instance, might be owing to the kindred blood of the two parties," since they were cousins. Sylph fancied that "in some of her day-dreams, imagination had conjured up the true similitude of her distant and unseen lover." (p. 512) Thus Sylph had lived as in a "moonlight garden" nourished by "blissful fantasies" and "disquieted if reality threw a momentary cloud" between herself and her imaginary lover (p. 513). "She had been left to seek associates and friends for herself in the haunts of imagination, and to converse with them, sometimes in the language of dead poets, oftener in the poetry of her own mind," tinting with "stronger hues" the "fancy-picture" of her idealized lover (p. 510).

In broad terms, this story of the tragic fate of the over-imaginative Sylph Etherege is in accord with Hawthorne's favorite, Dr. Johnson, who also warned his readers against the "dangerous tendencies of the imagination" when unbalanced by understanding of the realities of life. Hawthorne's ability on occasion to see life realistically is evident in stories such as "Mrs. Bullfrog" and in *Our Old Home* and in his shrewd conduct in his three political posts. If Hawthorne was at times a romancer, this story shows that he understood the harm which could be done by a "villain" who deliberately by artistic creations (the "miniature") plays upon the weakness of viewers who are addicted to wishful thinking, illusions, "blissful fantasies," and a life of imagination unbalanced by a vigilant regard for "realities." (Sylph's illusions remind one of James' Isabel Archer's illusions which Henrietta Stackpole says caused her unhappiness.) From another angle, "Sylph Etherege" (enamoured of a countenance "too perfect" to belong to our "fallen and world-worn race") reminds one of the conclusion of "The Birthmark" where Hawthorne says the idealist Aylmer's tragedy in causing the death of his bride could have been avoided if he had learned humbly to live with earthly imperfections. The creative imagination can be dangerous, especially when its counterfeit creations are made plausible by flattering the credulous and the vain. Thus the "villain" says that in creating the counterfeit picture "I did but look into this delicate creature's [Sylph's] heart; and with the pure fantasies I found there I made what seemed a man,—and the delusive shadow has wiled her away to Shadow-land, and vanished there! It is no new tale. Many a sweet maid has shared the lot of poor Sylph Etherege!" (p. 516). Hawthorne's 1851 preface to *The Snow Image and Other Twice-Told Tales* in which this tale is collected speaks of his concern with burrowing "into the depths of our common nature, for the purposes of psychological romance" as contrasted with Cooper's kind of extrovert romance, and hence this tale forms a bridge to the psychological James, who began publishing about fourteen years later.

Hawthorne's "Chippings with a Chisel" *(Democratic Review,* 1838) centers on the advantages of the naturally heart-felt vs. traditionally universalized utterances (as eulogies), and on the extent to which visible symbols are needed. The fable involves the narrator's acquaintance with "a carver of tombstones" at Edgartown on the island of Martha's Vineyard, and his reactions to "interviews" with eight or nine of his typical customers as they choose inscriptions and designs to commemorate the dead. Hawthorne insists that this "sculptor . . . may share that title with Greenough, since the dauber of signs (cf. "Drowne's Wooden Image") is a painter as well as Raphael" (I, 456, *TTT)*. When a girl chooses an epitaph for her deceased sister which had already been "inscribed upon innumerable tombstones," Hawthorne remarks that "when we ridicule the triteness of monumental verses, we forget that [individualized and sincere] Sorrow reads far deeper in them than we can, and finds a profound and individual purport in what seems so vague and inexpressive, unless interpreted by her. She [Sorrow] makes the epitaph anew, though the self-same words may have served for a thousand graves" (p. 462–3). And the sculptor, with his keen "pride of art," expresses a preference for the "comfort to be gathered from these old scraps of poetry" rather thon from "any new fangled ones." (p. 465) In another contexture, however, Hawthorne in commenting on artificial gravestones "of Gothic taste," "carved in London" and imported to Martha's Vineyard, says that the gravestones "far the most impressive both to my taste and feelings" were those "roughly hewn from the gray rocks of the island, evidently by the unskilled hands of surviving friends and relatives" (p. 456). "It is an old theme of satire, the falsehood and vanity of monumental eulogies; but when affection and sorrow grave the letters with their own painful labor, then may we be sure that they copy from the record on their hearts." (p. 456) And this preference for the natural simplicity of individualized grief is again shown in Hawthorne's mentioning that in contrast to the triteness of verses already used on innumerable tombstones " 'I was struck by at least a dozen simple and natural expressions from the lips' " of the bereaved who were choosing epitaphs, and that one of these "simple and natural expressions" would "have formed an inscription equally original and appropriate" (463). Notice here he refrains from saying "more appropriate."

The second artistic theme developed in the story involves the extent of the need for symbols. Hawthorne claims that wives are more reluctant than husbands to erect tombstones to their departed mates, not because of the wives' lack of constancy but because women "are conscious that a portion of their being has gone with the departed. . . . Soul clings to soul; the living dust has a sympathy with the dust of the grave; and, by the very strength of that sympathy, the wife of the dead shrinks the more sensitively from reminding the world of its existence. The link is already strong enough; it needs no visible symbol (p. 461). Yet Hawthorne praises some "emblematical" designs on tombstones, such as the "chiselling an open book upon a marble headstone" to symbolize "the scriptural knowledge of an old woman who had never read anything but her Bible" (p. 465). Finally, when the sculptor asks Hawthorne's own choice of a tombstone, he expresses himself as questioning the propriety of erecting monuments at all, since for him they suggest imprisonment "instead of the freedom of the skies" whither one would "soar upward with the butterfly." He would forget what the dead have "cast off," "forget the Grave," for "Every gravestone that you ever made is the visible symbol of a mistaken system." (p. 467) In this story it is possible that the apparent rejection of symbols is limited to those of the grave and that this was influenced in part by Hawthorne's semi-Unitarian rearing and the revolt of the Unitarians from earlier mortuary symbols. Elsewhere, of course, Hawthorne shows he was dedicated to the use of symbols in the interest of artistically presenting general truths, which he wished to flesh out in vivid sensuous form.

"The Birthmark" *(Pioneer Magazine,* 1843) does not center directly on an artist but rather on a scientist, Aylmer, one who in his pride devotes his scientific artistry to trying to remove the tiny birthmark from the cheek of his bride Georgiana, a birthmark which is the only thing which detracts from her complete loveliness. (The scientist, and also the humanitarian [Cf. Hollingsworth] and the artist, in Hawthorne's general view, were especially vulnerable to a pride which deprived them of the sympathy for others which he regarded as all-important.) In this story Hawthorne has the scientist-lover create a boudoir setting whose fabulous loveliness matches that of the bride who dies through her husband's attempt to make her beauty completely perfect. Recalling "antique naturalists" (Albertus Magnus, Agrippa, and Paracelsus), Aylmer is like them in that they "imagined themselves to have acquired from the investigation of Nature a power above Nature, and from physics a sway over the spiritual world" (II, 61). At the end, the birthmark being "the bond by which an angelic spirit kept itself in union with a mortal [imperfect] frame," as the birthmark fades, Georgiana's "soul took its heavenward flight." Hawthorne adds that "had Aylmer reached a profounder wisdom, he need not have flung away the happiness which would have woven his mortal life of the self-same texture with the celestial," since things of earth in their imperfect loveliness represent a "dim sphere of half development" to be made perfect hereafter in "a higher state"(II, 69).

"The Hall of Fantasy" *(Pioneer Magazine,* 1843)[4] is interesting as showing Hawthorne's mid-way position between the transcendentalists and the practical multitude. In over-all plan, the story involves the author's visit with a friend to a large edifice " 'which occupies in the world of fancy the same position which the Bourse, the Rialto, and the Exchange do in the commercial world,' " (II, 197) which admits "the light of heaven only through stained and pictured glass" which gave one the effect of a "visionary atmosphere" and "the fantasies of poetic minds." He surveys four groups—the writers, "the inventors of fantastic machines," the "noted reformers of the day," and Father Miller and his followers whose theories about the approaching end of the world "scatters all their dreams like so many withered leaves." And Hawthorne ends with an anti-Platonic panegyric "like the very spirit of earth, imbued with a scent of freshly turned soil." He had sympathized with the aspirations of those devoted to the various fantasies, and "*almost* desired that the whole of life might be spent in that visionary scene," but he concludes as a practical person that we should be "content" with "merely an *occasional* visit, for the sake of spiritualizing the grossness of this actual life" (p. 201, 207, 211). In the section on writers, Hawthorne indicates his personal choice of the world's masters.

> In niches and on pedestals around the hall stood the statues or busts of men who in every age have been rulers and demigods in the realms of imagination and its kindred regions. The grand old countenance of Homer;

[4] H. P. Miller, ("Hawthorne Surveys his Contemporaries," *American Literature,* 12: (May, 1940), 228–235) discusses the way in which the first version of Hawthorne's "The Hall of Fantasy" first published in *Pioneer* in February 1843 contains "the fullest notice and characterization of his contemporaries which he ever wrote for publication." This was drastically revised three years later when the story was included in *Mosses from an Old Manse.* Miller cites the original passages on Alcott and Emerson (as strong influences on others), and on Poe who "had gained ready admission for the sake of his imagination, but was threatened with ejectment as belonging to the obnoxious class of critics." This passage omitted in the 1846 version is Hawthorne's only published comment on Poe.

> the shrunken and decrepit form but vivid face of Aesop; the dark presence of Dante; the wild Ariosto, Rabelais' smile of deep-wrought mirth; the profound, pathetic humor of Cervantes; the all-glorious Shakespeare; Spenser, meet guest for an allegoric structure; the severe dignity of Milton; and Bunyan, moulded of homeliest clay, but instinct with celestial fire,—were those that chiefly attracted my eye. Fielding, Richardson, and Scott occupied conspicuous pedestals. In an obscure and shadowy niche was deposited the bust of our countryman, the author of Arthur Mervyn." Hawthorne adds, interestingly, since he omits Coleridge to whose theory of imagination he is sometimes supposed to have been mainly indebted, that Goethe will never be the victim of oblivion, and that "next" to his statue is that of Emanuel Swedenborg. Goethe and Swedenborg, the first admired by Margaret Fuller and the second by Emerson, were to Hawthorne "two men of transcendent imagination" (II, 197–8).

If one compares this list with that in "Earth's Holocaust" it will be noted that he omits Shelley; the Bible, also imperishable in the Holocaust, did not lend itself to a personalized statue. The statues of these "men who in every age have been rulers and demigods in the realms of imagination" front an "ornamental fountain of water . . . with its endless transformation, in which the imaginative beholder may discern what form he will," the water of which is extolled as "uniting the virtues of the Fountain of Youth with those of many other enchanted wells long celebrated in tale and song" (p. 198). Those who in their "poetic absorption" view these statues admiringly have "thoughtful, inward eyes"; and Hawthorne "felt an inward attraction towards these men, as if the sympathy of feeling, if not of genius, had united me to their order." In the light of other stories in which Hawthorne seems to suggest that great writers are necessarily above or estranged from society, it is noteworthy that he says here that "so far as my experience goes [in 1843] men of [literary] genius are fairly gifted with the social qualities; and in this age there appears to be a fellow-feeling among them which had not heretofore been developed. As men, [unlike Owen Warland] they ask nothing better than to be on equal terms with their fellowmen; and as authors, they . . . acknowledge a generous brotherhood" (p. 200). Occasionally, however, some of the literary admirers of their imaginative earlier "rulers" are "dreamers" whose "madness is contagious," although the true "poet knows his whereabout, and is less likely to make a fool of himself in real life" (p. 201).

In the main, Hawthorne's personal evaluation in this story seems to be one of mediation and balance. He would "thank God that there is such a place of refuge" from "actual life," and he concludes "in truth, that there is but half a life—the meaner and earthlier half—for those who never find their way into the hall" of fantasy or imagination (p. 203). Seemingly wild and impracticable as may be some of the inventors of machines and the "self-styled reformers" who have seen only one isolated "fragment of truth" (cf. Hollingsworth) Hawthorne recognizes that these three types [writer, inventors and reformers] are basically united in their quest of a better life through the use of the imagination. "The fantasies of one day are the deepest realities of a future one," but "the white sunshine of actual life is necessary in order to *test* them" (p. 204). (Compare "Slyph Etherege" on the great dangers of unbalanced and untested imagination.) "Be the individual theory as wild as fancy could make it, still the wiser spirit would recognize the struggle of the race after a better and purer life than had yet been recognized on earth" (p. 205). As contrasted with Platonic or transcendental abstractions, it will not satisfy Hawthorne to have "our mother earth . . . exist merely in Idea. I want her great, round, solid self to endure interminably, and still to be peopled with the kindly race of man . . ." (p. 210).

In "The Procession of Life" (1843), a paean to American democracy, the hostility toward an artistically unsympathetic populace, frequently evident in Hawthorne, is muted almost to praise as he denounces social stratification according to wealth. Before he concludes the story with death leveling all, Hawthorne suggests that artists with their "electric sympathy" help to make all men brothers:

> Were Byron now alive, and Burns, the first would come from his ancestral abbey, flinging aside, although unwillingly, the inherited honors of a thousand years, to take the arm of the mighty peasant who grew immortal while he stooped behind his plough. These are gone; but the hall, the farmer's fireside, the hut, perhaps the palace, the counting room, the workshop, the village, the city, life's high places and low ones, may all produce their poets, whom a common temperament pervades like an electric sympathy. Peer or ploughman, we will muster them pair by pair and shoulder to shoulder. Even society, in its most artificial state, consents to this arrangement (N.P., pp. 1084–1085).

Then Hawthorne quickly disdains for a quantitative distinction the qualitative distinction between the artist and the populace, an attitude which partially counterbalances the opposite attitude in "The Artist of the Beautiful":

> Yet the longer I reflect the less am I satisfied with the idea of forming a separate class of mankind on the basis of high intellectual power. At best it is but a higher development of innate gifts common to all. Perhaps, moreover, he whose genius appears deepest and truest excels his fellows in nothing save the knack of expression; he throws out occasionally a lucky hint at truths of which every human soul is profoundly, though unutterably, conscious (N.P., p. 1085).

"A Select Party" (1844) emphasizes the view that the world of ideality, which the creative imagination of the artist perceives, is more real than the material world. To his castle in the air, representing ideality, a Man of Fancy (again the creative faculty) invites guests to a select party. To the people of the lower world looking upward, the castle seemed "unreal, because they lacked the imaginative faith [possessed by the artist and other selfless persons]. Had they been worthy to pass within its portal, they would have recognized the truth, that the dominions which the spirit conquers for itself, among unrealities become a thousand times more real than the earth whereon they stamp their feet saying, 'This is solid and substantial; this may be called a fact'" (H.H., p. 238). Represented by "the wise and witty," "generous and heroic friends," and "the beautiful dream woman" of the host's youth, the material world is discovered by the Man of Fancy to be far more insubstantial than "a number of guests whom incredulous readers may be inclined to rank equally among creatures of imagination. The most noteworthy were an incorruptible Patriot; a Scholar without Pedantry; a Priest without worldly ambition; and a Beautiful woman without pride or coquetry; a Married Pair whose life had never been disturbed by incongruity of feeling; a Reformer untrammelled by his theory; and a Poet who felt no jealousy towards other votaries of the lyre" (H.H., p. 242).

The selfless artist is the future Great American Poet. He is of

> . . . poor attire, with no insignia of rank . . . [with] a high, white forehead, beneath which a pair of deepset eyes were glowing with warm light. It was such a light as never illuminates the earth save when a great heart burns at the household fire of a grand intellect. And who was he?—who but the Master Genius for whom our country is looking anxiously into the mist of Time, as destined to fulfil the great mission of creating an American literature, hewing it, as it were, out of the unwrought granite of our intellectual quarries? From him, whether moulded in the form of an epic poem or assuming a guise altogether new as the spirit itself may determine, we are to receive our first great original work, which shall do all that remains to be achieved for our glory among the nations.

This literary genius, to whom is given the chair of honor at the banquet, is not snobbish or aloof but

> passes daily amid the throng of people toiling and troubling themselves about the trifles of a moment, and none pay reverence to the worker of immortality. Nor does it matter much to him, in his triumph over all the ages, though a generation or two of his own times shall do themselves the wrong to disregard him (H.H., pp. 242–243).

The ideality perceived by the artist's imagination is concretized by a room illuminated by moonlight (Hawthorne's usual creative atmosphere):

> Along the walls, illuminated by the mild intensity of the moonshine, stood a multitude of ideal statues, the original conceptions of the great works of ancient or modern art, which the sculptors did but imperfectly succeed in putting into marble; for it is not to be supposed that the pure idea of an immortal creation ceases to exist; it is only necessary to know where

> they are deposited in order to obtain possession of them. In the alcoves of another vast apartment was arranged a splendid library, the volumes of which were inestimable, because they consisted not of actual performances, but of the works which the authors only planned, without ever finding the happy season to achieve them. To take familiar instances, here were the untold tales of Chaucer's Canterbury Pilgrims; the unwritten cantos of the Fairy Queen; the conclusion of Coleridge's Christabel; and the whole of Dryden's projected epic on the subject of King Arthur. The shelves were crowded; for it would not be too much to affirm that every author has imagined and shaped out in his thought more and far better works than those which actually proceeded from his pen (HH., pp. 244–245).

"Drowne's Wooden Image" *(Godey's Magazine,* June, 1844) centers on the quickening effect of love (even if unilateral) on an artist's creativity, on the organic vs. obedience to mechanical rules, with allusion to the problem of literalism (in the Kodak sense) vs. idealisation. Briefly, the fable involves the supposedly stolid Drowne, a carver of wooden images to be used as figure-heads for ships, who is rapt out of his prosaic routine by his admiration for a very lovely Portuguese young lady. The setting is the port of Boston, evidently in the late eighteenth century, since the actual painter Copley visits Drowne's workshop and acts as a kind of Chorus, pointing the moral. Evidently the lady sits as the artist's model and then leaves the port on the arm of her escort, Captain Hunnewell; and Drowne, disillusioned, loses his temporary artistic inspiration. Broadly speaking, Drowne's turn from utilitarian and prosaic "carving ornamental pump heads, and wooden urns for gate posts" to his matchless figurehead followed by defeatism, resembles Owen Warland's early concern with prosaic clocks, his hope that Annie could respond to his love which in part inspired his attempt to spiritualize machinery (the artificial butterfly) and the fact that if she had responded he could have risen to an art that was "worthier." This "first American" pioneer in sculpture, "that art in which we can now reckon so many names already distinguished" (II, 348), is set in the environment where the embryo artist was functional in providing decoration for American ships, on which our "specimens of native sculpture had crossed the sea in all directions, and had been not ignobly noticed among the crowded shipping of the Thames" and other foreign ports. (II, 349). Such utilitarian and mechanistic sculpture had no deficiency, Hawthorne remarks, "*except* that deep quality, be it of soul or intellect, which bestows life upon the lifeless and warmth upon the cold, and which, had it been present, would have made Drowne's wooden image instinct with spirit" (II, 350).

After the young lady arrives and Drowne is known to be carving a new figurehead, Copley, "the celebrated painter," who had noted that hitherto none of Drowne's art-works embodied "the ethereal essence of humanity," (II, 351) noted in his unfinished sculpture "the divine, the life-giving touch," and he eagerly inquired, "What inspired hand is beckoning this wood to arise and live?" (II, 353). "Day by day, however, the work assumed greater precision, and settled its irregular and misty outline into distincter grace and beauty. . . . Gradually, by a magic touch, intelligence and sensibility brightened through the features, with all the effect of light gleaming forth from within the solid oak" (II, 353–4). It will be noted that Hawthorne here stresses a dual kind of inwardness associated with organic art—the irradiation of light from within the artist's materials, and (as Drowne's puts it), "A well-spring of inward wisdom gushed within me as I wrought upon the oak with my whole strength, and soul, and faith" in creating "this creature of my heart" (II, 355). Drowne tells Copley he knows nothing of the sculptor's *rules* of art (Copley repeatedly attacks the rules"), and Copley recognizes in Drowne "that expression of human love which, in a spiritual sense, as the artist could not help imagining, was the secret of the life that had been breathed into this block of wood" (II, 355). In the statue's "dark eyes, and around the voluptuous mouth, there played a look made up of pride, coquetry, and a gleam of mirthfulness." (II, 356). The townspeople claimed Drowne had been seen "kneeling at the feet of the oaken lady, and gazing with a passionate ardor into the face that his own hands had created" as "a modern Pygmalion" (II, 357, 353). Copley, who admired the lady, remarked that it was "No wonder that she inspired a genius in you, and first created the artist who afterwards created her image" (II, 361). (One is reminded of Milton's saying that before the poet can create a true poem, he must have made his own life a true poem.)

But when the unresponsive lady departs from the tearful Drowne, "the light of imagination and sensibility, so recently illuminating it [his face], had departed," and during the remainder of his life he returned to creating merely wooden images, (II, 361), during this brief period having wrought his art "in a kind of dream." (II, 361). Hawthorne's conclusion is that "in every human spirit there is imagination, sensibility, creative power, genius, which, according to circumstances [especially whether or not one is capable of love], may either be developed in this world, or shrouded in a mask of dulness until another state of being. To our friend Drowne there came a brief season of excitement, kindled by love. It rendered him a genius for that one occasion, but, quenched in disappointment, left him again the mechanical carver . . ." (II, 362). While Copley says the statue "is as ideal as an antique statue" (II, 354), yet this idealization was also a *literal* reproduction in all minute details.

In her appearance the actual lady "was exactly and minutely the shape, the garb, and the face which the towns-people had so recently thronged to see and admire [in the statue]. Not a rich flower upon her head, not a single leaf, but had its protype in Drowne's wooden workmanship, although now their fragile grace had become flexible, and was shaken by every footstep that the wearer made. The broad gold chain upon the neck was identical with the one represented on the image . . ." (II, 358). Obviously Hawthorne held that the artist had to begin with actuality or nature, and love was to him the alchemy which enabled the artist to interfuse the actual and the ideal, the particular and the universal.

"Earth's Holocaust" *(Graham's Magazine,* March, 1844) in broad terms is a comprehensive satire of those who imagine that progress can be insured by merely destroying (burning in the context of this story) all the "wornout trumpery" of the past as embodied in external things, such as "the blazonry of coat armor, the crests and devices of illustrious families, pedigrees that extended back . . . into the dark ages" as symbols of caste or inequalities. As regards our immediate topic of literature, the story tests the immortality of various writers and books by indicating which ones cannot be destroyed by fire. The setting of the test-by-fire is a site on "one of the broadest prairies of the West.'" II, 430–1.

Hawthorne has the case for the literary opposition, for traditional patronage, stated by "a grayhaired man, of stately presence, wearing a coat" with a "badge of rank." This man protests that "this fire is consuming all that marked your advance from barbarism, or that could have prevented your relapse thither. We, the men of the privileged orders (note the title of a pamphlet by Joel Barlow whose verses Hawthorne elsewhere called "leaden"), were those who kept alive from age to age the old chivalrous spirit; the gentle and generous thought; the higher, the purer, the more refined and delicate life. With the nobles, too, you cast off the poet, the painter, the sculptor—all the beautiful arts; for we were their patrons (cf. Hawthorne's praise of Dr. Johnson, the conservative who revolted from Lord Chesterfield's offer of patronage), and created the atmosphere in which they flourish" as they are nourished by "the gorgeous past." (II, 432–34; 431). After the reformers burn everything associated with the "robes of royalty," liquors, "all the boxes of tea and bags of coffee in the world," tobacco, purses and banknotes, physicians' equipment involving homoeopathy, gunpowder, instruments of prisons and torture, and even "marriage certificates," and "title deeds of landed property," the reformers being convinced that "Reason and Philanthropy combined will constitute just such a tribunal as is requisite" for the "millenium," (p. 441), these iconoclasts attempt to "get rid of the weight of dead men's thoughts" embodied in "books and pamphlets." The volumes of Voltaire "threw an infernal light over the visages of the spectators," and German stories "emitted a scent of brimstone." (Cf. Hawthorne's "Celestial Railroad" and its attack on German works which nourished "Giant Transcendentalist" as like "smoke, mist, moonshine, raw potatoes, and sawdust" (II, 224). Byron's works produced "lurid gleams and gushes of black vapor," and Tom Moore's "diffused an odor like a burning pastil," but among American writings, the poems of Ellery Channing showed an "excellent inflammability," while Hawthorne's own works "were changed to vapor by the first action of the heat." He pays conventional tribute to the "powerful blaze" of Milton's works as promising "to endure longer than almost any other material of the pile," and mentions that "from Shakespeare there gushed a flame of such marvellous splendor that men shaded their eyes." As regards literary values, the two surprises in this story are Hawthorne's tribute to Shelley and (considering his coolness to the churches and theology) to the Bible. "Shelley's[5] poetry emitted a purer light than almost any other productions of his day. . . ." And the Bible, the "head" of all "human literature," and representing "the main pillars which supported the whole edifice of our moral and spiritual state," instead of "being blackened into tinder, only assumed a more dazzling whiteness as the finger marks of human imperfection were purified away . . . without detriment to the smallest syllable that had flamed from the pen of inspiration" (444–53). The "titan of innovation," represented by the reforming mob, was awed as the attempt to destroy the Bible aroused "a mighty wind . . . roaring across the plain with a desolate howl, as if it were the angry lamentation of the earth for the loss of heaven's sunshine . . ." (452). When the narrator asks whether anything will be left for humanity to build on, his wise friend replies that "you will find among the ashes everything really valuable"—i.e., The Bible, Shakespeare, Milton, and Shelley. "Not a truth is destroyed nor buried so deep among the ashes but it will be raked up at last" (p. 453). The frantic "bookworm" who sees everything as lost is characterized as having "no *inward* fountain of ideas," mere traditionalists being thus seen as comparable to

[5] In "P's Correspondence" (1845) Hawthorne says Shelley eventually in his latest period approached "the threshold of heaven." High praise indeed, from Hawthorne! "Shelley has really climbed . . . from a lower region (of Godwin) to a loftier one (of Platonism and love). His later works such as *Prometheus Unbound* "are warmer with human love, which has served as an interpreter between his mind and the multitude, [i.e., he has used the vicarious imagination and is in accord with Hawthorne's own ideal of the Jacksonians of the Young America party]. The author has learned to dip his pen oftener into his heart, and has thereby avoided the faults into which a too exclusive use of fancy (as opposed to the vicarious imagination) and (Godwinian) intellect are wont (in his earlier period) to betray him . . . Now you . . . are conscious of a heart warmth responsive to your own. In his private character Shelley can hardly have grown more gentle, kind, and affectionate, than his friends always represented him to be. . ." (II, 420).

the short-sighted reformers who commit the fatal "error at the very root of the matter," the need to "Purify that inward sphere" of the individual's own heart. Hawthorne asks, "Is not Nature better than a book? Is not the human heart deeper than any system of philosophy? Is not life replete with more instruction than past observers have found it possible to write down in maxims? Be of good cheer. The great book of Time is still spread wide open before us; and, if we read it aright, it will be to us a volume of eternal truth." (p. 449)

Hawthorne's "Artist of the Beautiful" *(Democratic Review,* June, 1844) in which art is objectified in a mechanical butterfly, is sometimes erroneously said to present beauty as completely disassociated from religion. The general framework of the story and the contexture of the beautiful involves a revolt from the "utilitarian"—here represented by the blacksmith and the practical clock-maker. As a boy the artist, Owen, "was attempting to imitate the beautiful movements of Nature as exemplified in the flight of birds or the activity of little animals," (p. 249) his interest at first being in externals rather than in introspection. Hawthorne himself, after speaking of Owen's "chasing butterflies" as mere "playthings," remarks, "Alas that the artist, whether in poetry, or whatever other material, may not content himself with inward enjoyment of the beautiful. . . ." As long as this artist subordinates his art to drink and riotous living (i.e., is unethical) he is unable to create even mechanical art. One aspect of moralism, at least as associated with the social solidarity of Dr. Johnson's eighteenth century neo-classicism, is involved in the fact that Hawthorne says that the artist's "morbid sensibility" and "creative eccentricity," which made the townspeople of "unimaginative sagacity" think the artist mad, were aggravated by the artist's lack of social conformity. "The lack of sympathy—that contrast between himself and his neighbors which took away the restraint of example—was enough to make him" seem mad. One may also find some spiritual implication in Annie's early interpretation of the artist's aim as involving "the spiritualization of matter"; but it should be noted that the artist himself calls this "a strange idea," and he expresses a "strange distaste at the stiff and regular processes of ordinary machinery." "In his idle and dreamy days he had considered it possible, in a certain sense, to spiritualize machinery, and to combine with the new species of life and motion thus produced a beauty that should attain to the ideal which Nature has proposed to herself in all creatures, but never has taken pains to realize." To be completely successful this artist needs the intuitive sympathy of Annie, he needs to be "enlightened by the deep intelligence of love" (Cf. "Drowne's Wooden Image") which would, Owen says, "give firmness to my heart and hand." But actually Annie "had shown herself incapable of any deep response" or any "spiritual power that he worshipped," since this capacity had existed only "within the artist's imagination," and he "had deceived himself." Hawthorne adds, had the artist "found Annie what he fancied, his lot would have been so rich in beauty that out of its mere redundancy he might have wrought the beautiful into many a worthier type than he had toiled for," i.e., worthier than the merely mechanical butterfly. Viewed from this angle, the story deals with the way in which an artist's failure to find fulfillment in genuine love truncates his art which emerges in unworthy forms. In this case, the child of Owen's beloved, fathered by another, destroys even the artist's unworthy art. When Owen temporarily thinks he has "thrown . . . aside" his artist's dream and turned to "common sense" alone, after he recovers from "the calamity of men whose spiritual part dies out of them," he is led to "thank Heaven for rendering him again the being of thought, imagination, and keenest sensibility that he had long ceased to be." In other words, for Hawthorne the artist with spiritual orientation needs the harmonious balance of "thought, imagination, and keenest sensibility" rather than the extremist's[6] espousal of any one of these alone viewed as completely apart from the practical clock-maker's cold, "unimaginative sagacity" (cf. 514–5 Locke's Understanding without Reason), and apart from "the hard, cold world." (The quotations, in order, in the last paragraph will be found in II, 507, 515, 514, 521, 507, 524, 519, 523, 525, 514–5.)

In this story the antithesis of time and eternity (cf. Melville on man's-time and God's-time in *Pierre)* and the antithesis of the mechanistic and the organic, appear to involve a hierarchical progression of values in which art tends to be associated at its best with the universalized timeless and the organic. Is the very fact that the butterfly *is* mechanical a major explanation for its inability to survive? Is Hawthorne suggesting that art cannot have sufficient organic vitality to endure, to be timeless (transcending me-

[6] In connection with this recognition that a "worthier" art than that represented by the mechanized butterfly was desirable, it is interesting to recall that in Hawthorne's preface to *The House of Seven Gables* he had used the image of the butterfly associated with mechanical things in a satiric or disparaging way. "The author has considered it hardly worth his while, therefore, relentlessly to impale the story with its moral as with an iron rod,—or, rather, as by sticking a pin through a butterfly,—thus depriving it of life, and causing it to stiffen in an ungainly and unnatural attitude." It is noteworthy that in the "germ" for "The Artist of the Beautiful" in *American Note-Books* Hawthorne had cited as the artist's product various things which he called trivially mechanical; this original conception would appear to support the present interpretation of the mechanical butterfly as being *not* the "worthier type" of art he strove for. It will be recalled that in *The House of Seven Gables* Hawthorne thought the artistic Clifford, had his normal development not been stunted by imprisonment, might have developed into a "Sybarite." "The Procession of Life" has already been cited as counterbalancing "The Artist of the Beautiful" in its view that the true artist is not at the opposite pole from the populace and warm human sympathies.

chanical clockmakers) unless it is vitalized by the quickening and redemptive love of a woman endowed by sympathy and spiritual understanding? After the butterfly is destroyed, the artist, rather than being frantic, "looked placidly at what seemed the ruin of his life's labour," for, Hawthorne moralizes, "when the artist rose high enough to achieve the beautiful, the symbol [the mechanical] by which he made it perceptible to mortal senses became of little value in his eyes while his *spirit* possessed itself in the enjoyment of the reality." Finally, Hawthorne says in this story that when artistic ideas "grow up within the imagination" and appear to "be shattered and annihilated by contact with the practical" world, the artist "must stand up *against mankind* and be his own sole disciple, both as respects his genius and the objects to which it is directed." This doctrine, again, would seem to be out of accord with Hawthorne's more frequent view as a Jacksonian democrat that the artist gains power by expressing himself in harmony with the sentiment of the "uninstructed multitude." (II, 535–6; 512).

In Hawthorne's "The Great Stone Face," *(National Era,* Jan., 1850) in which the poet loses (along with the merchant [Gathergold], with the warrior [Old Blood-and-Thunder] and the politician [Old Stony Phiz]), in the contest as to who will most resemble the magnaminity and "divine sympathy" of the Stone Face, the author makes three points relating to aesthetics and the quest of greatness. First, the poet's literary "genius" includes the art of idealizing. "If he sang of a mountain, the eyes of all mankind beheld a mightier grandeur reposing on its breast, or soaring to its summit, than had before been seen there. If his theme were a lowly lake, a celestial smile had now been thrown over it, to gleam forever on its surface. If it were the vast old sea, even the deep immensity of its dread bosom seemed to swell the higher, as if moved by the emotions of the song. Thus the world assumed another and a better aspect from the hour that the poet blessed it with his happy eyes. The Creator had bestowed him, as the last best touch of his own handiwork. Creation was not finished till the poet came to interpret, and so to complete it." (III, 432–433) Broadly speaking, Hawthorne's presentation of the poet who idealizes "the mountains which had been familiar to him in his childhood" belongs to the tradition associated with Wordsworth. Nature, as represented by the Stone Face, had "become a teacher to him [Ernest], and . . . the sentiment which was expressed in it would enlarge the young man's heart, and fill it with wider and deeper sympathies than other hearts. They [the villagers] knew not that thence [from nature] would come a better wisdom than could be learned from books, and a better life than could be moulded on the defaced example of other human lives. Neither did Ernest know that the thoughts and affections which came to him so naturally in the fields and at the fireside, and wherever he communed with himself, were of a higher tone than those which all men shared with him." (III, 421). Cf. Wordsworth's doctrine that "one impulse from a vernal wood" can teach man more "than all the [human] sages can." Second, as regards aesthetics, "The Great Stone Face" also contains Hawthorne's sharpest statement as to the reality of nature and its beauty as opposed to the current transcendental doctrine that nature's beauty exists only in the human observer's fancy. Some of the villagers who looked upon the Stone Face were given to "affirming that all the beauty and dignity of the natural world existed only in the poet's fancy." Notice Hawthorne's own editorial verdict: "Let such men speak for themselves, who undoubtedly appear to have been spawned forth by Nature with a contemptuous bitterness, she having plastered them up out of her refuse stuff, after all the swine were made. As respects all things else, the poet's ideal was the truest truth." Finally, much as Ernest admired "the living images which the poet flung out of his mind, and which peopled all . . . with shapes of beauty," the poet himself in his humble self-appraisal recognized that he was "not worthy to be typified by yonder benign and majestic image,"—i.e., the Stone Face. Why? Because his conduct, his life, has not been sincerely organic with his poetic professions. "My life, dear Ernest," the poet says, "has not corresponded with my thought. I have had grand dreams, but they have been only dreams. . . . Sometimes even—shall I dare to say it?—I lack faith in the grandeur, the beauty, and the goodness, which my works are said to have made more evident in nature and in human life. Why, then, pure seeker of the good and the true, shouldst thou hope to find me, in yonder image of the divine?" In contrast, Ernest's own words from his "natural pulpit" had organic "power, because they accorded with his thoughts; and his thoughts had reality and depth, because they harmonized with the life which he had always lived. It was not a mere breath that this preacher uttered; they were the words of life, because a life of good deeds and holy love was melted into them. . . . The poet, as he listened, felt that the being and character of Ernest were a nobler strain of poetry than he had ever written. . . . Behold! Behold! Ernest is himself the likeness of the Great Stone Face" so "imbued with benevolence" and a "grand beneficence." This doctrine that the expresser of beauty must go beyond mere verbal technique and must make the "deeds" of his actual life and his personal thought harmonize with his words and vitalize them belongs to the tradition of John Milton and his lofty organic doctrine that no man can be a true poet who has not first made his own life a noble poem. This organic doctrine links Hawthorne's religious-ethical doctrine with his aesthetic doctrine, and helps to explain why he has so little to say, relatively, about technical matters. (II, 433–38)

In conclusion, what artistic problems do these stories show Hawthorne concerned with? First, in "The Artist of the Beautiful" he reflects a transient pique because the artist feels himself at times out of accord with the multitude, but as an ardent member of George Bancroft's Jacksonian party Hawthorne more characteristically thinks that the artist should be the spokesman for deeper insights shared by all men. Second, in "Prophetic Pictures" he warns the artist against excessive *pride* as an irresponsible creator of portraits which prophecy a character's future development while he retained faith that the artist could exert free will to forestall his own bad influence. But in "Randolph's Portrait" he seems to excuse the use of art to prophecy when such art was used in the interest of political freedom as against tyranny. Third, Hawthorne was deeply concerned with the relative values of the mechanistic versus the organic, the latter being essential to the greatest art. The organic approach was inspired by an artist's sincere love even if unilateral (as in "Drowne's Wooden Image") and by a life of genuine ethical elevation and selfless magnanimity (as in "The Great Stone Face"). (For orientation, see R. R. Male's " 'From the Innermost Germ' ". . . . ELH, XX, 218ff., Sept. 1953). Fourth, while he honored two writers of "transcendent imagination," Swedenborg and Goethe ("Hall of Fantasy"), he thought that counterfeit art could mislead a viewers' imagination toward ruinous wishful thinking, as in "Sylph Etherege." Imagination needed to be balanced by reasonableness, warmth of heart, and a vigilant regard for actuality. (For orientation, see R. J. Coanda's unpublished dissertation, "Hawthorne on the Imagination," University of Wisconsin, 1960). Fifth, the stories surveyed help to round out Hawthorne's evaluation of literary masters, including his contemporaries such as Shelley whose later work he exalted. Sixth, while in "Chippings" he thought symbols (such as tombstones) unnecessary, he has his narrator in "The Antique Ring" say that the symbol and the idea symbolized cannot be separated, thus moving toward a less mechanical and a more fused and organic view of symbolism as transcending allegory, Seventh, he resigns himself to the fact that beauty on earth cannot be perfect, that one should learn to live with some imperfection, as in "The Birthmark." As an anti-transcendental empiricist in part, he is not satisfied to have round Mother Earth "exist only in Idea" (as in "The Hall of Fantasy"), although he does take hope in the fact that the cloudiest mud-puddle can reflect the purest Heavens. The true writer can idealize. Eighth, Hawthorne is concerned with the way in which literature can make use of the timely or the familiar scene to transcend itself and suggest in symbols timeless and hence enduringly suggestive human and spiritual values, as in "The Hall of Fantasy" and especially in "Earth's Holocaust," where he tries to show that man's transient reforms and even fire cannot destroy the deathless works such as *The Bible,* and those of Shakespeare and Milton.

As regards chronological development in these stories by Hawthorne one can note his *growth* toward an increasing fusion of image and idea, culminating in "The Artist of the Beautiful, perhaps his most subtle story on an artist, as well as a growth toward more concern with the organic, with a concern with the artist's need for love and sympathy, a recognition of the perils of the artist succumbing to pride in the sense of prophecy, and, after variants, a growing sense of the artist's need to reconcile faith in his art with his role as spokesman of insights shared by all men, along with a need to try to balance the imagination with understanding of reality and with reason, a need for the "counterpoise between his mind and heart" (N.P., 1194). If these stories on artists are not without a few apparent contradictions or inconsistencies, it should be recalled that R. H. Fogle's excellent book, *Hawthorne's Fiction: The Light and the Dark* (1952), p. 192, concludes that in general "there is no synthesis in Hawthorne's thinking, only thesis and antithesis in balance. . . .His only reconciliation is acceptance of life's differences and contradictions." Finally, for a general, overall brief survey, the reader is directed to C. H. Foster's useful study by C. H. Foster of "Hawthorne's Literary Theory," PMLA, LVII (March, 1942), pp. 241–54, a study which the present one is intended to supplement in its concern with the way the artist and his concern with beauty function in terms of images within actual stories as works of art.

"THE ACTUAL AND THE IMAGINARY": HAWTHORNE'S CONCEPT OF ART IN THEORY AND PRACTICE

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Few students of modern fiction—that peculiarly Western evolution—deny Nathaniel Hawthorne's "absolute greatness as a writer and the centrality of his position in American literature."[1] But too many go on to assert that "allegory is organic" to Hawthorne's work.[2] As a result, the familiar deduction from these casual premises is the widely accepted assumption that Hawthorne wrote great allegory. By such an approach we can prove that every play that Shakespeare wrote was good. However, in point of fact, no one has shown satisfactorily either that *Titus Andronious* is a good play or that Hawthorne was a great allegorist. If we are to reach a sound critical understanding of Hawthorne and his place in literature, we must come to grips with the unconscious syllogism which has weakened many of the recent, generally perceptive studies of him.[3] What must be decided is how "organic"—or central, to be more exact—to Hawthorne's artistic purposes and methods was his "inveterate love of allegory."[4]

A more helpful hypothesis is that an inveterate love of human life—that odd mixture of body and soul—was central to, and controlled Hawthorne's philosophy of art. His particular understanding of the nature of man led him to a parallel, but elevated view of the artist as one who lives and works among the Actual and the Imaginary for the purpose of giving the ordinary man a greater appreciation of life. By seeing then, (1) what elements it takes to make an artist and (2) how an artist goes about his work, we can reach (3) an understanding of Hawthorne's aesthetic of the Actual

[1] Roy R. Male, *Hawthorne's Tragic Vision* (Austin, Texas, 1957), p. 19. But see also Rudolph Von Abele, *The Death of the Artist: A Study of Hawthorne's Disintegration* (The Hague, 1955), a work based on the assumption that "in his own right Hawthorne is moderately interesting, but scarcely great" (p. 101).

[2] Richard H. Fogle, *Hawthorne's Fiction: The Light and the Dark* (Norman, Oklahoma, 1952), p. 7.

[3] See, for example, Fogle, *Hawthorne's Fiction,* p. 41, for the clearest evidence of the syllogism; Ivor Winters, "Maule's Curse: or Hawthorne and the Problem of Allegory" (1938), *In Defense of Reason* (Denver, 1947), pp. 157–175, who assumes the validity of the minor premise in order to deny Hawthorne's greatness; and Mark Van Doren, *Nathaniel Hawthorne* (New York, 1949) who reveals that he accepts the syllogism when he is forced to say that "without his allegory Hawthorne would be nothing" (p. 66).

[4] Certainly the main line of Hawthorne criticism from Poe and James; down to Newton Arvin, Austin Warren, Randall Stewart, and Leon Howard; and including now H. H. Waggoner and Harry Levin has reflected the idea that Hawthorne was "more than a mere allegorist"; however, the fact that each of these students of Hawthorne has felt he had to make some sort of general qualification with regard to "Hawthorne's allegory" shows the pervasiveness of the assumption being examined in this article. Only F. O. Mathiessen, to date, has undertaken a similar study.

and the Imaginary. Once we understand Hawthorne's theory of art we shall be able (4) to see to what degree and how "allegory" and imagination figure in his work, and (5) to come to a more exact estimate of his genius.

Melville long ago warned the "mere critic" of the futility that lies in trying to analyze Hawthorne's genius, "for it is not the brain that can test such a man; it is only the heart. You cannot come to know greatness by inspecting it; there is no glimpse to be caught of it, except by intuition." Nevertheless, any intuitive discoveries made by a critic can be reported only in the rhetorical patterns of humble prose. These two observations need not discourage us in our attempt to sound Hawthorne; they should remind us, rather, that the orderly progressions and philosophical schemes that follow are the report of a reader, not the product of an artist. No claim is made for Hawthorne as a logically consistent philosopher; insight and reflection can work together productively in an intelligent, sensitive adult without his knowing how or caring why. And, it should be needless to add, the processes of such cerebral production can be haphazard and apparently confusing without impairing the end result. Let us accept, then, the challenge offered by Hawthorne to "look through the entire range of his characters, good and evil, in order to detect any of his essential traits."[6]

I

Hawthorne quite rightly placed himself "between the Transcendentalists . . . and the great body of pen-and-ink men who address the intellect and sympathies of the multitude."[7] This could be taken as merely an evasive circumlocution concerning that fictitious alter-ego, M. de l'Aubépine; however, I find it to be an exact delineation of the area where Hawthorne felt that, as an artist, his creative work would be most effective. He affirms repeatedly that man, above the animals, has *soul, intellect,* and *heart.*[8] The Transcendentalists were overly concerned with the soul, while the majority of writers ignored what might be the divine or immortal—"ethereal" is Hawthorne's preference—aspect of man and stayed within the limits of the body's head (intellect) and heart. But Hawthorne felt that neither the body nor the soul should be neglected in favor of the other; rather, he attempted to formulate his work in such a

[5] "Hawthorne and His Mosses," *The Apple-tree Table and Other Sketches,* ed. Henry Chapin (Princeton, 1922), pp. 63–64.

[6] Preface, *The Snow Image,* III, 386. All references are to the Riverside Edition of *The Complete Works.* ed. G. P. Lathrop, 13 vols. (Boston, 1882–84). When the general source of a quotation is clear, its exact location will be noted in the text.

[7] Preface, "Rappaccini's Daughter," II, 107.

[8] E.g., *The Scarlet Letter,* V, 33–34; *The American Notebooks,* ed. Randall Stewart (New Haven, 1933), p. 126. See Marvin Laser, "'Head', 'Heart', and 'Will' in Hawthorne's Psychology," *Nineteenth Century Fiction,* X (September, 1955), 130–140 for an account of the academic roots of Hawthorne's working hypothesis concerning man.

way that it would be written from, and addressed to, the total man: soul, intellect, and heart.

At first glance, Hawthorne's view of man appears to follow traditional humanistic thought. However, Hawthorne separated what Shakespeare would have called simply "the rational soul" into intellect and soul; the soul alone remained uncorrupted by Adam's fall, while reason (intellect) lost its divine efficacy, a view in accord both with Hawthorne's Puritan heritage and with his exposure to Romanticism. The heart, in turn, serves as a kind of middle ground. Bodily and impure, it is "that foul cavern . . . wherein existed the original wrong of which the crime and misery of this outward world were merely types."[9] Yet, the two *Allegories of the Heart* (II, 303–346) remind us that the redeeming power of love also resides within the heart. Thus, although the soul alone is spiritual while the head and the heart are earthly, they must all work in harmony if man is to be happy and at peace with himself.

Basically, the artist is representative of Everyman;[10] however, his innate moral characteristics of intellect, soul, and heart are expanded to "thought, imagination, and keenest sensibility."[11] These three powers must be acute, but also must remain in balance, if they are to produce great art: if they are "to put the very spirit of beauty into form and give it motion."[12]

The first step necessary in artistic creation is the full exercise of intellectual power in the analysis of actual material flux and fact, be it butterflies, a birthmark, or the "varying characteristic traits" of a young couple.[13] This is the step which Hilda could not accomplish; she had the requisite imagination and sensibility (soul and heart) which could re-create some one else's analysis of external reality, but she did not have enough mind to be an original artist. "Instructed by sorrow," however, at the end of *The Marble Faun,* Hilda had lost her ability to copy, for "she could not yield herself up to the painter so unreservedly as in times past; her character had developed a sturdier quality, which made her less pliable to the influence of other minds. . . . She had known such a reality, that it taught her to distinguish inevitably the large portion that is unreal, in every work of art."[14]

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[9] "Earth's Holocaust," II, 445. (On the same page, the intellect alone is shown to be powerless with regard to the heart.)

[10] See "The Procession of Life," II, 240, and "Drowne's Wooden Image," II, 362.

[11] "The Artist of the Beautiful," II, 525. See also, Preface, *The Scarlet Letter,* V, 44, and "P's Correspondence," II, 420.

[12] "The Artist of the Beautiful," II, 509.

[13] "The Prophetic Pictures," I, 199.

[14] *The Marble Faun,* VI, 427. This passage is important not only because it reflects Hawthorne's views on aesthetics but also because it gives support to that school which sees the theme of the work as a reaffirmation of *felix culpa:* Hilda clearly has been educated now that her virtue is no longer fugitive and cloistered. Perhaps the violence of her retort to Kenyon in the next chapter (XLII) is the reflection of her realization of this fact. In any case, the entire present chapter (XLI) should be read, for it supplies a wealth of evidence which supports the thesis being presented in this article.

Once we make this discovery, that appearance is unreal, we fall apart like Feathertop unless our new knowledge leads to a sense of a higher reality. Hence, at this stage, Hawthorne's conception of the imagination enters into his aesthetic, for the imagination is an "innate tendency of soul"[15] which reaffirms with the new Adam and Eve that 'heaven is my home.' It is necessary in art, for "it is only through the medium of the imagination that we can lessen those iron fetters, which we call truth and reality, and make ourselves even partially sensible what prisoners we are" (II, 278). Hawthorne was not a Subjective Idealist—witness the fate of Sylph Etherege who lived entirely within "the haunts of imagination" (III, 510)—, nor was he a Transcendentalist; nevertheless, he did believe that there was a truth and a reality higher than those represented by material flux and fact alone. No weighty metaphysic such as Coleridge's, nor a well defined theology such as Edwards' specifically informed his thought; but, brought up in the mixed atmosphere of both philosophies and being a man of sensitive mind and spirit, Hawthorne was conditioned to accept some sort of heaven, absolute, or perfect Idea as an empirical fact. We need look no further than "The Old Manse" to see that, in truth, he did. There, it is clear that the beauties of nature, especially as reflected in the river, informed his soul of an ideal realm;[16] but even at the mundane Salem Custom House, he believed with all his power that there was a "true and indestructible value that lay hidden in . . . petty and wearisome incidents, and ordinary characters" (V, 57). It is the function of the imagination to discern "in this sphere of strangely mingled elements, the beauty and the majesty which are compelled to assume a garb so sordid."[17]

But "the coolness of a meditative habit" and the "glittering icicles" of imagination[18] will remain cold and lifeless "till the heart is touched," until thought and imagination (mind and soul) are warmed by mixing with the artist's sensibility or sympathy. The warming, humanizing power of the heart hardly needs to be labored anymore,[19] but it receives an interesting illustration in the Preface to *The Scarlet Letter*. There, Hawthorne's innate sympathy was so stirred by the "A" that it scorched him.

[15] "The Artist of the Beautiful," II, 515.

[16] Malcolm Cowley, "Hawthorne in the Looking Glass," *Sewanee Review*, LVI (Autumn, 1948), 545–563, and Jesse Bier, "Hawthorne on the Romance: His Prefaces Related and Examined," *Modern Philology*, LIII (August, 1955), 17–24, have pointed out that the reflections seen in mirrors, rivers, and ponds are symbols of the imagination in Hawthorne.

[17] *The House of Seven Gables*, III, 59.

[38] Preface, *Twice-told Tales*, I, 16; "The Village Uncle," I, 356.

[91] See, for example, John W. Shroeder, " 'That Inward Sphere': Notes on Hawthorne's Heart Imagery and Symbolism," *PMLA*, LXV (March, 1950), 106–119; Donald A. Ringe, "Hawthorne's Psychology of the Head and Heart," *PMLA*, LXV (March, 1950), 120–132; and Roy R. Male, "Hawthorne and the Concept of Sympathy," *PMLA*, LXVIII (March, 1953), 138–149.

Yet, he could not write his novel at that time, for even though the story was "subtly communicating itself to my sensibilities, . . . it was evading the analysis of my mind," and "my imagination was a tarnished mirror" (V, 50, 53). How, then, does the artist combine and mold his creative powers? To answer this question we must delve into the light and shade, and enter the lives of every day affairs and of solitude. When we come out, we should have a clearer idea of Hawthorne's conception of the Actual and the Imaginary, and should be in a better position to interpret his "inveterate love of allegory."

II

From Hawthorne's *Note-books,* his Prefaces (especially those to the *Twice-told Tales* and *The Scarlet Letter),* the many sketches such as "Snow-flakes" and "Fragments from the Journal of a Solitary Man" [Oberon], the tales "Drowne's Wooden Image" and "The Artist of the Beautiful," and some passages in *The Marble Faun* we get a consistent picture of the artist at work.[20] In all, the artist lives a divided life: half in the sunshine amid nature or the bustle of life, half in the shade and in solitude. The sun is necessary for the studied and passive observation of all the potential materials and subjects later to figure in artistic creations. But the sun shines equally on the just and the unjust, confusing apparent reality with the manifestations of a higher reality. Thus, the artist must retire to a study where daylight does not interfere with the figuring forth of the imagination. Hawthorne's warning to his fiancé could have been addressed as well to a young artist: "Keep thy imagination sane—that is one of the truest conditions of a communion with Heaven."[21]

In solitude, then, surrounded by shade created by fire or some subdued light, an artist can serve his imagination—the shade hiding "whatever was unworthy to be noticed" and the fire picturing forth "golden glimpses of a better world."[22] Thus, the study itself becomes a symbol of the imagination, just as is Miriam's studio in *The Marble Faun,* which was

> one of those delightful spots that hardly seem to belong to the actual world, but rather to be the outward type of the poet's haunted imagination [See "The Haunted Mind]", where there are glimpses, sketches, and

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[20] Annette K. Baxter, "Independence vs. Isolation: Hawthorne and James on the Problem of the Artist," *Nineteenth Century Fiction,* X (December, 1955), 225–231, correctly warns us not to assume that Hawthorne projected himself in the pictures of his own artists, for his total achievement reads otherwise; and Arlin Turner, "Hawthorne as Self-Critic," *South Atlantic Quarterly,* XXXVII (April, 1938), 132–138, points out that Hawthorne purposely underrated himself as a kind of protective device.

[21] *The Heart of Hawthorne's Journals,* ed. Newton Arvin (Boston, 1929), p. 86.

[22] "A Select Party," II, 71–72; "Fire Worship," II, 162. ("Fire Worship" serves as "Il Penseroso" to his "L'Allegro": "Buds and Bird Voices.")

> half-developed hints of beings and objects grander and more beautiful than we can anywhere find in reality. The windows were closed with shutters, or deeply curtained, except one which was partly open to a sunless portion of the sky, admitting only from high upward that partial light which, with its strongly marked contrast of shadow, is the first requisite towards seeing objects pictorially. (VI, 57)

Yet, if the hints of the imagination are to receive full development, the artist even in solitude must somehow keep his heart warm so that his natural sensibility will be communicated to his artifact. As Kenyon fell in love, his "genius unconsciously wrought upon by Hilda's influence, took a more delicate character than heretofore"; when she is lost, "imagination and the love of art" die within him (VI, 426, 483).

Hawthorne often repeated this conception of how a creative imagination functioned; let us take our summary, then, from *Dr. Grimshawe's Secret,* in order to show his consistency. In describing Ned, he says, "there were the rudiments of a poetic and imaginative mind within the boy, if its subsequent culture should be such as the growth of that delicate flower requires; a brooding habit taking outward things into itself and imbuing them with its own essence until, after they had lain there awhile, they assumed a relation both to truth and to himself, and became mediums to affect other minds with the magnetism of his own." Like Hawthorne, Ned grew up in a shadow, "with less sunshine than he needed for a robust and exuberent development, though enough" to cultivate his imagination. Ned, too, lived "an inward life . . . , keeping his imagination always awake and strong." Although he lived in a "castle in the air" [see *Our Old Home,* VII, 150–51, "A Select Party," and "The Hall of Fantasy"], Little Elsie was there "to keep life real, and substantial" (XIII, 108–110).

III

A castle in the air, a study, or living an inward life should not be taken as evidence of a denial of actual life. Hawthorne calls the world unreal because it is not complete reality; it has the appearance of reality only when close contact with earthly things successfully masks the higher reality. Since the degrees of reality and unreality which the world offers will vary from person to person, Hawthorne avoids confusion by calling material fact and flux "the Present, the Immediate, the Actual."[23] In spite of his use of the diction of Berkeleian psychology, his emphasis was of an opposite nature. The Actual exists and man exists within it.

[23] Dedication *Our Old Home,* VII, 16. The rest of the dedication may be read in support of the present article.

On the other hand, the Ideal may lie "above, below, or beyond the actual."[24] It matters little, for the Ideal can only be imagined within each person. The Imaginary, then, is just that: a condition of the mind. But the imagination, nevertheless, can have a real effect on man. Having its origin in the soul, it can bring to bear on man's vision the soul's knowledge of the Ideal. Through the imagination, a man is given an elevated perception of the material fact and flux which might otherwise cloud his vision of a better life. By exercising the active faculty of his soul he can purge away the petty aspects of earthly life so that life is endowed with a purer meaning.

In spite of my separation of the Actual and the Imaginary for purposes of definition, they play equally important roles in artistic creation, the purpose of which is to "affect other minds with the magnetism" of the artist's mind. If a work is too imaginary, or exclusively Transcendental, contact cannot be made with other minds. If it is too much a pen-and-ink copy of actual life, there will be no magnetism, no shock of human recognition, no impulse along the magnetic chain of humanity. Effective art lies somewhere in between.

Hawthorne observed in his *American Notebooks* that "on being transported to strange scenes, we feel as if all were unreal. This is but the perception of the true unreality of earthly things, made evident between ourselves and them. By and by we become mutually adapted, and the perception is lost" (IX, 109). The artist's retreat to some kind of study is necessary, then, so that the imagination can work to regain that perception.

This idea receives dramatic illustration from an incident reported in *Our Old Home*. Hawthorne had gone to Uttoxeter because the story of Dr. Johnson's having done penance there as an old man had always touched him deeply. Once arrived, however, he was surprised to find that he felt no emotional reaction; rather, he walked around the market place quietly bemused, observing and pondering the details of the setting, but careful not to fall into a literal reenactment of the penance. Hawthorne understood that

> a sensible man had better not let himself be betrayed into these attempts to realize the things which he has dreamed about, and which, when they cease to be purely ideal in his mind, will have lost the truest of their truth, the loftiest and profoundest part of their power over his sympathies. Facts, as we really find them, whatever poetry they may involve, are covered with a stony excrescene of prose, resembling the crust on a beautiful sea-shell, and they never show their most delicate and divinest colors until we shall have dissolved away their grosser actualities by steeping them long in the powerful menstruum of thought. And seeking to actualize them again, we do but renew the crust. If this were otherwise,—if the moral sublimity of a great fact depended in any degree on its

[24] "The Hall of Fantasy," II, 197.

> garb of external circumstance, things which change and decay,—it could not itself be immortal and ubiquitous, and only a brief point of time and a little neighborhood would be spiritually nourished by its grandeur and beauty. (VII, 165–66)

Even though Hawthorne was careful, then, not to stand in the middle of the market place, he felt no grandeur and beauty while visiting Uttoxeter. As soon as he had left the town, however, "this sad and lovely story . . . [became] holy to my contemplation, again. . . . It but confirms what I have been saying, that sublime and beautiful facts are best understood when etherialized by distance" (VII, 16).

It is clear now why an artist needs a study, why he needs to enter "a neutral territory, somewhere between the real world and fairy-land, where the Actual and the Imaginary may meet, and each imbue itself with the nature of the other."[25] When such a mixture of the Actual and the Imaginary is obtained, the result will be effective art. We get a total view of this aesthetic theory through "The Hall of Fantasy."

The Hall of Fantasy, like the soul and heaven itself, "is likely to endure longer than the most substantial structure that ever cumbered the earth." It is important for the artist to visit the hall, for "here the wise head and capacious heart may do their work; and what is good and true becomes gradually hardened into fact." Yet the hall can not be a home, for "the root of human nature strikes down deep into this earthly soil, and it is but reluctantly that we submit to be transplanted, even for a higher cultivation in heaven." No, that "allegoric structure," the Imaginary, is only a "place of refuge from the gloom and chilliness of actual life." Granted that "there is but half a life—the meaner and earthlier half—for those who never find their way into the hall," it is equally true that the Imaginary is but half a life, and good art will mix the Actual and the Imaginary to soften the "hard angles" of earthly existence. Hawthorne concludes, "Let us be content, therefore, with merely an occasional visit to the Hall, for the sake of spiritualizing the grossness of this actual life, and prefiguring to ourselves a state in which the Idea shall be all in all" (II, 196–211).

Hawthorne's mention of 'prefiguring the Idea' seems to lay the ground work for Symbolism and the idea of 'spiritualizing this life' could validly lead to Allegory. But symbolism demands a kind of imagination which Hawthorne did not have; moreover, a symbol tends to separate the Actual and the Imaginary, even while yoking them. Allegory, indeed, does mix the Actual and the Imaginary; however, it demands a strict and well-defined philosophy or theology which it wishes to expound. But Hawthorne would join neither the 'School of Philosophy' nor any church; they were too narrow

[25] Preface, *The Scarlet Letter,* V, 55.

in their approaches to life. What then of his confessed "love of allegory"? The phrase is a vague expression which described the manner in which Hawthorne's imagination worked—a manner partly symbolical and partly allegorical.

IV

With Hawthorne's constant emphasis on the necessity of the imagination's working hand and glove with the head and the heart, we are reminded of Coleridge's metaphysic of Organic Vitalism. Drowne's repetition of the aesthetic commonplace that a "figures lies hidden within that block of oak, and it is my business to find it" (II, 353) has, in fact, suggested to recent critics that Hawthorne knew Coleridge's theory.[26] But the correspondence between Hawthorne and Coleridge is only a similarity, not an identity, for Hawthorne's conception of the imagination was not so rarefied as the Englishman's. F. O. Matthiessen was quite right when he said that Hawthorne never distinguished between the imagination and fancy,[27] and we can agree with Coleridge that the distinction, in itself, is rather pointless. Nevertheless, his analysis of the imagination does give us a measure which we may use to determine the degree of esemplastic creative power which lies within Hawthorne's conception of the imagination.

Coleridge's primary imagination is "the living Power and prime Agent of all human Perception, and is a repetition of the eternal act of creation of the infinite I AM."[28] This is the power in the theory of Organic Vitalism which can create a world above nature by using its knowledge to postulate the essential creative process of nature. But Hawthorne was mystified by that process. Although he saw that somehow the Gothic represented "the very process of nature", he was equally sure that it "produces an effect we know not of." Because he took the world as he found it and believed that its essential qualities could not be changed, he affirmed that his taste was Gothic, not Platonic as was Coleridge's: "classic statues escape you with their slippery beauty, as if they were made of ice. Rough and ugly things can be clutched." Hence, Hawthorne's reac-

[26] Roy R. Male, "'From the Innermost Germ': The Organic Principle in Hawthorne's Fiction," *ELH*, XX (September, 1953), 219. See also, Male, *Hawthorne's Tragic Vision* (Austin, Texas, 1957), p. 20 ff., et passim; C. H. Foster "Hawthorne's Literary Theory," *PMLA*, LVII (March, 1942), 241–254; and Jesse Bier, "Hawthorne on the Romance: His Prefaces Related and Examined," *Modern Philology*, LIII (August, 1955), 17–24.

[27] *American Renaissance* (New York, 1941), pp. 249–250. Matthiessen tends to overrate the archetypal thrust of Hawthorne's imagination; he, like Male, *Tragic Vision*, pp. 29–32, has to draw heavily from Melville in order to illustrate the esemplastic power of Hawthorne's mind. Hawthorne did not have enough self-reliance, in the Emersonian sense, to be a symbolist.

[28] *Biographia Literaria*, Ch. XIII (*Criticism: The Major Texts*, ed. Walter Jackson Bate (New York, 1952), p. 387).

tion to nature and the Gothic was "moral rather than intellectual"; he needed the Actual "where human feelings may cling and overgrow like ivy."[29]

The difference between the two men is most clearly seen in "The Artist of the Beautiful" (II, 504–536). Hawthorne's delineation of Owen Warland's attempt to create "a beauty that should attain to the ideal which Nature proposed to herself in all her creatures, but has never taken the pains to realize" entails both a Platonic conception of art and the creative process of Organic Vitalism. But what is Hawthorne's evaluation of Owen's desire? He suggests ironically that "the chase of butterflies was an apt emblem of the ideal pursuit in which he had spent so many golden hours." He further implies that had Owen spent his golden hours (hours in which the spirit and imagination are exercised) in courting Annie and had he fallen in love with her, "his lot would have been so rich in beauty that out of its mere redundancy he might have wrought the beautiful in many a worthier type than he had toiled for." Once Owen's aim had been realized, the result fell far below any Coleridgean Ideal. Hawthorne keeps reminding us that it was a mechanical butterfly, that it sought humans before heaven, and that when it did attempt heaven, a ceiling—"that earthly medium"—prevented any escape from the world. If we recall that Hawthorne repeatedly symbolized the heart by a house, the implication at the end of "The Owen's heart so warmed that he could turn his attention to earthly beauty as represented by a mother and child before a domestic fire. Because, as Owen realized, the butterfly contained "the intellect, the imagination, the sensibility, the soul of an Artist of the Beautiful," he had to reject the symbol if he was to affirm his own life and reality. After the butterfly had been exorcised, Owen's "spirit possessed itself in the enjoyment of the reality." He had learned how to perceive beauty on earth and how to bring others closer to a perception.[30]

Coleridge's primary imagination leads to a symbolism which expands from the material and points to the supernatural, to the realm of archetypes; but Hawthorne was so committed to existence in this world that his imagination could conceive only of symbols which pointed to life itself. His was the imagination which saw a

[29] *The French and Italian Note-books,* X, 399–400. See also Matthiessen, pp. 269–270, for a discussion of Hawthorne's Gothic taste.

[30] Contrasting readings can be found in Geo. E. Woodberry, *Nathaniel Hawthorne: How to Know Him* (Indianapolis, 1918), pp. 74–89; R. H. Fogle, *Hawthorne's Fiction,* pp. 70–90; and Rudolph Von Abele, "Baby and Butterfly," *Kenyon Review,* XV (Spring, 1953), 280–292. Woodberry believed that the story is a perfect illustration of Hawthorne's artistic aim and method; Fogle believes that Warland's achievement represents the superior spiritual validity of aesthetic experience; and Von Abele believes that there is a tension in the tale which is a projection of Hawthorne's inability to reconcile the contradictory allegiances to which he was committed as a man and as an artist.

house not as a type of eternity but as the human heart, which was able to put the music of the spheres into a music box, and which believed that the microscopic techniques of "the old Dutch masters" get "at the soul of common things, and so make them types and interpreters of the spiritual world."[31] A description of such an imagination can be found in Coleridge on Fancy:

> FANCY, on the contrary, has no other counters to play with, but fixities and definites. The Fancy is indeed no other than a mode of Memory emancipated from the order of time and space; while it is blended with, and modified by the empirical phenomenon of the will, which we express by the word CHOICE. But equally with the ordinary memory the Fancy must receive all its materials ready made from the law of association.[32]

If this is a just delineation of Hawthorne's "imagination," and if, as Matthiessen says, "allegory deals with fixities and definites which it does not basically modify,"[33] then we should be able to conclude that Hawthorne wrote Allegory. But the essential quality of Allegory is that it has a particular philosophy or theology from which it deduces its particular symbols and to which those symbols must consistently refer. In this respect *The Fairie Queene* and *The Pilgrim's Progress* are allegories, but *Gulliver's Travels* is not. And, in spite of Melville and Fogle, I should say that neither "A Select Party" nor "The Celestial Railroad" is, strictly speaking, an allegory.[34] They present us with types, not archetypes; hence, they are quasi-allegorical in that they contain Imaginary figures, which are deduced from Actual life and refer to Actual life, and quasi-symbolical in that they contain Actual symbols which only pass through the Imaginary and refer back to the Actual.[35]

V

Against the background of Hawthorne's ideas concerning the function of the artist and his theory of the Actual and the Imaginary, I have tried to estimate the nature of his imagination in order to show that neither symbolism nor, more particularly, allegory, considered as genres, plays a central part in his conception of art. Because Hawthorne did work with the Imaginary, however, a tendency towards symbolism and allegory seemed to enter his

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[31] *The American Notebooks*, ed. Randall Stewart (New Haven, 1933), pp. 98, 145; and *The English Notebooks*, ed. Stewart (New York, 1941), p. 556.

[32] *Biographia Literaria*, Ch. XIII (Bate, p. 387).

[33] Matthiessen, p. 249. See Edwin Honig, "In Defense of Allegory," *Kenyon Review*, XX (Winter, 1958), 1–19, for an excellent discussion of the rhetorical nature of Coleridge's distinctions and of the comprehensive nature of allegory in general.

[34] "Hawthorne and His Mosses," *The Apple-tree Table and Other Sketches*, ed. Henry Chapin (Princeton, 1922) pp. 82–83; *Hawthorne's Fiction*, p. 13. The ensuing quotations of Melville are from this famous review and will not be noted.

[35] H. H. Waggoner, *Hawthorne: A Critical Study* (Cambridge Mass, 1955), p. 58 (et passim) presents the same general conclusion, but without much clarity of definition: "Hawthorne's best tales exist . . . in a realm somewhere between symbolism and allegory, as those terms are used today."

writing, but the following remarks concerning M. de l'Aubépine in the preface to "Rappaccini's Daughter" show that Hawthorne was not entirely happy with that tendency: "His writings, to do them justice, are not altogether destitute of fancy and originality; they might have won him greater reputation but for an inveterate love of allegory, which is apt to invest his plots and characters with the aspect of scenery and people in the clouds, and to steal away the human warmth out of his conceptions" (II, 107). Hawthorne here apologizes because the "love of allegory" over-balances and has not mixed with "human warmth." The whole context, then, supports his belief that the Actual and the Imaginary must "each imbue itself with the nature of other" in order to create scenes "that seem the reality of a better earth, and yet are the very truth of the scenes around us."[36] Unless the scenes around us can be recognized in an artistic form, their potential spiritual manifestations will not be felt or communicated. The artist must return all the way to earth from the Hall of Fantasy.

A return is necessary because of the simple empirical fact that a man cannot shake the dirt off his feet. Man may have a spirit, but it is a "spirit burdened with clay and working in matter." Even though we must accept the "composite" condition of human life, the soul can permeate the material, enabling man to weave this "mortal life of the selfsame texture with the celestial."[37]

Hawthorne, then, accepted the fact of material human existence, but he did not believe that man was necessarily forced to live a life of materialism. The soul must be given as much freedom as is possible in order that life may be preserved in its *purest* earthly form. In his 'L'Allegro,'—"Buds and Bird Voices"—he affirms, "There is no decay. Each human soul is the first-created inhabitant of its own Eden" (II, 175). By approaching life through the "renewing power of the spirit" (hence through the imagination) life can be preserved *as created*, and it is the role of the artistic imagination to save men such as the watchmaker Peter Hovenden from getting so enmeshed in the fact and flux of material decay that they cannot respond to the impulses of the soul. Hawthorne was an existentialist with enough general theology and a large enough heart and mind to see a beauty in life above a hampered existence in time and space. This is the man that Melville recommended to an American audience, for "the smell of your beeches and hemlocks is upon him; your own broad prairies are in his soul; and if you travel inland into his deep and noble nature, you will hear the roar of his Niagara." This is the man whom Julian Hawthorne knew:

[36] *The Marble Faun*, VI, 160.
[37] "The Birthmark," II, 62, 69.

> Even when we enter the "Hall of Fantasy", or are among the guests at "A Select Party," or try the virtues of "Dr. Heidegger's Experiment," still we feel that the "great, round, solid earth" of which Hawthorne speaks so affectionately is beneath our feet. He does not float vaguely in mid-air, but takes his stand somewhere near the center of things, and always knows what he is about. Tracing back his fanciful vagaries, we invariably find them originating in some settled and constant middle ground of belief, from which they are measured and which renders them comprehensible and significant.[38]

Julian felt the empirical commitment of his father, but Hawthorne would have disagreed when Julian said his father never floated vaguely in mid-air. Hawthorne thought that at times he did get lost in the clouds, and his uncertainty greatly contributed to the shade and gloom in his work.

The major reason for the shadows in Hawthorne is, of course, artistic. His belief that the pervasiveness of variegated, attention-binding fact and flux can negate the power of the soul to see a higher reality led him to create gloomy projections of life. Life lived without relief is painted without relief. In addition, Hawthorne's portrayal of this aspect of life derives a great part of its force, as Melville realized, from its appeal to a "Calvinistic sense of Innate Depravity and Original Sin." Still, this "power of blackness" is mainly aesthetic.[39] For example, in *The Scarlet Letter* all the themes and motifs combine in a plea for man to live and act in accordance with the spiritual potential given him at birth. The fact of a 17th century Puritan colony in New England is real, but, at least in 1850, Hawthorne felt that the inherent qualities of men were allowed a freer action and more natural play in 17th century Old England; hence, fair England represented a closer approximation to the "better life." Nevertheless, I suggest that the gloom and shade in Hawthorne is antecedent to his artistic handling of the Actual; it involves the man in relation to his work. By understanding this relationship, we can see why Hawthorne apologized for his so-called "love" of allegory.

Hawthorne held in theory that an artist must visit some Hall of Fantasy in order to get a true perspective of the Actual and that he must descend to earth and "open an intercourse with the world" if his art is to serve its purpose. But at the end of "A Select Party" he says,

> How, in the darkness that ensued, the imaginary guests contrived to get back to earth, or whether the greater part of them contrived to get back at all, or are still wandering among clouds, mists, and puffs of tempestuous wind, bruised by the beams and rafters of the overthrown castle in

[38] "Hawthorne's Philosophy," *The Century Magazine,* XXXII (May, 1886), 86.

[39] Harry Levin, *The Power of Blackness* (New York, 1958), p. 40, reminds us that Hawthorne always assumed that aesthetics and ethics were inseparable; for R. H. Fogle, the light and the dark in Hawthorne's fiction are primarily the result of the artist's moral vision.

> the air, and deluded by all sorts of unrealities, are points that concern themselves much more than the writer or the public. People should think of these matters before they thrust themselves on a pleasure party into the Realm of Nowhere. (II, 87–88)

This passage can be read as a clear description of what Hawthorne felt was his actual artistic predicament. Realizing that the Imaginary was, in point of fact, an unreality, and that its only purpose was to serve and rescue the soul imprisoned among the temporal and spacial realities of the Actual, Hawthorne knew that he must execute on paper what he could see and feel in his imagination while in his study. The cloudy figures and scenes which he talks about in his discussion of M. de l'Aubépine are not trying to escape the world through allegory or symbolism; rather they are merely trying to get back to earth. He wanted to make his pale flowers and nearly blank pages strong enough not just to withstand, but also to shape and order the Actual. All his 'Oberon's,' 'P's,' and Solitary Men lament that they cannot give material life and warmth to their creatures of imagination, and Melville almost could be quoting Hawthorne in any number of places when he says, "the immediate products of a great mind are not so great as that undeveloped and sometimes undevelopable yet dimly-discernible greatness" which lies within. Melville saw such a greatness in Hawthorne "to which these immediate products [the *Mosses*] are but the infallible indices." In spite of Melville's optimism, Hawthorne always felt that he failed in giving shape and substance to the vision which he saw. Whereas Melville says that the greatness of Shakespeare lies in "those occasional flashings-forth of the intuitive Truth in him," Hawthorne puts this telling parenthesis into a speech of Holgrave: "A mere observer like myself (who never have intuitions, and am, at best, only subtile and acute), is pretty certain to go astray" (III, 215). Even as late as the second edition of *The Marble Faun,* Hawthorne confesses,

> The idea of the modern Faun . . . loses all the poetry and beauty which the Author fancied in it, and becomes nothing better than a grotesque absurdity, if we bring it into the actual light of day. He had hoped to mystify this anomalous creature between the Real and the Fantastic, in such a manner that the reader's sympathies might be excited to a certain pleasurable degree, without impelling him to ask how Cuvier would have classified poor Donatello, or to insist on being told, in so many words, whether he had furry ears or no. As respects all who ask such a question, the book is, to that extent, a failure. (VI, 522–23)

Thus we see that, although he followed a consistent conception of the imagination, Hawthorne felt that he never successfully created anything "at once earthly and immortal,"[40] never imbued the

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[40] "The Prophetic Pictures," I, 207.

Actual and the Imaginary each with the nature of the other. Because he felt frustrated by his own theory, part of the gloom which suffuses his work is subjective. On one hand, he believed that the shadows of half-created figures fluttered about his work, but on the other, Hawthorne himself asked Kenyon at the very end of the Conclusion to *The Marble Faun,* "Did Donatello's ears resemble those of the Faun of Praxiteles?" (VI, 527). But does such a question necessarily indicate an artistic weakness in the novel? Is it a revelation of aesthetic insensitivity to ask the question? Or to put your finger into the muzzle of Rob Roy's pistol to determine its calibre, to imagine the music of the spheres in a music box, to be overcome by the noble proportions of St. Peter's, or to feel a message in the Swiss Alps but be unable to express it? These human experiences of Hawthorne show an awe for life, an awe so strong and embracing that it cannot fail to engage our hearts and minds. I wonder if indeed he failed in his purpose of exercising the spirit through the material. If we insist on wrestling with Hawthorne's shadows, we are in great danger of missing the genius of the man that really existed. We would do well to heed this warning from *The American Note-books:* "It is dangerous to look too minutely at such phenomena ['lights and shadows']. It is apt to create a substance where at first there was a mere shadow" (IX, 219).

There is an object lesson in reading Hawthorne to be found in the account of his first view of Litchfield cathedral, "so vast, so intricate, and so profoundly simple, with such strange, delightful recesses in its grand figure, so difficult to comprehend within one idea, and yet all so consonant that it ultimately draws the beholder and his universe into its harmony." Draw, yes; but not absorb, for Hawthorne remained "a gazer from below, . . . excluded from the interior mystery." Hence, his rapture waned, he lost "the vision of a spiritual or ideal edifice behind the time-worn and weather-stained front of the actual structure," and began a "minute investigation of . . . the intricate and multitudinous adornment that was lavished on the exterior wall of this great church." But Hawthorne turned his attention to material detail neither completely frustrated by, nor happily oblivious of, his just-experienced wonder, for

> it was something gained, even to have that painful sense of my own limitations, and that half-smothered yearning to soar beyond them. The cathedral showed me how earthly I was, but yet whispered deeply of immortality. After all, this was probably the best lesson that it would bestow, and, taking it as thoroughly as possible home to my heart, I was fain to be content. (VII, 155–54)

Hawthorne should have been content, as well, with his own work, for it reveals that he would have been one of the few people who could have understood what Howells really meant by 'the smiling aspects of life.'[41] Hawthorne, with Ernest, could see in the Great Stone Face the "glow of a vast, warm heart, that embraced all mankind in its affections, and had room for more" (III, 414). Hawthorne says that it took imagination to feel the spirit of the Face, and in Hawthorne imagination is a quality of the soul. Hawthorne's man of imagination, then, does not have to live in the clouds; rather, he chooses, as the politician did not will to do, to enlarge his spirit by living on this earth by the truths of imagination. Having no strict philosophy of his own, Hawthorne could not say just what those truths might be. Young Goodman Brown could have exercised his spirit equally well either through religion or by an abiding love of his wife. The choice is unimportant to Hawthorne, so long as a choice is made. He implied as much when he had the occupant of the Intelligence Office confess, "I am no minister of action, but the Recording Spirit" (II, 380), for Hawthorne professed no special philosophy, but recorded the truths of men's successes and failures in choosing to exercise their spiritual potential. Because he sincerely believed that "the deeds of earth, however etherealized by piety or genius, are without value, except as exercises and manifestations of the spirit,"[42] it mattered little to him whether a man should choose to live by a Romantic ideal or by Calvinism or by any other philosophy or religion, for "each human soul is the first-created inhabitant of its own Eden."

All men have minds, hearts, and souls; therefore, all men can understand, feel, and act upon the imaginative figurings-forth of an artist. Hawthorne ultimately suggests, then, that "he whose genius appears deepest and truest excels his fellows in nothing save the knack of expression; he throws out occasionally a lucky hint at truths of which every human soul is profoundly, though unutterably, conscious."[43] Hence, "there is no harm, but, on the contrary, good, in arraying some of the ordinary facts of life in a slightly idealized and artistic guise";[44] so doing affords the reader an opportunity to exercise his spirit, raising him out of time and space to a position where he can better enjoy the potential richness of this life. Hawthorne's fiction reminds us that, "the great book of Time is still spread before us; and, if we read it aright, it will be to us a volume of eternal truth."[45]

[41] Although their reports of the human scene differed in tone both writers wrote from a comic point of view. R. R. Male, however, believes that Hawthorne's was a tragic vision, in spite of the fact that he also believes that "the last four books of *Paradise Lost* remain the best possible introduction to Hawthorne" (*Tragic Vision,* p. 162).

[42] "The Artist of the Beautiful," II, 527.

[43] "The Procession of Life," II, 240.

[44] Preface, *The Snow Image,* III, 386.

[45] "Earth's Holocaust," II, 449.

Hawthorne is a great writer, great not because he attempted allegory, but because he did not. G. P. Lathrop believed that Hawthorne was a "man of reverie, whose observation of the actual constantly stimulates and brings into play a faculty that perceives more than the actual." He called that faculty "the idealizing, imaginative faculty," and concluded with words which show us where Hawthorne's imaginative genius lay: "capable of extracting the utmost intellectual stimulus from the least of mundane phenomena, he maintained intact a true sense of relativity and a knowledge that the attainable best is, in the final analysis, incomplete."[46] Perhaps we no longer need the subtle corrective at the end of Hawthorne's critique on M. de l'Aubépine:

> His fictions are sometimes historical, sometimes of the present day, and sometimes, so far as can be discovered, have little or no reference either to time or space. In any case, he generally contents himself with a very slight embroidery of outward manners,—the faintest possible counterfeit of real life,—and endeavors to create an interest by some less obvious peculiarity of the subject. Occasionally a breath of Nature, a raindrop of pathos and tenderness, or a gleam of humor, will find its way into the midst of his fantastic imagery, and make us feel as if after all, we were yet within the limits of our native earth.

[46] "A Biographical Sketch," *Works of Hawthorne*, XII, 516, 534, and 567.

THE PROTESTANTISM OF THE ABBÉ PREVOST*

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André Chamson of the French Academy writes the preface to the latest biography of the Abbé Prévost by Claire-Eliane Engel. He begins by telling the rather sensational legend about the Abbé's death. Prévost, it is said, was walking in the forest of Chantilly when he was stricken with apoplexy. There he was found by peasants who carried the body to the priest of a nearby village. Since the cause of death was uncertain and some persons suspected foul play, a surgeon began at once to perform an autopsy upon the supposed corpse. Suddenly the surgeon and his assistants were startled by a horrible cry. The corpse came to life. Unfortunately, the autopsy had proceeded so far that the Abbé actually did die soon after his brief return to life.

M. Chamson uses this story to make the analogy that the author of this latest biography of Prévost, *Le Véritable Abbé Prévost,* has chosen for her subject, not a cadaver, but a man very much alive through his great work *Manon Lescaut.*[1] For me, also, Prévost is very much alive, but he lives for me through his novel *Cleveland.* The true Abbé Prévost is for me not exactly the same person whom Miss Engel presents. Her portrait is for me only a partial one which needs to be completed by a study of Prévost's later novel, *Le Philosophe anglais,* or *Cleveland,* as it is usually called, the story of the search for a satisfactory philosophy of life by the English philosopher Cleveland.

Miss Engel's recent biography enlarges upon an interpretation of Prévost which she presented in a 1952 article, "La Vie secrète de l'Abbé Prévost."[2] Here she argued that in 1728, just before he fled from the Benedictine order to six years of exile in Holland and England, he was a convert to Protestantism. Part of her evidence is drawn from letters she has discovered. Except for some minor reservations,[3] I can accept the conclusions she draws from these letters. It is consistent with earlier events in the Abbé's life that he may have been a proselyte at that time. He had been a Jesuit, had twice escaped from that order, been twice forgiven and reinstated

* Paper read at the 91st annual meeting of the Wisconsin Academy of Sciences, Arts, and Letters.

1 "Preface," *Le Véritable Abbé Prévost* (Monaco: Rocher, 1957), pp. 7–8.

2 *Revue des sciences humaines,* Juillet–Septembre, 1952, pp. 199–214.

3 Note her explanation that the reference to "Dom Prévost et il s'apelle de l'Islebourg," may be an error for Prévost d'Exiles. Ibid., pp. 202–203.

before he fled again and later entered the Benedictine order, taking his vows, he himself says, with mental reservations that would justify breaking these vows later.

My real difference with Miss Engel's conclusions in her 1952 article concerns her use of passages from *Cleveland* as evidence that Prévost was a convert to Protestantism. She fails to consider the context of these passages and their relation to the purpose and the structure of the whole novel.[4] The purpose of this paper is to discuss these passages in relation to the question of Prévost's Protestantism and to consider the theme, plot structure, and tone of the novel as further evidence toward reaching a conclusion as to Prévost's attitude toward Protestantism, an important consideration in any complete evaluation of his character and work.

In her recent critical biography, *Le Véritable Abbé Prévost,* Miss Engel finds the real Abbé to be an extremely unstable person.[5] Near the end of her book, she summarizes what she feels are his intellectual deficiencies:

> Une seule croyance reste inébranlable chez Prévost: sa foi en la bonté de la nature. On peut se demander si cette idée enracinée en lui n'est pas l' unique dogme auquel il finisse par rattacher sa vie spirituelle. La philosophie pure ne l'a jamais tenté. Sa religion n'est qu'une morale, qui ne le lie pas. Il discute la religion, toutes les religions, en se fiant aveuglément à la raison humaine, la sienne. Les croyances orthodoxes se concilient chez lui, avec une aisance extraordinaire, avec des opinions religieuses à la fois avancées et timides. Une nécessité intellectuelle ne lie pas jamais. D'où son arrogance sur certains points, ses crises de certitude et ses refus soudains de prolonger une recherche ou d'en admettre les résultats. Lorsque l'intuition sentimentale lui fait défaut, il sombre dans l'incohérence. Toute spéculation abstraite se révèle contraire à sa nature profonde, le rebute et éveille sa sensibilité. La culte du vrai et de l'utile amène Prévost à révéler avec complaisance et souvent avec génie une âme bien curieuse: la sienne.[6]

Like nearly all the biographers and critics who have preceded her, Miss Engel praises the Abbé's contribution to the sentimental novel and the emotional power of his masterpiece, *Manon Lescaut.*

There is plenty of evidence to support this estimate, but I maintain that it is only a partial estimate and that Miss Engel ignores qualities of the real Abbé Prévost which are revealed by a study of his novel *Cleveland.* Prévost's statement of his purpose and his plan for the novel, the structure of the plot, and the intellectual content of the story show Prévost as an author who has a deep concern for the intellectual life of his period, as a man who is attracted, not repelled by philosophical speculation.

[4] Ibid., pp. 209–210.

[5] *Le Véritable Abbé Prévost,* p. 46.

[6] Ibid., pp. 282–283.

Of the biographers and critics who have written on Prévost, only Franz Pauli has given a detailed analysis of the intellectual content of Cleveland.[7] Even such an authority as Gustav Lanson, writing on the revolt against orthodoxy in the France of 1700–1750, groups Prévost with Marivaux and Piron among those early eighteenth century writers who were unaffected by the violent religious and philosophical controversies of their time.[8]

It seems strange that nearly all critics have ignored the several pieces of evidence in the case of *Cleveland* that the author was much concerned with religious and philosophical controversy, that in spite of that side of his nature which responded to the call of the world and to the sensuous and sentimental, there was another side of his nature which has never been adequately recognized.

Important pieces of evidence for such a revised estimate of the true character of Prévost are his defense of his purpose in writing *Cleveland,* his statement that his views are the same as his hero's, the structure of the plot, the content and tone of the narrative.

Prévost has made a clear statement of the theme of *Cleveland.* After the publication of the first four volumes (1731–32), he published an answer to the criticism that the novel was deistic in which he stated that his purpose was to show that peace of mind and true wisdom came only through religion. This defense he republished in the preface to the continuation volume of 1738.[9] He had said in an earlier preface that his views so closely resembled Cleveland's that their minds might be said to be cast in the same mold.[10]

An examination of the plot structure and content of *Cleveland* supports Prévost's statement of the theme and indicates an author who is concerned with religious and philosophical controversy. The views of the hero of the novel, with which the author says he agrees, are not those of a man repelled by philosophical speculation. Without minimizing the evidence for the sentimental aspects of the many-sided character of Prévost, a careful reading of *Cleveland* supports the contention that the usual estimate of the author's character and interests needs to be revised and enlarged.

The reader who looks beneath the superficial plot of melodrama and sentiment finds in *Cleveland* a novel of ideas. The fundamental theme, obscured by the intrigue and adventure of the typical eighteenth century novel, is the hero's search for a religious faith that is rational in its basis. The conclusion of the search is the rec-

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[7] Franz Pauli, *Die Philosophischen Grundanshauungen in den Romanen des Abbé Prévost im Besonderen in der Manon Lescaut,* Marburg, 1912.

[8] Gustav Lanson, "Questions diverses sur l'histoire de l'esprit philosophique en France avant 1750," *Revue d'histoire litteraire de la France,* XIX (1912), 2–4.

[9] "Avertissement," *Le Philosophe anglais* (Utrecht: Neaulme, 1738) VI, ii–iv.

[10] "Preface," Ibid. (1736), I, iii–iv.

ognition that man has need for both intellectual and emotional satisfaction. The structure of the plot is broken into five stages

1. The period of Cleveland's faith in natural philosophy, of which the fundamental doctrine is Stoical, that the passions are responsible for all evil and that man could be happy if he could overcome the passions by the use of reason.
2. The period of disillusionment with natural philosophy because it fails to bring strength to bear great sorrow.
3. The examination of orthodox religions, all of which fail because they do not meet Cleveland's standards of rationalism.
4. A period of alliance with a group of French *philosophes* who are influenced by Hobbes' materialism.
5. The conversion to "true religion" which reconciles rational philosophy with religious faith, or as Cleveland puts it, shows that natural law needs to be supplemented by the law of grace.

Such a plan for a novel is scarcely evidence that Prévost was not concerned, as Lanson has stated, with the controversial matters in the philosophy and religion of his period, or, as Miss Engel has stated, that he becomes incoherent when sentimental intuition fails him and is repelled by philosophical speculations. In fact so many pages of *Cleveland* are given to long discussions of philosophical and religious controversies that a sort of *Reader's Digest* condensed novel was published in 1788, which omitted all pages of intellectual discussion and gave the reader only the melodramatic story of Cleveland's adventures in England, America, and France.

Cleveland's natural philosophy is summarized and the deistic religion, which he taught to a tribe of American Indians during his period of rationalism, is explained in detail. In his period of disillusionment, he carefully analyzes his former views to see if he can find any flaw in them. He finds no logical flaw, only their failure to bring comfort in his time of great sorrow. When, to please two members of his household, he listens to the views of both a Protestant clergyman and a Catholic priest, the conversations and expositions are painstakingly recorded. The *philosophes* are treated at less length. But the resolution of the conflict between rationalism and religious faith through Cleveland's conversion to a religion that satisfies his reason and gives him a comforting faith, produces pages of discussion of philosophy and religion.

This emphasis upon the religious and philosophical controversies of the early eighteenth century does not support Miss Engel's conclusion that pure philosophy never holds Prévost, that abstract speculation is contrary to his nature, that it repels him. This novel of ideas presents a side of Prévost's character which is a part of any just estimate of Prévost. The real Abbé Prévost is more than a sentimentalist.

Another point upon which I disagree with Miss Engel's interpretation is her use of Cleveland's conversations with the Protestant minister as evidence for Prévost's being a convert to Protestantism. The speech of Minister C., says Miss Engel, could have been written only by a Protestant.[11]

Here, I feel, Miss Engel has lifted the words of Minister C. out of the context of the novel and has not considered the manifest theme of the novel, the contribution of this conversation to the development of the theme, and the satirical tone of all the incidents concerning Cleveland's investigation of orthodoxy. Miss Engel states that Cleveland sends for the Protestant clergyman,[12] but Cleveland says that his sister-in-law and his friend Mme. Lallin were so concerned over his depression and his attempt at suicide that they arranged to distract his mind by conversations with some of the intellectuals residing in Saumur. Since Mrs. Bridge, the sister-in-law, was a Protestant and Mme. Lallin was a Catholic, Cleveland agreed to discuss religion with both the Protestant Minister C. and the Jansenist priest Father LeBane.[13]

These conversations about orthodox religion are a contribution to the third step in the evolution of Cleveland's ideas from natural philosophy and deistical religious belief toward the "true religion" which he finally accepts. The theme of the search for a satisfying religion is worked out by a plan of eliminating one by one the views that either fail to satisfy his reason or to meet the needs of his heart after he has suffered great personal loss. The conversations with Minister C., with Father Le Bane, and later with a member of the Jesuit order are all parts of the eliminating process in the search for the truth.

The tone of Cleveland's comments in introducing these conversations is satirical. On the matter of the many Protestant sects, he says that sectarian differences have hitherto prevented him from examining orthodox religion. If the total number of religious sects were reduced to fifty, each one would consider the other forty-nine in error and itself the sole possessor of the truth. Where, he asks, can I find light enough to discover which one does possess the truth?

> Supposons, avois-je dit, que le nombre de toutes les Sectes se réduise à cinquante. Il n' y en a pas une seule qui ne condamne toutes les autres, & qui ne se croye seule en possession du vrai culte. Mais les quarante-neuf autres, qui s' attribuënt le même avantage, la condamnent aussi. Si je les interroge séparément, ou toutes ensemble, je trouve toujours quarante-

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11 "La Vie secrète . . . ," p. 210.
12 Ibid., p. 209.
13 *Le Philosophe anglais* (Neaulme, 1736), V:69–72; 80–83.

> neuf voix, qui sont contraires à chacune, & une seule voix qui lui est favorable: encore n'est-ce que sa propre voix. J'ai donc toujours quarante-neuf motifs contre un, pour les rejetter toutes, & les croire fausses sans exception. Je veux néanmoins supposer encore qu' il n'y ait que quarante-neuf Sectes dans l'erreur, ce qui est absolument necessaire, s'il est vrai qu'il y en ait une qui n'y soit point: Suis-je plus avancé après cette supposition? Où trouverai-je assez de lumieres pour démêler celle qui posséde le précieux trésor de la vérité?[14]

As Cleveland has anticipated, both the Protestant Minister C. and the Catholic Father Le Bane attempt to demonstrate that his church represents the only true religion.

Cleveland finds that the Catholics look upon the Protestants as rebels who have risen against a good king, a king who ruled with a code of laws that had for its purpose the happiness of all people. This rebellion was incited by obscure persons motivated either by resentment or a love of change. On the other hand, the Protestants regard themselves as patriots who have put down a usurper, one who overthrew the legitimate king, instituted new laws, and denied the people the right to read the laws of the legitimate king.[15]

Both Catholic and Protestants lack logical proofs for their views, Cleveland thinks. He says of the Protestant minister that "his system seemed reasonable enough to make me wish he were able to support it with some solid proofs."

> . . . son Systême parut assez raisonnable pour me faire souhaiter qu'il pût l'appuyer dans la suite par des preuves solides.[16]

After talking with the Jansenist, Cleveland remarks that since he had never been disposed to believe without proofs, it would take something less general to persuade him.

> Cependant comme je n'étois pas disposé à croire sans preuves, je lui fis connoître qu'il falloit quelque chose de moins général pour me persuader.[17]

He later characterizes the picture he received of orthodox religion as "sad and repulsive."[18]

The tone throughout the novel is equally satirical and objective whether the orthodox views are Protestant or Catholic.

Satire of the Protestants is introduced even before the conversations on orthodox theology by incidents and characterization. Cleveland is the natural son of Oliver Cromwell, who abandoned his mistress, Elizabeth Cleveland; and it is his malicious plotting against the lives of Cleveland and his mother that initiates the action in the

[14] Ibid., pp. 75–76.
[15] Ibid., pp. 82–86; 88–91.
[16] Ibid., p. 80.
[17] Ibid., p. 86.
[18] Ibid., (Rouen: Racine, 1785), VIII, 205. It is necessary to refer to a different edition for this passage as the last volume of the 1736–38 continuation volumes is missing.

superficial melodramatic plot. Bridge, another illegitimate son of Cromwell, has an experience in the Protestant colony on St. Helena which shows the Protestant minister of the group to be one of the most bigoted and cruel of men.

In satirizing the Catholics, Prévost is just as severe. Because Cleveland becomes confused by listening alternately to Catholic and Protestant dogma, he decides to hear all Minister C. has to say and then to listen to Father Le Bane's counter-arguments. When the Catholic hears this decision, he takes action. Cleveland receives a *lettre de cachet* and with his two sons is made a prisoner by the church. The reason given him is that he has showed so great an interest in religion that the church wants him to receive correct instruction.[19] Standing on his rights as a British citizen and appealing to the British-born Duchess d'Orléans, Cleveland gets his freedom.[20]

Then, through the Duchess, Cleveland is introduced to a worldly Jesuit who, the Duchess assures him, will give him a cheerful view of religion. A series of episodes here satirize this Jesuit. He recommends light reading and falling in love as a cure for Cleveland's melancholy. With convenient casuistry, he persuades the Catholic Mme. Lallin to betray Cleveland's plan to escape to England.[21] (These passages and all passages satirical of the Catholic religion were amended or omitted in the censored editions of 1757–1785)[22]

The relation of Cleveland's examination of orthodox religion to the theme and structure of the whole novel argues rather for an objective disapproval of all bigotry and dogmatism and any kind of narrow sectarianism than for a sympathetic attitude toward Protestantism on the part of Prévost. It may indeed be true that he was for a period a proselyte to Protestantism but the content and tone of *Cleveland* is such that it is difficult to accept Miss Engel's argument that the speech of the Protestant Minister C. could have been written only by a Protestant. In relation to the development of the plan for the whole novel, the conversation with Minister C. appears to be one incident of several which reveal the weakness of orthodoxy.

To the satire of orthodox religion, both Catholic and Protestant, should be added a passage lamenting the divisions of religious people into sects separated by narrow dogmatism; this passage occurs at the end of the story of Cleveland's conversion and was omitted from the censored editions published between 1757 and 1785.

[19] Ibid., (Neaulme, 1736), V, 93–94; 102.
[20] Ibid., pp. 102–108.
[21] Ibid., pp. 257–289.
[22] See my paper, "Variations in the Texts of Eighteenth Century Editions of *Le Philosophe anglais*," *Transactions of the Wisconsin Academy of Sciences, Arts and Letters*, XXXII (1940), pp. 187–198.

> Je tremble néanmoins que ce ne soit faire tort à la religion que d'en resserrer les élemens dans les bornes si étroites. . . . J'ajoute que , n' étant encore qu' à l'entrée de la Foi, je ne pouvois être arrêté par la concurrence de quelques Religions monstrueuses qui sont opprobre de la Raison; et quand mon objection auroit eu quelque force, ce ne pouvoit être qu' à l'égard des différentes sectes qui partagent le Christianisme.[23]

These passages are representative of many others which deal with the principal religious and philosophical controversies in the thought of the early eighteenth century. On the one hand is the rationalism of natural religion; on the other, the supernaturalism of the revealed religion of orthodoxy.

An analysis of the "true religion" to which Cleveland is converted shows that he resolves the conflict by accepting the best in each but without becoming a convert to any orthodox church.[24] He appears to have no connection with any organized group. He is converted by a layman, Lord Clarendon, who at this time is living in exile in France. There is no mention of any clergyman or any church. Orthodox ideas such as a conviction of sin, salvation through repentance and the vicarious sacrifice of Christ, the sacraments of baptism and communion play no part in the discussions of this "true religion." Conversion seems to be an individual matter of intellectual acceptance of the fact that man needs supernatural help in order to lead a good life and to bear the sorrows that are a part of life.

Cleveland discovers that his earlier views are incomplete and need to be supplemented, although they are consistent with his new views and have prepared the way for them.

> . . . sans abandonner l'étude de la nature, dont je n'avois guere moins de fruits à tirer pour les mêmes vues, puisqu' à des yeux biens êclaires par le Religion l'ordre naturel se raporte à Dieu comme celui de la grace . . . cette disposition, dans laquelle il [le Chrétien] est soutenu par les secours intérieurs de la Religion, lui fait conserver cette paix & cette égalité d'âme dont la seule Philosophie ne donne que l'ombre, & qui est déja comme une anticipation de bonheur auquel il aspire.[25]

Again, I can partially agree with Miss Engel, for she says that Cleveland almost returns to his first position of rationalism.[26]

But she does not note that Cleveland has reconciled the differences between rational philosophy and revealed religion, that he is in agreement with many English and French rational theologians of his period in maintaining that a true religion can stand the tests of the rational point of view.

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23 Ibid., p. 187.

24 See my paper, "The Religious Convictions of the Abbé Prévost," *Transactions*, XLI (1952), 189–199.

25 *Le Philosophe anglais* (Rouen: Racine, 1785), VIII, 213–214; 215.

26 *Le Véritable Abbé Prévost*, p. 282.

Cleveland's unorthodox religion retains his earlier beliefs that the reason must be satisfied, that love of God and of fellow men, regard for principles of justice, and a high standard of ethics are more important than dogma. But I can not agree with Miss Engel that this is a reconciliation of orthodox views with religious opinions that are at the same time advanced and timid, a reconciliation attained with extraordinary ease.[27] A reconciliation of conflicting views which has been attained through years of search for a satisfying faith that will meet the needs of both head and heart, has not been easily attained.

In using Cleveland's final statement of his religious views as evidence for a fairer estimate of the character of the real Abbé Prévost, it is important to remember these words from the author's preface to the novel:

> Je trouvai en effet de rapport entre les inclinations de Mr. Cleveland & les miennes, tant de ressemblance dans notre maniere de penser & dans nos sentimens, que je confessai au Fils, que je m'étois reconnu dans les traits de son Pere, & que nos coeurs, si l'on me permet cette expression, étoient de meme trempe & sortis de même moule.[28]

An examination of the principles of this "true religion" shows that they are more advanced in tolerance and breadth of ideas than is the dogmatic sectarian religion of orthodoxy, but the satire of orthodoxy which precedes Cleveland's conversion is far from timid.

The story of his examination of Protestant and Catholic orthodoxy occurs in the volumes published in 1731–32 when Prévost was an exile from France and the church. The story of Cleveland's conversion concludes the continuation volumes of 1736–38, published after Prévost's reconciliation with the church and the Benedictine order in 1734.

The satire of the Jesuits in these continuation volumes is milder and more tolerant in tone than the previous satire of orthodoxy, but the tone is not timid; it is mildly amused over the inconsistencies of human beings and it accepts the fact that there are great differences of opinion in matters of religion; it is the tone of a man who views life as it is, not as it ought to be.[29] As mentioned above, Cleveland still regrets the many sectarian divisions among religious people.[30]

In his fairly detailed summary of the principles of his new religion, Cleveland arranges in order of rank according to importance

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[27] Ibid.

[28] *Le Philosophe anglais* (Utrecht:Neaulme, 1736), I, iii–iv. The explanation of the reference to Cleveland's son is that Prévost first represented the novel to be the memoirs of an actual person, Mr. Cleveland, published from a manuscript obtained from his son.

[29] Cooper, "The Abbé Prévost and the Jesuits," *Transactions,* XLIII (1954), pp. 125–132.

[30] See footnote 23.

the desires of his heart and the duties and pleasures of life: first, love of God and heavenly things; then, in order of descending importance, religious duties, love for his wife, duties toward friends and society, study of the Bible without abandoning the study of nature, and last the moderate use of pleasures of the world. He stresses moderation in the use of pleasure and condemns absolute withdrawal from the world, although he does not specifically mention monastic life in his condemnation of such withdrawal as excessive zeal, and a fanaticism which wounds religion as well as nature.[31]

These views are closer to Deism than to orthodox Protestantism. They are very far from Catholicism, and it is interesting to note that Cleveland's wife has been converted to Catholicism, that before his own conversion Cleveland envied his wife the comfort she drew from her religion; also it is interesting that his wife shows no zeal for converting Cleveland to Catholicism and seems to approve of and agree with many of the ideas of his "true religion" after his conversion. In this respect the narrative is an example of the principle of tolerance.

Cleveland's religion has much in common with the views of various free-thought groups of the late seventeenth and early eighteenth centuries. In the emphasis upon belief in God with no mention of Christ or of any Trinitarian ideas, this religion has the characteristics of Unitarianism which was influencing thought in Europe and England during this period. English Latitudinarians would agree with Cleveland's emphasis upon beliefs fundamental to all religions and his disregard for sectarian creeds.

On the basis of the principles of Cleveland's religion, with which Prévost states he agrees, on the basis of the theme of the novel as stated in the preface and the structure of the plot which consistently supports this theme, and on the basis of the tone toward orthodoxy, the conclusion offered by this paper is that Prévost was a protestant without the capital letter. He protested narrowness and unreasonable views in matters of religion. He protested the intolerance and bigotry of those who called themselves religious leaders. He protested pure materialism and an exclusively rational philosophy. He asserted that both reason and emotion must be the basis of any satisfactory religion.

For the reader who will consider the integration of theme, structure, intellectual content, and tone of the novel *Cleveland*, there is evidence that the Abbé Prévost was not only a master of the sentimental novel, but a writer so deeply concerned with the issues in the intellectual controversies of his time that he wrote a coherent

[31] *Le Philosophe anglais* (Rouen: Rouen, 1785), VIII, 213–214.

argument for a religion purified from the corruption of narrow dogmatism. The novel *Cleveland* emphasizes ethical living rather than orthodox creed as the basis of true religion.

The evidence presented in this paper is only a small part of the evidence which exists in the bibliographical history of Cleveland, in the structure, and in the content of this novel to support the thesis that a complete portrait of Prévost and a fair estimate of his work recognizes his contribution to the intellectual history of his time. From an examination of the novel *Cleveland,* this reader can not accept a characterization of the author as a shallow thinker to whom abstract speculation is repulsive.

EXISTENTIAL NIHILISM AND HERMAN MELVILLE*

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There are many critical manners of looking at any writer. It is impossible for anyone to absolutely disclaim the validity of any of these manners. For instance, we can study Shakespeare from the varying points of view of (1) the Renaissance stage conventions that shaped his work, (2) historical and biographical data that illuminate his work, (3) problems in textual scholarship, (4) the New Criticism's wholly aesthetic approach, or (5) the medieval and renaissance notions of cosmology and ethics that inform his plays—and there are many more approaches. This study explores the point of view of the existentialist as critic of life and literature and then suggests how this point of view may be valuable in regarding the works of Herman Melville.

I

Existentialism is in our time a household word, and it is applied to every study from politics to literature—often wrongly, often cheaply and sensationally. It has been commandeered by novelists like Richard Wright to explain the plight of the Negro as an *outsider*. It has been attached to singer Juliette Greco; and it has been taken over in part by the San Francisco Beats. But in its most seriously philosophical terms, it is a form of ontology or at least of phenomenology. And it can, as such, direct the thinking of a literary critic in exegesis of certain kinds of literature.

Existentialism as a philosophical movement, or rather as a way of looking at oneself and the world about one, is not a recent phenomenon. For the average reader it has been linked only with certain bohemian cafes in Paris after World War II. Undesirable sensationalism, faddism, cultism, and superficial sophistication have all unfortunately attached themselves to the most recent manifestations of this method of thought and drawn upon it the disapproval of the serious intellectual in other countries besides France. I say that this is unfortunate not out of pity for the existentialists, but out of regard for the general understanding of intellectual movements and their consequences in history. Existential thought is a very real and a very potent force in modern living, and a blindness to this movement or trend is a blindness to what is happening

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around one. I fear that our conservative scholars, disgusted by some of the lunatic fringe and the cultism of modern existentialism, have committed themselves to a seriously debilitating blindness in the field of modern philosophical movements. This is particularly true, I think, of our literary critics. Existentialism in the twentieth century is closely linked to literary art. The most important of recent existential thinkers have not been philosophers only, but literary artists. I am thinking particularly of Jean-Paul Sartre, Albert Camus, and Simone de Beauvoir.

A literary critic whose field is American literature of the period from 1830 to 1860 would scarcely dream of divorcing an examination of the works of Ralph Waldo Emerson, Henry David Thoreau, and Walt Whitman from Transcendentalism, that extraordinary brand of idealism which dominated the thought and literary creations of these men. Even the critics of their era were aware of their philosophical biases and duly noted them. By the same token literary critics of our time should not close their eyes to existentialism.

Existentialism is not new. Its elements certainly appear in the fragmentary philosophies of the pre-Socratic philosophers. Thales, Heraclitus, and the major Sophists all represent certain existential attitudes. With the coming of Socrates and Plato, idealism swept away the relativism and pluralism of the pre-Socratics, and the ordered rationalism of Aristotle's mind denied the irrational elements which are foundations of existential thinking. On Socrates, Plato, and Aristotle the philosophy of twenty centuries was built. With a few notable exceptions the philosophical and religious thought of those centuries was dominated by three factors: by idealism, optimism, rationalism, or by a combination of two or three of them. It is true that some of the Church mystics were irrationalists. There were also some heretic, pantheist mystics in the history of Western thought. Indeed, late Roman Stoicism was a tiny camp of pessimism and anti-idealism in the Western world, but it was eventually smothered by a combination of Christianity, Platonism, and Aristotelianism. In general this long twenty-century period was thoroughly dominated by the rationalism of Plotinian Christian Platonism, the rationalism of St. Thomas Aquinas' Aristotelian Christianity, and a general feeling—despite human cruelty, plagues, fires, pestilence, wars, famines—that God was in his heaven and all was right with the world.

The eighteenth century saw a de-emphasis of God and a deification of Reason. But this was merely an emphasis on another aspect of the same general train of thought that had prevailed since the great Greeks. Granted, the eighteenth century upheaval was enormous. The movement from religious to secular thinking was profoundly disturbing to the world, but in some respects it was merely a surface manifestation of something far more significant going on underneath.

During the second half of the eighteenth century and throughout the entire nineteenth century, Germanic idealism seemed to dominate Western thinking. Kant, Fichte, Hegel, and the English and American transcendental followers of these philosophers were the important thinkers of the time. But it is important to notice that contemporary with these men arose two movements in thought which were to overthrow this brand of idealism. On the one hand were Marx, Engels, and dialectical materialism; on the other were Kierkegaard, Nietzsche, and the existentialists. It is ironic to note that both of these movements derived their vitality from a reaction to the systematic idealism of G. W. F. Hegel.

At this point we must be certain to note the vast differences that exist within the broad term "existentialism." One of the disturbing factors to the student of philosophy in approaching existential thought is the fact that he finds difficulty in systematizing it. There is a very good reason for this. One of the few things which all existentialists have in common is a rebellion against all systematization or attempts to unify things into wholes. It is easy to see then why Kierkegaard rebelled so violently against Hegel. The vast, artificial "world career" of Hegel, so carefully worked out through thesis, antithesis, and synthesis, was maddening to Kierkegaard. He saw it not as the dynamic process which Hegel had intended, but as an empty shell without a self. The thing which was missing was the philosopher himself. No man, said Kierkegaard, can set up an artificial system which actually represents external reality, because all he can know is within himself. His senses are faulty, even with the most intricate extensions of them which man can contrive. Knowledge comes from within, but not from Kant's ordered categorical and intuitive Reason. Rather "Truth is subjectivity," says Kierkegaard. Nietzsche extends this thought to the extreme of the Superman. The will to power is the subjective force of truth. Man alone must breed moral superiority by reversing the weak moral tenets of Christianity.

For both of these men the world presented a welter and a chaos. It was "absurd," in the sense that it was, they felt, vastly different in its physical and psychological reality from what man, through scientific rationalism and blind idealism, attempted to bend it into. The "absurd," then, arises out of the ironic disparity between what promises the world actually makes to man and what man fancies he sees in the world or what he, with his infinitely complex moral imagination, thinks that the world should be. This element of existentialism can be recognized as a favorite theme of world literature. It is the basis of Shakespeare's *Hamlet*. For the existentialist, Hamlet is the "absurd" man. It is a particularly potent theme in literature beginning with the Romantic movement in the late eighteenth century and continuing with some abatement through the nineteenth and twentieth centuries. The definition of "Byronism" is contained within the dichotomy of the ironic "should-be" and "is." Goethe, Keats, Tennyson, Baudelaire, Poe—all of these men represent this theme in their works and lives.

But Nietzsche was an atheist (or at any rate a violent anti-Christian), and Kierkegaard was a great Christian theologian. How can this wide disparity occur? I suggested previously that all existentialists are different. Since they are anti-systematists it is difficult to make philosophies or systems out of their thinking. Kierkegaard said that the fact that man feels himself alone within his subjective being, that he is riddled with the anguish of existence, aware of the chaos of the real world around him, aware that existence and the universe are "absurd"—this is the fact, Kierkegaard says, which helps produce the leap of faith by which man discovers that God *is* the "absurd." There is a bitter relief and glory in this realization which is one way of regarding the gift of Grace. It is perhaps easy to see in this what some of the more realistic and less sanguine Christians have maintained about Christianity from the very beginning. All the great mystic saints of the Church have been aware of the "dark night of the soul," the agony of being a Christian.

Modern atheistic existentialists such as Martin Heidegger, Jean-Paul Sartre, Albert Camus, and Simone de Beauvoir are probably most responsible for the twentieth century revivification of existentialist thought. But there are Christians among these contemporary existentialists. Father Gabriel Marcel, Karl Jaspers, and even Reinhold Niebuhr can be classified, at least in part, as existential thinkers. There is a similarity in thought amongst all these writer-philosophers, up to the point, that is, at which the Christians make the leap of faith. Existentialists see man thrown alone into a materialistic jungle. If he keeps good faith with himself, he realizes his aloneness and does not create moral fantasies around himself. This realization causes dread, anguish, "fear and trembling," and even "nausea." Concomitant with this feeling of aloneness comes a nauseating awareness of subjective selfhood. The existentialist becomes terribly aware of himself as a single, individual entity in the process of creating itself. In a world with no external values, the individual is faced with the fact that he is merely a blob of sentient and intelligent protoplasm with the necessity of shaping not only its own personality, but its entire code of values. In other words, in every action a choice is made by the individual which helps to delineate the values of the individual and therefore adds to the totality of his personality. This holds particularly true in the case of the actions of an individual facing death. The way he faces death sums him up.

Thus the existentialist sees that the world is "absurd." It is "absurd" because of the incongruity between the chaotic nature of the universe into which man is thrown and the functioning of man's moral imagination. In other words, man's mind is so constructed that he conceives of an ordered moral universe. He does not live in such a place, they say. Consequently, he is torn among the following possibilities: living in a constant dream fantasy (where, by the way, he is continually betrayed); not living in this impossible environment at all (suicide); or living in this chaos stripped bare of the trappings of all false systems, schemes, moral formulae, easy religions, God-comfort, "Ben-Franklin" type moral virtue—everything.

These are the only three paths. The first—for the person who respects intellect and reality—is unthinkable. It is hiding; it is unreal; it is escape. It might be a solution, of course, but in the long run reality will betray the illusion. All the false codes and formulae break down and betray. So the strong man has only two paths to choose; he may commit suicide, or he may face the chaos of living in this bitter world he never chose and learn to live without hope in the midst of absurdity—in fact, to become an "absurd" man as did Hamlet. Hamlet suddenly sees the world bare, denuded of the pretty formulae presented him in youth and in "your philosophy" at Wittenberg. And the world becomes an "unweeded garden." Things "rank and gross in nature" possess it entirely. Hamlet sees the vast absurdity of man in this world (note his "What is man?" speech), and for a time, when he realizes the horrible necessity for self-definitive action on his part, he contemplates the other path—suicide (note the "To be or not to be" soliloquy). But when he decides to live in the chaos in which love is a liar; his mother a whore; his unshriven, ghostly father a wanderer in an earthly purgatory; his uncle a bestial, lecherous murderer; his school chums his potential murderers—when he decides to live in such a world, he realizes that the "readiness is all." Note that he comes close to accepting the philosophy of Horatio, the friend who admits that he is "more of an antique Roman than a Dane." Horatio is a Stoic, and we have already observed that is many respects Roman Stoicism was a sort of ancient existentialism. For the Senecan Roman there was no moral fantasy. The Stoic admitted he had been tossed into a chaotic universe. He either learned to live in that bitter environment (as did Marcus Aurelius) or he calmly slashed his wrists and bled to death while unconcernedly gossiping or reciting poetry (as did Petronius Arbiter).

Hamlet, in some respects, follows both paths. He learns how to live in this world in the sense of performing the necessary self-definitive actions. But his actions lead inevitably to his own destruction. So Hamlet becomes an excellent archetypal existential figure.

At the point of choosing one of the three possible paths—the moral dream-fantasy, suicide, or living without hope—the Christian existentialists and the atheists part. The Christian feels that at that point the leap to faith in God is made—that He *is* the "absurd," that finding him is an agony, a little Crucifixion, a bitter but glorifying experience. This, they feel, is the way to learn to live without hope—by living with faith in God. The atheistic existentialists, of course, would say that the so-called Christians are actually creating another fantasy world to live in.

Of the other two paths—suicide or actually living without hope—either is acceptable, say the atheistic or agnostic existentialists. A man may kill himself or learn to live without systems. This is why Albert Camus says in the first sentence of *The Myth of Sisyphus,* "There is but one truly serious philosophical problem and that is suicide."[1] He feels that before man can solve any other problems, he must ask himself if the pain of living is worth remaining alive. If not, suicide. But if remaining alive is worth the pain, the man must find some way to live in a bitter world and reconcile himself to the absurdity about him.

Herman Melville is one of the supreme examples of a man continuously shuttling between these two possibilities—self-destruction and learning to live in a bitter world without hope. He never succeeded in either, but he poured both of these possibilities into his literary works. As a result, in Melville's writing we find a continual undertone of actual, symbolic, and vicarious suicide, while at the same time we find a collection of heroes or major figures who are trying to come to grips with reality, to strip the world of pretenses and to learn to live outside the aegis of moral and religious fantasies and wish-fulfillment dreams. The fact that almost without exception these heroes annihilate themselves in the process is significant.

In other words, in Herman Melville, one finds an existential writer (but then, so was Shakespeare) who had probably never heard of Kierkegaard and who lived long before Heidegger, Sartre, Camus, and company.

[1] Albert Camus, *The Myth of Sisyphus* (London: Hamish Hamilton, 1955), p. 11.

II

This discussion of existentialism will serve to place Melville in the proper category of thinkers. It is tremendously important to understand the relative intellectual and artistic position of this man who—in an age of transcendental idealism, optimism, progressivism, false liberalism, Utopian Brook-Farmism, "best-of-all-possible-worlds" philosophy, comfortable Christianity, platitudinous poets afraid of a single real idea or image in their poetry, Victorian novelists with one foot in syrup and the other being twisted by Mr. Bowdler—dared "to eat a peach," dared to "roll the universe into a ball" and hurl it at the "overwhelming question" that faced and will always face humanity. It is not necessary to call Melville an existentialist. It would be wisest not to call the existentialists by that name. The term has come to be so inclusive as to be of little value. But one must have a label for certain kinds of thinking, certain attitudes toward life. Ralph Waldo Emerson was a Transcendentalist. No one would gainsay that fact. And I think it is obvious that Herman Melville was as far from the thinking of Ralph Waldo Emerson as it is possible to go. Why not give Melville's attitudes a title also? Since existentialism is such a broad term, and since it implies a connection with people and concepts Melville never dreamt of, I use the word "nihilism" to categorize Melville's view of life. Melville's nihilism, then, is the opposite side of the coin of transcendental idealism, optimism, and general nineteenth century namby-pambyism. Is it any wonder that *Moby-Dick* and *Pierre* were such failures in their time?

Melville did not actually commit suicide; he learned to live without hope. But in his inner world of images, the world that he depicted in words on paper, Melville committed suicide over and over. Like his leaning "Tower of Pisa," he was actually only a "would-be suicide." In a late poem entitled "Pisa's Leaning Tower," Melville discusses the tower's construction and then finishes with the following personification of the masonry.

> It thinks to plunge—but hesitates;
> Shrinks back—yet fain would slide;
> Withholds itself—itself would urge;
> Hovering, shivering on the verge,
> A would-be suicide![2]

But vicariously through Taji, Ahab, Pierre, Bartleby, Benito Cereno, Billy Budd, and even through Tom (in *Typee*), Ishmael, Israel Potter, Redburn, and White-Jacket—through all these Melville vicariously indulged his self-destructive wishes.

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[2] Herman Melville, *Works* (London: Constable and Company Ltd., 1922), XVI, p. 279.

First of all, Melville represented in *Pierre* an actual suicide. Pierre, in prison for murder, takes poison—and it is interesting to note that his actions throughout the novel are self-destructive and in the process destructive to all the other major figures. Through Pierre Glendinning's desire to act virtuously, he destroys his mother, his cousin Glen, Lucy Tartan, his sister Isabel, and himself. And death imagery vies with love imagery throughout the book. Love, it is suggested by Melville, is ultimately self-destructive and universally destructive. Mrs. Glendinning's possessive love of Pierre contributes to Pierre's dilemma and to her death. The unnatural love of Isabel and Pierre precipitates Pierre's flight from the prelapsarian Eden of Saddle Meadows. Lucy Tartan's misplaced, almost religious, devotion to Pierre motivates the fatal duel. At one point Melville says, "Love is here, love is there, love is busy everywhere,"[3] and the careful reader recognizes ironic Melville's echoing the lines of a late poem by the suicidal Percy Shelley—"Death is here, death is there, death is busy everywhere."[4]

The masterpiece *Moby-Dick* contains actual suicide. Mad Ahab, certainly one of the most important examples of what Mario Praz calls "The Fatal Men of the Romantics," is suicidal. He is determined, at the end of the novel, to "strike God and die." He recognizes his finiteness and the infinite qualities (represented by the white whale) against which he rebels. But like Milton's Satan who says "better to reign in Hell than serve in Heaven," Ahab would rather die (as he knows he must) than submit to any force beyond his own ego. And it is again worth noting that he carries his entire world to destruction with him. His crew become the willing tools of their "monomaniac commander's soul," and even Starbuck (who represents orthodox Christianity) is unable to act against this destructive tendency as is pagan but quiescent Ishmael, whose physical salvation at the end of the novel was a matter of pure expediency on Melville's part. Note that he is ironically saved on a coffin.

The novels of Melville written before *Moby-Dick* show the suicide motif in varying degrees of intensity. The plunge of Tommo and Toby into the Vale of Typee in Melville's first novel seems totally suicidal. And as a matter of fact, the theme of "ship-jumping" (taking French-leave from the microcosm of a ship to plunge into a destructive environment such as the ocean or a cannibal isle) becomes symbolically an act of physical or moral suicide in at least three of Melville's novels—*Typee, Omoo,* and *Mardi.* In *Mardi,* of course, the actions of the protagonist, Taji, at the end of the novel,

[3] *Ibid.,* IX, p. 45.

[4] Percy Bysshe Shelley, *The Complete Poetical Works* (Boston: Houghton Mifflin, 1901), p. 398.

are distinctly self-destructive. All of his companions finally leave him, and he sails in search of Yillah (his lost love) "beyond the reef" that encircles the islands that make up Mardi. Since in the novel Mardi comes to represent the world, Taji's sailing "beyond the reef" suggests suicide.

It would be possible to show the suicide motif also in such minor works as *Redburn, White-Jacket, Israel Potter,* and even in the quietistic deaths of Bartleby the Scrivener and Billy Budd—but this brief synopsis of the theme in the major works would indicate Melville's literary preoccupation with this existential drive toward self-annihilation—what Freud called the *Thanatos urge.*

Was this sublimated suicide, then, an act of bad faith on Melville's part? Probably not. Albert Camus speaks of various suicidal and non-suicidal writers who held that life was meaningless. The most significant that he mentions is Arthur Schopenhauer! He says, "Schopenhauer is often cited, as a fit subject for laughter, because he praised suicide while seated at a well-set table."[5] Obviously there is the other path of living without hope. We presume that this was Schopenhauer's path. (It is interesting to note that Schopenhauer was Melville's major reading during the last years of his life.) The evidence of interest in suicide in a man's writing, however, identifies him with this particular attitude toward life, and indicates a desire channeled off into fantasy creation.

But is this shuffling off of the suicide urge through created characters, then, pure fantasy or should it be considered more closely connected with a man's life? According to Albert Camus, creative fiction is inextricably bound up with the life of the creator of that fiction. An observation which Camus makes concerning actors is applicable also, I believe, to writers. He says,

> It is certain that apparently, though I have seen the same actor a hundred times, I shall not for that reason know him any better personally. Yet if I add up the heroes he has personified and if I say that I know him a little better at the hundredth character counted off, this will be felt to contain an element of truth. For this apparent paradox is also an apologue. There is a moral to it. It teaches that a man defines himself by his make-believe as well as by his sincere impulses.[6]

Melville "defined himself by his make-believe," that is, by his make-believe characters, "as well as by his sincere impulses." And since nearly all Melville's major characters are suicidal, and nearly all of his works contain the theme of self-destruction, Melville defined himself as a "would-be suicide."

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[5] Camus, p. 14.

[6] *Ibid.,* p. 17.

III

To turn briefly from Melville's themes of self-destruction to the author's metaphysical or cosmic nihilism, we shift from the existentialist who desires to leave this world because of the pain which living entails, and turn to the existentialist who has decided to live without hope. To keep good faith with himself, if he is to live in this world, the existentialist learns to live without hope. This means to live without reliance on any system of religious, moral, or ethical principles, without faith in any ordered doctrine or philosophy. In this respect Melville certainly fills the bill. His entire literary life was devoted to a graphic demonstration that no philosophy, religion, or pattern of thought is adequate for man in the face of the inscrutable universe into which he has been cast. One may haul the Kantian whale's head up on one side of the ship to balance the Lockeian whale's head on the other side, but the two together merely weigh the ship down without helping it in any way through the sea of life. Better it is, says Melville, to cut both philosophical heads away and steer the ship in a lonely, nihilistic manner. Nowhere is this nihilistic attitude toward life-guides, toward moral and religious systems, toward a concept of a benevolent creator in the universe, toward even a belief in Fate, more completely rehearsed than in *Moby-Dick* where many approaches toward life—Ahab's fanatical pursuit of truth and the infinite, Ishmael's fatalistic resignation, Starbuck's orthodox Christianity, Stubb's self-blinding escapism, Flask's unthinking materialistic utilitarianism, and Pip's insane mysticism—all prove futile in the face of the chaotic universe, so completely malignant in its relationship to the humans who inhabit it and try to understand it. In various fashions Melville demonstrates the same concept in all of his works—even in the so-called final "testament of acceptance"—*Billy Budd.*

But for a moment let us return to the modern existentialists for a background against which to place Melville's metaphysical nihilism.

The closest that modern existentialist writers have come to real metaphysical and ethical explorations is probably Simone de Beauvoir's book, *The Ethics of Ambiguity.*[7] Most contemporary existential thinkers restrict their publication to works on psychoanalysis and phenomenology. Madame de Beauvoir, however, insists that there can be a positive ethical value-scheme even within the limits of atheist existentialism's chaos-ridden universe. The book just mentioned explores this possibility—the creation of a positive ethical attitude in a world without any absolute values. A human discovers

[7] Simone de Beauvoir, *The Ethics of Ambiguity* (New York: Philosophical Library, 1949).

this ethical positivity, says Madame de Beauvoir, in a realization of the relationship between himself and other selves, and this relationship is a balance of freedoms. One's moral freedom is the most important aspect of his existence. On another level, it is his struggle for self-realization. And while in certain respects, say Jean-Paul Sartre and Madame de Beauvoir, every other person's freedom is a threat to my own self-realization, still I cannot really be free without the concomitant moral freedom of others. It is by a complicated process of ontological juggling that the existentialist arrives at this position, and it is not the purpose here, nor is it necessary, to explain the process in detail. The point is that there is an attempt by the modern existentialists to draw away from a sense of quiescent fatalism on the one hand and sheer nihilism on the other.

In drawing away from these possible alternate existential world-outlooks, Madame de Beauvoir presents a very interesting and a very valuable picture of what she calls the "serious" man and his ultimate extreme—the "nihilist." Her book is especially valuable for a student of Melville, since it seems to present in capsule form a description of the Melvillean attitude toward life. By Madame de Beauvoir's definition Melville is unquestionably a nihilist.

First of all, Madame de Beauvoir discusses what she calls the "serious" man. This is, essentially, man in society or societal man carried to his ideal and fanatic extremes. This is the man who willingly gives over his attempts at subjective self-realization because he understands that this will conflict with society. Consequently, he subordinates himself to something in which he believes (or in which he tries desperately hard to believe). This may be a cause, a religion, a movement, science, philosophy—any organized system of moral or religious thought. "The thing that matters to the serious man is not so much the nature of the object which he prefers to himself, but rather the fact of being able to lose himself in it."[8] This serious man is actually making a subjective value-choice, but he refuses to realize this, says Madame de Beauvoir; he assumes that the values are absolute and smothers himself in them. This is dishonest and dangerous, according to the existentialists. It leads to fanaticism, tyranny, and despotism. Ordinarily this person does not put all his eggs in one basket. He believes in a number of causes. But occasionally fanaticism centers a man in one cause. If this fails him, the "serious" man is destitute. Then he "joins the sub-man [an unthinking amoeba], unless by suicide he once and for all puts an end to the agony of his freedom."[9]

The only possibility for the disillusioned "serious" man is to put himself the question "What's the use?" And with this question

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[8] *Ibid.*, p. 47.
[9] *Ibid.*, p. 51.

should come an insight into the absurdity of the universe. At this point, "Conscious of being unable to be anything, man then decides to be nothing. We call this attitude nihilistic," says Madame de Beauvoir.[10] To put it another way, Nihilism is disappointed seriousness which has turned back upon itself."[11]

In a further discussion of the nihilist, as he is seen by the practicing existentialist, Madame de Beauvoir presents for us a picture which might be that of Herman Melville as well as of Baudelaire.

> It sometimes happens that, in his state of deception, a man maintains a sort of affection for the serious world; this is how Sartre describes Baudelaire in his study of the poet. Baudelaire felt a burning rancor in regard to the values of his childhood, but this rancor still involved some respect. Scorn alone liberated him. It was necessary for him that the universe which he rejected continue in order for him to detest it and scoff at it; it is the attitude of the demoniacal man as Jouhandeau has also described him: one stubbornly maintains the values of childhood, of a society, or of a Church in order to be able to trample upon them. The demoniacal man is still very close to the serious; he wants to believe in it; he confirms it by his very revolt; he feels himself as a negation and a freedom, but he does not realize this freedom as a positive liberation.[12]

Thus the values of Melville's youth and of the bourgeois American world around him are constantly returned to in his novels. By returning to God, idealism, Saddle Meadows, the "prosy old Guide Book" of Redburn's father, Romantic aspiration, and prelapsarian innocence, Melville could try to believe in them and scorn them at the same time. More important, he was well equipped with values to scorn. He insisted on retracing the same path of his rejection again and again, employing each time a new work of art and sometimes new symbolism.

But, says Madame de Beauvoir, "One can go much further in rejection by occupying himself not in scorning but in annihilating the rejected world and himself along with it." And it was in this area of endeavor that Melville proved himself undeniably a metaphysical nihilist. A man may devote himself to a lost cause or fritter his life away on trivialities. Or he may follow other paths.

> Surrealism provides us with a historical and concrete example of different possible kinds of evolution. Certain initiates, such as Vache and Crevel, had recourse to the radical solution of suicide. Others destroyed their bodies and ruined their minds by drugs. Others succeeded in a sort of *moral suicide;* by dint of depopulating the world around them, they found themselves in a desert, with themselves reduced to the level of the subman.[13]

Melville's entire canon manifests this "moral suicide" by which he depopulated his created worlds. (Witness the decimation of char-

[10] *Ibid.,* p. 52.
[11] *Ibid.*
[12] *Ibid.,* p. 53.
[13] *Ibid.,* pp. 54–55.

acters in *Moby-Dick* and *Pierre* in particular.) In addition to this, Melville systematically disproved the validity of every system of morality, metaphysics, and philosophy maintained by his various characters. In so doing he reduced to zero the possibilities of his own belief in anything. He had become a nihilist. Melville committed a continual vicarious suicide in his literary world; and he also reduced all the metaphysical possibilities in his created worlds to nothing.

First of all, since he was born and baptized into Christianity, we might infer his major interest in the religion of his fathers. Three major proponents of the Christian way seem to leap out at us from his works—Starbuck in *Moby-Dick,* Pierre, and Billy Budd. In Starbuck, orthodox Christianity is suggested, and we see in this man the "fall of valor in the soul." Unable, through religious scruples, to kill Ahab, Starbuck and his Christian world are carried helplessly to destruction. And in Pierre we see the opposite kind of Christian from Starbuck. Pierre acts too rashly in the name of Christian virtue and in the process destroys all around him. In Billy Budd, Melville attempted to picture a boy who approximated perfection in Christian ethics (although Billy is too unlearned in all ways to understand the rudiments of Christianity). Billy is as close to complete goodness, Melville implies, as man perhaps ever reaches. But when he is trapped by the utter depravity of a Claggart, his basic human fallibility arises in him in the form of a speech defect, and he commits unwitting murder. Human imperfection eventually defeats Christian virtue.

In *Clarel,* Melville's long poem concerning his pilgrimage in the Holy Land, the poet very straightforwardly and unsymbolically indicates that Christian faith, or religious faith of any sort, is impossible for the man of a "deep-diving temperament," however much he may *wish* he could believe. It is a poem as arid as the Holy deserts which it treats.

But Melville does not stop with decimation of religion. The major philosophies of the Western world are all tried and found wanting. Melville was a formidable opponent of nineteenth century German idealism as it derived from Kant and was developed by Hegel. And he was no less an attacker of American Transcendentalism. Plinlimmon and his followers in the novel *Pierre* suggest Emerson and the Concord Platonists. And the character of Mark Winsome in *The Confidence-Man* is obviously a vicious burlesque of the personality of Ralph Waldo Emerson. All transcendental idealism appalled Melville. His major warning against it occurs in the chapter of *Moby-Dick* called "The Mast-Head," where he warns the young look-out in the crow's nest not to be lulled into a sense of oneness with the beautiful ocean, because one misstep can send him hurtling eighty feet to a death by drowning or a discovery of sharks under the beautiful surface of the water.

But Melville was not a proponent of those philosophies that run counter to idealism. One remembers that he likens, in *Moby-Dick,* the two whales' heads that are hoisted on either side of the *Pequod* to the philosophies of Kant and Locke. These represent the two great streams of modern Western philosophy—rationalism and empiricism. One is needed to balance the other. But Melville suggests cutting them both away and sailing without either.

About modern pragmatism and scientific positivism, Melville had less to say, since they were not in his time serious avenues of belief as they have become in our time with the deification of science. But Melville does indicate his distrust of these atheistic, materialistic approaches to life in his attack on Margoth—the Hegelized, science-ridden Jew in the poem *Clarel.*

So in his literary works, Melville destroyed all possibilities of faith or belief and in nearly all he committed vicarious suicide through his characters. And in a manner of speaking he committed actual literary suicide, since after his first two successes, he deliberately wrote unpopular books and spent the last thirty years of his life in relative literary silence. When he died he was actually forgotten as a literary figure.

He was indeed the "disillusioned serious man" of the existentialists—if you wish, the "nihilist," the man who—in an era when it was popular to be the smiling optimist—said "No" to practically all aspects of the wretched existence into which he found himself thrown.

A portion of Melville's letters to Nathaniel Hawthorne makes a fitting summation of Melville's world-view and a good summary of this study. The letter was written to Hawthorne in praise of the latter's *House of the Seven Gables.* Melville says:

> There is the grand truth about Nathaniel Hawthorne. He says *No!* in thunder; but the Devil himself cannot make him say *yes.* For all men who say *yes,* lie; and all men who say *no,*—why, they are in the happy condition of judicious unincumbered travellers in Europe; they cross the frontiers into Eternity with nothing but a carpetbag,—that is to say, the Ego.[14]

[14] Jay Leyda, *The Melville Log* (New York: Harcourt Brace and Company, 1955), I, p. 410.

AMERICAN PROTESTANTISM AND THE HIGHER CRITICISM, 1870–1910*

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The last quarter of the nineteenth century proved to be a most difficult period in the history of American Protestantism. Plagued by the social problems inherent in an emerging urban, industrial society, Protestantism was also confronted with the theological problems posed by evolution and the historical criticism of the Bible. The question of Biblical criticism was especially crucial to Protestantism, for during the Reformation the reformers had utterly abolished belief in the infallibility of ecclesiastical authority in interpretation and rested their entire position on belief in the infallibility of the Scriptures. This Protestant doctrine of the infallibility of the Bible assumed its complete authority not only in the area of religion but in science and history as well. There was no place in the inherited theologies for growth, correction, or further revelation. Lyman Abbott phrased the orthodox view of the Bible in these words:

> The Bible was dictated by God to amanuenses; it is wholly free from error; if in our version there are errors, they are due to copyists or translators; the inspiration is verbal, for there can be no inspiration of ideas or sentiments except by means of words . . . it is not only the infallible word of God, it is his final word and there can be no further revelation; the Bible is the truth the whole truth and nothing but the truth.[1]

The higher criticism, or the study of the Bible by critical methods of historical and literary analysis, began in Europe early in the nineteenth century with Germany as the center of the new Biblical scholarship. The Bible was treated as a collection of literature whose date, authorship, and character should be investigated critically, rather than a book known in advance to be inerrant and the product of inspiration. The impact of these ideas was by no means immediate. As late as 1875 it was known only to some in the United States that a critical study of the Bible was being made by German scholars, and very little was known of the results either in the churches or the seminaries of this country.[2]

With the publication of Professor Charles A. Briggs' *Biblical Study: Its Principles, Methods and History* in 1883, a wider con-

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* Paper read at the 91st annual meeting of the Wisconsin Academy of Sciences, Arts, and Letters.

[1] Lyman Abbott, *Reminiscences,* (Boston, 1915), p. 447.

[2] Washington Gladden, *Recollections,* (Boston, 1909), pp. 259 f.

sciousness of Biblical scholarship began to develop in America. This study was designed to acquaint both the intelligent laymen and the clergy with the field of Biblical study. As a liberal Presbyterian professor at Union Theological Seminary, Briggs was convinced that piety and scholarship should be combined for the best results.[3] Yet, the scientific approach was the essence of this method of Biblical criticism, for Briggs later stated that it was the purpose of the higher criticism to determine on purely scientific principles the integrity, authenticity, literary form, and credibility of the Scriptures. These principles were:

1. The writing must be in accordance with its supposed historic position as to time, place and circumstances.
2. Differences of style imply differences of experiences and age of the same author, or, when sufficiently great, differences of author and period of composition.
3. Differences of opinion and conception imply differences of author when these are sufficiently great, and also differences of period of composition.
4. Citations show the dependence of author upon author, or authors cited.
5. Positive testimony.
6. The argument from silence.[4]

Regardless of the amount of piety involved, the application of these rules to the study of the Bible indicated that a large part of the traditions as to authorship, date, style, and integrity had no solid ground.

Prior to the turn of the century it was the regular practice of a great part of the Protestant clergy to expound the Scriptures to their congregations in long and minute exegesis. Consequently men knew their Bible, and it was used in family devotions, as well as public orations. Its wisdom on all subjects was considered irrefutable. Through various channels people now heard that some of the books were not composed by the authors to whom they had been attributed; that the first five books were not written by one person, and only a very few of the Psalms were written by David; that the Levitical ritual was not practiced in the wilderness, or even until some centuries afterward; and that the account of Jonah was a parable.[5] The first reaction on the part of many individuals was a profound sense of shock. Essentially, it did not make much difference what errors were found or how trivial they were, for to many,

[3] Charles A. Briggs, *Biblical Study: Its Principles, Methods and History,* (New York, 1887), p. viii.

[4] Charles A. Briggs, *Church Unity: Studies of its Most Important Problems,* (New York, 1909), p. 326.

[5] George Harris, *A Century's Change in Religion,* (New York, 1914), pp. 76 f.

both clergy and laity, the admission of any error seemed fatal to the authority of the Bible and therefore undermined the very basis of their faith.

One of the early difficulties was a lack of finality in the conclusions of the Biblical scholars. Conclusions drawn by some scholars were bitterly contested by others. Where the specialists found themselves in doubt, the average man was in a state of utter confusion.[6] It is obvious from the sermons of the last two decades of the nineteenth century that even the more liberal denominations mentioned the results of the Biblical scholars from the pulpit very infrequently. Apparently this was due to fear on the part of the clergy that their congregations would misunderstand the implications of the findings and their faith, in what was already a period of spiritual unrest, would be further unsettled.

One liberal minister who felt that the people had a right to know what was going on in the field of Biblical scholarship was Washington Gladden. He was convinced that the Bible, even when all the findings of the scholars had been presented, would still remain the most precious and inspiring book in the world. In fact, he felt that it would be even more precious and inspiring when all the truth had been told about it than it ever could be as a mere object of superstition.[7] It was with this aim in mind that in 1891 Dr. Gladden published his book, *Who Wrote the Bible?* Delivering it originally as a series of sermons, he stated at the very outset his reasons for undertaking this work.

> The results of conservative scholarship have been very imperfectly reported to the laity of the churches. Many facts about the Bible are now known by intelligent ministers of which their congregations do not hear. An anxious and not unnatural feeling has prevailed that the faith of the people in the Bible would be shaken if the facts were known. The belief that the truth is the safest thing in the world, and that the things which cannot be shaken will remain after it is all told, has led to the preparation of this volume.[8]

Concentrating principally on the Old Testament, Dr. Gladden attempted to "put into compact and popular form, for the benefit of intelligent readers, the principal facts upon which scholars are not generally agreed concerning the literary history of the Bible."[9] The last chapter of this study is entitled, "How Much is the Bible Worth?" Here he concluded that the Bible was not infallible historically, scientifically or morally, but, "The Bible is the record of

[6] Gaius Glenn Atkins, *Modern Religious Cults and Movements,* (New York, 1923), pp. 56 f.
[7] Gladden, *Recollections,* p. 319.
[8] Washington Gladden, *Who Wrote the Bible? A Book for the People,* (Boston, 1891), pp. 5 f.
[9] *Ibid.,* p. 1.

the development of the kingdom of righteousness in the world."[10] Gladden was very much gratified to find that no excitement or controversy had developed in his congregation while his lectures were in progress. However, from outside his congregation he received much censure and condemnation.[11]

On the basis of the continuing study of the Bible, Washington Gladden at the turn of the century published another work entitled, *How Much Is Left of the Old Doctrines?* This was an attempt to set forth the doctrinal position on which he, as a liberal who had kept abreast of the findings of science and Biblical scholarship, then stood. "I am going to maintain that the intelligent Christian may stand in the presence of modern thought, and accept everything that has been proved by science or history or criticism, and not be frightened at all by any of it; firmly believing that the great verities of the Christian faith will still remain untouched."[12]

Many conservative Protestants felt strongly that there could be no compromise, that they must stand firm in the face of threats to true religion. This group knew that they were in the right, by holding to the old faiths, for they could see the hand of God working in the world to illustrate that any revision of faith was false. One of the most obvious results of this dilution according to the Presiding Elder of the Detroit Conference of the Methodist Church was the depression of 1893. National prosperity was absolutely impossible in the absence of political and commercial confidence. Since all confidence, political and social, ultimately rested in faith in the Bible, the existing lack of faith had obviously caused the downfall of the whole system of American prosperity.[13]

That there was an increasing amount of vice and crime, such as homicide, suicide, adultery, and kindred sins was not a mere coincidence to conservatives. The logical explanation for this was in the fact that men had departed from the fear of the Lord. Having nothing to fear, men went their own way "like the wild asses of the wilderness."[14] The dilution of orthodox theology had not only affected the national prosperity and the morals of the times but it had affected church attendance as well. The churches had once been crowded Sunday after Sunday, it was held, with congregations eager to hear the unadulterated Word of God; but by 1911 these churches

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[10] *Ibid.*, p. 362.

[11] Gladden, *Recollections*, pp. 321 f. Also, *The Milwaukee Journal*, December 19, 1904, p. 4.

[12] Washington Gladden, *How Much is Left of the Old Doctrines? A Book for the People*, (Boston, 1899), pp. 15 f.

[13] *The Methodist Episcopal Church Pulpit*, Charles T. Allen, "Christ Glorified in His People," (Monroe, Michigan, 1897), p. 35. Also, ed., Knut Seehuus, *The Old Paths*, (Decorah, Iowa, 1914), p. 173.

[14] J. Sheatsley, *Sermons on the Eisenach Gospels*, (Columbus, 1915), p. 68. Also, Samuel Smith Harris, *The Dignity of Man; Select Sermons*, (Chicago, 1889), pp. 160 f.

were reported to be practically empty. This was because the pastors of many churches had read the "so-called higher critics" more than they had their Bibles and, therefore, had lost their faith in the Inspired Word of God. Consequently, they had no message for the people that was worth hearing. "God will not bother Himself to send hearers to false messengers."[15]

From the decade of the 1870's on, some conservative groups to an ever increasing extent attempted to discourage the growth of the new ideas through the use of heresy trials. Since the Lutherans were practically unanimous in maintaining their orthodox theology, they had little occasion to resort to such drastic means. The Baptists and the Disciples had no ecclesiastical courts for dealing with matters of heresy, so their only recourse was to thresh out cases involving heretics in their religious papers without decisive results. Both the Congregational and Episcopal faiths developed a marked degree of theological tolerance at a relatively early date and therefore had little intradenominational difficulty over the question of the higher criticism. The Methodists did have some heresy trials before the turn of the century, but for the most part they were more interested in administrative efficiency than in doctrinal uniformity.

It was the orthodox group within the Presbyterian Church that made a determined effort to root out evidences of the encroachment of scientific findings in their pulpits and seminaries. In this they were aided by a well-defined ecclesiastical system which embodied excellent provisions for trying suspected heretics. In May, 1891, over seventy Presbyterian ministers, meeting in Detroit, petitioned the General Assembly to bring charges against the distinguished Hebrew scholar of Union Theological Seminary, Charles A. Briggs. Professor Briggs was finally brought to trial in 1893 and was found guilty of violating his ordination vows and suspended from the Presbyterian Church. Briggs promptly withdrew and took orders in the Protestant Episcopal Church. Through this same means the Presbyterian Church lost two more of her distinguished scholars; Henry Preserved Smith in 1894, and A. S. McGiffert in 1899.[16]

Severe as this controversy was, it was not serious enough to produce schisms of major importance. Thus a period of enforced contact was brought about within the denominations between the liberal and conservative elements. This period of enforced contact resulted in some gradual change of position. Within the major denominations this movement was always in the direction of the lib-

15 S. P. Long, *Prophetic Pearls*, (Columbus, 1913), pp. 193, 343.

16 Robert Ellis Thompson, *A History of the Presbyterian Churches in the United States*, (New York, 1895), p. 261. Winfred Ernest Garrison, *The March of Faith; The Story of Religion in America Since 1865*, (New York, 1933), p. 94.

erals. In the more conservative denominations the progress toward a liberal view was sometimes so gradual as to be hardly discernible, but taking a long view of this process, progress was certain.[17] Yet, F. H. Foster caught the sense of impatience with which the liberals witnessed this very gradual progress when he termed it a conservative movement. In fact, some liberals felt that this movement merited criticism for its slowness and hesitation, rather than condemnation for haste and recklessness.[18]

That the period of indiscriminate denunciation of the higher criticism had passed by 1905 for the mass of the Protestant clergy seems to be indicated in a sermon by the Dr. D. W. C. Huntington, Chancellor of Nebraska Wesleyan University. He warned that ministers who engaged in such denunciation were becoming increasingly unacceptable. Such preaching "has prejudiced more thinking men with ministers, than all that is called higher criticism."[19] Moreover, the Methodists by this time were no longer interested in pressing heresy charges against their clergy. Charges were brought against Professor H. G. Mitchell of Boston University in 1905, but they did not reach the General Conference until 1908. The bishops then inserted a clause in the discipline relieving them of the duty of investigating erroneous opinion in the seminaries. The highest Methodist court having ruled itself out of such cases, there was no other body to fill such a position of authority, and as a consequence the Methodist Church was saved from further heresy hunting.[20]

It would be virtually impossible to estimate what proportion of the Protestant clergy held to the ideas of the higher criticism at any given time during the period 1870 to 1910. Some felt that they were restricted intellectually by the conservatism of their congregations and this conservatism, of course, was reflected in the temper of their sermons.[21] However, sermons used in the process of this research would suggest that the decade of the 1880's was, generally speaking, one of opposition to the findings of the higher criticism. The decade of the 90's found an increasing number of liberal clergy, particularly in Congregationalism, embracing these findings. Such conservative denominations as the Lutherans and Presbyterians continued to reject the historical approach through the first decade

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[17] Shailer Mathews, *New Faith for Old: An Autobiography,* (New York, 1936), pp. 77 f. Also, Atkins, *Modern Religious Cults and Movements,* p. 14.

[18] Frank Hugh Foster, *The Modern Movement in American Theology,* (New York, 1939), pp. 11 f.

[19] D. W. C. Huntington, *Half Century Messages to Pastors and People,* (Cincinnati, 1905), p. 16.

[20] Halford Edward Luccock, and Paul Hutchinson, *The Story of Methodism,* (New York, 1926), pp. 428 f. Also, Stewart G. Cole, *The History of Fundamentalism,* (New York, 1931), pp. 185–190, *passim.*

[21] Charles A. Stelzle, *A Son of the Bowery: the Life of an East Side American,* (New York, 1926), pp. 106 f. Ernest Hamlin Abbott, *Religious Life in America; A Record of Personal Observation,* (New York, 1902), p. 354.

of the twentieth century. The majority of such groups as the Methodists, Baptists and Episcopalians raised ever less objection.

It was only in the Congregational Church that we find a genuine acceptance of the historical criticism of the Bible. And this acceptance did not come until mid-way in the first decade of the new century. The election of Washington Gladden to the post of moderator of the Congregational Church in 1904 probably marks the final acceptance. The Reverend Henry Stauffer who was for some years associated with Gladden in his work in Columbus, Ohio, put it this way.

> For many years, Dr. Gladden has been under a cloud, so to speak, because of his advanced views. His recent election as moderator of the national council touched him deeply, not only the honor, but the recognition and acceptance of his views that it indicated. It removed the stigma that had hung over him.[22]

Actually, the number of Protestant ministers who adopted the higher criticism during the period to 1910 was probably something less than one-fourth of the total number. But since this small group was to a very great extent made up of the intellectual and denominational leaders, such as Lyman Abbott, Washington Gladden and Shailer Mathews, its total effect was much more far-reaching than mere numbers would indicate.[23]

The use of historical criticism as applied to the Bible had not been confined to the Old Testament, but only in examining the Old Testament had it been applied in completely thoroughgoing fashion. Unlike the European scene where as early as 1835, Dr. David Friedrich Strauss had written *The Life of Jesus; Critically Examined;* American theologians, even leading liberals such as Gladden, had not pressed the historical examination of the New Testament. However, an Episcopal rector, the Reverend Algernon Sidney Crapsey publicly applied the higher criticism to the life of Christ, in a sermon delivered on February 18, 1905, with startling conclusions.

> In the light of scientific research, the Founder of Christianity, Jesus the son of Joseph, no longer stands apart from the common destiny of man

[22] *The Milwaukee Journal,* December 19, 1904, p. 4.

[23] The survey of the beliefs of 700 ministers made by Professor George Betts in 1929 gives some indication of the penetration of the higher criticism within Protestantism to that date. It was found that 55% of the ministers believed that the Bible was written by men chosen and supernaturally endowed by God for that purpose, and by him given the exact message they were to write; 70% that the inspiration that resulted in the writing of the Bible is different from that of other great religious literature; 34% that every part of the Bible is of equal validity and authority with every other part; 38% that the Bible is wholly free from legend or myth. In a breakdown by denominations on the question of whether or not the Bible was written by men chosen and supernaturally endowed by God for that purpose, and by him given the exact message they were to write, 98% of the Lutherans, 62% of the Baptists, 44% of the Presbyterians, 40% of the Episcopalians, 30% of the Methodists, and 15% of the Congregationalists believed this to be substantially true. George Herbert Betts, *The Beliefs of 700 Ministers and Their Meaning for Religious Education,* (New York, 1929), p. 45.

> in life and death, but He is in all things physical like as we are, born as we are born, dying as we die, and both in life and death in the keeping of that same Divine Power, that heavenly Fatherhood, which delivers us from the womb and carries us down to the grave. When we come to know Jesus in his historical relations, we see that miracle is not a help, it is a hindrance, to an intelligent comprehension of His person, His character and His mission. We are not alarmed, the fact of His miraculous birth was unknown to Himself, unknown to His mother, and unknown to the whole Christian community of the first generation.[24]

The fact that this sermon was printed gave rise to serious question on the part of some of the Episcopal clergy. In April of 1906 Mr. Crapsey was tried for heresy and forced to renounce the ministry.[25] The Episcopal Church which had provided a haven for Professor Briggs in 1893 when he was expelled by the Presbyterian Church, refused thirteen years later to allow the application of Briggs' principles to the New Testament.

The Crapsey decision could not conceal the fact that conservative Protestants had been slowly but steadily losing ground to their liberal opponents. Some conservatives felt that the situation demanded rapid and forceful action. In 1909 under the leadership of the Reverend A. C. Dixon, pastor of the Moody Church in Chicago, a group of earnest believers organized a movement of protest. "Two Christian Laymen" subsidized the publication of *The Fundamentals*, a series of twelve volumes aimed at "strengthening the faith of Christians, unto the defence of the truth against the various forms of error so prevalent at the present day, and, above all, in stirring up Christians everywhere to more active effort and more earnest prayer for the conversion of a great number of the unsaved."[26] At the expense of the Two Laymen, three million copies of *The Fundamentals* were sent to "All English-speaking Protestant pastors, evangelists, missionaries, theological professors, theological students, Y.M.C.A. secretaries, Y.W.C.A. secretaries, Sunday School superintendents, religious lay workers, and editors of religious publications throughout the earth."[27] Although the leadership seemed to be dominated by the Moody organization, it also cut across denominational lines, for contributions to *The Fundamentals* were received from professors, ministers, and laymen of most of the leading denominations.

This group insisted on re-emphasizing the absolute authenticity of the Word of God. In doing this they cast suspicion on the findings of science and especially of the higher criticism; and not infrequently did they discount the sincerity of the liberal leaders. Canon

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[24] Algernon Sidney Crapsey, *The Last of the Heretics*, (New York, 1924), pp. 251 f.
[25] *Ibid.*, p. 260. See *The Milwaukee Journal*, June 4, 1906, p. 9, for reactions to the Crapsey trial in Wisconsin.
[26] *The Fundamentals*, Chicago, n. d., vol. XII, p. 7.
[27] *Ibid.*, p. 6.

Dyson Hague of London, Ontario, stated the basic assumption of the Fundamentalist movement:

> If we have any bias, it must be against a teaching which unsteadies heart and unsettles faith. Even at the expense of being thought behind the times, we prefer to stand with our Lord and Saviour Jesus Christ in receiving the Scriptures as the Word of God, without objection and without doubt.[28]

The first decade of the twentieth century was, then, the crucial decade for the higher criticism. Its principles and general findings had been largely accepted by liberal Protestants, although the Crapsey trial indicated the possible perils of carrying these principles too far. Moreover, it had spawned a small but vigorous and well-organized opposition movement in Fundamentalism. The higher criticism had, by 1910, come to occupy a recognized place in American Protestantism.

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[28] *The Fundamentals*, Dyson Hague, "The History of the Higher Criticism," Vol. I, pp. 119 f.

PATTERNS OF OBSERVATION: A STUDY OF HAMLIN GARLAND'S MIDDLE BORDER LANDSCAPE

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When an author appoints himself spokesman for a region, as Garland did for the Middle Border, it is useful to have some touchstone by which to measure the quality of his observation. And in applying such a touchstone one frequently learns to what extent an author is dependent on his actual experiences in his creation of fiction. In Garland's case it is probably significant that he never laid a story in a locality he had not visited, and the largest number of his works are laid in the area which he knew best. This area which he termed the "Middle Border" has been facetiously defined as "wherever Hamlin Garland was", but actually he used the term for western Wisconsin, Iowa, and South Dakota.

Although it is, perhaps, theoretically not impossible to reconstruct the way of life of a region more than half a century ago and then to compare one author's account of such a life with the actuality, it would be extremely difficult in practice. Detailed accounts of homestead life are scarce and fragmentary. Moreover the more detailed and intimate they are the less they are able to reflect the diversity of frontier life which was the result of the diverse backgrounds which settlers from Europe and America, the North and South, from rural and urban communities, and from artisan, farm, and commercial classes brought with them to their new homes and which modified the manner of life from community to community and even farm to farm. But the landscape and climate were rather more constant, and botanists and zoologists have recorded the composition of the prairie and oak openings, the ranges of plants and animals in sufficient detail so that Garland's descriptions of such phenomena can serve as a test of his observations.

Lists of Garland's descriptions of nature and of the plants and animals he names reveal similar patterns of observation. First, he works almost entirely from first hand experience, largely uncorrected by subsequent study or learning. Second, his observations are typically those of the farmer, the herdsman and the trailer. His eye for panorama is better than that for detail, except in those cases in which there is some practical reason for observing detail. He is accurate in what he observes but despite the fact that he was familiar with unbroken prairie both in Iowa and in South Dakota his observations would be of little value to a botanist or zoologist.

Garland is at his best in descriptions of weather—the raw autumn mornings which mellow into noon in *Boy Life on the Prairie,* the lowering sky and cold gray wind of the Thanksgiving Day on which young Lincoln Stewart picks corn, the still heat of "Among the Cornrows", the swift mountain showers in *Tyranny of the Dark* and *The Forester's Daughter,* the violent summer storm which destroys Jason Edwards' final crop, and, most frequently, blizzards. There are vivid accounts of blizzards in *Moccasin Ranch,* in *A Little Norsk,* and in *Boy Life on the Prairie* as well as in the autobiographical *Son of the Middle Border.* Actually one of Garland's earliest published pieces is a fictionalized account of going out to his South Dakota claim and being caught there in a blizzard.[1] It is also interesting that, with one exception, the novels which deal with a cycle of seasons are the Middle Border novels. *Rose of Dutcher's Cooley, A Spoil of Office, A Little Norsk, Moccasin Ranch, Boy Life on the Prairie, Trailmakers of the Middle Border,* and the collections of short stories, *Main Travelled Roads, Wayside Courtships, Prairie Folks,* and *More Main Travelled Roads* all contain stories both of summer and winter.

Garland's western novels tend to be stories of summer and fall, the seasons at which he visited the west. The action of *Cavanaugh* takes place in a single summer. The action of *Captain of the Gray Horse Troop,* though it is spread over more than one year, simply omits winter scenes of the reservation. *The Eagle's Heart* chronicles several years of life in the west, but all the action takes place in the summer. The boy's story, *The Long Trail,* parallels Garland's own trip to Alaska, and therefore is restricted to a single summer. *The Forester's Daughter* takes place in autumn, but although it includes a wet autumn snow, the snow is brief, local and not unexpected there early in September or even August. The long serialized novelette, "The Ranger and the Woman", describes only summer scenes. The mountain scenes of *Her Mountain Lover, The Tyranny of the Dark* and *Money Magic* are laid in summer. One is aware of a change of seasons in *Hesper* but it is difficult always to know how much this change is seasonal and how much altitudinal.

"The Outlaw," a story from *They of the High Trails,* contains another description of a mountain snowstorm, this one of blizzard proportions, but it stands as the only approximation of winter in the west except for two stories in *The Book of the American Indian.* The Indian stories are largely transcriptions of stories told to Garland, but in "The Storm Child" he can call his experience with prairie blizzards to aid him and writes authentically. "The Silent Eaters" mentions snow and cold but centers on the summer and

[1] Hamlin Garland, "Holding Down a Claim in a Blizzard," *Harper's Weekly,* XXXII (Jan. 28, 1883) pp. 66–67.

autumn of the death of The Sitting Bull. By contrast, in the Middle Border stories Garland includes such winter details as the feel of frozen ground underfoot, the ring of horses' hooves on frozen ground, the brief ponds which form on the plowed land in a thaw and then freeze to provide a prairie boy with skating, as well as the cold white fury of snow driven before a prairie wind—authentic details derived from his own experience.

Similarly Garland exhibits a keen eye for panorama, for what his fellow Middle Borderers might have termed the "lay of the land". It is not surprising that he should be aware of the gradual rise of the Great Plains to the mountains and the locations of the major ranges, or even of the vegetation zones of the mountains themselves. After all, generations of naturalists and travelers had described the transitions from hardwoods to pine to timberline and Garland had himself observed the change in Colorado and also on his trail trip to Alaska when the necessity for finding pasture for his horses made him keenly aware of the pattern of grass and forest. He records it in more or less detail in most of his western novels. *Cavanaugh, Money Magic, Spirit of Sweetwater, Captain of the Gray Horse Troop,* and even *The Tyranny of the Dark* contain records of journeys up a mountain, or mountains, but the most extensive descriptions outside of *On the Trail of the Goldseekers* occur in *The Forester's Daughter.*

A better test of Garland's eye for landscape pattern is found in his description of prairie landscape such as that of the "brush" or "hazel" prairie which, with a casual authenticity born of intimate knowledge, combines site, soil and the pattern of the dominant vegetation:

> Scattered over the clay lands were small groves or clumps of popple trees, called "tow-heads" by the settlers. They were commonly only two or three hundred feet in diameter, though in some cases they grew along a ridge many acres in extent. Around these islands seas of hazel brush rolled, interspersed with lagoons of blue-joint grass, that most beautiful and stately product of prairie soil.[2]

It is also noteworthy that in *Boy Life on the Prairie* he correctly charts the vegetation zones from prairie to river bottom in Iowa, a transition which is less readily apparent to an untrained eye than the transition from aspen to pine to timberline of the mountains and one that has found very little place in American literature. Bryant had observed it in Illinois and written a description of it in his letters, but it is not included in his long poem on the prairie. It would seem then, that in this description Garland is working

[2] Hamlin Garland, *Boy Life on the Prairie,* New York, Bacon & Allyn, 1926, p. 90.

from his own observation without benefit of prior prompting by conventional descriptions.

> The Cedar River was about four miles away, a bright, sparkling stream, with occasional pools, overhung by elm and basswood trees, and bordered with drooping watergrasses. The road to these swimmingplaces led through beautiful wild meadows, rich with waving crow's-foot, lit as with flame by pinks, lilies, roses, and sweet-williams. Young prairie chickens rose before each galloping horse with a sudden buzz, and the smell of blossoms burdened the slow wind. A mile of burr-oak openings followed, and then came the dip into the wooded bottom where the river ran.[3]

The foregoing paragraph is also typical of Garland's use of plant names. The paragraph quoted contains one of his most extensive lists of species: it mentions three kinds of trees, a grass and four flowers, but of these only the trees and roses are recognizable to a botanist today. In the plant world Garland was most familiar with trees. He mentions burr-oak, elm, and basswood, willow and soft maple, poplar, aspen, spruce and fir, and recognizes the proper habitats for each. But he does not usually discriminate one oak from another except in the case of burr-oaks. The farmers of the prairie planted willow and poplar and soft maple because they were quick-growing trees, and the practical recognition of the differences in growth habits of the hard and soft maple causes Garland and other farmers to distinguish between them, but such discrimination was the exception rather than the rule.

Garland apparently knew only a few herbs by name. He uses no latin names except in those cases in which the generic name is also the common name as is the case with asters and roses. He actually lists only about a dozen prairie species and no greater number of mountain species despite the fact that of the forty books he published only one or two are entirely without episodes laid in the middle or mountain west. The impression that Garland is not familiar with plant nomenclature is reinforced by the fact that the same plants are referred to in several contexts although others might have been substituted with equal accuracy. As in the case of trees there is no discrimination of species even in genera such as asters which are highly variable. Garland uses only the common inclusive term aster or sunflower, etc.

Thus of the prairie species, Bluejoint grass, wild oats and sunflowers are mentioned in the beginning of *Boy Life on the Prairie* and there are occasional short lists such as "pinks, sweet-williams, tiger lilies and lady slippers"[4] but a composite list made from his lists would hardly begin to enumerate the rich and conspicuous prairie flora.

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[3] *Ibid.*, p. 168.
[4] *Ibid.*, p. 96.

In *The Spirit of Sweetwater* and *The Forester's Daughter* he mentions sage brush, painted cup, cactus, Spanish dagger and also the crow's foot grass and blue joint grass at higher levels. These lists of species which Garland recognized are complicated by the fact that he often included so little reference even to color that it is difficult to establish which plants he was referring to. The brief notes prepared by Garland for the school edition of *Boy Life on the Prairie* indicate that he at least used the names for the three grasses to which he most often refers with some precision. His description of bluejoint,

> "a tall beautiful grass, growing often as high as a man's shoulder: Apparently it is green, but close study shows that the joints, which are six or eight inches apart, are really dark blue or purple, the color shading off above and below the joints. The boys chewed the joints for the sweet juice. In the autumn before withering and becoming sear, the grass turns reddish purple."[5]

rather clearly identifies *Andropogon*. On the other hand the description of what Garland refers to as Crow's-foot, though it certainly indicates that he had a specific grass in mind, fails to provide characteristics necessary for identification as does that for the wild oats.

It is almost as difficult to identify flowers in Garland's writings with any degree of accuracy as it is to identify the grasses. Thus "Pink" and "Sweet William" may both refer to phloxes; although the "Pink" could have been used for the firepink *(Silena Virginica)* and may even have reference to the grasspink orchid *(Calopogon pulchellus)*. Sweet William is given as a common name by Fernald in the new *Gray's Manual of Botany* only for an introduced species, but in the Middle West *Phlox divaricata* is sometimes called by that name. Similarly Fernald and other authorities give Crow's-foot as a common name only for an introduced species of grass. Such use of almost unidentifiable common names suggests that Garland was using highly local nomenclature which has been largely superseded by names taught in the schools. Garland then, apparently learned these names in his childhood and never adopted later, more standard, nomenclature.

All of the species which Garland names identifiably are conspicuous either for their size or color, with the exception of violets which are so commonly known that the veriest novice at botany recognizes violets as easily as roses. It seems probable that what Garland wrote of Lincoln Stewart and his friends, "Almost without realizing it, he and his companions came to know every weed, every curious flower, every living thing big enough to be seen from the back of a horse",[6] was also true of Garland and that the qualification was

[5] *Ibid.*, p. 326.
[6] *Ibid.*, p. 87.

equally accurate in both cases. The only exceptions were plants such as wild buckwheat which interfered with the plowing and wild strawberries which had the virtue of being edible.

As a matter of fact Garland names all the more common fruits, berries and nuts used by the settlers such as crab apples, wild plums, and hazel nuts; although there is no mention of some of those such as hog peanut, Jerusalem artichoke, hackberry, elderberry, and serviceberry used by the Indians and by the first settlers in more southern states. Actually all these latter plants produce meager quantities of food in proportion to the effort required to gather and prepare them; they tend to be foods of desperation or poverty and their omission serves as an indication that the farmers whom Garland knew had never been reduced to a diet so meager or unvaried as to make these wild foods attractive.

But if Garland knew names only for a limited number of prairie plants he nevertheless was able to distinguish prairie species from introduced species. When, in *Boy Life on the Prairie,* Lincoln Stewart returns to his boyhood home and finds that the prairie has vanished, he recognizes the introduced roadside weeds as strangers:

> The wild flowers were gone. Tumble weed, smartweed, pigweed, mayflower, and all the other parasites of civilization had taken the place of wild asters, pea-vines, crow's-foot, sunflowers, snake-weed, sweetwilliams, and tiger lilies.[7]

Also when Lincoln and Rance do finally locate a bit of remnant prairie it is precisely where a modern botanist would expect it—along a railroad right of way. He lists only half a dozen plants, again by common and ambiguous names, but he has accurately located the best place to look for remnant prairie, on land unbroken by the plow and protected by fences from grazing cattle:

> At last, beside a railroad track that gashed the hill and spewed gravel along the bottom of what had been a beautiful green dip in the plain, the two friends came upon a slender slip of prairie sod.
>
> ". . . Here they are—the buffalo berries, the rose bushes, the rattlesnake weed, the wild barley, just as they were!"[8]

It would seem that his train journeys to Colorado and his multitudinous lecture tours provided the same kind of observation which once he had made from the back of a horse. The picture is accurate in outline, but fuzzy in detail.

A similar pattern of lack of specific names and failure to observe small forms is evident in Garland's references to animals and birds. Blacksnakes and rattlers are mentioned as are prairie dogs, gophers and the rats which infested the corn crib, but although some of

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[7] *Ibid.*, p. 311.
[8] *Ibid.*, p. 318.

these are comparatively small creatures they all have economic significance for a farmer. Prairie dog holes were a menace to horses and gopher hunting was a task regularly assigned to farm boys because gophers dig up and eat seed corn. *Boy Life on the Prairie,* in fact, contains an entire chapter on Hamlin Garland's memories of shooting and trapping gophers.

Marmots, foxes, coyotes appear in appropriate contexts in Garland's western novels, and there is a mention of antelope in *Moccasin Ranch.* Joe Gregg kills a mountain sheep in *Cavanagh* and Garland himself deliberately withholds his fire when he sees a deer along the *Trail of the Goldseekers,* but there is really very little mention of large game. The bison of course existed only in a carefully nurtured remnant herd. Elk and bear were largely gone from the middle western frontier. In *The Forester's Daughter,* Berrie tells of an encounter she had previously had with a mountain lion but the cat has no place in the story proper. There are mentions of foxes, a badger, "wolves" and "prairie wolves", which Garland describes as looking like a combination of wolf and coyote, in *Boy Life on the Prairie* and an episode in which wolves follow Richard Graham in *Trail Makers of the Middle Border,* but that is a book set in pre-Civil War Wisconsin and draws not upon Garland's own memories but those of his father.

Paradoxical as the idea appears at first, the absence of large animals, particularly predatory animals, is probably testimony to Garland's faithfulness to his own observations. There was ample literary tradition ranging from Cooper and Simms to Davy Crockett for introducing encounters with ferocious beasts in chronicles of the frontier. But the fact remains that the population of large animals, either game animals or predators, was probably lower in the years when Garland knew the middle and mountain west than it is now after half a century of conservation and game management.

The names of birds appear with greater frequency in Garland's novels than names either of herbs or animals but follow the already established pattern. Few small birds are named and when they are it is only generically, a sparrow or a warbler. In *Moccasin Ranch* in which he writes of homesteading in South Dakota when it was virgin territory he lists plover, redwinged blackbirds, meadow larks, prairie chickens, ducks, geese, and sandhill cranes; all of which are conspicuous and most of which were considered game birds. But even ducks and geese are undifferentiated. In *Money Magic* a magpie steals Mart Haney's strychnine bottle, and jays and grouse appear in the *Forester's Daughter.* From such representative references to herbs, animals and birds, it would seem that Garland learned the details of his nature lore as a child and young man, that he learned them primarily in his occupation as a farmer and to a lesser degree in his recreation as a trailer and that his knowledge exhibits limits characteristic of these occupations.

But the lists serve also to demonstrate that Garland almost never went beyond first hand observation in his use of nature either as a background for his novels or as material for his plots, and his omission of mention of native plants marginally useful for food, together with the almost complete disregard of rabbits, squirrels, ducks, geese or even fish in the Middle Border novels reinforces the impression of those novels that, though Garland's characters may be burdened by mortgages, neither they nor the farmers Garland knew on the Middle Border were ever reduced to consistent use of wild foods, nor even interested in such foods except for those nuts and berries which were generally considered delicacies.[9]

[9] In *Boy Life on the Prairie* Garland included a chapter on "Prairie Game" which mentions that the boys shot rabbits and squirrels as sport, but "Squirrels they seldom cared to carry home, but occasionally roasted them at their campfires in the woods" (p. 212). Ducks which the boys hunted in season were also largely hunted for sport for "His mother had a prejudice against ducks and never liked to cook them, and, in truth, they never tasted very good". (p. 205) As the boys "grew older and wiser, they considered all the game of the prairie too small". (p. 212)

ILLUSTRATING POLITICAL THEORY THROUGH SPEECH—CHARLES KENDALL ADAMS' "REPRESENTATIVE BRITISH ORATIONS"*

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G. P. Putnam's Sons, the New York publishing house, wanted some one to edit a collection of British orations. Speech anthologies were selling well in the post-Civil War period and Putnam's wanted to bring out a set of its own.[1] The man chosen for the job was the dean of the new school of political science at the University of Michigan. His name was Charles Kendall Adams.

Adams brought to this assignment a truly unique background. He was in the first place a professional historian.[2] While still a freshman at Michigan in 1857, he became a disciple of Andrew Dickson White. White was a brilliant teacher and a first rate historian. It was he who suggested that Adams become a specialist in English political history. After a year and a half of European study, Adams succeeded White in the chair of history at Michigan. In 1870, Adams established the first graduate seminar ever to be offered in an American university.[3] His courses, though usually elective, came in time to be among the most popular in the University.[4] In addition, Adams did much to build up the manuscript collections of the university library, first at Michigan and later at Cornell and Wisconsin.[5] In 1890, he would become president of the American Historical Association.

Adams was equally at home in the field of political science. At Michigan, he formed a student-faculty group known as the "political science association." Adams' group pre-dated the national association of the same name by over fifteen years.[6] Adams' historical

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1 An examination of Thonssen and Fatherson's *Bibliography of Speech Education* reveals that at least thirty-five collections of speeches were published during the latter half of the nineteenth century. Lester Thonssn and Elizabeth Fatherson, comp. *Bibliography of Speech Education* (New York, 1939).

2 For a sketch of Adams' career, see C. F. Smith, "Memorial Addresses: President Charles Kendall Adams," *Transactions of the Wisconsin Academy of Sciences, Arts and Letters,* XIV, Part II, 1903, 670–8.

3 H. B. Adams, *The Study of History in American Colleges and Universities* (Washington, 1887), p. 240.

4 *The Chronicle* (University of Michigan student newspaper), April 3, 1880, as quoted in C. F. Smith, *Charles Kendall Adams: A Life Sketch* (Madison, 1924), p. 14.

5 In fact, Smith credits Adams with being the prime mover in the establishment of the magnificent Historical Library at Madison. *Ibid.*, p. 40.

6 "Political Science at the University of Michigan, 1910–1960," n.p.

study of the British Constitution now served him well as he prepared new courses in comparative government and constitutional law. Later as president of Cornell, he would seek to unite history, political science and economics into a single administrative unit.[7]

A third field which interested Adams was the field of speech. Since 1846 speech had been taught at Michigan and a historian had usually served as the instructor. In fact, years before Adams arrived at Ann Arbor, there existed an endowed chair of "logic, rhetoric, and the philosophy of history."[8] Far from opposing this speech tradition, Adams sought to build upon it. In his seminar teaching, he incorporated elements of both debate and extempore speaking.[9] Thus Adams' students were exposed to communication skills along with historiography. In his inaugural address as dean of political science, Adams paid special attention to the importance of platform speaking in America.[10] Adams was one of the Michigan faculty who asked the board of regents to expand course offerings in speech.[11] Again and again in his historical writings Adams called students' attention to speeches as important primary source data.[12] Later on, as president of the University of Wisconsin, he would demonstrate a keen interest in the development of intercollegiate debating.[13]

One incident at Wisconsin is an especially vivid illustration of Adams' awareness of the importance of speech in a democracy. Richard T. Ely, director of the University's school of economics, political science and history, was falsely charged with fomenting strikes and boycotts during Adams' term as president. Ely was one of America's foremost political economists. At stake was his right and the right of every other professor in the University to speak out and teach what he believed to be the truth. According to Herfurth, Adams drafted the report of the regents committee which investigated the charges.[14] The concluding statement, long hailed as a milestone of American academic freedom, reads as follows:

> . . . Whatever may be the limitations which trammel inquiry elsewhere, we believe that the great state university of Wisconsin should ever encourage that continual and fearless sifting and winnowing by which alone the truth can be found.

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[7] Adams' efforts in this regard proved unsuccessful at Ithaca, but he was able to achieve this goal later at Madison.

[8] Marvin L. Esch, "Student Speaking at the University of Michigan" (Unpublished Ph.D. dissertation, University of Michigan, 1959), p. 137.

[9] *The Chronicle*, October 18, 1879, as quoted in H. B. Adams, *op. cit.*, p. 106.

[10] "Relations of Political Science to National Prosperity," as quoted in *Ibid.*, p. 117.

[11] Esch, *op. cit.*, p. 174.

[12] Cf. especially C. K. Adams, "The Growth of Liberty in England" (course of lectures for a seminar at the University of Michigan: Ann Arbor, 1870).

[13] C. F. Smith, *Charles Kendall Adams*, p. 71.

[14] Theodore Herfurth, "Sifting and Winnowing: A Chapter in the History of Academic Freedom at the University of Wisconsin" (Madison, 1949), pp. 5–11.

Speech, therefore, along with history and political science, was one of Adams' abiding interests.

The editing of a collection of British speeches gave Adams the opportunity to pool all three of his interests. Speech texts were themselves historical documents. Each text involved the essence of a speaker's political ideas at a key stage in his career. As speeches, Adams felt the texts needed no editing; the speakers themselves had long ago seen to this. But the introductions to each speech gave him the chance to analyze the special qualities which led to each orator's effectiveness. Here was an opportunity to bring political theory to every American in a form both readable and meaningful.

To what degree did Adams accomplish this goal? A critical examination of the volumes themselves should suggest the answer. Each of Adams' academic interests—history, political science and speech—will be analyzed in turn.

As a professional historian, Adams was cautious about describing his collection of speeches in terms of historical cause and effect. He knew that most historical events result from multiple causation. Yet he also knew that occasionally speeches did exercise a force in history. Of the sixteen speeches included in *Representative British Orations,* Adams described only one as resulting in an immediate historical effect.[15] Pym's oration on national grievances in the Short Parliament of 1640 did cause an immediate reaction; Commons at once appointed a committee to look into the wrongs Pym had so carefully catalogued.

Usually Adams would qualify his assertions about cause and effect by grouping speeches together as a force designed to influence events. Thus Macaulay's four speeches on parliamentary reform "contributed not a little to the final triumph of that great movement."[16] Bright's speeches delivered during the American Civil War "more than any other one thing" restrained Britain from recognizing the Confederacy.[17]

Sometimes, too, Adams was forced to admit that a particular speech had no perceptible effect upon the immediate audience. Thus the speeches of Chatham and Burke on American affairs could hardly influence members whose income and position were grants of the king. Fox's plea for negotiations with Bonaparte had little apparent impact on a Pitt-controlled House dedicated to an exactly

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[15] C. K. Adams, *Representative British Orations* (New York, 1884), I, 84. Actually Pym's speech achieved a great deal more. It was the first party platform in English history, a platform Pym's followers would vote into law six months later. See my doctoral study, "The Parliamentary Speaking of John Pym, 1621–1643" (Unpublished Ph.D. dissertation, The Pennsylvania State University, 1958), p. 167, *passim.*

[16] C. K. Adams, *Representative British Orations,* III, 55.

[17] *Ibid.,* III, 157. A later estimate of England in the 1860's contests this position. Cf. E. James Lennon, "The Pro-Northern Movement in England, 1861–1865," *Quarterly Journal of Speech,* XLI (February, 1955), 27–37.

opposite course of action. Historical judgments of this kind are as sound today as when Adams wrote them in 1884.

As a historian, Adams' principal weakness was his biased interpretation of historical events in sixteenth and seventeenth century England. Witness, for example, his account of the country at the end of the reign of Elizabeth. Right after the Spanish Armada, according to Adams, a new question arose:

> That question was whether the English Constitution was to be developed in the direction of its traditional methods, or whether the government and people should adopt the reactionary methods that were coming to be generally accepted on the Continent.[18]

The use of the words "traditional" and "reactionary" are most revealing here. Britain did in time become a parliamentary state but in the sixteenth and seventeenth centuries, it seldom was. The *traditional* form of government at that time was absolute monarchy, not parliamentary democracy. "Reactionary" is a peculiar adjective to use to describe a sixteenth century government whose form had remained substantially the same for centuries. The fact that most historians writing in Adams' day shared this "Whig" or parliamentary bias does not change the situation.

As a further illustration of this weakness, take Adams' account of the impeachment of the Duke of Buckingham in 1626. He describes this trial of the king's favorite as "the constitutional method of redress."[19] The British Constitution is a series of loose historical precedents. But in 1626, precedence for impeachment of a royal minister by the Commons was scarce indeed. Again Adams engaged in an *ex post facto* judgment more in harmony with the nineteenth than the seventeenth century.

From a second point of view, the orations were meant to be a digest of English political thought. Eliot and Pym chronicled the parliamentary indictment of Stuart rule in the seventeenth century. Chatham, Mansfield and Burke debated the rights of crown and colony in the American Revolutionary War period. Pitt and Fox argued about the role England should play on the Continent during Napoleon's reign as Emperor of the French. Mackintosh and Erskine defended freedom of the press and of juries. Canning on imperialism, Macaulay on parliamentary reform, Cobden on the Corn Laws—each of these found a place in *Representative British Orations.* John Bright's indictment of ministerial handling of the Crimean War is included as well. The third volume of the set ends with a statement of party principles by Disraeli for the Conservatives and Gladstone for the Liberals.

[18] C. K. Adams, *Representative British Orations,* I, 2–3.
[19] *Ibid.,* I, 4.

By and large, Adams' selection of speeches is balanced and inclusive. To be sure, there are a few gaps in the collection. In the matter of subjects covered, for instance, no speeches relating to the Revolutionary Settlement of 1688 or the great anti-slavery movement appear here. And conceivably one might take issue with Adams' decision to start the collection with a speech of Sir John Eliot in 1628. According to Adams, Eliot's oration was "the earliest parliamentary speech of real importance that has been preserved to us."[20] Yet earlier orations of stature by Wentworth, Bacon and Coke come to mind.[21] At any rate, in the time period in which Adams chose to concentrate, his selections did in fact represent the core of the speaker's thinking on the key political issue of the day.

In addition to political science and history, Adams had a third academic interest which was to emerge in this work, his interest in speech. He was concerned about the speaker himself as well as the overall speaking situation. At one stage or another in the three volumes, Adams mentions virtually every phase of rhetorical criticism known to the modern speech scholar. References appear relating to: the authenticity of speech texts; logical, emotional and ethical proof; style, memory and delivery; short and long range effectiveness; theme development; and above all else, speech training and the speaker's overall education. As a speech critic, Adams chose to sift and winnow, to include only the outstanding characteristics of each orator and oration. The result is a primer in that area of modern speech known as British Public Address.

To cite one example of his ability to size up a speaker, here is Adams' terse description of the speaking of Pitt the Elder:

> He was not in a true sense a great debater. His ability lay not in any power to analyze a difficult and complicated subject and present the bearings of its several parts in a manner to convince the reason. His peculiarities were rather in his way of seizing upon the more obvious phases of the question at issue, and presenting them with a nobility of sentiment, a fervor of energy, a loftiness of conception, and a power of invective that bore down and destroyed all opposition.[22]

The weakness in this approach is one of depth rather than scope. No single speaker ever receives a comprehensive analysis. Value judgments about a speaker's effectiveness are presented without supporting evidence. And the sources of information Adams uses are seldom documented.

Nevertheless the end result made rewarding reading. Adams' prose style is refreshingly free of fine writing. His historical de-

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[20] *Ibid.*, I, 11.

[21] See for example Peter Wentworth's address on liberty in 1576; Sir Francis Bacon, on the king's electioneers, 1614; and Sir Edward Coke on the Petition of Right, a speech delivered just a few months before Eliot's.

[22] C. K. Adams, *Representative British Orations*, I, 89.

scriptions are vivid and fluent and well coordinated with the biographical and speech detail. And from the outset of volume one, the theme of Britain's struggle for individual rights is clearly associated with the American reader.

In summary, *Representative British Orations* is a collection of English speeches designed to illustrate political theory to the layman. Ahead of its time in its interdisciplinary stress, the set has much about it that is appealing, even today.

At the time of publication, the reaction of Adams' contemporaries could best be described as apathetic. Neither popular magazines nor professional journals bothered to review the work. The publishers were so indifferent that in their advertisement of the set, they credited a non-existent editor and appended an inaccurate description of the content matter.[23]

Yet the evidence suggests that the general public reacted differently. Sixteen years after its release, *Representative British Orations* was reprinted in a second, expanded edition.

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[23] *Publisher's Weekly,* July 19, 1884, p. 97. It was more than a year before the advertisement was corrected.

THE BACKGROUND OF THE ADULT EDUCATION MOVEMENT*

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> The fact that throughout almost the whole nineteenth century constant efforts have been made to build up a system of higher education suited to the needs of adult men and women suggests that they are not the outcome of a merely evanescent interest or fashion, but are founded on permanent needs which, when disappointed in one direction, seek satisfaction in another.[1]

Adult education is not a new concept. Since the beginning of recorded history, we have evidence of men who have learned throughout their individual lifetime, and have used numerous informal methods to perpetuate culture. But formal institutional adult education in any large scale is relatively modern. The development of various programs has been marked by diversity due to the changing interests and the variety of needs of adults. Adult education has been identified with the institutional organizations which have been created within society to provide meaningful learning experiences for individuals and groups. These institutions and agencies of education for adults have usually been organized so that persons at the same stage of development or having similar interests may receive instruction efficiently and effectively. In many ways, there is a similarity in the programs of the different countries, since the basic needs of adults are similar in all countries and at specific stages in man's development. In their particulars, however, the adult educational agencies and institutions of each country tend to reflect the distinctive culture of the country in which they have developed. At times, for example, adult programs in various countries have been so dominant that persons have identified adult education with some particular institution, as in the case of the Danish folk high schools.[2]

Progress and growth in education have developed on four basic levels in our society: the elementary, secondary, higher, and adult educational levels. The progress of each has been dependent on and interwoven with the growth of the others. For example, the leaders of adult education in the lyceums in America during the first half of the 19th century were proponents of more adequate elementary education. This paper will deal with the adult educational aspects

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[1] *A Design for Democracy*, "1919 Report" by the Adult Education Committee of the British Ministry of Reconstruction, p. 161.

[2] Cyril O. Houle, *"Adult Education,"* Encyclopedia Brittanica, Vol. I (1957), 184.

only, since the other levels of education have been treated exhaustively in numerous scholarly studies. To examine a few of the highlights of the institutions of adult education in England and America will provide a background for understanding the movement.

English Heritage in Adult Education

Although the growth in educational opportunities progressed slowly through the centuries, during and following the industrial revolution there began to appear in Britain indications that education was a privilege desired by more than the elite. A British historian, Robert Peers, contends that the movement for adult education was part of the revolution which transformed a country of small scale craftsmen and farmers into a great industrial democracy.[3] He further ties this economic trend to the religious awakening of the mid-eighteenth century, and both of these movements to the dissolution of the old social order in England and the drift of population to the towns.

Mechanics' Institutes. Dr. George Birkbeck, founder of the Mechanics' Institute movement, was Professor of Natural Philosophy at Anderson University in Glasgow in 1799. He had become aware of the unsatisfied desire for knowledge of the workers while supervising mechanics in the production of apparatus required for his demonstrations. Birkbeck was so taken with the interest shown by the workmen that he proposed the establishment of a Mechanics' Class. It was an immediate success. In 1804 Birkbeck moved to London, but the work was carried on by his successor, Dr. Ure.

People's Colleges. In 1842, an independent minister, the Rev. R. S. Bayley, criticized the shortcomings of the Mechanics' Institutes in meeting the needs of working men for higher education. Bayley recognized that many workingmen were not ready for higher studies, and that provision needed to be made for more elementary subjects. He succeeded in establishing a People's College in Sheffield to provide general education of a humane character. The number of students at this College rose rapidly until, in 1849–50, there were 630 enrolled. The London Working Men's College was founded by a group of Christian Socialists in England in 1854. This institution was a practical experiment in social reform undertaken by Frederick Denison Maurice and his colleagues.

University Extension. Frederick Maurice intended that the Working Men's College should work closely with the existing institutions such as the universities. It was his hope that the Universities would accept persons coming from the colleges (such as the

[3] Robert Peers, *Adult Education: A Comparative Study* (London: Routledge and Kegan Paul: New York: Humanities Press) pp. 3–30.

Working Men's Colleges), as they would from any other, and that they would grant students their degrees, through examinations, once the work was completed. Maurice felt confident that no fee would stand in the way of working men obtaining the same advantages as their countrymen possessed.[4] Unfortunately, Maurice's hopes for adult students to go from the London College on to Oxford and Cambridge did not come to realization.

There have been two rather distinct approaches to the conception of University Extension as it was carried on in England. One has been that mainly associated with Cambridge, which concerned itself mostly with the promotion of serious, systematic study. The other, which is characterized mostly by the Oxford movement in university extension, has been the idea of the stimulation of intellectual life at numerous levels of adult development. The university extension lectures tended to accomplish the second objective more successfully than they did the first. The later developments of colleges and centers grew out of a desire for opportunities for more continuous and systematic study than was offered in university extension lectures. One of the leading examples of the expression of the Oxford point of view in university extension was the work of Canon Barnett at Toynbee Hall.

Toynbee Hall. Toynbee Hall was founded in 1883, and expressed a new recognition among the universities of their responsibilities to the underprivileged. Canon Barnett brought many men from the Colleges of Oxford to Toynbee Hall, where they worked in the heart of the slums of London in both social settlement house and educational endeavors. Later movements in adult education in England and America took inspiration from the efforts of these idealistic young scholars. The very idea of tutorial classes grew out of the experience of Canon Barnett in his extension lectures at Toynbee Hall.

Adult Education in the United States

The definitive study of the origins of university extension in this country was published by Herbert B. Adams in 1900.[5] In it he pointed out the interrelationship of democratic traditions of education between England and the United States. England, perhaps, received impulses in the direction of democratic education from the American and French revolutions, but, in later stages, the role of leadership was reversed. The growth in educational democracy was

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[4] *A Design for Democracy,* The Adult Education Committee of the British Ministry of Reconstruction commonly called the "1919 Report." New York, Association Press, p. 188. Quoted from the "Original Circular of the Working Men's College," issued in 1854.

[5] Herbert B. Adams, *University Extension in the United States.* (U. S. Government Printing Office, Office of Education, 1900), p. 275.

an outgrowth of the pioneer influence of the English leaders of social enlightenment and was closely tied in with the reform movements in British politics, particularly with the extension of suffrage.

Organized adult education in the United States began in colonial days. It was a fruit of the Protestant revolt of the 16th century and the general awakening of Europe taking place at that time.[6] An early form was the proprietary school which taught vocational subjects and usually met in the evening. Arithmetic and language were staple parts of the curriculum. With the continued influx of early settlers from Europe there developed the need for a culture which would bring cohesiveness to this new land. The founders of the new nation realized that political independence was not sufficient, and that there must be, in addition, an informed electorate. There thus ensued during the early part of the 19th century in the United States a number of loosely organized efforts in adult education, many of them unrelated to each other.

Lyceums. One of the most important of these individual group efforts was the lyceum. Farmers, mechanics, and other groups with some formal education organized small local associations for the purpose of self-improvement. They were concerned not only with their own improved learning, but with the development of a public school system. Josiah Holbrook was a leader in the establishment of lyceums in New England, the first of them being held at Millbury, Massachusetts, in 1826.[7]

The lyceum had as its purpose self-culture, instruction in speech, debate, and discussion of common public interests. These town lyceums grew rapidly, and by 1839 some three thousand existed throughout the country. Through the years they became potent influences in promoting public education, and many participants assumed educational leadership. These groups had among their number some of the leading intellectual figures of the time, including Henry Ward Beecher, Wendell Phillips, Ralph Waldo Emerson, Oliver Wendell Holmes, Bayard Taylor, Horace Greeley, Frederick Douglass, and George William Curtis. The most famous was Abraham Lincoln.[8]

But like so many ventures of adult education, which tend to be episodic,[9] the lyceum waned just before the beginning of the twentieth century. During the period that the lyceums were gaining strength, there were developing other agencies of adult education.

[6] Cubberley, Ellwood P. *Public Education in the United States* Boston: Houghton, Mifflin Co., 1947.

[7] Homer Kempfer, *Adult Education* New York: McGraw-Hill Book Co., 1955, p. 4.

[8] Adams, *op. cit.*, p. 298. Also see *American Journal of Education* XIV, October, 1826, 535; and Carl Bode, *The American Lyceum* (New York: Oxford University Press, 1956), pp. 19–26.

[9] Cyril O. Houle, *op. cit.*, p. 185.

Some of these grew out of the interests of those active in the lyceums—museums, libraries, lecture series, mechanics' institutes, and evening schools with public support. While the lyceums tended to decline, many of the other institutions tended to become permanent. For example, 1833 saw the first tax-supported library in Peterborough, New Hampshire.

The Chautauqua Institution. The lyceums had given Bishop John H. Vincent an example of what could be done in adult education. In 1874 Vincent and his colleagues embarked on an expansion of a Sunday school association and established the Chautauqua Institution. The name "Chautauqua" can be considered both as a place and as an idea. Bishop Vincent chose, as the place, Lake Chautauqua in southern New York. The idea was that annually, during the summer months, thousands of persons should go there to hear lectures and music, and to attend courses of instruction especially developed for Sunday school teachers. Vincent's idea was that all learning was sacred, and that the secular life should be pervaded by the religious spirit. This spirit he meant to achieve through the Chautauqua Institution. His early emphasis was on the training of Sunday school teachers, but he soon added to the usual Biblical study in the curriculum a variety of additional subjects: literature, languages (ancient and modern), history, art, science, music, elocution, and physical culture.

Chautauqua offered one of the earliest correspondence study programs in America. The early program was carried on through the Chautauqua Literary and Scientific Circle (known as C.L.S.C.), founded in 1878.[10] Then, as now, C.L.S.C. provided a number of "reading courses" available by mail. In 1883 a program leading to a diploma through correspondence study was also added to Chautauqua, so that a student could continue his study through the mails.[11] This set a pattern later adopted by university extension when William Rainey Harper founded The University of Chicago in 1892.

The Extension of University Teaching

University extension was another expression of the desire of adults in America for increased enlightenment.[12] History records

[10] Ronald Brandt, "Culture by Correspondence: The Chautauqua Literary and Scientific Circle," Unpublished paper, July ,1960, 11 pp., author's files. (Research based on W. R. Harper's Letters, Harper Library, the University of Chicago).

[11] W. S. Bittner and H. F. Mallory, *University Teaching by Mail* (New York: Macmillan Company, 1933), p. 17.

[12] Mr. M. E. Sadler, Secretary of the Oxford Delegacy, is quoted as saying that "the phrase 'University Extension' seems to have become current in the discussions on University reform during the years immediately preceding 1850." George Henderson, *Report Upon the University Extension Movement in England.* Published by order of the Philadelphia Society for the Extension of University Teaching, 1600 Chestnut St., Philadelphia (n.d., *ca.* 1890), p. 3.

that University extension was first publicly presented in the United States at sessions of the American Library Association at Thousand Islands, New York, in September, 1887. This essentially English system, adapted to local needs in America, was taken up by many public spirited librarians in America in Chicago, St. Louis, and New York.[13]

In January, 1888, Melvil Dewey, chief librarian of Columbia University, laid before the regents of the University of the State of New York a plan for university extension in connection with public libraries. On May 1, 1891, $10,000 was appropriated for the state organization of university extension. The bill stipulated that no part of the grant should be used for lectures, but should be used "for purposes of organization, supervision, and printing.[14]

Following the lead of the University of the State of New York, another major educational extension effort in the United States was undertaken by the American Society for the Extension of University Teaching. This Society was organized in Philadelphia in 1890. Public-minded institutions cooperated with able and well trained lecturers (many invited from England), extending their service to the cause of popular education in America. The American Society was supported by subscription, and a periodical, *The Citizen and the University Extension,* was published to unite and promote the extension movement.

For a decade the Society flourished. The University of the State of New York reported in June, 1899, that the American Society for the Extension of University Teaching gave lecture courses in fourteen places in Philadelphia and in twenty-nine different towns throughout Pennsylvania and in states near by.[15] The activities of this society, however, began to wane after the turn of the century.

Other Extension Ventures

During the period of 1880 to 1900 many efforts were made to transplant to the United States the forms of university extension which had proved successful in England. In 1892 at a national congress held for those interested in the extension movement, it was reported that in the past four years twenty-eight states had organized extension programs. The University of Wisconsin listed a group of extension lecturers as early as 1890–91 and offered them to groups off the resident campus.[16] Morton reports that by the turn of the century, however, university extension ventures had dimin-

[13] J. N. Larned, "An Experiment in University Extension," *Library Journal* (March–April, 1888). p. 75.
[14] Adams, *op. cit.,* p. 303.
[15] *Ibid.,* p. 307.
[16] Copy in author's files.

ished almost to the vanishing point.[17] Some of the reasons listed for the decline in extension efforts during this period were inadequate financing, unavailability of suitable lecturers, inability of university staffs to understand the interests and capacities of adults, and the great increase of university campus enrollments. By the early 1900's the enrollment bulge of undergraduate day students taxed university facilities and the energies of the faculty, and most faculty members were unwilling to lecture off campus.

The University of Wisconsin and University Extension

The University of Wisconsin pioneered in the development of a general educational outreach in this country, and over the years has been a leader in dynamic programs of adult education and public services. With the appointment of Dr. Charles R. Van Hise as its president in 1903, Wisconsin led among public institutions of higher learning in taking the stored-up knowledge of the university to the people beyond the immediate campus. James Creese, in his book *The Extension of University Teaching,* has stated that "in the entire history of university extension, no event had more critical importance than the re-establishment of the Extension Division of the University of Wisconsin by President Charles R. Van Hise and Dean Louis E. Reber in 1906–07. The revival at Wisconsin led to restoration of partly abandoned extension divisions in universities all over the country, at privately endowed institutions as well as at state universities."[18]

Wisconsin has provided education for its adults not only through the University of Wisconsin, but through other institutions. A system of Vocational and Adult Schools was founded through the imaginative leadership of Dr. Charles McCarthy in 1911 and is unique to Wisconsin in its statewide pattern. The Free Library Commission through the vision of Frank A. Hutchins has enriched the enlightenment of adults by more than half a century of services to the people of the state. And the Co-operative Extension Service has carried on a broad program of public service through support by U. S. Department of Agriculture, and the county governments. With the rich heritage and background of adult education in Wisconsin it is hoped that the state will continue to pioneer in creative programs for adults in the decades ahead.

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[17] John R. Morton, *University Extension in the United States,* University of Alabama Press (Birmingham: Birmingham Printing Co., 1953), p. 5.

[18] James Creese, *The Extension of University Teaching,* New York: American Association for Adult Education, 1941. p. 98.

ETRUSCAN AND TUSCAN PARALLELS, A STUDY OF THE ETRUSCAN CIVILIZATION AND OF THE FLORENTINE RENAISSANCE

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PART ONE

The Italian region of Tuscany, once the heart of ancient Etruria, is a land of contrasts. The rocky eastern shores open to the mild winds of the Tyrrhenian sea, recede into a forest of black pine trees tempered by silvery *tamerici* shrubs and red sprays of oleanders. Golden clusters of broom overlooking the sea from barren cliffs are guarded by needled agave-cacti aimed at the sky like naked *daghe*—the deadly short sword the Romans inherited from the Etruscans.

Away from the sea the vegetation changes, but not in color. The black of the pine trees becomes the dark green of the fragrant laurels hiding behind garden walls. The silver of the *tamerici* becomes the shimmer of the olive trees scattered on low, terraced hills among even rows of grapevines. Slender cypresses climb the narrow paths in lonely procession like votive lamps set aglow by the last rays of the sun.

Tuscany is a land of harmony. The brightness of the wild flowers never clashes with the graceful solemnity of the landscape. Perhaps because of this natural propensity to subdue all excesses, Tuscany's history is the history of spring. Like spring it has the feeling for essential values, like spring it has the seed of ideas, like spring it has the creativeness of youth. And this promise of creativeness became a reality during two historical cycles far apart, yet intimately related in their cultural development. The first spanned from the VI century B.C. to the IV century B.C. when Etruscan influence in Italy reached its peak; the second spanned from the XIII century A.D. to the XV century A.D. when Florence, then a prosperous Republic, became the center of the Italian Renaissance.

This presentation deals with the first part of this history: the Etruscan civilization in Italy.

In the first century B.C. Italy experienced two events of great importance. The first event was the rising of dictatorship within the Roman Republic that led to the formation of the Roman Empire, the second event was the hopeless fight of two Etruscan cities, Faesulae (Fiesole in Tuscany) and Perusia (Perugia in Umbria) to regain their freedom from Rome.

In the year 78 B.C. when the Roman leader Lucius Cornelius Silla was dead, Faesulae rebelled against the colonists left by Silla to punish the city for the help it had given his arch-enemy Gaius Marius. The rebellion was unsuccessful, it only worsened conditions for Faesulae. Within thirty-eight years, in 40 B.C. the city of Perusia suffered a much worse fate for aiding Lucius Antonius, the brother of Mark Anthony. Octavianus, the future Caesar Augustus, conquered the city and to commemorate the Ides of March ordered three hundred illustrious citizens put to death.[1]

These instances of rebellion in Faesulae and Perusia, are especially important because they mark the last attempt of any Etruscan city to regain political independence from Rome since the fall of Faleri Veteres (Civita Castellana) in 218 B.C.

During the Roman empire to facilitate administration, the central part of Etruria which included modern Tuscany, northern Latium and parts of Umbria, became known as Region VII. The Emperor Diocletianus (3 century A.D.) reorganized the Region VII into the districts of Tuscia and Umbria[2] with Florence as the most important city.

Except for these geographical informations which reached us through Latin texts, the Etruscans left very few traces of their civilization which became a mystery perhaps as great as the mystery of their provenience. The only documentation the Tusci, as the Latin called them or Tyrseni, as they were known to the Greeks left of their way of life[3] is in the tombs or houses of the dead. where the walls come alive with frescoes depicting their activities and their diversions.

Who were the Etruscans and where did they come from? There are several theories concerning their origin and none can be honestly discarded for a lack of final, negative proof. Nicola Fréret[4] associated the Etruscan word *Rasenna* (probably man or people) to Reti, a section of the Italian Alps still known as Alpi Retiche, forwarding the hypothesis that the Etruscans came from Northern Europe.

Dyonysus of Alicarnassus, historian of the Augustian era, claimed the Etruscans to be autochtonous because their language and customs did not resemble those of any other people in the Italian peninsula.

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[1] Svetonius. Octavianus 15. Applianus. Of Civil Wars, v. 30 & following.

[2] Tuscia et Umbria correspond to the modern regions of Tuscany, with capital Florence, and Umbria, with capital Perugia.

[3] Central Italy became known as Tuscia, Etruria, or Tuscany, from the name of *Tusci* which the Latins used for the Etruscans. Their Greek name *Tyrseni* probably derives from *Tyrsis* or turris meaning tower.

[4] Nicola Fréret was a member of the *Academie D'Iscritions et Belles Lettres de Paris.* (1750).

Most Greek and Latin historians, however, believed the Etruscans came to Italy from Lydia in Asia Minor[5] and Herodotus left a famous legend to describe their arrival. It seems that a famine which lasted eighteen years compelled the King of Lydia, Athis, to send away half of his people led by his son Tyrrenus. After a long journey by sea, Tyrrenus landed on the rocky shores of the Italian peninsula somewhere north of the future Rome, and here he sacrificed a native white pig to Tinia, Uni and Menrva, the three most important Etruscan Gods that the Romans were to adopt with the names of Jupiter, Juno and Minerva.

The Etruscans who were careful with numbers as they considered them an important part of their religious ceremonial, traced their historical beginnings to the XI century B.C., approximately between the years 1045 and 1025 B.C.[6]

It is not until the VII century B.C. however, that we can speak of Etruria proper. The Etruscan civilization was in fact a by product of the peaceful integration of the local Umbrian-Sabellic populations with the followers of Tyrrenus. This process can be traced to the Villanovan cinerary urns[7] where the transition from a cup or *patera* covering the urn to a typical Etruscan helmet or to the clay model of the head of the deceased gives us the important data of this process of acculturation.

Thus the most complete political and artistic development of the Etruscan Dodecapolis or government of the twelve cities can be placed between the VI century B.C. when the Etruscans fully imposed their cultural supremacy in Italy, and the IV century B.C. when the rising power of Rome brought a slow death to the Dodecapolis.[8]

The Etruscan cities were at first governed by some form of a primitive monarchy. The leading citizens of Etruria bore the name of *Lucumones,* but identification between the word *Lucumo* and king is becoming increasingly obsolete.

Between the VI century B.C. and the V century B.C. the Etruscan cities became republics united by a common religious bond.[9]

It seems that the constant preoccupation of these republics was to decrease the power of the individual citizen in order to avoid

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[5] Among the Latin writers we can list Virgil, *Aeneid,* Book 2, v 781; Book VIII, v 479; Book IX v 11. Also Horatius, Ovidius, Cicero, Seneca, Plinius, Tacitus. The related story above is found in Herodotus I. 94.

[6] Varro gives us this information in his *Tuscae Historiae.*

[7] From Villanova a village near modern Bologna in Emilia.

[8] The cities of the Dodecapolis at the time of Roman conquest were: Caere (Cerveteri), Tarquinii (Tarquinia), Vulci, Rusellae (Roselle), Vetulonia, Populonia, Volsinii (Bolsena), Clusium (Chiusi), Arretium (Arezzo), Perusia (Perugia), Volaterrae (Volterra), Faesulae (Fiesole), Cortona. Veii had already been destroyed by the Romans. All the twelve cities of the original dodecapolis were located in central Italy.

[9] The twelve people of Etruria gathered every year at the sanctuary of the Fanum Voltumnae for religious celebrations.

tyranny. This steady mistrust that bordered on anarchy, generated such a hatred for all types of absolute power that when the city of Veii, which had reverted to a monarchy, was sieged by the Romans (396–386, B.C.) no sister city moved to its aid and Veii was completely destroyed.

This rebellion against authority, this exceeding *gusto* for self expression and individualism, is evident in Etruscan artistic manifestations of the golden period which spanned from about the VI century B.C. to the IV century B.C. Though greatly influenced by Greek art, Etruscan art at its best has a unique realism and psychological insight, especially evident in funerary statuary and animal sculpture.[10]

In order to understand Etruscan realism in art is necessary to penetrate the profound implications of religion among the *Rasenna.* The Etruscans believed in a complete, fatalistic submission to the will of the Gods. This need for identification between their daily lives and a preconceived destiny, increased the importance of every action they performed during their stay on earth. The soul went to the underworld equipped with a scroll where its good deeds were registered for the final judgment. The deceased was escorted by a winged creature, a *Lasa*[11] who was to guarantee a safe journey.

Because the after life was intended as a mere continuation of life on earth, nothing could be more appealing to the Etruscans than the blue skies of their native Tuscia where through pirate ships and through great commercial skill they had created a veritable paradise on earth. While the Greeks translated religion into art, the Etruscans translated art into religion, religion into life, life into eternity.

This can be clearly seen in the Tomb of Hunting and Fishing in Tarquinii (VI century B.C.). Here the walls become alive with agile dolphins leaping out of the Tyrrhenian sea, with birds cutting the skies like winged arrows, with brown naked men diving in the green waters.

Above them, in a different panel, husband and wife banquet on the kline, a reclining bed, attended by servants. The woman holds the affectionate hand over the chest of the spouse as if to affirm the very important place she holds in his heart. And indeed the Etruscan woman held a unique place in all the ancient world. She was allowed to take part in every type of amusement the men enjoyed.

The freedom allowed by Etruscan men to their women was often misinterpreted. The historian Ateneus (XII, pp. 517–518) writes

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[10] Outstanding are the works of Vulca—the greatest of Etruscan sculptors. Especially notable are his Apollus and Mercury, both from Veii. Other important pieces of Etruscan statuary are Aule Meteli and the Capitoline Brutus. In animal sculpture the Chimaera from Arezzo and the Lupa Capitolina are wonderfully realistic.

[11] Lately scholars tend to identify the *Lasa* with the *Lares* of the Romans.

that Etruscan women "Lie on the kline not only with their husbands but also with strangers and have relations with anyone willing to do so." While Plautus, the Latin playwright in the *Cistellaria* (II, 3 v 20 etc.) calls prostitution, "The Etruscan way to acquire a dowry."

These misconceptions of Etruscan customs may be ascribed to the fact that both writers lived at a time when Rome was extremely proud of its Latin ancestry and regarded the early Etruscan influences on its civilization as a blemish on its past.

Life in Etruria as the murals in the tombs point out was largely given to entertainment.[12] Most games we know through the Romans were of Etruscan extraction. Thus the games of the Gladiators were first played in Etruria and from there they spread to the South, to Campania, where the Romans learned them. The *subulones* or pipe players, so popular in Rome, were Etruscan, and so were most of the pantomime performers and the clowns. Acrobats and trick riders were also Etruscan and polo was one of their favorite games.

The Etruscans were masters in playing the double flute called *tibia* and legend wanted Athena to have invented the horn for their very special use. Ateneus tells us (XII, p. 518 b) "The Etruscans do every thing at the sound of music, they make *pasta* (noodles), they have fist fights, they whip people while listening to the flute."

Their homes were perhaps the most comfortable of ancient times. From the tombs we know the way these homes were built again because of the Etruscan tendency to see in the after life a continuation of the present. The houses were divided into three rooms of which the largest was the nuptial chamber to symbolize the importance of the wedded pair, therefore of the family unit.

The rooms were furnished with throne-like chairs, *bucchero*[13] vases, bronze containers, candelabra, incense holders, kitchen knives, grills, colanders, even knapsacks. Toilette articles consisted of mirrors, safety pins which they called *fibulae,* scissors, depilators, short ivory sticks, and different types of brushes.

The jewelry was exquisite and abundantly used by the women who loved to wear heavy make up on their expressive faces crowned by the blonde hair and a pointed cap called *tutulus*.[14] The make up was not limited to women. The *Lucumones* walked the streets of Rome wrapped in their *tebennos,* the future Roman *toga,* their faces painted in red to assert their proud masculinity.

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[12] This can be seen in most murals of the VI, V century B.C. notably in the Tomb of the Augurs, Tomb of the Lioness, Tomb of the Baron, Tomb of the Triclinii, all in Tarquinii. Also in the Tomb of the Monkey in Chiusi.

[13] *Bucchero* is a native black clay.

[14] On their feet they wore the *calcei repandi,* a pointed shoe of Ionic-Oriental origin.

The Etruscans controlled rain water by an opening on top of the house or *cumpluvium* which allowed the water to gather in a small pool at the center of the atrium. They also used a reclined roof that forced the water to slide on the sides of the house. This type of water drainage was called *displuvium* and is the kind still used today on the roof of modern homes.

The Etruscans were engineers of great skill[15] being able to restore the swamp lands of Tuscany and Latium to cultivation and make them produce great quantities of wheat, lineum, olives, wood, and delicious grapes. The arch which they masterfully used in building bridges, aqueducts and city walls was an Etruscan architectural innovation of probable Oriental origin.

They worked metals, especially iron, with such intensity that the iron scraps they left on the shores of Polpulonia, across from the island of Elba, are still used today.

They were so skilled in medicine that a legend wanted the sons of the enchantress Circes[16] to have found shelter in Etruria where they brought their medical craft. Chirurgical instruments such as bistoury, forceps, tweezers, have been found in different tombs to attest to their widespread use. Dentistry was highly developed in Etruscan times and gold teeth were not a rarity. We know this from a Roman law that forbade bodies to be buried with gold to discourage thieves. An exception was made for the gold in dental work, and the deceased could be buried *auro dentes juncti* or "with the gold that keeps the teeth together" inside the mouth.

The typical Etruscan infernal deity, Charu (Charon) was represented holding a hammer. The meaning was quick death—the mercy killing often inflicted by the Etruscans on their elders when gravely ill.

Charu and his hammer became predominant in Etruscan painting toward the end of the IV century B.C. During the years of Etruscan decadence, the after life became a nightmare of demons and horrible creatures as symbolized by the Lasa Tuchulcha—a winged monster with a beak-like nose and snakes winding around its hair and on its left arm.

The rising danger of the Romans in the south aggravated by the savage excursions of the Gauls in the north impoverished the Etruscans and drained their creative capabilities. Perhaps because of the stress they placed on the resemblance of their after life to everyday reality, they saw no reason for survival in a world ravaged by wars and in a home destroyed by tragedy and mourning. This re-

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[15] The *Cloaca Massima* in Rome was built by the Etruscans under the Etruscan king Tarquinius Priscus.

[16] See the *Odyssey* by Homer. Chapter 10. (Valgimigli Italian Translation).

fusal to survive, may be one of the reasons why their language is nearly completely unknown and seems destined to remain a secret forever.

According to the Romans the Etruscans left no noteworthy literary inheritance. Their only books[17] were concerned with rituals and the way to carry them out properly. Possible interpretation of longer funerary inscriptions however, leads us to believe that the Etruscans had some form of *elogia* or dramatic poetry written to honor important deceased.

Whatever the case, the Etruscan language fell into complete disuse during the Roman Empire and the Etruscan civilization withdrew itself in the hidden tombs of the *Lucomones* in a world that in the darkness of the underground seemed to cry for a new chance to live under the limpid skies of beautiful Tuscany.

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[17] Notably the *Libri Haruspicini, Libri Fulgurales, Libri Rituales.*

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