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PRESIDENTIAL ADDRESS

KNOWLEDGE AND THE LAW OF DIMINISHING RETURNS*

JOEL CARL WELTY
President, Wisconsin Academy of Sciences, Arts, and Letters, May 6, 1961 to May 5, 1962

About half a century ago, my youngest brother was given a birthday present of seventeen cents to do with as he pleased. In those days that was, for a child, a princely sum. My brother liked licorice candy, so he invested his complete fortune in licorice sticks, licorice straps, whips, and jawbreakers, with the predictable result that to this day he cannot abide the taste of licorice. Early in life he learned about the law of diminishing returns.

It is an interesting fact that in many affairs changes in quantity often bring about changes in quality or in essential nature. When a solid cone is intersected with a plane, the resulting figure may describe an ellipse. If the tilt of the plane is increased in one direction, the ellipse gradually shortens until it suddenly becomes a circle: a geometric figure with quite different mathematical properties. Increased in the opposite direction, the ellipse eventually turns into a parabola: again, a very different figure from an ellipse. Even in the esthetic enjoyment of simple pleasures, this same principle may be demonstrated. The Japanese have a poem which underscores this idea:

> The moon is at its loveliest tonight.
> I thank the clouds that o'er it flit
> And let me rest my neck a bit.

Consider, for example, the sizes and shapes of mammals. Elephants and mice are both warm-blooded animals, and one might think that a mouse is, so to speak, an elephant cut into 200,000 pieces, or an elephant, 200,000 mice huddled together. But their metabolism is geared to the amount of body surface each animal possesses, and proportionately the mouse has much more surface through which it loses body heat. You could never make an elephant-size animal out of a mouse simply by enlarging the mouse. Whereas an elephant burns oxygen at the rate of 67 cubic millimeters per gram of body weight per hour, a mouse burns 1,580 cubic millimeters per gram, or 24 times as much. If the tissues of the elephant metabolized as rapidly as those of the mouse, the elephant would literally cook itself to death in minutes. This all hinges

* Address of the retiring president, delivered at the 92nd annual meeting of the Academy, May 5, 1962.

on a simple geometric law: as one doubles the linear dimension of an object, its surface increases 4 times, but its mass, 8 times. As an animal increases in size, its metabolic needs change strikingly.

Body architecture is also subject to the laws of geometry. The strength of a supporting column such as the thigh-bone of a leg depends on its cross-section area. Since area does not increase as rapidly as mass as an animal grows larger, a big animal such as an elephant must have proportionately stronger, stockier legs than an antelope. Merely enlarging an antelope to the size of an elephant would not equip the animal with strong enough legs to hold the heavy body. A whale has so great a mass that there would not be space enough under the body to accommodate four legs large enough and strong enough to support it.

One more biological example. Turkey growers are interested in raising as much tender meat, on as little food, in as short a time as they can. Breeds of Turkeys that cooperate with these goals have been developed, among them the Broad-breasted Bronze Turkey. But here again the law of diminishing returns has caught up with "progress." Apparently, rapid, efficient meat production requires high blood pressure. As a result, these birds have developed blood pressures of 300 to 400 millimeters of mercury—high enough to rupture their aortas in epidemic proportions. Incidentally, Turkey growers have, for the time being, successfully countered this operation of the law of diminishing returns by lowering the birds' blood pressures through the use of tranquilizers! However, this example reveals that there may be dangers in the pursuit of a single objective to the neglect of a healthy, balanced concern for the good of the whole organism.

How does this law of diminishing returns apply to mankind? There is nothing on earth lovelier than a small, healthy, happy child, brimming with promise for the future, unless, perhaps, it is a pair of twins. Doubts begin to arise, however, when one has six or eight children, especially when several of them are of an age when one has to provide them with a college education. Doubt turns to alarm when the numbers of humans increase to the population densities found in Java, India, British Guiana, and many other countries.

Most people are familiar with the fact that all organisms, man included, can produce more offspring than are required to perpetuate the race. When living conditions are favorable and the death rate drops, population climbs. This is what modern medicine has done for British Guiana, where the population has doubled in the past seven years (1). Few people are aware of the fact, however, that population growth is by a form of geometric increase, or compound interest, which accelerates astonishingly in its later stages.

Demographers of the United Nations estimate that today the population of the world is increasing at the rate of two per cent per year, and that the rate is still rising (2). Two per cent is not an awesome figure, but given a little time to work it can produce fantastic results. Professor Hauser of the University of Chicago points out that an initial population of only 100 persons, multiplying at the rate of not two per cent, but only one per cent per year, and not over the full million year span of man's life on earth, but merely for the last 5000 years of recorded history, would by today have produced a population of one and one-half billion persons per square foot of land surface of the earth (3)!

Obviously such an increase has not occurred, and some of you may be inclined to shrug off any concern over such pure theory. What are the facts? Well, they are sobering enough. According to estimates from the United Nations, the world had a population of roughly one-quarter of a billion persons at the beginning of the Christian era. 1620 years later, when the Pilgrims landed at Plymouth Rock, that number had doubled to make one-half billion. About two centuries later, at the time of the Civil War, another half billion was added to make a total of one billion persons in the world. Since then, half-billion increases in population have occurred in successively shorter intervals of time. The sixth half billion, just added, required only eleven years. At the present rate of population growth, the next half billion will come in only six or seven years (4). Assuming a rate of population growth of two per cent, "In 150 years the number of people in the United States would approach the number currently inhabiting the whole world" (5). In 1915 Java's population was estimated to be five million persons; by 1957 it had reached 52 million.

It requires very little imagination to understand how the law of diminishing returns applies to human population increase. Our lovely little child already shows signs of becoming a hideous monster. Inevitably, there will be less food, housing, irreplaceable raw materials, and sheer space for living, as the population of the world snowballs toward self destruction. Back in the 1920's, if one wished to make a trip to Chicago to go shopping, he drove into the Loop, parked on State Street ouside of Marshall Field's, spent a leisurely hour shopping, came out, hopped in the car and drove home. Today the situation is somewhat different. One can't even park his car beside the interstate highway to admire the view or to get out and pick a daisy. In most parts of the world, the population has now reached a threshold where every increase brings some loss in human freedom, human rights, human dignity. Man must very soon choose between high mortality or low fertility. Either man's freedom to have as many children as he wants must be curtailed, or else the quality of human living will inevitably deteriorate.

Research studies by the New York City Youth Board (6) have shown that less than one per cent of the city's families produce 75 per cent of its juvenile delinquents. When there are already too many people in the world, how much longer can society afford the democratic luxury of unlimited freedom of procreation by all men? I realize that this is not a simple problem. But I am willing to hazard the prediction that if our population continues to grow at its present rate, or faster, for another century, democracy as we now know it will cease to exist.

There are other, less obvious, aspects of dense populations, through which the law of diminishing returns operates. Some years ago, Arthur Morgan of Antioch College made the observation that big communities offered evil men a greater opportunity to practice their skills as shysters, quacks, grafters, and gangsters than did small communities, because of the anonymity possible in large crowds. Pretending to be what one is not has survival value among strangers. In a small community, bluff and cheating are soon discovered, and countered if not corrected. It is in the populous cities that one finds also the anxiety-ridden man, rubbing elbows daily with thousands of strangers, in the "lonely crowd." Quite obviously, bigger communities are not necessarily better communities.

A subtler complication of population increase is already causing people to search their consciences. One of the basic tenets of Judeo-Christian ethics declares the worth and dignity of every man, regardless of his race, religion, economic station, or politics. We find this ethic hard enough to apply in low density populations like our own. Must it be sacrificed entirely when the day comes when the world is jammed with human beings barely able to find standing room?

To make the problem more concrete, shall we, the next time there is a famine in India, send surplus food and doctors to keep men alive, only to create a more acute famine the next time? To say that we should also send agricultural and economic experts to increase the production of food and goods only begs the question. In the race between the production of food and the reproduction of humans, unless some restraining factor is introduced, reproduction is guaranteed to win.

So far we have merely been setting the stage for our main concern. Our chief question is this: Does the law of diminishing returns apply to knowledge? This is an intriguing question, and worth some scrutiny. The Wisconsin Academy of Sciences, Arts, and Letters is firmly dedicated to the increase and diffusion of knowledge. This principle is one of the unchallenged absolutes of Western Civilization. It is one of the basic articles of faith of numberless universities, colleges, seminaries, and commencement speakers. "Fiat Lux." "Lux et Veritas." "Ye shall know the truth, and the truth shall make you free." "A little knowledge is a dangerous thing," said Alexander Pope. "Drink deep, or taste not the Pierian spring." Can one drink too much learning—to a point of intellectual inebriation? Is it conceivable that too *much* learning is a dangerous thing? Even to suggest that the unlimited increase of knowledge might be undesirable or unprofitable comes close to committing intellectual treason. However, if there ever was a time ripe for examining this question, it is now, for the production and accumulation of knowledge has accelerated phenomenally in recent decades.

We are all amply aware that the increase of knowledge has enriched man's life by giving him more power over his environment, and by making his life easier, safer, and more interesting. Technological science has made it possible for man to circle the globe, not only in 80 days but in 80 minutes, and it promises soon to broaden his horizons to include other planets. Agricultural knowledge enables us now to grow two blades of grass where one grew before. In 1900, man's life expectancy was 47 years; today, it is over 70 years. But there is no need to elaborate the virtues of growing knowledge before this assembly. We live in a remarkable age of intellectual, emotional, and material riches never before attained by the common man.

Can it be possible that knowledge, like human population, is in danger of snowballing into destruction? Is our store of knowledge a chest of jewels which may be transformed as it overflows into a Pandora's box of horrid problems? Already some problems have appeared, and others seem to be in prospect.

The massive quantity of modern knowledge has already created problems of storage and retrieval. Several recent writers have estimated that scientific knowledge is now doubling every 10 or 15 years—a rate of increase more than twice that of the world's population. The rate at which biological information has been increasing is revealed, for example, by the growth of the technical journal *Biological Abstracts*. Volume 1 of this periodical, published in 1926–27, had 976 pages and contained 10,900 abstracts. Volume 36 for 1961 contained 8,436 pages and 87,000 abstracts. Incidentally, the price of a single subscription to this journal is $170 a year! This single "volume" now requires about 16 inches of shelf space. Since first published, this journal has roughly doubled in size every 10 years. If this rate continues for only 100 years, by then each single annual volume will require 1400 feet of shelf space. And this is only one of several abstracting journals, not to mention the thousands of other journals from which the abstracts are made. The mere housekeeping problem of accommodating these books will be a librarian's nightmare. Certainly, before this unhappy day arrives, the law of diminishing returns will begin to operate.

Are we in danger of accumulating so much knowledge that, like the massive whale, grown too large for legs, our store of information will wallow uselessly on miles of library shelving, unable to be moved for man's good simply because of its enormous bulk? Like the Turkey growers, have we concentrated too much on one limited objective—the accumulation of knowledge—without winnowing it for its wholesome use to man?

At this point, someone might point out that 25 or 50 years from now, books will be discarded in favor of microfilm, microcards, information tape, or some other form of condensation. This will of course help the storage problem, but I doubt that books will become entirely passé. They are too thoroughly established in our daily habits and affections. Not only is microfilm hard on the eyes, but it does not lend itself to casual summer reading while one is comfortably stretched out in a hammock.

The sheer bulk of recorded knowledge not only creates a storage problem, but a serious problem of retrieval. In all the tremendous mass of literature, how does one find what he wants? Gerard Piel (7) tells of a paper on Boolean Algebra published by Lunts in 1950 in the *Journal of the Academy of Science* of the U.S.S.R. It concerned the design of computer circuits. Between 1950 and 1955, American computer scientists spent five fruitless years and an estimated $200,000 seeking the information they could have had free had they only read this one Russian paper!

In other words, scientific communications no longer communicate. Today, American scientific and technical writing costs $10 billion per year and employs 90,000 persons in full-time writing, editing, and publishing. It is estimated that by 1970 the number will grow to 160,000 persons. Each day in this country "enough technical papers are written to fill an encyclopedia seven times as large as the 24-volume *Britannica.*" (17) It is any wonder that much of this knowledge lies sterile and unproductive? The annual production of military weapons manuals alone costs us $2.8 billions.

While it is true that electronic machines may be effectively used to retrieve and collate wanted information from a massive store, such machines used as "brains" for the creation of new ideas out of the raw material of stored knowledge are analogous to the player piano as an instrument for playing great music. Both lack the authentic touch of individual human creativity.

Probably the most serious defect inherent in the massive proliferation of modern knowledge is its fragmentation. Specialization is the price man pays for intellectual progress. Not only has specialization proceeded so far that there has arisen a "conflict of cultures" between scientists and humanists, eloquently described by C. P. Snow (8), but scientists are becoming isolated from other scientists, and humanists from other humanists, as each burrows deep into his own specialty. A man spends so much time trying to master his little, isolated fragment of the knowable, that he is forced to neglect great expanses of knowledge from sheer lack of time. Experts make matters worse, often quite unnecessarily, by speaking a technical jargon incomprehensible to anyone not in their particular field. Recently there occurred in a Kansas City hotel three separate scientific meetings of nuclear physicists. When asked why the three groups did not join together in one meeting, one of the participants replied that they could not because they did not speak the same technical language. As a result of this confusion of tongues, a man is driven to depend on the judgment and opinions of "authorities" in almost every field but his own. Thus, the vast expanses of modern knowledge provide splendid opportunities for ignoramuses and intellectual quacks to ply their trades; they create opportunities for pretense and bluff worthy of Phineas T. Barnum. Here is a single sentence from an "authoritative" art criticism which appeared in *Art News* not long ago (9). I defy anyone to make sense out of it.

> "He [the artist] pictures the stultified intricacy of tension at the plasmic level; his prototypical zygotes and somnolent somatomes inhabit a primordial lagoon where impulse is an omnidirectional drift and isolation is the consequence of an inexplicable exogamy."

This of course is pure intellectual quackery; it could not be so common if technical jargon were frowned on rather than cultivated. But even when authorities are conscientious and honest, they are likely to suffer the defects of intellectual myopia and isolation, and, at times, dogmatism. Although modern man is driven to depend on authorities for much of his information, he must constantly recall that authoritarianism has many times in human history poisoned and stunted the growth of man's mind. He must always keep alive his right to doubt, to question, and to challenge "authority."

In nature, the extreme specialization that one occasionally finds in animals is commonly the result and not the cause of isolation. Animals isolated on oceanic islands often become so specialized that when their environment changes, or when competing forms are introduced, they become extinct. The isolated species lack the interflow of hereditary characters that keeps the mainland species tough and resilient. I think it is a fair analogy to say that intensified isolation in the intellectual realm carries comparable hazards.

Coupled with the sheer bulk of our rapidly growing fund of information is an attribute that presents another embarrassment of riches. That is the velocity both of the appearance of new knowledge and of its application to human use. Scientific technology has done more to change the modern world (for both good and evil) than any other intellectual force. And the speed with which scientific discoveries are put into use has itself been accelerating. According to Piel (7) it took about 100 years "for the steam engine to make its arrival felt in economic and social history, and 50 years for electricity to make its impact." The present interval between basic scientific discoveries and their application in technology he estimates to be about 10 years, with even shorter intervals in the fields of communications, electronics, aircraft, and chemistry. The Du Pont Corporation estimates, for example, that one-half of its sales, and three-fourths of its profits come from products that were still in the laboratory ten years ago.

You may object that rapid change is in itself not a bad thing, even though it may be uncomfortable to persons over 40 or 50 years of age. I think that it is here that a disquieting lack of concord begins to appear between the bulk, complexity, and velocity of change of modern knowledge, and the innate nervous and mental equipment that man uses in handling that knowledge. We are living in a world of increasingly great complexity and of incredibly rapid change. While it is true that the greater one's store of information, the greater his freedom of choice, Warren Weaver (7) points out that the greater one's choice the greater his uncertainty, and the greater his uncertainty, the greater his mental instability. Do we have too many choices to make today? Must we make them too hurriedly for our mental equilibrium?

Man's mind evolved in a relatively simple environment that posed relatively simple problems. These generally had simple either-or solutions: eat or go hungry; attack or flee; work or rest; go out and get cold, or stay in a smelly cave and be warm; and so on. Problems for primitive man were generally black or white, and not the many confusing shades of gray that so many of them are for modern man. Although primitive man had to make simple choices between clear-cut alternatives, they were often life and death choices vital to his survival. The primary urgency of scrabbling a living from a reluctant environment not only left for Neanderthal Man no leisure time for such culturally stimulating things as composing chamber music or attending an intertribal disarmament conference, but they riveted in his mind two lamentably durable attributes: a tendency to seek simple solutions to problems, and an egocentric, all-consuming preoccupation with security and with material acquisition.

Is modern man really heir to these stone-age mental attributes? Has evolution changed us much? Are our minds out of tune with the intellectual conditions of modern existence? Let us consider one of Neanderthal Man's chief problems: food. Physiologically, modern man is still chained to the prehistoric past. His digestive machinery still requires about the same calories, minerals, vitamins, and roughage as did that of the Neanderthalers. Our cave man forebear had a palate which told him to eat while the eating was good, because tomorrow the hunting might be poor. Apparently, we still have the cave man's palate, but as far as *American* eating goes, the hunting is never poor. The result? Overeating, overweight, cholesterol, coronaries, exit. This, of course, helps a little to solve the over-population problem, but in a rather unintelligent way.

Do we still carry vestiges of a paleolithic acquisitive instinct? Some of you are familiar with that intriguing book by Charles Mackay, *Memoirs of Extraordinary Popular Delusions and the Madness of Crowds* (10). This book, written in England 120 years ago, tells in fascinating detail some of the popular follies of our gullible ancestors: the Mississippi Bubble; the South-Sea Bubble; the Alchymists; Fortune telling; the Crusades; Witch Hunting; Relics of the True Cross; and others. Many of the mass delusions portrayed by Mackay gained their chief impetus from human avarice, or our cave man's acquisitive instinct. For example, during the tulip mania in Holland in the 15th century, this appetite for selfish gain rose to such heights of folly—before the boom collapsed—that a single tulip bulb sold for as much as 5500 Florins. To make this fantastic price more intelligible to modern ears, Mackay tells of a somewhat less valuable tulip bulb, a variety called the Viceroy, worth only 2500 Florins, which was paid for in goods rather than in currency. Here is the amount paid for one bulb:

170 bushels of wheat	1008 gallons of beer
340 bushels of rye	504 gallons of butter
4 fat oxen	1000 pounds of cheese
8 fat swine	A complete bed
12 fat sheep	A suit of clothes
105 gallons of wine	A silver drinking cup

All of this, mind you, was paid for only *one* fragile, perishable tulip bulb.

Surely, you will say, we sophisticated moderns do not behave in any such gullible fashion. We may have our weaknesses, but we are surely not *that* stupid. Perhaps not, but it makes an interesting exercise to observe, if we can, any lingering vestiges of paleolithic man's single-minded concern with himself. Are there any latter-day popular delusions? What of the wild speculation on the stock market, or in Florida real estate, in the late 20's? Or the Gadarene stampede of the Italian people into fascism, or of the German people into Nazism? Do we consistently use reason to guide our conduct? Do we make sensible use of accumulated knowledge?

We Americans are very health conscious. A man may regulate his diet, take regular exercise, eat vitamin pills, brush his teeth, and make sure that his children are inoculated with Salk vaccine. Then, all too often, he may visit a tavern for a quick drink, hop into his car, and speed 70 miles per hour down a crowded two-lane highway while smoking a carcinogenic cigarette. To me, this provides one of the most striking illustrations of a popular delusion available on the modern scene. It is second only to war itself as a present day example of the madness of crowds.

In the past 20 years there have been at least 18 independent studies in five different countries carried out on hundreds of thousands of persons by medical research organizations of unimpeachable qualifications—all to determine the statistical association between smoking and lung cancer (11). The scientific evidence obtained from these studies establishes beyond the slightest doubt the fact that cirgarette smoking causes lung cancer. Whereas among non-smokers, one man in 275 will probably die of lung cancer, among heavy smokers the statistical chances of death from lung cancer are one in ten. The British Ministry of Health, alarmed by such statistics, has displayed over 400,000 posters in an educational anti-smoking campaign. One of these posters states: "Danger! Heavy cigarette smokers are thirty times more likely to die of lung cancer than non-smokers. You have been warned." (19). Add to the hazard of lung cancer the fact that cigarette smokers are twice as likely as non-smokers to die from coronary heart failure, and it becomes clearly evident that cigarettes are causing the needless deaths of well over 100,000 Americans every year (18). This means that every day the lives of more than 250 U. S. citizens are prematurely snuffed out because they smoke cigarettes. Can you not imagine the public outcry for immediate remedy should 250 persons be killed every day in airplane disasters? And yet, last year Americans spent $6.9 billion to buy and consume 528 billion cigarettes (19). Is this not a striking example of collective stupidity? When confronted by such statistics, many smokers will remark, "It can't be as bad as all that, or nobody would be smoking. Fifty million smokers can't be wrong." Exactly the same logic was advanced to justify the speculative mania of the South Sea Bubble and the tulip-buying mania of the Dutch.

Quite aside from the damning fact that in the United States our smoothly purring automobiles injure one and one-half million persons each year, and kill outright 38,000 (and in Italy the death rate is, percentagewise, six times as great), they have become egocentric symbols of conspicuous power and wealth, just as were tulips in Holland 400 years ago. The typical American breezes down a costly super-highway in a chromium chariot pulled by 200 horses. The staggering cost of such transportation was recently brought home to me by an advertisement for the Santa Fe Railroad in *Time Magazine* (12). With a typical four-unit diesel locomotive of 8,000 horsepower, a modern freight train will carry on an average trip, 1,250 pounds of freight for each engine horsepower. On an average trip, my two-year-old Ford will carry less than one pound of freight for each engine horsepower. Whereas my car on a typical trip will carry a 150 pound man 15 miles on a gallon of fuel, a freight locomotive will carry that same man 2,666 miles, and on a gallon of cheaper fuel. The sad part about this is that the difference in the standard of living provided by an automobile of 200 horsepower compared with one of 199 horsepower is barely, if at all, detectable. But if we could give up only one of these horse-power to furnish a poor Indian or African peasant with a one-horsepower garden tractor or irrigation pump, it could easily double his meager standard of living. The law of diminishing returns began to operate in automobiles even before the advent of the Model T, but instead of causing a self-correcting feed-back reaction, as in the case of eating too much licorice, it inaugurated a regime of unparalleled conspicuous consumption and waste. Were our grandparents so much more short-sighted and wicked when they killed a buffalo merely to remove, cook, and eat its tongue? We citizens of the United States account for only 7 per cent of the world's population; yet we consume nearly 50 per cent of the material wealth that the world consumes (13). While we are worrying about obesity an dcholesterol, at least one third of all the world's people go to bed hungry every night. Do not these facts reflect a vestigial Neanderthal mentality rather than that of a modern, intelligent citizen of the world?

By this time some of you are realizing that I have departed somewhat from my announced topic. What have popular delusions and the madness of crowds to do with the increase of knowledge? Where does the population explosion fit into the law of diminishing returns as it applies to the increase of knowledge? Simply in this way. If we use man as the measure of all things, as we universally do, the increase in knowledge has no point whatever unless it ministers to human needs; unless it is put to some use by man. The real difficulty is that knowledge may be put to good use or to bad use; and uses which initially may be very good, if applied to too many people or on too wide a scale, may become harmful.

Medical knowledge has conferred priceless boons on mankind in relieving pain, promoting health, and prolonging lives. At the same time, it is creating at least three very serious problems. First, it is intensifying the problem of too many people. It is because modern medical knowledge, in only two years, has made possible a reduction in infant mortality from 350 per thousand of population to 67 per thousand, that the population of British Guiana is now doubling every seven years. In Ceylon in 1946, the malaria mosquito was practically eliminated through the use of DDT. As a result, in two years that island's death rate dropped from 20 per thousand to 13 per thousand. But the birth rate remained constant, with the consequence that hunger and starvation increased in severity (1).

Secondly, by keeping alive both the strong and the weak, modern medicine has effectively rescinded many of the rigorous laws of natural selection that operated in the days of *Pithecanthropus* to keep the hereditary quality of mankind tough and self reliant. As a result, today the genetic quality of human protoplasm is gradually deteriorating. Imagine the predicament of modern man should nuclear war destroy civilized communities to such an extent that all of the modern medical crutches which now support defective humans were no longer available: glasses, hearing aids, false teeth, wheel chairs, insulin, vitamins, antibiotics, anesthetics, antiseptic surgery. How many of us in this room would survive if we had to go back and compete with Neanderthal man under such conditions?

Even worse is the deliberate misuse of medical knowledge. I do not refer to medical quackery, but to the icily efficient scientists in this country, Russia, and elsewhere who are dedicating their skills to the systematic, organized murder of their fellow men through fiendish inventions for biological warfare. It is not the knowledge itself that is necessarily good or bad, but the use to which man puts it. Knowledge is power, and too often the power it brings is perverted to evil ends. Even when man does not deliberately pervert that power, sometimes he lacks the wisdom to use it properly, like the teen-ager who does not have sufficient respect for the enormous power of a modern automobile.

What is man to do? Build a cabin on Walden Pond? The chances are that the bulldozers have already been there to level off the land for a suburban shopping center. No, none of us cares to go back to the days of Neanderthal Man, or even of Thoreau, and give up antiseptic surgery, blood banks, old age security, libraries, theatres, colleges, or institutions such as the Wisconsin Academy of Sciences, Arts, and Letters.

The human mind still has enormous, unfathomed potentialities for education—for adapting to those problems posed by the quantity, complexity, and rapid change of modern knowledge. Already, in widely scattered parts of the globe, intelligent steps are being inaugurated to diminish the threat of overpopulation. I think, however, that the urgency of the times calls for a change in emphasis in our intellectual pursuits. Our chief problems, I believe, stem from the fact that knowledge, especially scientific knowledge, has grown faster than man's wisdom in its use. The growth of pure knowledge has outdistanced man's ability and willingness to retrieve, digest, coordinate, and apply its truths for the benefit of all mankind. Things are getting out of hand when a biologist, for example, hasn't the time to read all that he should in his own field, let alone the swirling, printed floods of new information in physics, astronomy, archaeology, political science, art, and economics.

I am not suggesting that our great universities close their doors and cease their search for the truth. But I *do* think that a good case can be made for spending less effort and less money in certain fields of intellectual interest.

Since World War II a great change has come over our universities and colleges, especially in the field of scientific research. According to Dr. Max Tishler (14), in 1940 our federal government spent $15 million for research and development in our institutions of higher learning. In 1960 the amount spent was $9 billion—60 times as much. About 75 per cent of all academic research in the physical and life sciences is now paid for with tax money. In 1958–59, the government accounted for 83.6 per cent of Cal Tech's total income; 78.2 per cent of MIT's. The taxpayer has now become the patron of science.

Gerard Piel (7) points out that in these lavish governmental programs the scientist becomes an employee of the government, a fact which conditions his intellectual independence. Tishler adds the further observation that scientific "discoveries are seldom made by direction." I think it is only fair to add that the weight of the government's hand in directing research is often light to the point of non-existence. At other times it is overpoweringly heavy and dictatorial.

With the federal government now pouring $12 billion a year into scientific research, what wonderful new scientific knowledge does this buy? Not much. The trouble is that most of this money is spent, as Piel remarks, on the "lowly, short-term gains of practical advantage in weapons," consumer goods and the like, rather than on the "lofty, long-range goals" of pure science. Before the war, for every dollar spent by the government on pure science, six dollars were spent on applied science. Today the ratio is one dollar for pure science for every twenty dollars on applied science, and nearly half of the applied science is devoted to weapons development.

This, says Tishler, is no "real resurgence of interest in the intellect nor is it a rising dedication to learning. Rather it is an attempt to mobilize science through our educational system for the single-minded purpose of solving the immediate problems of national health and security." We have already seen how the law of diminishing returns applies to discoveries in the field of medicine. It has operated with even greater effect in the field of security. In the laudable pursuit of personal security, primitive man used his opposable thumb to pick up a rock in self-defense. With the gradual increase in knowledge, this rock, as a symbol of security, has evolved through the inventions of the flint arrowhead, bronze spear, wooden crossbow, flint-lock, gatling gun and flame thrower, all the way up until today, instead of security, we have reaped the agonizing insecurity of the hydrogen bomb. I think it is time that we diverted some of this torrent of money and human skills toward more constructive ends.

As a suggestive example of constructive alternatives to the futile production of information about ever more devastating weapons, Piel tells of a project of the Rockefeller Foundation in combating malnutrition in Mexico. Over the past 20 years the Foundation, at a cost of less than $2 million per year, has supplied United States agronomists who have established a sort of county agent system to train young Mexicans in agricultural sciences. In this short time, food production has risen 80 per cent, and the improved diet is already showing up in vital statistics. All this for less than $2 million a year—much less than the cost of a single small satellite.

Speaking of the Rockefeller Foundation recalls a notable article in their annual *Review for 1941,* written by Raymond B. Fosdick (15). This article is a favorite of mine and I quote from it each year to my beginning biology students. It illustrates so well the final point that I wish to make that I would like to read to you an excerpt from it. Speaking of the international character of medical science, Fosdick writes:

"There is not an area of activity in which this cannot be illustrated. An American soldier wounded on a battlefield in the Far East owes his life to the Japanese scientist, Kitasato, who isolated the bacillus of tetanus. A Russian soldier saved by a blood transfusion is indebted to Landsteiner, an Austrian. A German soldier is shielded from typhoid fever with the help of a Russian, Metchnikoff. A Dutch marine in the East Indies is protected from malaria because of the experiments of an Italian, Grassi; while a British aviator in North Africa escapes death from surgical infection because a Frenchman, Pasteur, and a German, Koch, elaborated a new technique.

"In peace as in war, we are all of us the beneficiaries of contributions to knowledge made by every nation in the world. Our children are guarded from diphtheria by what a Japanese and a German did; they are protected from smallpox by an Englishman's work; they are saved from rabies because of a Frenchman; they are cured of pellagra through the researches of an Austrian. From birth to death they are surrounded by an invisible host—the spirits of men who never served a lesser loyalty than the welfare of mankind."

This breaking down of barriers is urgently needed in the intellectual world today. Not just international barriers, but intellectual barriers that prevent intelligent men from comprehending each other. What is needed is a greater integration of existing knowledge—more cross-fertilization of ideas—so that artists, writers, scientists, and laymen can all speak a common language. We must bend our minds toward dissolving the barriers that fragment and isolate our various intellectual specialties. We must reaffirm the unity of knowledge and make it truly liberal. Last year at our annual banquet, Professor Merritt Hughes, (16) then our President, emphasized that the Wisconsin Academy, unlike all other academies in the country save one, is devoted to the integration of all knowledge—sciences, arts, and letters. That is truly one of its glories, and we should continue to emphasize it even more than we have.

Finally, while we have to accept man as he is, with all his primitive appetites and limitations, it is well to remember that man is more than intellect alone. L. P. Jacks, for many years the editor of the *Hibbert Journal,* once wrote that he believed that all the good in the world could be accounted for by honest thinking, hard work, and kindly feelings. The biggest problems in the world today do not stem from ignorant minds, but from uneducated hearts and wills. It is here that we should dedicate more of our substance and energies. After spending many billions of dollars and many years of time by our cleverest minds, we have acquired sufficient knowledge about the atom so that we can use it to ease man's burdens and enrich his life to heights undreamed of—or we can use it to destroy man and his works, completely and finally. There is a Buddhist proverb that says, "To every man is given the key to the gates of Heaven; the same key opens the gates of Hell."

I think we are all aware that in our pursuit of security we have passed the threshold where the law of diminishing returns has operated to produce, instead of security, a precarious balance of international terror; instead of a blessing, a world-wide curse.

It is time to redress the balance. It is time that we realize that knowledge for its own sake is not enough. Knowledge for the sake of security is not enough. We need to recover the full dimensions of a knowledge that ministers to the whole man—his body, mind, and spirit; that ministers to all men of whatever position throughout the whole wide world; knowledge "that never serves a lesser loyalty than the welfare of mankind."

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14. Tishler, M. 1961. The debt of discovery to learning. Merck, Sharp and Dohme.
15. Fosdick, R. B. 1941. *A Review for 1941.* The Rockefeller Foundation. New York, N. Y.
16. Hughes, M. Y. 1961. An Academy . . . of Arts and Letters. *Transactions of the Wisconsin Academy of Sciences, Arts, and Letters*, 50:3–14.
17. *Newsletter*, 3(3):1. 1962. American Institute of Biological Sciences.
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19. Greenberg, D. S. 1962. Cigarettes and cancer. *Science*, 136:638–639.

NATURAL SCIENCES

WILDLIFE RESTORATION IN WISCONSIN

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The restoration of wildlife falls under the following headings: 1) Stocking of species of animals still found in our state in areas where they have been extirpated; 2) Introduction of species that have become extinct in the state; 3) Planting of exotic species. Long experience has shown that it is preferable to concentrate on animals native to the state rather than to import foreign species with the hope that they will fill a void. Foreign introductions are seldom successful and leave a memory only of costly failures. Many plantings are made against the advice of game biologists but carried out under the guise of "good public relations." Present land utilization prohibits attempts to restore any of the large extinct mammals such as the cougar, bison, elk, caribou, and moose.

Three members of the deer family are extinct. The woodland caribou occurred in extreme northern Wisconsin in very small numbers and was soon exterminated. Twenty Newfoundland caribou were liberated on the Pierce estate, on the Brule River, Douglas County in 1906. All are supposed to have died on the estate. The moose was uncommon except in five of the extreme northwestern counties.[1] The native population became extinct about 1900. Since this date an occasional moose has wandered into the state from Minnesota, and from the Upper Peninsula of Michigan where moose from Isle Royale had been liberated. An individual immigrant may be seen in the future but there is no chance for the moose to become established with us. The elk was once common in the open terrain of southern and western Wisconsin.[2] The last certain date of its occurrence is 1866. The state in 1913, 1917, and 1932 released three shipments of elk from Yellowstone Park and Jackson Hole in Vilas County. None remains due to poaching and other causes. The white-tailed deer, on the other hand is remarkably adaptable.[3] After receiving adequate protection it moved southward so that today it is doubtful if there is a county in the state where deer are not present. The problem with this deer is the harvesting of the surplus population. In many areas in the northern part of the state the herds are

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[1] A. W. Schorger. 1956. The moose in early Wisconsin. *Trans. Wis. Acad. Sci.* 45: 1–10.

[2] ————. 1954. The elk in early Wisconsin. *Trans. Wisc. Acad. Sci.* 43:1–23.

[3] ————. 1953. The white-tailed deer in early Wisconsin. *Trans. Wis. Acad. Sci.* 42:197–247.

too large to be sustained properly by the local vegetation .This results in stunted growth of the deer and death from starvation in severe winters. A long-range economic problem is the great reduction in tree reproduction as a result of overbrowsing.

At the turn of the century it was inconceivable that the timber wolf was worthy of protection. Today there is a generally held belief that no member of our fauna should be allowed to become extinct if it is practical to save it. The timber wolf once roamed the entire state. Thompson[4] studied the habits of a pack of four wolves in Oneida County and found that it ranged over a territory of 150 square miles. One trapper had pursued this pack over a period of 15 years for the sake of the bounty. The bounty on both wolves and coyotes was withdrawn from July, 1943, to March, 1945, then restored in deference to local public protest. The timber wolf received protection again in 1957 by a closed season but as long as a bounty on coyotes exists it will be impossible to avoid trapping wolves. The present status of the wolf is unknown, but a few are believed to still exist in the state. The range occupied by wolves is virtually void of livestock so that economic damage would be almost nil. A study of the food habits showed deer remains in 97 percent of the scats; however, there was no evidence that the wolves could keep the deer population within desirable bounds. The eradication of wolves on the grounds that they kill deer is thoughtless, as the predation may be a benefit to the deer population where it is too high.

The coyote, morphologically so similar to the timber wolf, is amply capable of holding its own due to its well deserved reputation for cleverness. The unfortunate bounty on the coyote, if continued, will lead to the extermination of its larger brother. In 1945 bounties were paid on 4,134 wolves and coyotes. The number bountied in 1953 dropped to 1,703, but rose to 4,498 adults and 324 cubs in 1960. The total expended on coyote bounties in 1960 was $93,200, a sum that could and should have been expended on worthy conservation projects. The bounty merely removes a surplus population that nature eventually eliminates without a monetary consideration.

Two valuable furbearers, the fisher *(Martes pennanti)* and marten *(Martes americana)*, became extinct about 1920. Their restoration was desirable *per se*. There was also the possibility that if they became sufficiently numerous to permit trapping the returns to the trapper might be sufficient to diminish the pressure for bounties. In 1953, prior to suggesting to the Wisconsin Conservation Department the stocking of marten, I had considerable correspondence with state departments, and private organizations to deter-

[4] D. Q. Thompson. 1952. Travel, range, and food habits of timber wolves in Wisconsin. *Jour. Mam.* 33:429–442.

mine if marten could be obtained at a reasonable price. It finally developed that the state of Montana would provide some of the animals in exchange for eggs of the walleyed pike. The procurement of five marten from Montana and their release on Stockton Island in Lake Superior on November 19, 1953 was performed very efficiently by the Wisconsin Conservation Department that has since made an annual survey of the wildlife of the island. In June, 1956, five pine marten from the state game farm were also released on the island. Dr. William H. Marshall, with others, did live-trapping on the island from September 13 to 18, 1954. One immature marten was caught showing that there had been some breeding from the original stock. Tracks of marten were seen as late as March 18, 1959. It was my suggestion that the marten be released on Stockton Island, an area of 10,560 acres, with the thought that they could breed here unmolested and the surplus trapped and released in a suitable area on the mainland. The project has been far from successful, but seems to illustrate the difficulty in restoring an extirpated species. The area of the island may have been too small, or too few marten were rel eased. Food does not seem to be a problem since even in winter dead deer are available.

In September, 1955, having read of the great increase of the fisher in the state of New York, I suggested to Mr. Cyril Kabat of the Wisconsin Conservation Department, that some fisher be obtained for release in our state. An exchange for quail was made. Two shipments were received on February 28 and March 16, 1956, respectively. The releases consisted of two males and five females. Three additional fisher were received on January 17, 1957. Subsequently 20 fisher were received from the state of Minnesota through the agency of the U. S. Forest Service. All of the animals were released in northwestern Forest County. In 1960 one fisher was trapped accidentally near Crandon, Forest County, and another near Carpenter Lake, northeast of Eagle River, Vilas County. The latter animal was released in April, 1959, near the Nettleton fire tower, hence had traveled 17 miles airline. Since at the present time there is no difficulty in finding tracks of the fisher on and near the release area, there is reason to believe that the transplants will be successful.

The beaver is an excellent example of an animal that can spread and maintain itself with no other aid than protection from overharvesting. A century ago it was extinct in southern Wisconsin, but now is to be found in most of the southwestern counties. During the 1959 season, 11,515 beaver were trapped in 50 of the counties of the state. Crawford and Grant Counties contributed approximately 200 beaver each. It is doubtful if the state ever furnished as many beaver as at present. Indian and white trappers were unrestrained and thought nothing of exterminating a colony. In some areas, due to building dams and flooding lands, the beaver becomes a nuisance and must be removed.

The first known release of the white-tailed jackrabbit *(Lepus townsendii)* in the state was made about 1900.[5] Of 10 releases made prior to 1945 only three resulted in the establishment of new colonies. Lemke[6] traced the history of eight releases made subsequent to 1945 and concluded that additional releases would be useless since this hare had spread into all parts of the state except the extreme northern tip. It is by no means as common as the cottontail and is unlikely to become so. It is at least an addition to our fauna.

A great, tangible achievement of the Wisconsin Conservation Department is the creation and development of waterfowl habitat. Horicon Marsh, Germania Marsh, Pine Island, Meadow Valley Flowage, Wood County Public Hunting and Fishing Grounds, and Crex Meadows, are especially worthy of mention. During the migrations Horicon Marsh draws hundreds of whistling swans and many thousands of geese. It was estimated from an aerial census that at one time in the spring of 1961 there were 100,000 geese at Horicon Marsh and the surrounding area. The marsh has no small aesthetic value for in the fall of 1960 approximately 80,000 people came to see the display of waterfowl. This heartening form of utilization may in the future surpass hunting in importance.

The Wisconsin Conservation Department has been active in attempting to increase the wood duck population. Breeding birds were obtained from the Illinois Conservation Department in exchange for ruffed grouse. The wood ducks were turned over to the Badger State Sportsman's Club, at La Crosse. In 1958 and 1960 this club released 855 wood ducks hatched from eggs laid in captivity. It is too early to determine the results of this program.

The sharp-tailed grouse *(Pedioecetes phasianellus campestris)* was formerly abundant in southern Wisconsin. The oak openings which it inhabited by preference earned for it the name of "bur oak" grouse. This species is far less tolerant of civilization than the prairie chicken so that its range was soon limited to the northern part of the state. The habitat requirement is semi-prairie containing grasses, and many shrubs and open woodlands.[7] Management tools to maintain a suitable habitat comprise spraying with herbicides, bulldozing, and burning. Where feasible burning is the cheapest and most efficient practice. The Wisconsin Conservation Department is managing several areas. Burning has been very successful

[5] A. Leopold. 1945. The distribution of Wisconsin hares. *Trans. Wis. Acad. Sci.* 37: 1–14.

[6] C. W. Lemke. 1956. White-tailed jackrabbit releases. *Wis. Consv. Dept.* 5 pp. Mimeo.

[7] W. B. Grange. 1950. Wisconsin grouse problems. *Wis. Consv. Dept.* 318 pp.

in the jack pine barrens of Douglas County. Here two or three burnings within a period of three or four years are necessary. Burning releases the seeds from the hard jack pine cones and the young pines that spring up must be destroyed by another burning. Other areas being managed for sharp-tailed grouse are located in the Chequamegon and Nicolet National Forests, the Dorothy Dunn area in the Northern Highland State Forest, Vilas County, the Spread Eagle Area in Florence County, and the Coleman Lake area in Marinette County. There is no immediate prospect that the population of this grouse will become dangerously low.

Disregarding outlying remnants, our prairie chicken *(Tympanuchus cupido americanus)* population is limited to the Buena Vista Marsh, southern Portage County, and the contiguous Leola Marsh in Adams County. The prairie chicken demands large areas of grassland, now very scarce in Wisconsin, of which not over one-fourth is wooded.[8] Vital for survival of the prairie chicken is nesting cover and winter food. An area of 40 acres per section, covered with grass of the proper height, will provide adequate nesting cover. Food patches of standing corn for winter use need be no closer to each other than four miles. The Conservation Department is now managing 5,052 acres of which 3,623 acres are in the Buena Vista Marsh. In addition there are about 5,000 acres in the Soil Bank. This spring the population should begin recovering from the low of the cycle, and if the hatching season is favorable, Mr. F. N. Hamerstrom estimates that the fall population should be 1,000 to 1,500 birds in the two marshes. The full beneficial effects of the management program will not be attainable for several years. There is little doubt but that this species can be retained as a part of our fauna. It is questionable that the population will increase sufficiently to permit an open season, but this is of secondary importance.

Planting of ruffed grouse *(Bonasa umbellus)* particularly on islands, has seldom been successful. Warden William Barnhart stocked some of these grouse on Washington Island in 1900. This grouse, though supposedly present in 1910, eventually disappeared. The state restocked Washington Island in 1956. Madeline Island was also stocked in the years 1954–56. Prior to this time I spent several vacations on the island. None of the inhabitants with whom I talked had ever seen a ruffed grouse on the island. The present status of the species on the two islands is unknown.

The quail is a most difficult bird to manage in Wisconsin. It was incredibly abundant in the period 1845–1854.[9] The most favorable

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[8] F. N. Hamerstrom, O. E. Mattson, and F. Hamerstrom. A guide to prairie chicken management. *Wis. Consv. Dept., Tech. Wildl. Bull.* 15:127 pp.

[9] A. W. Schorger. 1944. The quail in early Wisconsin. *Trans. Wis. Acad. Sci.* 36; 77–103.

factor was a succession of mild winters. It is reasonably certain that at this time there was ample food and cover. In 1854 it was stated that the cultivated portion of Dane County, consisting of about 1,600 farms, comprised only one-eighth of its area. The quail population declined so rapidly that private introductions were begun in 1884 and continued into the early 1900's. Quail were imported from Texas, Louisiana, Tennessee, and Kansas. These plantings were failures. No thought seems to have been given to the unsuitability of southern quail for survival during a Wisconsin winter. The experimental plantings of native birds in recent years by the Wisconsin Conservation Department soon disappeared. Quail released in the Arboretum at Madison in 1950 and in Waukesha County in 1953 and 1955, simply vanished. A planting at Horicon Marsh, Dodge County, in 1950, disappeared within less than a year, while two plantings in Milwaukee County in 1950 and 1952 survived for two years.

The precise requirements for perpetuating quail in an area after it has been stocked are unknown. The two factors, weather and food, are seemingly readily capable of appraisement, yet differences of opinion arise. Errington[10] thought that strong well-fed birds could survive the severest cold. On the other hand, Leopold[11] found that fat, well-fed quail died during the winter of 1935–36. Mortality ranged from 30 to 83 percent. Buss[12] followed the population trends of quail on an area in Dunn County. The greatest loss occurred just prior to the nesting season and was due presumably to predation, though supporting data are lacking. There is general agreement that the greatest need for quail restoration is cover. Between "clean farming" and the fervor for destroying every shrub along the highways, cover has been reduced to a minimum. The recent program for quail management by Kabat and Thompson[13] stresses the necessity of hedgerows. Restoration requires a minimum area of 15,000 acres with one mile of hedgerow for every 550 acres. Management of this magnitude, to be successful, requires the full cooperation of the owners of the farm lands.

Our largest gamebird, the wild turkey, has shown resistance to establishment. It was not common originally except in the wooded hilly areas of southwestern Wisconsin. The extremely severe winter of 1842–43, with its deep, crusted snow reduced the population to a remnant that gradually disappeared. The first attempt at restora-

[10] P. L. Errington. 1933. The wintering of the Wisconsin bobwhite. *Trans. Wis. Acad. Sci.*, 28:1–35.

[11] A. Leopold. 1937. The effect of the winter of 1935–36 on Wisconsin quail. *Am. Midl. Nat.*, 18:408–416.

[12] I. O. Buss, H. Mattison, and F. M. Kozlik, 1947. The bobwhite quail in Dunn County, Wisconsin. *Wis. Consv. Bull.*, 12(7):6–13.

[13] C. Kabat and D. R. Thompson. 1960. A program for quail and upland game management. *Wis. Consv. Dept., Special Wildl. Rept.* 4:212–253.

tion of which I am aware was made in 1887 when a pair of wild turkeys from the Indian Territory was released in woods at Lake Koshkonong.[14] Crossing with domestic turkeys soon followed so that birds of pure stock never became established. A few turkeys were released by the Wisconsin Conservation Department prior to 1929 but no records were kept of their number. Between 1929 and 1939 there were planted, mainly in Grant and Sauk Counties a total of 2,942 turkeys.[15] Though the best stock of game farm birds available was used, the turkeys refused to become wild and associated with their domestic relatives. An open season in 1939 for bow hunting resulted in the killing of 54 turkeys. It was thought that hunting would remove the least wary birds and render the remainder more wild. Five turkeys from the Sauk County plant appeared in 1937 near Grand Marsh, Adams County, and became permanent residents. The last member mixed with domestic blood, died February 1, 1958.[16]

The project was renewed in 1954. In 1954, 1956, and 1957 a total of 746 game farm turkeys were released in northern Juneau County on the Meadow Valley wildlife management area.[17] The plantings have undergone various vicissitudes. The blackhead disease was introduced in 1937 through the release of infected young raised at the game farm at Poynette. In March, 1959, a blizzard deposited 36 to 45 inches of snow.[18] Some birds died of starvation while the survivors were in poor condition for breeding. On May 7, 1960, seven inches of wet snow fell causing the females to abandon their nests. May and June were exceptionally rainy, wetness being highly injurious to the young that hatched. The desire to restore the wild turkey is understandable. There is no doubt also that the Meadow Valley area was the best available for restoration, as the wild turkey requires a large tract of wilderness with a minimum of human disturbance. The Meadow Valley area was originally a marsh. It has been greatly changed by repeated burnings and the digging of drainage ditches. It is now covered with a growth of trees, jack pine, aspen, oak and other hardwoods. The terrain is by no means ideal for turkeys and the area lies north of their original range. The spread of the turkeys from Juneau County into Adams, Wood, Jackson and Monroe Counties indicates a search for a more suitable habitat. There is a high hunting pressure for deer, within the

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[14] A. W. Schorger. 1942. The wild turkey in early Wisconsin. *Wilson Bull.,* 54:173–182.

[15] F. Hopkins. 1940. The wild turkey problem in Wisconsin. *Wis. Consv. Bull.,* 5(12): 47–48.

[16] A. W. Schorger. 1958. Extirpation of a flock of wild turkeys in Adams County, Wisconsin. *Pass. Pigeon,* 20:170–171.

[17] S. Plis and G. Hartman. 1958. Are the turkeys taking? *Wis. Consv. Bull.,* 23(2): 11–14.

[18] S. Plis. 1960. How are our turkeys doing? *Wis. Consv. Dept.* Ms. 3 pp.

birds' range, which aside from poaching, cannot fail to have a disturbing influence. Long experience in turkey management has shown that the first essential is stocking with completely wild birds. These are difficult to obtain in sufficient number. Game farm birds rarely have the ability to establish themselves. In the long run, therefore, it is unlikely that there will be a successful stocking of the turkey in Wisconsin.

There is always the hope that game birds of foreign origin can be found to fill the areas vacated by native species. The only species that has produced respectable populations is the ring-necked pheasant *(Phasianus colchicus)*. Private introductions of the pheasant in Wisconsin began in 1895 and continued for many years before the species became well established.[19] Little knowledge of the bird was shown when the state planted 50 pheasants near Washburn in the fall of 1897. There was no chance for survival in this locality. Due to the Pabst liberations beginning in 1911, the pheasant became firmly established in the southeastern counties. The state program of raising and liberating pheasants, begun in 1928 and continued without interruption, served to spread them over four-fifths of the state. The peak populations reached in the early 1940's have never been equalled since. This condition is due in part to a steady reduction in suitable cover.

It was once thought that the Hungarian partridge *(Perdix perdix)* would become an abundant bird in the North Central States. Habitat proved to be more subtle than was anticipated with the result that most of the plantings failed. Apparently the summers must not be too warm, the rainfall should be between 15 and 25 inches annually, and the terrain open with rich soil. The first release of this bird was made in 1911 by Gustav Pabst on his farm near Oconomowoc. Based on hunting statistics, a peak was reached in 1939 when 50,478 birds were killed. The kill declined to 2,636 in 1945, a low that was followed by a closed season. The kill was approximately 50,000 birds annually from 1950 through 1954, since which time the population has declined steadily. The data indicate that the species may be cyclic. This partridge continued to increase in Ohio and Indiana until about 1937–40 then declined rapidly. Westerskov[20] concluded that the bird is not cyclic in Ohio. McCabe and Hawkins,[21] in their comprehensive study of the Hungarian partridge in Wisconsin, concluded: "Despite averages, the climographs

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[19] A. W. Schorger. 1947. The introduction of pheasants into Wisconsin. *Pass. Pigeon*, 9:101–102.

[20] K. Westerskov. 1956. History and distribution of the Hungarian partridge in Ohio, 1909–1948. *Ohio Jour. Sci.*, 56:65–70.

[21] R. A. McCabe and A. S. Hawkins. 1946. The Hungarian partirdge in Wisconsin. *Am. Midl. Nat.*, 36:1–75.

emphasize the facts that the climate in the north central United States does not conform to the European optimum during the nesting season of the partridge and that severe cold alone is not a limiting factor." It is doubtful if management could effect an increase in the population to any degree commensurate with the cost.

The chukar partridge *(Alectoris graeca chukar)* has refused to become established in spite of numerous plantings. Between 1935 and 1945, 35,285 pen-reared chukars were released in Wisconsin, some in every county. All disappeared within one year after release. Chukars usually disperse widely after release. As a result, too few birds may settle down in any one locality to form a permanent colony. A semiarid, rocky, broken country seems to be essential to the chukar and Wisconsin can not provide a habitat of this kind. In 1950 and 1952 a total of 122 European red-legged partridges *(Alectoris rufa rufa)* were released in Waushara County to determine the length of survival. They vanished within one and one-half years.

A project for stocking the capercaille *(Tetrao urogallus)* and black grouse *(Lyrurus tetrix)* in Wisconsin was initiated by Gardiner Bump of the Fish and Wildlife Service.[22] The capercaille is a large grouse, the males weighing up to twelve pounds. It is a bird of coniferous forests and its food from October to April consists almost entirely of the needles and buds of conifers. The flesh becomes so tainted from this diet as to be unpalatable. Outer Island was selected for release of the birds owing to its isolation and as an apparently suitable habitat. There would be little incentive for emigration since the nearest islands are distant 4.5 miles which is the limit of the flight capability of the capercaille. The stock was obtained from northern Europe. Releases of 26 capercaille and 9 black grouse were made in the fall of 1949, and 4 each of capercaille and black grouse in the spring of 1950. Of the 60 birds purchased only 43 were released, the others having died of disease and accident. The total cost of the project was $7,954.50, or $185 for each bird released. This is not a high figure when we consider that in 1950 it cost a hunter $187 to kill a turkey gobbler in Texas. Prior to release, some predators, raptors and foxes, were eliminated. Two black grouse are known to have been killed by hawks shortly after liberation. A female capercaille, seen in September, 1950, was the last bird observed. Though disease and predation played a part, the main reason for the failure of the plantings remains unknown. The causes of the decline or disappearance of a population remains one of the most baffling problems in wildlife management. Many introductions of the two species into North America have been made

[22] J. M. Keener. 1955. A study of the introduction, and survival of capercaillie and black grouse. *Wis. Wildl. Res., P. R. Quart. Prog. Repts.,* 14(1):195–204.

and all have ended in failure.[23] A case close to home was the planting of 201 capercaille and black grouse on Grand Island, Lake Superior, in 1904 and 1905 by the Cleveland Cliffs Iron Company. All the birds vanished within a year or two. Hope is eternal, so it should occasion no surprise if, within another generation, the stocking is repeated on the basis that it was not done properly in the first place.

Some members of the Legislature, in a moment of exuberance, decided that since Wisconsin was a prairie state it should have prairie dogs. Some were procured and released in June, 1881 on the grounds surrounding the Capitol. A local newspaper was not long in printing an obituary: "The prairie dogs which the state tried to nurse went up the spout. They wouldn't live."[24] Since the above date several other species have gone "up the spout"; however, in view of the difficulties so frequently encountered, restoration of wildlife in Wisconsin should be judged highly successful.

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[23] J. C. Phillips. 1928. Wild birds introduced or transplanted in North America. *U. S. Dept. Agr., Tech. Bull.* 61:64 pp.

[24] Madison *Democrat* June 29, July 20, 1881.

BIONOMICS OF *PODISUS* SPP. ASSOCIATED WITH THE INTRODUCED PINE SAWFLY, *DIPRION SIMILIS* (HTG.), IN WISCONSIN[1]

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The dearth of insect parasites of the larval stages of the introduced pine sawfly, *Diprion similis* (Htg.), is compensated for, in part, by the presence of insect predators, particularly in the family Pentatomidae. It was possible, during studies on the overall effects of biotic factors which help to reduce populations of this forest insect pest, to collect series of predacious pentatomids in the genus *Podisus*. Data on their seasonal history in the plots at Amery, Wisconsin, were accumulated and extensive laboratory studies were undertaken at Madison, Wisconsin, to clarify their biologies. Data were accumulated on four species and one hybrid.

MATERIALS AND METHODS

In the Amery, Wisconsin, area *D. similis* has two distinct but overlapping generations each year. Large collections of sawfly larvae, required for other studies, were made in June and July and again from late August through September to coincide with periods of greatest larval abundance. During these periods, pentatomids of all ages were accumulated in the collections and maintained in the laboratory at Amery. Throughout the field season (May to October) individual pentatomids observed feeding on larvae of *D. similis* were collected and maintained singly in cages.

Collections were made by beating both small white pine trees and the lower branches of large white pine trees with a 10 ft. bamboo pole. The sawfly larvae and pentatomids were collected from a 9 x 9 ft. cotton mat placed under the trees. Another collecting method utilized a circular, 4 ft. diameter, cloth beating sheet mounted on a steel wire loop attached to a 5 ft. handle. A 4 ft. beating stick was used to dislodge the insects from the branches. The latter method was ideal when larval populations were low, when a high degree of maneuverability was desired, or when strong winds were encountered.

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The pentatomids collected with the sawfly larval collections and on which no feeding data were established, were placed in wooden-framed, screen-sided cages (15 x 9 x 9 in. or 7 x 7 x 5.5 in.). The cages were stocked with sawfly larvae to provide food for the predacious species. The predacious species were removed and placed (several males and females of the same species) in cages to obtain mating pairs. Mated pairs were isolated in 4 x 4 x 2.5 in. cages and provided with food, moisture, and oviposition sites. Food consisted of larvae of *D. similis,* moisture was provided by soaking sections of dental wick in water, and oviposition sites consisted of either white pine twigs with needles or strands of excelsior. At the end of the field season all insect material was transferred to Madison.

In the Madison laboratory attempts were made to rear each species throughout the year to provide data on their biology. The mated pairs were transferred to different rearing cages (Figure 1) consisting of one pint ice cream cartons provided with petri-dish covers. Continuous moisture was supplied through a dental wick, stabilized by a glass sleeve. Excelsior was used exclusively in the containers for perching and oviposition sites. Each cage was supported above a water source by a wooden rack constructed to hold four such cages. The racks were set up in series by species (Figure 2). This technique was modified from Scheel, Beck, and Medler (1958).

Larvae and fresh pupae of the greater wax moth, *Galleria mellonella* (L.) were utilized as food. Stock cultures were maintained in the laboratory by a method similar to that described by Beck (1960).

Progeny of mated pairs of pentatomids were reared in the laboratory throughout the year at room temperature ($24 \pm 7°$ C.) with no attempt to vary other environmental factors, or to simulate natural conditions such as those required for hibernation. Numerous experiments were undertaken on the effects of low temperature on dormancy and oviposition response, feeding habits etc. and these are treated under the particular species involved.

Seasonal history notes were compiled from field observations. Notes from laboratory studies were accumulated to include data on premating period, mating interval, duration of mating, preoviposition period, number of matings, time from adult to first egg laying, length of life of adult, length of period from egg hatching to adult, number of egg batches, arrangement of eggs, period between egg laying, percentage of eggs hatched, time in days for eggs to hatch and time spent in each instar.

Eggs and nymphal exuviae of each species were measured with a binocular microscope equipped with a calibrated ocular micrometer. Egg measurements were made at the widest and longest points.

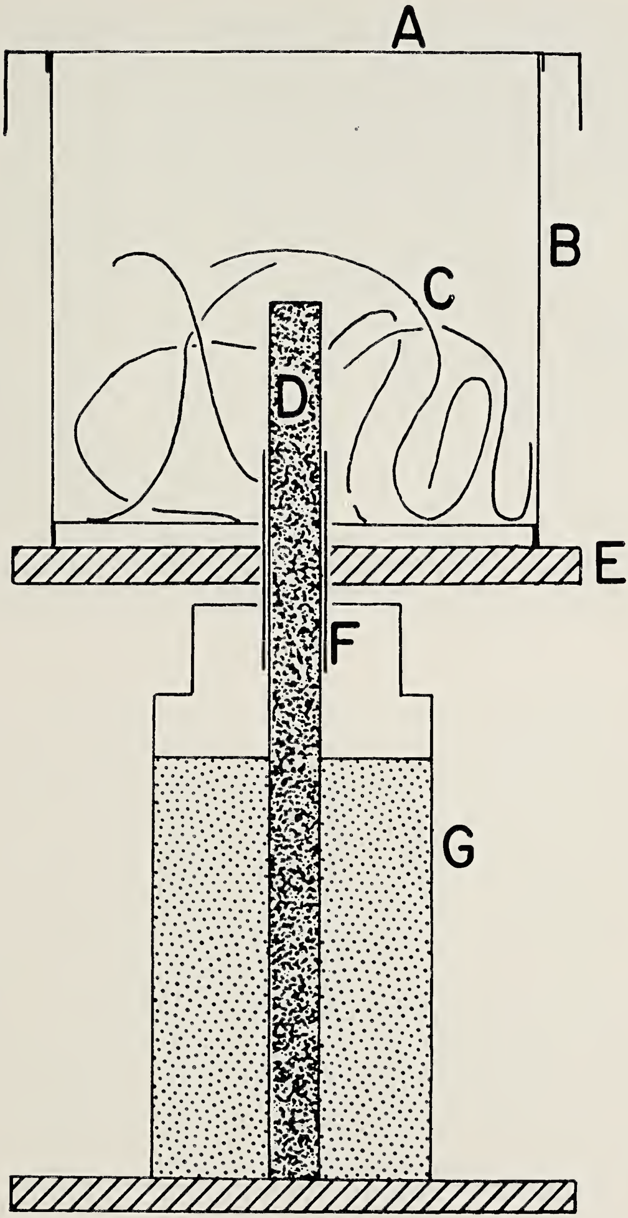

FIGURE 1. Longitudinal section through rearing container. A, petri dish cover; B, 1 pint ice cream carton; C, excelsior; D, dental wick; E, Masonite support; F, glass tubing sleeve; G, 4 oz. jar containing water.

FIGURE 2. Group of rearing containers.

Micropylar processes were measured from their tips to their lowest points of attachment i.e., the bottom outside edge of the process where it becomes confluent with the egg shell. Head width measurements from exuviae were made between the annular sclerites along the mesodorsal margins of the eyes (Figure 10).

Illustrations were made of the eggs and their characteristic structures. To facilitate study of the pseudoperculum, micropylar processes, and egg-bursters, excised sections were placed on slides and examined with a binocular microscope at 160X. To retain the sections on a slide, a strip of transparent mending tape (Scotch Brand Magic Mending Tape No. 810, Minnesota Mining and Manufacturing Co., St. Paul, Minnesota) used as a mounting medium, was inverted on a slide and held at each end with short strips of masking tape. Use of the tape for mounting egg segments was efficient as both transmitted and incident light could be used for examining the sections under the microscope.

Adult insects, at death, were pinned and later identified by P. Ashlock and R. Froeschner of the Insect Identification and Parasite Introduction Research Branch, Entomology Research Division, United States Department of Agriculture, Beltsville, Maryland, and L. A. Kelton, Taxonomy Section, Entomology Research Institute, Canada Department of Agriculture, Ottawa, Canada.

All data were treated with standard statistical procedures (Snedecor and Cochran 1959).

Results and Discussion

The field collected *Podisus* spp. were separated arbitrarily into groups by gross external characteristics and reared as five separate entities before being authoritatively identified as *Podisus maculiventris* (Say), *P. serieventris* Uhl., *P. placidus* Uhl. and *P. modestus* Uhl. A fifth group derived from a mating of a female *P. maculiventris* and a male *P. serieventris* was intermediate between the two and with characters of both.

The most common species in collections made in the summer of 1960 was *P. maculiventris,* whereas the following summer *P. placidus* was more prevalent. Collected in lesser numbers during both summers were *P. serieventris* and *P. modestus* in that order.

Data accumulated during the 1960–1962 laboratory rearings of *Podisus* spp. have been placed in tabular form (Tables 1–5) or are included in the text.

Podisus serieventris Uhl.

Field collections of *P. serieventris* indicate that this species has a single generation each year. It overwinters as a hibernating adult, but can be found in collections most commonly from late July through early September. Nymphs in the third instar were collected on July 22, the earliest collection date in 1960. Fifth stage nymphs were found four days later. The first field record for an adult in 1960 was August 15, compared to a 1961 record of nearly three weeks earlier on July 20. The extended period of three weeks in 1960 between first observing a fifth stage nymph and the first sighting of an adult can be accounted for by irregular collection dates for *Podisus* spp. An adult female was collected from white pine foliage as late as October 24, 1961.

According to Prebble (1933) the majority of adults in Nova Scotia, Canada, are blackish-grey in color with some greyish-brown. All specimens taken in the present study show the former color. From the rearings, which have been carried through the third generation, no color variants were observed. In some instances, after specimens were dead and pinned for some time, the greyish-cast was replaced by a brownish one along with a somewhat oily appearance.

The adults cannot be sexed by size, although the females are usually larger than the males (Table 1). The humeral width of the pronotum was measured with a vernier caliper and corresponds closely with measurements taken by Prebble (1933).

The data on adult longevity (Table 2A) were accumulated from those records which associated specific adults with dates. From the limited data available on longevity differences between the sexes,

TABLE 1. HUMERAL WIDTH OF PODISUS SPP. ADULTS

SPECIES	SEX	N	RANGE (MM.)	MEAN ± S. E.
P. serieventris	♂	20	4.9–6.0	5.35 ± .02
data ex Prebble (1933)	♂	11	4.6–5.5	5.0
P. serieventris	♀	25	5.1–6.7	5.79 ± .21
data ex Prebble (1933)	♀	10	4.9–6.3	5.7
P. placidus	♂	19	4.2–5.3	4.54 ± .26
P. placidus	♀	25	5.0–5.9	5.14 ± .22
P. modestus	♂	22	4.4–5.4	4.88 ± .49
P. modestus	♀	18	4.9–5.7	5.4 ± .57
P. maculiventris	♂	22	5.3–7.0	6.17 ± .11
P. maculiventris	♀	30	5.7–7.8	7.01 ± .11
P. hybrid	♂	26	4.9–6.2	5.72 ± .06
P. hybrid	♀	27	5.5–7.1	6.25 ± .08

TABLE 2. BIONOMIC CHARACTERS OF PODISUS SPP.

2A	Longevity of Adult *Podisus* spp.					
	Species:	*serieventris*	*placidus*	*modestus*	*maculiventris*	*P.* hybrid
	N:	19	30	25	2	13
	Range (days):	53–488	70–320	69–413	230–243	133–329
	Mean ± S.E.:	206.6 ± 23.58	201.6 ± 11.52	178.4 ± 15.18	236	199.2 ± 16.49
2B	Preoviposition Periods of Adult *Podisus* spp.					
	Species:	*serieventris*	*placidus*	*modestus*	*maculiventris*	*P.* hybrid
	N:	13	4	2	19	4
	Range (days):	1–13	11–28	3–6	2–11	7–57
	Mean ± S.E.:	5.5 ± 1.06	19.2	4.5	5.8 ± 1.43	30.0
2C	Periods Between Egg Laying of *Podisus* spp.					
	Species:	*serieventris*	*placidus*	*modestus*	*maculiventris*	*P.* hybrid
	N:	21	25	24	91	19
	Range (days):	1–22	1–17	1–40	1–7	1–12
	Mean ± S.E.:	5.2 ± 1.02	6.2 ± .79	8.1 ± 2.14	2.6 ± .15	5.1 ± .25
2D	Number of *Podisus* spp. Eggs per Batch					
	Species:	*serieventris*	*placidus*	*modestus*	*maculiventris*	*P.* hybrid
	N:	128	31	40	103	74
	Range (Eggs):	3–49	8–60	3–54	1–47	4–38
	Mean ± S.E.:	15.9 ± .78	26.9 ± 2.33	14.8 ± 1.45	19.6 ± .95	18.5 ± 1.02
2E	Number of Days for *Podisus* spp. Eggs to Hatch					
	Species:	*serieventris*	*placidus*	*modestus*	*maculiventris*	*P.* hybrid
	N:	28	17	7	17	14
	Range (days):	2–9	6–9	4–8	7–12	4–8
	Mean ± S.E.:	6.3 ± .33	6.8 ± .20	6.6 ± .37	9.6 ± .41	6.5 ± .39

the females with a mean length of life of 241 days are longer-lived than the males, by approximately 50 days. The length of life varied from 88 to 488 days for the females and 53 to 325 days for the males. For *P. serieventris* to complete its life cycle of one generation per year, the adult should have a longevity period of approximately 320 days. It is probable that the higher longevity values recorded in the laboratory rearing are more realistic and indicative of field conditions than those less than 320 days.

Longevity records do not indicate actual field conditions, since the records are from rearings at room temperature and do not take into account any period of overwintering in a dormant stage. Except for teneral specimens, field collected adults cannot be aged. A few of the shorter longevity periods may be from adults which had overwintered the previous year.

In the laboratory, the premating period, or the time spent as an adult before the first mating, was recorded on two occasions as 21 and 40 days. This was from late February to early April. The mating interval or time between matings varied from 3 to 81 days, with an average of 32 days, based on five observations. This average is disproportionately high as the 3 low periods of 3, 7, and 10 days are offset by two relatively high intervals of 59 and 81 days. As in other observations of this type, discrepancies are bound to occur, since observations have been limited to infrequent intervals during the normal work day.

Three isolated pairs of *P. serieventris* mated more than once. One pair mated three times between March 30 and May 4, another pair mated four times from March 31 to April 20 and a more sexually active pair mated six times, on November 11, 14, February 3, and April 3, 13, and 20.

The duration of mating was noted on four occasions as 5, 6.5, 7 and 8.5 hours. It is probable that the average mating period is 7 hours or more.

In two cases, unmated females reared from their immature stages deposited eggs 10 and 69 days after becoming adults. In addition, a fifth stage nymph collected on July 26 was reared in isolation and moulted to an adult female on August 3. This female deposited the first batch of eggs 12 days later on August 15 and the second batch of eggs 34 days later on September 6. The eggs were infertile and did not hatch. The adult lived for at least another five months when its identity was lost after it was incorporated with another rearing lot.

During the last three weeks of January, 1961, an experiment was undertaken to determine whether a short exposure to cool temperatures would stimulate mating and egg laying. It was apparent in the laboratory that a dormant period existed in the early winter when activity, mating, and egg laying was at a minimum even though the adults were held at room temperature of about 23 to 27° C. One group of adults was held at 4.4° C. for three weeks while a comparable group were maintained at room temperature. Those held at room temperature were sexually active and either mated or laid eggs at 8, 23, 78 and 80 days after beginning the test. Those adults exposed to cold required 51, 55 and 58 days for either mating or egg laying to occur after being returned to room temperature. Exposure to 4.4° C. at this period retarded the sexual development of the adults and consequently was ineffective in increasing the number of laboratory reared generations.

The preoviposition period (from first mating to first oviposition) (Table 2B), recorded from 14 occurrences, varied from 1 to 13 days with one exception; a period of 72 days elapsed between an observed mating and when the first eggs were laid. This latter extreme value was excluded from the statistics in Table 2B.

Similarly, as with the preoviposition data, the periods between egg laying (Table 2C) were marked by one high value of 22 days, the remaining 20 observations falling between 1 and 11 days. If the high value was excluded the mean or average period between egg laying would be 4.4 days instead of the 5.2 days shown.

The eggs of *P. serieventris* (Figure 3) are characteristic of the genus *Podisus* although each species has individual differences as noted in the accompanying key. Eggs are .86 ± S. E. .004 mm. in width and 1.10 ± S. E. .006 mm. in length (Table 5). The micropylar processes (chorionic processes of Esselbaugh 1946) range from 9–13 in number and are .22 to .25 mm. in length, or approximately one fifth the length of the egg.

The micropylar processes (Figure 8) consist of a "central canal" for sperm passage surrounded by a porous protein, the "air sponge", which allows gaseous exchange (Southwood 1956). They are closely appressed to the pseudoperculum until the egg is extruded from the oviduct when they recurve and dry to assume their final positions (Figure 8).

The pseudoperculum, as defined by Southwood (1956), is the type of egg cap occurring in the Pentatomidae, and is differentiated from a true operculum in that it is essentially the same structure as the rest of the chorion. It bears no fixed relationship to the micropylar processes and lacks a distinct sealing bar.

The egg burster (Figure 9) is well developed in the genus *Podisus,* but does not have species characteristics. Its function in hatching has been described and documented by Southwood (1956) with an extensive list of references as have the other structures and processes associated with eggs of the terrestrial Heteroptera.

Usually attached to the egg burster and associated with it is a thin membrane, the embryonic cuticle of the first nymphal instar (Southwood 1956). It would appear from the relative position of this cuticle or exuvium and the egg burster that the latter mechanically assists the shedding of this "first" exuvium by the soft nymph.

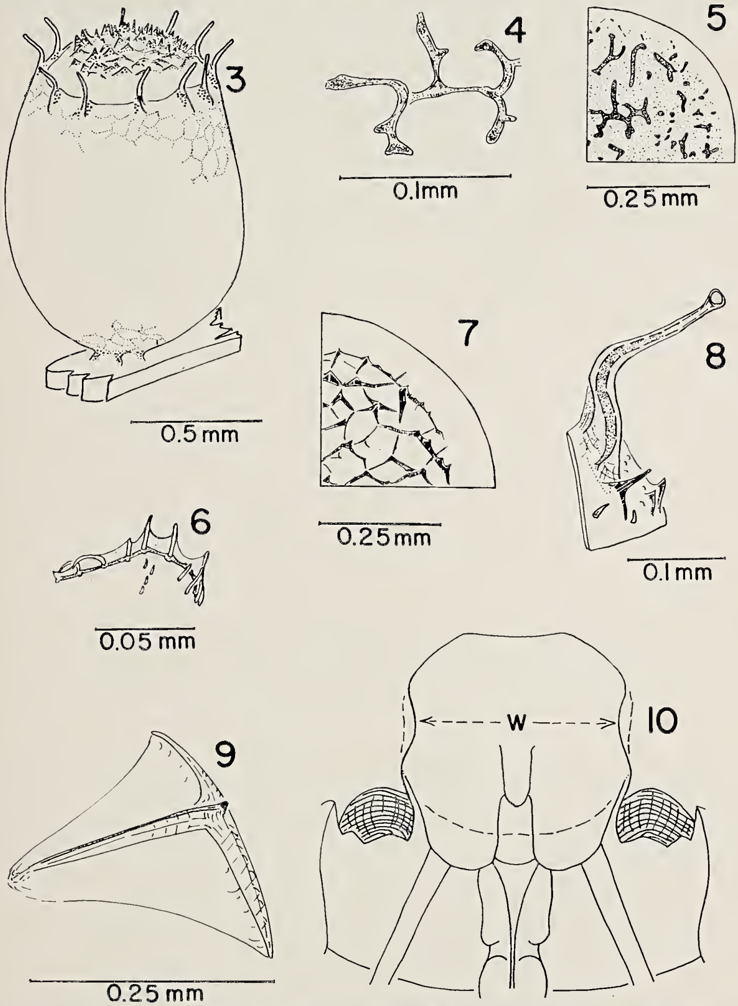

FIGURE 3. *P. serieventris* Uhl. egg; FIGURE 4. *P. placidus* Uhl., Chorionic ornamentation; FIGURE 5. *P. placidus* Uhl., section of pseudoperculum; FIGURE 6. *P. serieventris* Uhl., Chorionic spines draped with serous mantle; FIGURE 7. *P. serieventris* Uhl., section of pseudoperculum; FIGURE 8. *P. serieventris* Uhl., micropylar processes; FIGURE 9. *P. modestus* Uhl., egg burster; FIGURE 10. *Podisus* sp., diagrammatic view of third instar head capsule showing location of head capsule measurement (W).

The chorion of *P. serieventris* is armed with minute spines (Figure 6) which provide some semblance of a pattern (Figure 7). The chorial spines do not cover the entire surface of the eggs in any one egg batch, and as noted by Esselbaugh (1946) they may be longer on the central portion of the pseudoperculum and on the upper half of the side walls. A serous mantle which envelopes the egg (Couturier 1935) is a noticeable feature where it becomes draped over the spines (Figure 6).

The maximum number of eggs recorded from one female of *P. serieventris* was 162 eggs deposited in 10 batches. In two other instances 82 and 104 eggs were each laid in a total of 5 batches. One female was observed depositing eggs on a cage cover. Eight eggs had already been laid when oviposition was first noted. Seventeen eggs, or those from the 9th to the 25th inclusive were deposited in 42.5 minutes. Ten eggs were laid in the first 22 minutes of watching. The last 7 eggs laid were placed on the glass in 20.5 minutes.

When an unrestricted area for egg laying was used, there was no pattern to egg placement. In 128 egg batches of *P. serieventris,* the mean number of eggs per batch was 15.9 ± S. E. .78 with a range of 3 to 49 (Table 2D). The eggs laid on excelsior were usually in a linear arrangement, though occasionally they were deposited in circular masses. In 21 egg groups examined on excelsior, eggs were in rows of 2 and 3 with frequencies of 8 and 13 respectively.

There appeared to be a pattern to the egg laying interval as shown by the following consecutive times of 4, 3.5, 3.5, 3, 2.5 and 4 minutes. Whether this is indicative of a more general rhythm is not known.

As noted by Prebble (1933), the hatching of an egg mass of *P. serieventris* is characterized by its simultaneity. He suggested that those eggs which failed to hatch and which had collapsed chorions were probably not fertile. In eggs examined in the present study, additional causes of chorion collapse may have been either through dessication of the contents or predation. In six egg batches on which no predation was observed, there were three instances of 100% hatch and three with 83 to 93% hatch. Hatching of *P. servientris* eggs took place after 2 to 9 days incubation with a mean of 6.3 ± S. E. .33 days (Table 2E). That hatching could occur in less than four days incubation is extremely doubtful, so that those observations below four days should possibly be regarded as observational errors. Under present rearing conditions, eggs are more commonly laid on the undersurface of excelsior than on top and for this reason may be missed for several days.

All nymphs of *P. serieventris* fed equally well on *G. mellonella* pupae or on *D. similis* larvae, the only food supplied. Wax moth larvae were not used extensively as host material because they deteriorated too rapidly if killed, and if not immobilized their silk-spinning habits created additional problems in rearing. If the nymphs and adults of *Podisus* are not supplied with sufficient food, cannibalism will occur.

First instar nymphs normally are gregarious and group together on the eggs from which they hatched for at least the first 24 hours. After this initial period they will move as a unit but remain close to their egg mass until after the first moult, or for at least the first 48 or 72 hours. When two or more egg batches from the same parents were included in one rearing container the newly emerged sibling nymphs of each egg group remained clustered together and did not intermingle until after the second nymphal stage was reached. If simultaneous hatching from an egg batch did not occur the first instar nymphs sometimes fed on the unhatched eggs as also noted by Prebble (1933). This phenomenon appeared of relatively common occurrence. Whether the nymphs were using the host material primarily as a source of moisture rather than food is not known, although nymphs supplied only with moisture survived. First instar nymphs when feeding on an unhatched egg have their proboscis extended forward in the normal manner of predacious Pentatomids. In one case the proboscis sheath was rolled back with an insect pin with the result that the stylets could be seen entering the egg. To corroborate that the stylets actually entered the egg was determined by their relative position to the sheath. Considering that the stylets formed the hypotenuse of a right angle triangle, and the sheath the other two sides then the stylets would project past the apex of the triangle and hence have enough length, unprotected by the sheath, to enter the egg (Baker, 1927a).

After eclosion, nymphs pass through five instars or stages before becoming adults in approximately 28 days (Table 3). When the days spent in each instar are compared with the head capsule development (Table 4) the results can be shown graphically as nymphal growth in terms of instar progression (Figure 11). Here, the average number of days spent in each instar is accumulated on the abscissa while the ordinate shows the average head capsule width for each instar. The distance between each instar number on the ordinate represents one millimeter. Using a separate base line originating at each instar number the average head capsule measurements were plotted directly.

The growth ratio (Table 4) is the average head width of one instar divided by the average head width of the previous instar. The predicted head width range for a given instar was calculated by multiplying the growth ratio observed by the observed head width range of the previous instar. This is a slightly different method than that employed by Prebble (1933) who calculated an average ratio of increase from all instars. There were close agreements between the observed and expected head widths indicating the growth ratios were uniform and that five instars was a true figure. The calculated growth ratios compared favorably with those presented by Prebble (1933) of 1.257, 1.323, 1.296 and 1.230 respectively. The differences in growth ratios between similar stages varied from less than 1 to 2.8 per cent.

The nymphal instars of *P. serieventris* have been described and illustrated by Prebble (1933). A frequency histogram of head capsule widths of nymphs of *P. serieventris* (Figure 12) clearly shows no overlapping between the five stages. Possible confusion was avoided in setting off the limits for each instar as measurements were made from exuviae of known instars, thus each measurement could be associated with a definite stage of the insect.

TABLE 3. NYMPHAL DEVELOPMENT OF PODISUS SPP.

	Instars				
P. serieventris	1	2	3	4	5
N	35	34	30	30	29
Range (days)	3–8	3–7	3–7	3–9	6–16
Mean ± S.E.	5.5 ± .19	4.7 ± .18	4.2 ± .18	4.7 ± .23	9.0 ± .41
Acc. Age in Days	5.5	10.2	14.4	19.1	28.1
P. placidus					
N	9	11	7	11	11
Range (days)	5–8	5–7	3–6	4–9	7–11
Mean ± S.E.	6.1 ± .39	6.2 ± .23	4.3 ± .13	5.7 ± .41	9.4 ± .12
Acc. Age in Days	6.1	12.3	16.6	22.3	31.7
P. modestus					
N	11	11	13	10	9
Range (days)	3–5	3–6	3–5	4–6	6–9
Mean ± S.E.	3.9 ± .25	4.1 ± .32	3.9 ± .22	5.0 ± .21	7.6 ± .29
Acc. Age in Days	3.9	8.0	11.9	16.9	24.5
P. maculiventris					
N	8	9	8	8	8
Range (days)	4–6	4–7	3–5	4–5	6–9
Mean ± S.E.	4.5 ± .27	5.0 ± .41	4.0 ± .19	4.4 ± .18	7.5 ± .38
Acc. Age in Days	4.5	9.5	13.5	17.9	25.4
P. hybrid					
N	16	20	17	16	14
Range (days)	4–7	3–7	3–5	4–6	4–10
Mean ± S.E.	4.9 ± .26	4.7 ± .20	3.9 ± .18	4.3 ± .14	7.5 ± .37
Acc. Age in Days	4.9	9.6	13.5	17.8	25.3

TABLE 4. HEAD CAPSULE DATA OF PODISUS SPP. NYMPHS

	Instars				
P. serieventris	1	2	3	4	5
N:	126	115	112	96	80
Head with range: (obs.)	.40–.52	.54–.64	.68–.85	.88–1.05	1.07–1.30
Mean ± S.E.:	.46 ± .002	.59 ± .002	.77 ± .003	.97 ± .004	1.18 ± .005
Growth Ratio:	....	1.279	1.304	1.261	1.219
Head with range: (pred.)	....	.51–.66	.70–.83	.86–1.07	1.07–1.28
P. placidus					
N:	13	17	28	22	22
Head width range: (obs.)	.40–.47	.50–.57	.62–.75	.78–.95	.91–1.10
Mean ± S.E.:	.43 ± .006	.54 ± .005	.68 ± .007	.87 ± .009	1.03 ± .011
Growth Ratio:	....	1.251	1.258	1.271	1.185
Head width range: (pred.)	....	.50–.59	.63–.72	.79–.95	.92–1.13
P. modestus					
N:	65	63	49	42	34
Head width range: (obs.)	.39–.47	.48–.57	.62–.75	.78–.91	.95–1.10
Mean ± S.E.:	.44 ± .002	.53 ± .002	.68 ± .004	.86 ± .005	1.04 ± .007
Growth ratio:	....	1.213	1.284	1.268	1.204
Head width range: (pred.)	....	.47–.57	.62–.73	.79–.95	.94–1.10
P. maculiventris					
N:	54	40	47	44	31
Head width range: (obs.)	.39–.50	.53–.60	.70–.80	.95–1.03	1.15–1.25
Mean ± S.E.:	44. ± .003	.56 ± .003	.76 ± .004	.98 ± .004	1.21 ± .005
Growth ratio:	....	1.282	1.341	1.303	1.232
Head width range: (pred.)	....	.50–.64	.71–.80	.91–1.04	1.17–1.27
P. hybrid					
N:	31	32	26	28	25
Head width range: (obs.)	.40–.50	.52–.63	.70–.83	.94–1.08	1.13–1.33
Mean ± S.E.:	.46 ± .005	.59 ± .003	.78 ± .005	1.01 ± .007	1.24 ± .010
Growth ratio:	....	1.275	1.316	1.302	1.230
Head width range: (pred.)	....	.51–.64	.68–.83	.91–1.08	1.16–1.33

The presence of more than one peak in the histogram for each instar cannot be assessed but it is presumed that there may be a sex difference as noted by Prebble (1933). As there is a size difference between the sexes in the adult stage (Table 1), it is expected that this would be indicated also in the nymphal measurements. Insufficient individual rearings and differentiation as to sex did not allow testing this point.

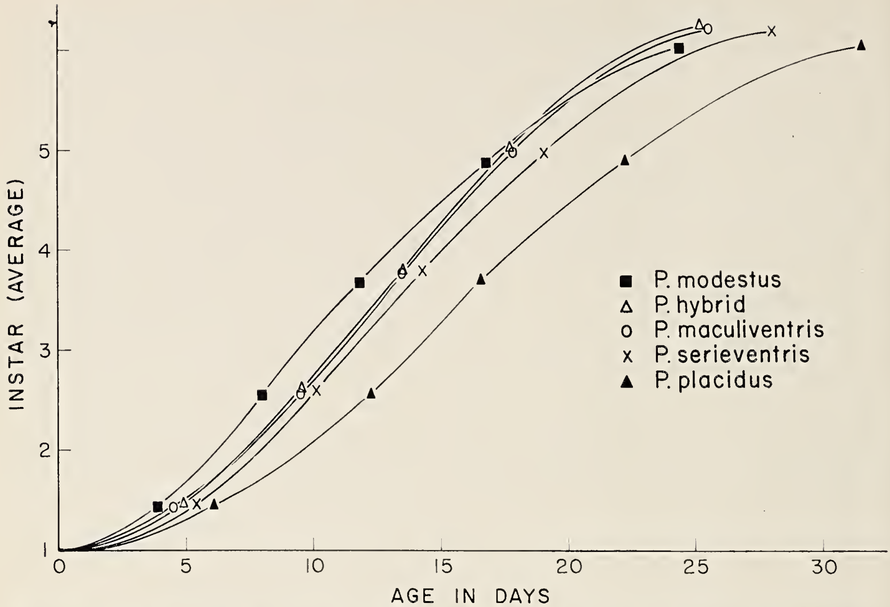

FIGURE 11. Nymphal growth of *Podisus* spp. in terms of instar progression.

Podisus placidus Uhl.

The seasonal history of *P. placidus* Uhl. was determined from the field collections made in both 1960 and 1961. In 1960, the first specimen, a second instar nymph, was collected on June 28, followed two days later by collections of third stage nymphs. Fourth stage nymphs were taken July 18 and 22. Apparently eggs hatch the middle of June through July, as a first stage nymph was also taken July 27. Adults were collected July 20, September 5 and 6, 1960. The following spring on June 16 a pair of adults in copulation were taken. Immatures were collected on only two days in 1961; a third stage nymph on July 19 and a fifth stage on August 23. Besides the pair of adults in copulation, adults in numbers were taken August 23 and October 3. The latter date is the latest this species has been collected in the Amery, Wisconsin area. *P. placidus* has a single generation each year. Kirkland (1897), studying the predators of gypsy moth, considered this species had two and sometimes three broods in a season, although his interpretation of the term brood is not clear.

P. placidus resembles *P. serieventris* but can be separated from the latter by two main characters (Van Duzee 1904). The humeri are obtuse and almost rounded in *P. placidus* compared to the more acute humeri of *P. serieventris*. *P. placidus* has an immaculate membrane whereas *P. serieventris* has a longitudinal dusky vitta on the

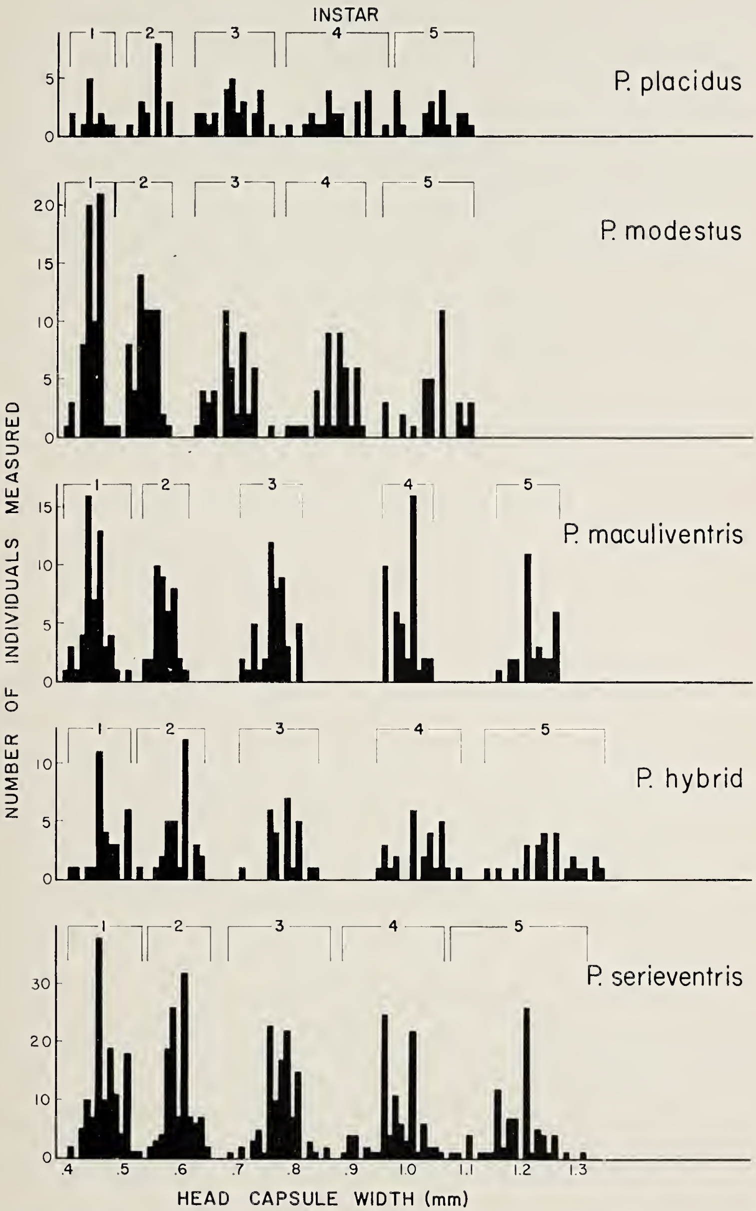

FIGURE 12. Frequency histogram of head capsule width of nymphs of *Podisus* spp.

membrane. Adult *P. placidus* are brown rather than the blackish-grey exhibited in *P. serieventris*. The humeral width of the pronotum was measured in a series of adult *P. placidus*. In both sexes, *P. placidus* averaged .7 mm less in mean width than *P. serieventris* (Table 1).

Longevity records (Table 2A) are incomplete but from the data presently accumulated the mean length of life of laboratory reared adults, sex ignored, is 201.6 $\pm$ S. E. 11.6 days, and for the males and females it is 212 and 216 days respectively. These values are low but not unreasonably so compared with the other species reared in the laboratory.

The premating period for *P. placidus* is not definitely known. One group of field collected immature *P. placidus* was reared through to the adult stage, but the actual date of becoming adults is not known and had to be interpolated. The immatures were collected June 28, 1960, as second stage nymphs. An average development time of 20 days can be assumed (Table 3) as the required time to reach the adult stage. Adults should therefore have been present on July 18. Mating by one pair was first observed on August 1 to give a premating period of 14 days. Subsequently this particular pair mated again on August 5 and 16 followed by the deposition of eggs on August 19.

The mating interval of *P. placidus* as determined from rearing records has varied, with one exception, from 1 to 22 days. The mean mating interval, excluding one long interval of 38 days, was 2.1 $\pm$ S. E. .25 (129) days with confidence limits at the 95% level of 1.6 to 2.6 days. One pair of adults exhibited an unusual behavior pattern by initiating mating on consecutive afternoons, about 4:00 p.m., then mating for periods of 4.5 to 9.5 hours. Mating on the fifth day was followed by egg deposition. This pattern occurred twice. The pair, whose record is cited above, mated an additional 32 times at approximately the same time each day and usually at one day intervals.

The duration of mating was established from 49 records in which the inception and completion of mating was known within a range of 1 to 2 hours. The mean period of mating was 6.7 $\pm$ S. E. .3 hours with 95% confidence limits of 6.1 to 7.3 hours.

The preoviposition period for *P. placidus* is an approximation only, developed from the rearing records of a few individuals. The tentative range for this period is 3 to 28 days, with an average of 14.5.

Data were accumulated on number of matings from five pairs of *P. placidus*. Records have not been completed on two pairs of adults which to date have mated 8 and 14 times from February 12 to March 20, 1962 and March 5 to March 25, 1962, respectively. Previous rearings of three isolated pairs showed matings occurring 3, 3, and 6 times. All of these matings took place in 2 to 3 weeks.

The periods between egg laying for *P. placidus* are of nearly the same duration as for *P. serieventris*. There did not appear to be any radical differences in the intervals at various times of the year in the laboratory reared material. Based on 25 observations involving seven females, two of which had single records only, the mean period between egg laying was calculated as 6.2 ± S. E. .79 days with confidence limits at the 95% level of 4.6 to 7.8 days (Table 2C).

The eggs of *P. placidus* are smaller and squatter than those of *P. serieventris* (Table 5). The mean width and length of the eggs is .81 ± S. E. .004 and .97 ± S. E. .006 mm, respectively. The micropylar processes range in number from 9 to 12, with a mean of 10.28 ± S. E. .17 just subequal to the mean of 10.32 ± S. E. .17 for *P. serieventris*. The processes which range in length from .26 to .32 mm are the longest of the *Podisus* spp. studied (Table 5). The chorion of the eggs of *P. placidus* have a serous mantle, somewhat similar to *P. serieventris,* but the ornamentation appears more convex (Figures 4 and 5) because the eggs of *P. placidus* lack the sharp ridges of spines from which the mantle is draped as in *P. serieventris*.

TABLE 5. EGG CHARACTERS OF PODISUS SPP.

	serieventris	*placidus*	*modestus*	*maculiventris*	*P.* hybrid
N. (Eggs measured):	74	56	29	30	20
Width Range (mm.):	.80–.97	.75–.88	.75–.93	.75–.88	.78–.95
Mean ± S.E.:	.86 ± .004	.81 ± .004	.84 ± .009	.82 ± .006	.86 ± .011
Length Range (mm.):	1.00–1.20	.90–1.08	.85–1.00	.90–1.01	.90–1.12
Mean ± S.E.:	1.10 ± .006	.97 ± .006	.90 ± .006	.95 ± .006	1.02 ± .015
Ratio width/length:	.782	.835	.933	.863	.843
Micropylar Processes:					
N. (eggs counted):	37	27	60	41	69
Range (no. per egg):	9–13	9–12	10–13	11–15	11–15
Mean ± S.E.:	10.32 ± .17	10.28 ± .17	11.68 ± .12	13.78 ± .16	12.77 ± .11
Micropylar process Length, Range Approx. (mm.):	.22–.25	.26–.32	.20–.25	.25–.28	.24–.28

In 31 egg batches of *P. placidus,* the mean number of eggs per batch was 26.9 ± S. E. 2.33, with an observed range of 8 to 60 eggs (Table 2D). The arrangement of the eggs was normally linear and in 2 or 3 rows. Very infrequently a batch of eggs was laid in a circular pattern 5 to 6 eggs in diameter.

The maximum number of eggs recorded from one *P. placidus* was 362 in 14 batches from March 7 to April 23, 1962. The adult involved is still living and may deposit more eggs. Four other adults laid totals of 104, 204, 260, and 335 eggs. One female laid six eggs in 16 minutes which is approximately the same rate as that observed for *P. serieventris*. During egg deposition, six seconds are required from when the egg is first observed leaving the oviduct, to the final movement away from the egg by the adult.

After deposition, eggs required 6 to 9 days to develop before hatching occurred. The mean number of days for hatching as observed in 17 egg masses, was 6.8 ± S. E. .2 days (Table 2E). Normally, 87.5 to 100 per cent of the eggs in a batch hatched.

Similar to the other *Podisus* spp. studied, *P. placidus* passed through five instars before becoming an adult 31.7 days after hatching. *P. placidus* had a longer developmental period in each instar than *P. serieventris* (Table 3). As with *P. serieventris* the days spent in each instar (Table 3) are compared with the head capsule development (Table 4) and the results are shown graphically as nymphal growth in terms of instar progression (Figure 11).

The predicted head width ranges (Table 4) showed a generally close agreement with the measured head width ranges from which they were calculated by use of the growth ratio, as explained under *P. serieventris.* The only overlapping in head widths between instars occurred with one individual, when a known fifth instar nymph showed a head capsule width of .91 mm. Although the overlapping is shown in Table 4, the singular measurement was eliminated from the data for the frequency histogram of head capsule widths (Figure 12). This was the only case of overlapping in all the *Podisus* spp. studied.

Podisus modestus Uhl.

Field collections of adult *P. modestus* Uhl. from white pine trees were made from June to October. The composite data from 1960 and 1961 signified one generation per year. In 1961, adults were taken June 9 and 16, the earliest records for this species. These were most likely overwintering adults, as eggs and immature stages were not collected until the first two weeks of July. In 1960, the first adult was taken July 18, with other adults collected from August 6 to September 5. The latest collection dates were recorded in 1961 when male and female adults were collected October 3 and a female on October 9.

P. modestus is separated from the other *Podisus* spp. in this study on the basis of shape of humeri and overall size (Table 1). The humeri are more acute than in *P. placidus* but lack the spines of *P. maculiventris. P. modestus* is smaller in size than *P. serieventris. P. modestus* resembles *P. placidus* most closely in size, both in width of humeri (Table 1) and in head capsule width (Table 4).

The mean length of life for an adult *P. modestus* was 178 days (Table 2A). The premating period recorded from rearings in the fall, late winter, and spring varied from 14 to 53 days. A short period of 14 days occurred in mid-August, the longest, of 53 days was in the winter from December 13 to February 3, and two spring occurrences lasted 44 and 47 days, from March 19 to May 2 and May 5, respectively. Only one consecutive mating by a pair of *P. modestus* was noted. The second mating took place 85 days after the first mating on August 24. The duration of mating was known from seven matings and lasted from 3 to 9 hours or an average of 6.4. The data from which a preoviposition period could be calculated were inadequate, but periods of three and six days were noted for two adults. The period from when adults were first present to the first egg laying varied from 56 days in the spring to 106 and 207 days through the winter. These are laboratory records and would, of course, not apply to field conditions. From 24 observations, the mean period between egg laying was approximately 8 days (Table 2C). It should be noted that the standard error is large, relative to the mean, in both *P. modestus* and *P. serieventris*.

The eggs of *P. modestus* are the most globular of the species studied, the width to length ratio most nearly approaching one (Table 5). The eggs are the shortest of those *Podisus* spp. measured but are of medium width. The mean number of micropylar processes is 11.68 ± S. E. .12 (Table 5), which is close to the group mean of 11.76. The processes range in length from .20 to .25 mm., the shortest group measured. There are no prominent spines on the chorion of the egg, thus they appear devoid of vestiture, even though covered by a serous mantle. The mean number of eggs in 40 batches counted was 14.8 ± S. E. 1.45 eggs with an observed range of 3 to 49. (Table 2D). The egg masses obtained were arranged in 2 to 4 rows with an occasional, roughly circular grouping, 4 to 5 eggs in diameter. One adult deposited 16 egg batches, totalling 235 eggs between June 12 and August 1. This was the largest number of eggs recorded from one individual. Two other females laid only 49 and 55 eggs each with the 49 laid in four batches during a period of 16 days. Eggs of *P. modestus* hatched approximately 6.5 days after deposition (Table 2E). Although records were available from only seven egg batches, the mean and calculated range compared favorably with the other species of *Podisus* studied. In general, all of the eggs hatched in each batch, though in some, hatch was as low as 60 per cent.

After emerging, nymphs require a mean period of 24.5 days to reach the adult stage (Table 3). During this period they pass through five instars. The days spent in each instar (Table 3) are compared with the head capsule development (Table 4) with the results shown graphically as nymphal growth in terms of instar progression (Figure 11).

The predicted head width ranges (Table 4) corresponded closely with the measured head width ranges. The head capsule measurements were arranged as a frequency histogram (Figure 12) which showed clearly the instar groupings as well as the characteristic bimodal distribution within each instar.

Podisus maculiventris (Say)

Field collections of *Podisus maculiventris* (Say) were made from mid-July to early October. The earliest and latest collection dates were in 1961 when female adults were obtained July 13 and October 3. Fifth stage nymphs which moulted to adults within one to three days of collection were taken August 6, September 4 and September 6 in 1960. Adults are common in August and September. It seems unlikely that *P. maculiventris* would have more than one generation per year in the study area. Stoner (1919) reported a double brood for Iowa with nymphs present in June and July and again in late September.

The adults of *P. maculiventris* as described by Stoner (1919), are noted for their remarkably pronounced spinose humeri from which their common name, the spined soldier bug, was probably derived. This species can be separated from the other *Podisus* spp. studied by the presence of a long ventral spine which extends forward between the posterior coxae (Stoner 1919, 1922). The sex ratio as determined from nearly 400 progeny of three females was essentially 1:1. The humeral width of the pronotum is the widest of those species measured (Table 1). The average width of the males was .8 mm less than the females.

Sufficient longevity records were not obtained to allow incorporation of the data into Table 2. From the rearing data available, the average length of life was 236 days with a range comparable to the other species studied. The premating period was not established from the rearing data. A premating period for *P. maculiventris* of five days was observed by Whitmarsh (1916). Mating intervals of 8 and 9 days were noted for two separate pairs of adults. The duration of mating varied from at least 6 to a maximum of 30 hours. The preoviposition period, established from 19 observations, had a mean duration of 5.8 $\pm$ S. E. 1.4 days with a range of 2 to 11 days (Table 2B). A closely allied statistic, the period from becoming adult to first egg laying, was observed as 12 days during the present investigations, and nine days by Morrill (1906). The data on periods between egg laying were compiled from observations of four females. The observed range of 1 to 7 days included a large number of periods close to the mean of 2.6 days as shown by the low value of .15 for the standard error and 95% confidence limits of 2.3 to 2.9 days.

The eggs of *P. maculiventris* are almost identical in size to those of *P. placidus*, but the mean width and length (Table 5) show they are a fraction shorter and a little wider. The eggs of this species have the greatest number of micropylar processes (Table 5). The processes are shorter than those on *P. placidus* eggs but are approximately the same length as the other species studied. The chorion of the egg is spinose and covered with a serous mantle, thus they are similar in appearance to those of *P. serieventris.* Eggs have been laid singly and in batches up to 47 eggs. The mean number of eggs laid in 103 batches was 19.6 $\pm$ S. E. .95 eggs (Table 2D). The eggs are generally arranged in two rows although there are occasional exceptions to this, such as eggs being laid in a triangular shaped mass, with two eggs at the apex of the triangle and four rows of 5, 5, 6, and 6 eggs consecutively towards the base of the triangle. The maximum number of eggs recorded from one *P. maculiventris* was 593 laid in 35 batches during the period March 3 to May 18, 1960. Three other females deposited 142, 544 and 576 eggs during periods of 28, 69 and 58 days respectively. Of 17 egg batches observed the mean time from egg deposition to hatching was 9.6 days with a range from 7 to 12 (Table 2E). In any one batch, 80 to 100 per cent of the eggs will hatch.

Temperature is an important factor in the development of eggs (Couturier 1938). Sixteen batches of eggs were reared in incubators, eight at 18° C. and eight at 24° C. The eggs developed faster at the higher temperature and took 3 to 5 days or an average of 4.4 to hatch. Those held at the lower temperature took 10 to 11 days or an average of 10.4 to hatch. Twenty-seven batches of eggs, reared at room temperature hatched in 7 to 12 days or an average of 8.9.

Nymphal development through five instars occurs before the adult stage is reached in a mean of 25.4 days (Table 3). Nymphal head capsule measurements agreed closely with those predicted (Table 4). The required calculations are explained in the *P. serieventris* section. The head capsule measurements when placed in a frequency histogram fall into distinct grouping corresponding to the five instars (Figure 12). The number of days spent in each instar by the nymphs is compared with the corresponding head widths (Table 4) and the results are shown graphically as nymphal growth in terms of instar progression (Figure 11). The process of moulting from the fifth nymphal stage to the adult takes 35 to 48 minutes to complete.

The food requirements of *Podisus* spp. were investigated using *P. maculiventris* as the test species. Nymphs were supplied with various combinations of green beans, *D. similis* larvae and water. Those nymphs which were without food or moisture died within 2 to 3 days. Those with water only died in 8 to 11 days without developing beyond the first instar. The nymphs which had access to beans and water died in an average of 18.7 days and progressed only to the second instar whereas those nymphs which were supplied moisture and also had beans and larvae available, or larvae only, completed development in 30 to 37 days. The nymphs developed fastest in those containers which had larvae and beans and slowest in those with larvae. The average number of days required for development were 32.9 for those nymphs which fed on beans and larvae and 34.3 days for those nymphs which fed on larvae. These developmental periods are longer than the average 25.4 days shown in Table 3. The data for Table 3 were gathered from nymphs fed on larvae only. The differences can be ascribed to dissimilar rearing conditions.

As well as studying the food requirements, some data were gathered on the effectiveness of *Podisus* spp. as predators. Individual nymphs during their period of development were able to kill but not necessarily consume 11 to 15 larvae of *D. similis,* or an average of 13.4 larvae. Nymphs if individually reared can pass through their entire development period using only one *D. similis* larva for food. There was no apparent difference in weight of the teneral adults which had developed on one larva compared with those which fed on two larvae during their nymphal period.

If nymphs are not disturbed while feeding and if reared as small groups they will consume an average of 2.8 larvae before becoming adults. If reared singly, then they will normally consume 4 larvae before reaching the adult state. This apparent discrepancy in number of larvae used for food may be due to dessication of the sawfly larvae if not consumed immediately, once they are killed by the attacking nymph.

If food was withheld from either nymphs or adults reared in a group cannibalism occurred. There is no differentiation as to size or stage of the nymphs or adults, as to which will be the attacker or attacked.

Podisus hybrid

In October, 1960, a small number of field-collected *Podisus* spp. adults were confined in a large laboratory cage before being set up in smaller containers. Two adults of different species were observed in copulation. As records of this nature are not common, the mating pair was removed and reared separately. The female was later identified as *P. maculiventris* and the male as *P. serieventris*. There have been previous reports of hybridization in Pentatomidae, particularly in the genus *Euschistus* (Foot and Strobell 1914, Sailer 1954), but apparently not in the genus *Podisus*.

The mating occurred on October 27 and three batches of eggs, consisting of 8, 26, and 32 eggs were deposited one, four, and eight days later. Nymphs hatched from 62 of the 66 eggs. Progeny from the original pair are now in the F_4 generation. The progeny examined have taxonomic characters common to both species (Kelton 1962 Personal communication).

The humeral width was measured on all hybrid adults retained for study. In both males and females the range in widths and the mean widths were between those measured for *P. serieventris* and *P. maculiventris* (Table 1).

Longevity records indicate that the length of life of the adults has not been shortened or lengthened because of the hybridization; the mean length of life of the adults was 199 $\pm$ S. E. 16.5 days (Table 2A).

The premating period is not known for this group of *Podisus*. The mating interval was obtained on only four occasions and showed a wide range of values, 5, 11, 41 and 88 days. Compared with data from the other species these figures are not unusual. The duration of mating was 8 to 9 hours.

The preoviposition period from four observations was 7, 28, 28 and 57 days, or an average of 30 days (Table 2B). This is probably not an accurate assessment in view of the premating periods for the other species. Also a second generation female deposited eggs at intervals from August 1961 to February 1962. There was no emergence from any of these eggs. A first generation male was placed with the female on February 5, 1962. Mating occurred four hours later, followed by egg deposition one day and seven days later. The eggs laid the day following mating did not hatch, but those produced seven days after mating were viable and hatched in four days. This indicates that the period between first mating and deposition of viable eggs is approximately seven days.

The periods between egg laying ranged from 1 to 12 days, plus one additional occurrence of 65 days. This latter extreme value was excluded from the statitsics for Table 2C. The mean number of days between egg laying was almost identical to that of *P. serieventris.*

The eggs of the hybrid have a mean width of .86 mm., similar to *P. serieventris,* and wider than the mean width of .82 mm of *P. maculiventris* (Table 5). It is of interest to note that the mean length of the hybrid egg is intermediate between those of the original parent species. When comparing the width to length ratio, which is a general indication of the shape of the egg, the ratio for the hybrid egg approaches most closely that of *P. maculiventris* with ratios of .843 and .863 respectively. The number of micropylar processes is intermediate between those of *P. serieventris* and *P. maculiventris* (Table 5). Their lengths are similar to those of the other *Podisus* spp. except for the longer ones of *P. placidus.* The spines and serous mantle on the exterior of the egg are similar in appearance to those of both *P. serieventris* and *P. maculiventris* and cannot be used for differentiation. The maximum number of eggs laid in any one batch was 38, the lowest maximum of the species studied. The mean number of eggs laid per batch was 18.5 compared to 15.9 for *P. serieventris* and 19.6 for *P. maculiventris* (Table 2D). The eggs are normally deposited in a linear arrangement of 2 to 5 rows with three rows the usual number. The maximum number of eggs deposited by one female was 292. These were laid in 212 days in 1961. They were deposited in 17 batches. Another female laid 261 eggs in 12 batches in 45 days. In contrast, a third female deposited 11 batches containing a total of 128 eggs in 24 days. The data included records from three other females which deposited 66, 104 and 122 eggs in three, six and five batches, respectively. Eggs hatched 4 to 8 days after deposition (Table 2E). This range was more restricted than that of *P. serieventris* but the mean of 6.5 days was similar, compared to the 9.6 mean days for development of the eggs of *P. maculiventris*. In any single batch of eggs, 85 to 100 per cent of the eggs could be expected to hatch.

Nymphs pass through five instars before becoming adults. The total developmental period, a summation of the mean time spent in each instar, was approximately 25 days, the same as for *P. maculiventris*, but three days shorter than for *P. serieventris* (Table 3). The periods spent in nymphal development are compared with the head capsule development (Table 4) with the results shown graphically as nymphal growth in terms of instar progression (Figure 11). As in the other species, there was close agreement between the observed and predicted head width ranges. The frequency histogram of head capsule measurements (Figure 12) showed a bimodal distribution in each instar, probably a reflection of sex differences.

Key to Eggs of *Podisus* spp.

A. Eggs immaculate, without ornamentation; usually yellowish-white in color ------------------------------ *modestus* Uhl.

AA. Eggs not immaculate, with ornamentation on surface; appear brownish in color.

B. Ornamentation rounded, chorionic spines not present. (Fig. 4) -- *placidus* Uhl.

BB. Ornamentation spinose, formed by chorionic spines with serous mantle draped over spines. (Fig. 6)

C. Eggs barrel-shaped, chorionic processes usually 9 to 13 in number, mean of 10. (see table 5) ------------ *serieventris* Uhl.

CC. Eggs not barrel-shaped, more globular; chorionic processes usually 11 to 15 in number, mean of 14. (See table 5) ------- ---------------------------------- *maculiventris* (Say)

Key to Adult *Podisus* spp.

(Adapted from Key by A. D. Baker, 1927 b)

A. Membrane without a distinct vitta ----------- *placidus* Uhl.
AA. Membrane with a longitudinal dusky vitta.
B. Humeral angles of pronotum rounded, color blackish grey ------------------------------------ *serieventris* Uhl.
BB. Humeral angles of pronotum prominent and acute, color greyish to reddish brown.
C. Basal spine of abdomen long, extending between hind coxae; color greyish brown; humeral width 5.3–7.8 mm. ---------- ----------------------------------- *maculiventris* (Say)
CC. Basal spine of abdomen short, not extending between hind coxae; color generally pale reddish brown; humeral width 4.4–5.7 mm. ------------------------------ *modestus* Uhl.

Summary and Conclusions

1. Four species of Pentatomidae, *Podisus serieventris* Uhl., *P. placidus* Uhl., *P. modestus* Uhl. and *P. maculiventris* (Say), commonly occur as predators of the introduced pine sawfly, *Diprion similis* (Htg.), in northwestern Wisconsin.

2. Though in general, the biology and habits of the four species are uniform, specific differences occur in these and in morphological characteristics to enable their separation.

3. All species have at least one generation per year; however, their developmental period is such that the possibility of two exists.

4. All species may be reared readily in the laboratory with *Galleria mellonella* (L.) as a substitute food.

5. A hybrid (*P. malculiventris* ♀ X *P. serieventris* ♂) was reared through four filial generations and was intermediate in characters between its parents.

6. Five instars were obtained for all species. In an attempt to shorten the period between generations in the laboratory exposure of adults to low temperature for short periods in January did not incite apparently dormant adults to mate and lay eggs.

7. The adult female is usually larger than the adult male. Difference is reflected in bimodal distribution of nymphal head capsule measurements.

8. Data were presented on bionomic characters including adult longevity, preoviposition period, interval between matings, mating period, period between egg laying, number of eggs per batch, development periods for eggs and nymphal stages, head capsule growth, food requirements and feeding habits of the nymphs and adults.

9. Keys to eggs and adults are included.

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NOTES ON WISCONSIN PARASITIC FUNGI. XXVIII*

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The collections referred to in this series of notes were, unless indicated otherwise, made during the season of 1961. A considerable number of the fungus specimens cited were noted on phanerogamic specimens in the University of Wisconsin Herbarium and are designated (U. W. Phan.).

Undetermined powdery mildews have been noted on the following hosts, not previously reported as bearing any of these fungi in Wisconsin: *Eupatorium altissimum.* Dane Co., near Lodi, September 22, 1946. Coll. M. H. Ingraham (U. W. Phan.); *Ranunculus fascicularis.* Dane Co., near Cross Plains, May 23. A very early date for powdery mildews in this area; *Valeriana officinalis* (cult.). Sauk Co., Baraboo, July 15. Coll. K. C. Nelson. Very destructive on this host.

SPHAEROTHECA HUMULI (DC.) Burr. has been considered to be the powdery mildew infecting roses in Wisconsin. However, D. L. Coyier of the University of Wisconsin Plant Pathology Department, who has made an intensive study of the biology and control of rose powdery mildew, is unable to differentiate satisfactorily, on a morphological basis, between *S. humuli* and *S. pannosa* (Wallr.) Lev. The latter has been widely reported in Europe as the principal, if not the only, powdery mildew of roses there.

SPHAEROTHECA HUMULI (DC.) Burr., as the late J. J. Davis once pointed out, seems to produce cleistothecia on *Rubus* in Wisconsin only on *R. parviflorus* and *R. pubescens (triflorus)*, and is common on the last-named only. Powdery mildews on other Wisconsin species of *Rubus,* although labeled *S. humuli,* have conidia only and their identification must be considered as tentative. In three successive years in June in the Madison School Forest near Verona, Dane Co., the writer has observed a massive development of powdery mildew amphigenously on leaves of *Rubus allegheniensis,* which commonly also bear the *Caeoma* stage of *Gymnoconia peckiana* which, in turn, is usually parasitized by *Tuberculina.* Most of the infected shoots are killed back, but on such as persist not even incipient development of cleistothecia has been noted in the course of periodic inspection of the host plants throughout the growing

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season and, in fact, by mid-July there is little evidence remaining of the earlier powdery mildew infection.

SCORIAS SPONGIOSA (Schw.) Fr. on *Pinus strobus* was collected in August at Roche a Cri State Park, Adams Co., by J. D. Rogers of the University of Wisconsin Plant Pathology Department. Rogers belives the fungus is mildly parasitic on this host, and it may be so, as it occurs on the green needles in very sharp and well-defined fashion, as opposed to the "messy" superficial development so often characteristic of sooty molds.

MYCOSPHAERELLA sp., believed to be probably connected with *Cylindrosporium interstitialis* Greene (Trans. Wis. Acad. Sci. Arts Lett. 42:79. 1953), developed on overwintered leaves of *Spartina pectinata,* collected at the type station of *C. interstitialis* in the University of Wisconsin Arboretum at Madison, April 13, and held in a moist chamber for two weeks. The host plants had been under observation late in the preceding fall, at which time they still showed traces of the *Cylindrosporium* infection, which has appeared regularly every year, plus extensive development of the immature perithecia in the same areas on the leaves. Mature perithecia are black, subglobose, ostiolate, intercostal and seriate in long rows, and are approx. 85–100 μ diam. Asci are hyaline, clavate, straight or curved, 40–45 x 9–11 μ, the ascospores subhyaline, uniseptate, subfusoid, 11–13 x 3.5–4 μ. This is plainly not *Sphaerella spartinae* Ell. & Ev., described as having elliptical perithecia, 100–112 x 170–190 μ. A further specimen collected in early September 1961 reinforces my impression that there is a connection, for here the *Cylindrosporium* is abundantly present and the presumptive perithecia, which contain many micronidia, are developing in direct association with it.

LEPTOSPHAERIA sp. which possibly developed parasitically occurs on oval, dark purplish-bordered ashen spots on *Schizachne purpurascens,* collected by J. J. Davis near Laona, Forest Co., July 13, 1915. The blackish, globose perithecia are epiphyllous and gregarious, approx. 150 μ diam. The asci are short-pedicellate and narrowly cylindric, 65–70 x 8–9 μ. The greenish-olivaceous ascospores are about 25 x 5 μ and rather obscurely 5–7 septate.

NECTRIA CINNABARINA (Tode) Fr., with its accompanying *Tubercularia* stage, occurred in profusion on dead upper portions of otherwise still living stems of *Solanum dulcamara* at Madison, October 24, and may have been parasitic.

PHACIDIUM BALSAMEAE J. J. Davis (Trans. Wis. Acad. Sci. Arts Lett. 20:424. 1922) described on *Abies balsamea* from Vilas Co. has been studied by R. P. Korf, who states that the fungus belongs under *Sarcotrochila* Hoehn. of the Hemiphacidiceae.

Pucciniastrum americanum (Farl.) Arth. II, III has been noted heavily infecting the fruits of cultivated red raspberries of the everbearing type in a specimen collected by G. C. Klingbiel in October at Westfield, Marquette Co.

Melampsora (medusae Thum. ?) III was collected on *Populus nigra* var. *italica* at Madison, October 24. Oudemans reports *Melampsora* on Lombardy poplar in Europe and the U. S. D. A. Index of Plant Diseases lists *M. medusae* on the black poplar group in Massachusetts, Missouri and Pennsylvania.

Phyllostictae, undetermined as to species, have been collected on several hosts as follows: 1) On *Podophyllum peltatum* at Gov. Dodge State Park, Iowa Co., July 20. Pycnidia are on broad, distal reddish-brown dead areas of the leaf lobes, hypophyllous, clustered, black, globose, widely ostiolate, approx. 65–100 μ diam. with hyaline, rod-shaped microconidia, .6–1 x 3.5–5 μ. 2) On *Rubus alleghenienisis,* near Verona, Dane Co. August 3. Spots are dull reddish-brown, often with a yellowish halo, wedge-shaped and involving the entire apical area of a leaflet, orbicular, or oval-elongate, approx. .7–1.5 cm. wide by up to 3 cm. long. Pycnidia very inconspicuous, scattered, pallid, visible only by transmitted light, subglobose, about 100–175 μ diam., the conidia hyaline, variable, from almost isodiametric to long-cylindric, 5–11 x 2–3.5 μ. Mostly on, but not confined to, small, 3-foliate, axillary leaves produced near the tips of the fruiting canes. Except for the size of the pycnidia, 100–175 vs. 60–85 μ, this is quite similar to a fungus on *Rubus strigosus,* discussed in an earlier note (Trans. Wis. Acad. Sci. Arts Lett. 47:121. 1958). 3) On *Angelica atropurpurea* collected near Swan Lake, Pacific Twp., Columbia Co., July 18. This is definitely not *Phyllosticta angelicae* Sacc., a microconidial form mentioned in my Notes IX (Trans. Wis. Acad. Sci. Arts Lett. 38:240. 1946). In the current specimen the spots are rounded, sordid-brownish below but somewhat paler above, with narrow darker margins, about 1 cm. diam. The thin-walled, carneous, subglobose pycnidia are about 100 μ diam., hypophyllous and scattered, the conidia hyaline, broadly ellipsoid or short-cylindric, (3.5–) 4–6 (–7) μ. 4) On *Valeriana edulis* at the Faville Prairie Preserve near Lake Mills, Jefferson Co., September 20. In small amount on ashen to brownish orbicular spots about 1 cm. diam. Pycnidia are pallid-brownish, subglobose, approx. 100 μ diam., with a large ostiole about 15 μ diam. marked by a ring of darker cells. Conidia hyaline, often biguttulate, oblong, narrow-ellipsoid or subfusoid, approx. 4–6 x 2–3 μ. 5) On *Campanula rotundifolia* collected at Nelson Dewey State Park near Cassville, Grant Co., September 19, on dead current season's leaves and still green stems. Pycnidia black, globose, non-ostiolate, about 85–100 μ diam., closely gregarious on both leaves and stems. Conidia are hyaline and rod-shaped, 4–6 x 1–2 μ. It seems possible this may be identical with *Phoma groenlandica* Allesch., described as occurring on dead stems of *C. rotundifolia* from Greenland, which has conidia ovoid-oblong or oblong, 5–6 x 1.5–3 μ. There seems no question that the Wisconsin specimen developed parasitically. 6) On *Aster sagittifolius* from Gibraltar Rock County Park, Columbia Co., August 7. The spots are small and purplish with ashen centers, the pycnidia epiphyllous, pallid, small, about 75 μ diam. Conidia are hyaline, broadly ellipsoid, 1.8–2 x 3.5–4 μ. Very similar to a *Phyllosticta* on *Aster novae-angliae* mentioned in my Notes XXIV (Trans. Wis. Acad. Sci. Arts Lett. 47:102. 1958). The latter, however had slightly larger conidia.

CONIOTHYRIUM sp., possibly parasitic, occurred on *Rubus occidentalis* near Cross Plains, Dane Co., June 17, 1960. The small, irregularly rounded or angled spots are often confluent in lines and are sordid whitish with narrow red, or reddish-brown, margins. The pycnidia are epiphyllous, sparingly scattered on the spots, dark brown, widely ostiolate, approx. 100–125 μ diam. The deep-greenish spores are broadly ellipsoid, 4–5 x 2.5–3 μ.

CONIOTHYRIUM sp., on the decolorized fruits and involucral bracts of *Cornus obliqua,* collected by R. Peters near Merrimac, Sauk Co., August 24, 1958, suggests a parasitic development. The black, globose pycnidia are almost superficial and are gregarious on the affected tissue. The olivaceous conidia are broadly ellipsoid, 4.5–6 x 3–4 μ. (U. W. Phan.)

ASTEROMA PADI Grev. is evidently common on *Prunus padus* in Europe. In Wisconsin a macroscopically similar and very conspicuous *Asteroma*-like fungus occurs commonly in the fall on leaves of *Prunus serotina,* but so far no fruiting has been noted, so identity remains speculative.

ASTEROMA TILIAE Rud., or what is taken to be that species, is quite common on *Tilia americana* in Wisconsin and elsewhere in North America. The fungus was originally described on a specimen on *Tilia europea* from Bavaria and since there was no fruiting in the type specimen it would seem to be of dubious validity. In American specimens the radiating fibrillae of a typical *Asteroma* are usually evident only in rather immature, early-season collections. Later, the lesions appear as large, fuscous, orbicular blotches which may or may not, still provide a suggestion of *Asteroma,* but which, in numerous North American specimens examined, have always shown characteristic pycnidia, usually discerible, however, only on the lower side of the leaf. The pycnidia are scattered to gregarious, rather thin-walled, pallid-brownish, apparently non-ostiolate, but with the wall tending to be imperfectly formed at a point adjacent to the host epidermis. Pycnidia are very deeply seated, usually occupying most, or all, of the space from epidermis to epidermis. They are globose, subglobose, or somewhat flattened, approx. (70–) 90–110 (–125) μ diam. The conidiophores are rather loosely ranked, vaguely bottle-shaped, hyaline structures, about 10–15 x 3–5 μ, which almost completely line the pycnidial cavity. The conidia are hyaline, short-cylindric or slightly curved and suballantoid, (3–) 4–5 (–6) x (1.3–) 1.5–2 μ Occasional larger, hyaline, subfusoid conidia have been observed in a few mounts, but none have been seen in place within a pycnidium, so their origin is uncertain. Of six European specimens in the University of Wisconsin Cryptogamic Herbarium only one, on *Tilia platyphylla,* shows any fruiting. Here the pycnidia are from 125–150 μ diam., distinctly larger than in American specimens, and they are moreover rather plainly ostiolate, while the conidia are smaller, approx. 4–4.5 (–5) x 1.2–1.5 (–1.8) μ. Thus, it is morphologically close to, but apparently not identical with, the fungus on *Tilia americana.* Clements and Shear indicate that a decisive key character in *Asteroma* is lack of an ostiole, but this is not specified in the generic description.

STAGONOSPORA sp. occurs on pallid areas of overwintered leaves of *Carex trichocarpa,* collected in the University of Wisconsin Arboretum at Madison, March 16, 1961. The scattered to subseriate, subglobose, black pycnidia are about 200–225 μ diam. and the hyaline, broadly subfusoid conidia mostly 2–3, occasionally 4-septate, 40–50 x (6.5–) 7.5–8.5 μ. This infection had been noted in the fall of 1960, but at the time of inspection such pycnidia as were examined did not have the contents delimited, and the plants were marked for future reference. In the material as brought in from the field in the spring conidia were poorly defined, but after the leaves had been in a moist chamber for 48 hours very good conidial development was noted, with the septa clear and sharply defined.

SEPTORIA sp. occurs on the brownish tips of otherwise still living leaves of *Castilleja coccinea,* collected by M. F. Johnson near Bancroft, Portage Co., June 23. The gregarious pycnidia are thin-walled, grayish, inconspicuous, subglobose, small, about 50–70 μ diam. The hyaline spores appear continuous or rarely obscurely septate and are straight and somewhat larger at one end than at the other, 15–21 x 1–1.5 μ. I have found no report of any *Septoria* on this or other species of *Castilleja.*

COLLETOTRICHUM sp., which appears parasitic, is on leaves of *Apios tuberosa* collected near Juda, Green Co., August 12. The conspicuous spots are orbicular to somewhat angled, dull reddish-brown and mottled with lighter areas, approx. .5–1 cm. diam. The acervuli are small, scattered to gregarious, amphigenous, loosely organized, with from a single seta to half a dozen or so in a cluster, where they are moderately divergent, tapered uniformly from base to pointed tip, slightly sinuous, but in overall appearance straight and rigid, uniform clear brown, not appreciably paler near tip, 1–2 septate, approx. 65–85 x 4.5–5 μ. The conidia are hyaline, cylindric to subfusoid, contents granular, (10–)12–13 x 3–4.5 μ.

CYLINDROSPORIUM RUBI Ell. & Morg. was abundantly present on fruiting canes of dead and dying *Rubus* (cult. red raspberry) collected July 27 near Mt. Horeb, Dane Co. In section the acervuli are subepidermal and deeply seated in the corky layer. Whether the fungus was primary is somewhat doubtful, as the dry, cold, open winter of 1960–61 was very hard on many cultivated woody plants, and the plants in question were on a high, exposed site.

BOTRYTIS sp., possibly parasitic, was present in heavy development on terminal portions of leaves of *Hyacinthus orientalis* (cult.) near Cross Plains, Dane Co., June 9. It does not appear to be the same species often found on tulips in this region.

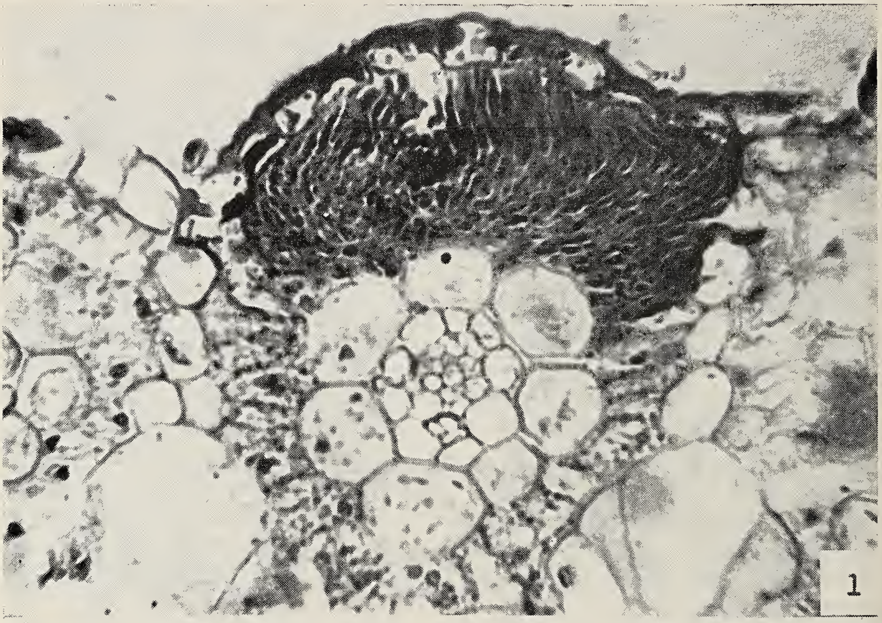
HELMINTHOSPORIUM sp. occurs on small, oval, grayish-brown spots on leaves of *Agrostis alba* collected near LaValle, Sauk Co., July 8. On heavily infected leaves the spots merge, with die-back of the entire leaf. The cylindric or subcylindric conidia are pallid grayish-brown, with hilum recessed, 55–75 x 11.5–13.5 μ, 4–6, mostly 5 septate, with little or no constriction at the septa. The conidiophores are dark brown below, from almost straight to somewhat tortuous, 2–3 times geniculate near the paler tip, about 140–215 x 7–8 μ, 4–7 septate, arising scattered individually, not in tufts. The spores seem similar in general characters to those described for *Helminthosporium gramineum* Rabh., but that species has the phores definitely tufted. Obviously not *H. sativum* Pamm., King & Bakke.

CERCOSPORA sp. occurred on leaves of *Salix adenophylla* (cult.) collected in the University of Wisconsin Arboretum at Madison, September 3. There are usually one to two or three spots per leaf. The spots are small, 1–2 mm. diam., with narrow dark borders and somewhat sunken whitish centers. The conidiophores are amphigenous, but mostly epiphyllous, in dense but spreading fascicles which are gregarious and mostly about 25–30 μ diam. at the base, but without any definite stroma. Viewed individually by transmitted light the conidiophores are pale olivaceous, non-septate, or rarely 1-septate, spreading and often tortuous and markedly geniculate near the tip, approx. 40–75 x 3.5–4.5 μ, many per fascicle. The better developed conidia are narrowly obclavate below, long-tapering toward the apex, truncate at base ,hyaline, indistinctly multiseptate, up to 100 x 4.5 μ. Others are merely obclavate, approx. 25–35 μ long, with the tips somewhat obtuse, truncate at base and about 3-septate. This does not correspond with either of the two species that Chupp mentions as occurring on *Salix* in his monographic treatment of *Cercospora*. These are *C. salicina* Ell. & Ev. and *C. salicis* Chupp & Greene, the latter based on a collection on *Salix alba* from Madison. The host plants were moved from the Lake Michigan shore in Manitowoc Co., and it is hoped it will be possible to visit this area to ascertain whether the fungus is naturally present there.

CERCOSPORA sp. has been noted on a phanerogamic specimen of *Primula mistissinica* Michx. var. *noveboracensis* Fern., collected by N. C. Fassett near Somerset, St. Croix Co., June 2, 1935. The numerous spots are sordid brownish and rounded and the infected leaves have been mostly killed back. The conidiophores are in small fasciclese from small stromata, olivaceous-brown, straight, approx. 12–25 x 3–3.5 μ. Conidia few remaining, those seen subhyaline, slender-obclavate, truncate at base, approx. 35–45 x 2.5–3 μ, 2–3 septate. Chupp mentions only *C. primulae* Fautr. as described on *Primula,* and he considers it to be a species of *Ramularia,* which this specimen certainly cannot be.

CERCOSPORA sp. occurs on *Valeriana edulis* collected September 20 at the Faville Prairie Preserve near Lake Mills, Jefferson Co. The sharply defined spots are rounded or oval with ashen-brown centers and dark brown borders, small, mostly about 2–3 mm. diam., and usually only one or two per leaf. The epiphyllous condiophores are olivaceous-brown below, somewhat paler above, widely spreading in clusters of approx. 5–15 from a small, compact, dark brown, substomatal stroma. The phores are decidedly geniculate and somewhat tortuous, about 5–7 septate, 95–140 x 4–5 μ. The conidia are hyaline, ranging from slender-obclavate and long-tapering to almost acicular, moderately curved, obscurely multiseptate, rounded at the base, with a noticeable scar, approx. 75–110 x 3–4 μ. Most of the conidia had fallen away and only half a dozen were measured, but these seemed characteristic. Chupp, in his monographic treatment of the Cercosporae, does not list any species on *Valeriana.*

Leaves of *Rhus copallina,* in plantings in the University of Wisconsin Arboretum at Madison, September 30, 1960, were infected by a sporodochium-producing fungus, so far undetermined, but well-marked and evidently strongly parasitic (Plate III, Fig. 6). The lesions are large, approx. 1–4 cm. diam., orbicular, or irregularly elongate and marginal, light brownish or sordid brownish above and usually subzonate with a narrow dark margin, the adjacent leaf areas often bright red. On the underside of the leaf the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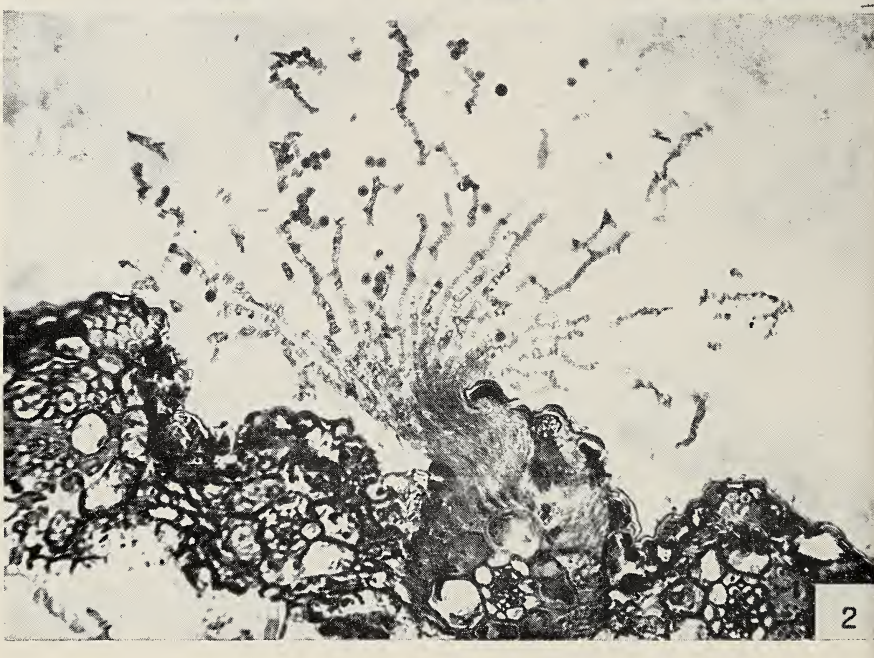
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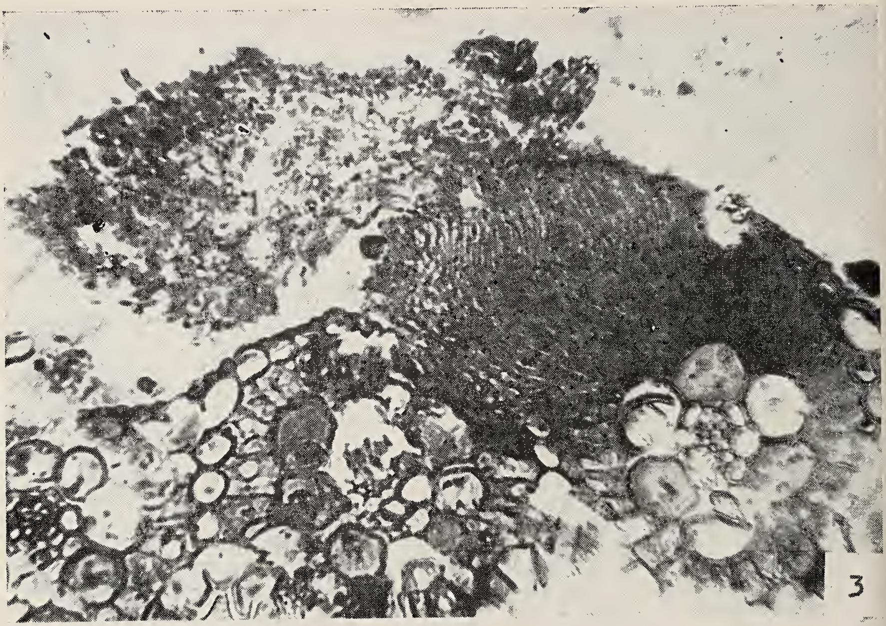
PLATE I

Explanation of Figures

Botrytis uredinicola Peck

Figure 1. Infection well advanced, but host epidermis still unruptured. The cells surrounding the vein sheath are filled with the hyphae of the parasite. Section 10 μ thick. $\times$ 410.

Figure 2. Mature fungus, showing spreading, anastomosing conidiophores, with conidia. Section 10 μ thick. $\times$ 235.



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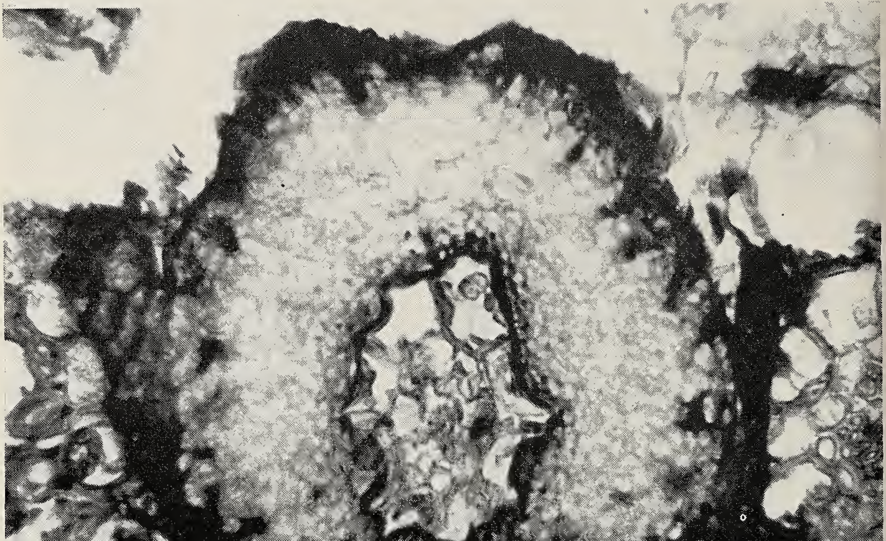

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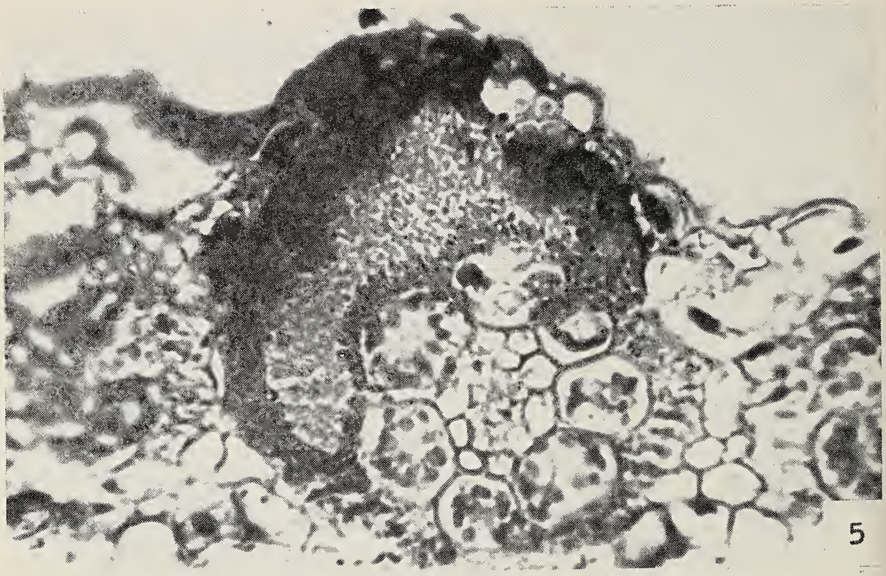
PLATE II

EXPLANATION OF FIGURES

Botrytis uredinicola Peck

FIGURE 3. Late season collection, showing breakdown of conidiophores and sclerotization of the mycelium around the veins. Section 15 μ thick. $\times$ 335.

FIGURE 4. Overwintering stage, with vein completely enveloped and the sheath crushed. The pseudoparenchymatous inner cells are filled with granular material. Section 10 μ thick. $\times$ 425.



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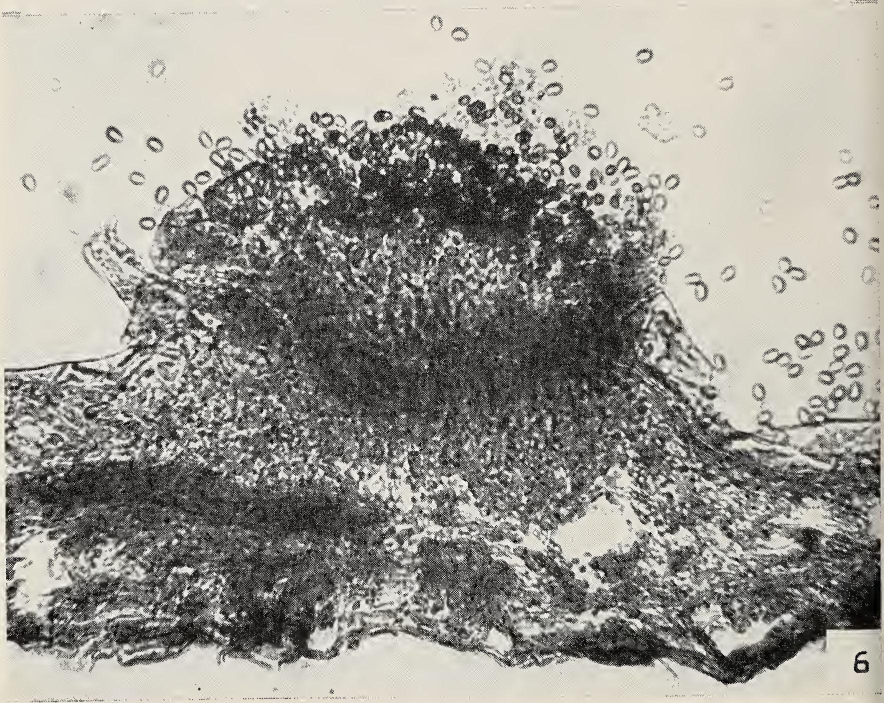

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PLATE III

Explanation of Figures

Figure 5. Botrytis uredinicola. Microconidial stage. The microconidia are escaping in a cirrhus, above and to the left. Section 10 μ thick. $\times$ 420.

Figure 6. Habit photo of free-hand section, in mounting fluid, of sporodoctium-forming fungus on Rhus copallina. $\times$ 315.

lesions are uniformly fuscous, immarginate and not zonate. The sporodochia are amphigenous, but more conspicuous and noticeable when epiphyllous, scattered to gregarious, rounded above and pulvinate, dull blackish, subcuticular and intraepidermal, or perhaps in some cases subepidermal in origin, elevated, but variable and sometimes wider than high. Thus, one sporodochium was approx. 180 μ high by 250 μ wide, while another was 230 μ high by 190 μ wide. There are many where the overall dimensions are less, but the measurements given seem representative. The conidiophores are in such a compact, non-separable, deep-brownish mass as to make individual description impractical. The conidia are brownish-olivaceous, smooth, broadly ellipsoid, or rarely subfusoid, (3–) 3.5–4 (–4.5) x (4.5–)5–6(–7) μ, very numerous, but appearing non-catenulate.

SCLEROTIOMYCES COLCHICUS Woronichin, the photosynthesis-retarding sooty mold mentioned in several previous notes has been collected at Gov. Dodge State Park, Iowa Co., September 19, on the following additional plant leaf substrates: *Corylus americana, Ranunculus septentrionalis, Geum canadense, Acer saccharum, Viola* sp. and *Phryma leptostachya.*

Sanguinaria canadensis, collected near Poynette, Columbia Co., June 7, 1960, bears numerous small, rounded to short-oblong, dark-bordered, ashen-brown spots on the still-green leaves. Present on the spots are *Phyllostictas,* a well-defined *Ascochyta,* a *Septoria,* an immature *Ascomycete,* a *Coniothyrium,* and probably others. Since the first three mentioned usually, if not always, are associated with parasitism, it seems possible but scarcely demonstrable that one or more were acting so in this instance. Winter described *Phyllosticta sanguinariae* on this host from Missouri, and one of the Phyllostictae mentioned has conidia in the size range specified by Winter.

ADDITIONAL HOSTS

The following hosts have not been previously recorded as bearing the fungi mentioned in Wisconsin.

PERONOSPORA PARASITICA (Pers.) Fr. on *Arabis shortii.* Rock Co., near Avon, May 26, 1947. Coll. J. Wickham. (U. W. Phan.)

SYZYGITES MEGALOCARPUS Ehrenb. ex Fr. (*Sporodinia grandis* Link) on *Lactarius trivialis.* Vilas Co., August 1910. On *Boletus felleus.* Sauk Co., Devils Lake, October 6, 1906. Both coll. R. A. Harper.

ERYSIPHE GRAMINIS DC. on *Poa nemoralis.* Fond du Lac Co., near Oakfield, July 4, 1932. Coll. N. C. Fassett (U. W. Phan.)

HYPOMYCES CHRYSOSPERMUS Tul. on *Boletus sphaerosporus.* Dane Co., Madison, October 1900. Coll. R. A. Harper.

PUCCINIA RECONDITA Rob. ex Desm. I on *Anemone riparia*. Rock Co., near Beloit, June 8, 1932. Coll. B. Anthoney. (U. W. Phan.)

PUCCINIA DIOICAE P. Magn. ii, III on overwintered leaves of *Carex debilis*. Juneau Co., Rocky Arbor Roadside Park, June 8, 1958. Coll. T. G. Hartley (U. W. Phan.). On *Carex cristatella*. Dane Co., Madison, July 16. Host det. J. H. Zimmerman.

PUCCINIA VIOLAE (Schum.) DC. I on *Viola adunca*. Washburn Co., near Spooner, June 18, 1897. (U. W. Phan.). II, III on *Viola sororia*. Lincoln Co., Schley Twp., August 23, 1955. Coll. F. C. Sey mour (U. W. Phan.)

GYMNOSPORANGIUM JUVENESCENS Kern I on *Amelanchier amabilis* Wieg. (*A. grandiflora* Wieg.) (cult.) Dane Co., Madison, June 26.

MELAMPSORA MEDUSAE Thum. II on *Populus balsamifera* (cult.). Dane Co., Madison, September 7. On leaves of rooted cuttings from a mature tree in the University of Wisconsin Arboretum. There has been a question as to the actual occurrence of *M. medusae* on balsam poplar in Wisconsin. Fungi Columbiani 3915, collected at Madison in 1910 on this host, was issued as *M. medusae*, but by later workers was somewhat tentatively placed under *M. occidentalis* Jacks., principally on the basis of spore size (Amer. Midl. Nat. 48: 39. 1952). In the present specimen the urediospores are well within the size range of *M. medusae* and show the extensive smooth areas on the wall, characteristic of the species.

EOCRONARTIUM MUSCICOLA (P. ex Fr.) Fitzp. on *Climacium dendroides*. Douglas Co., Brule, July 19, 1897. On *Hypnum cupressiforme*. Bayfield Co., between Herbster and Port Wing, July 8, 1897. On *Thuidium microphyllum*. Bayfield Co., Mason, July 6, 1896. All. coll. L. S. Cheney. Hosts det. R. I. Evans.

CERATOBASIDIUM ANCEPS (Bres. & Syd.) Jacks. on *Ranunculus abortivus*. Sauk Co., near LaValle, July 8.

NYCTALIS ASTEROPHORA Fr. on *Russula adusta*. Dane Co., Madison, August 1, 1903. Coll. R. H. Denniston. On *Russula sordida*. Same station, August 5, 1903. Coll. R. A. Harper.

PHYLLOSTICTA PHASEOLINA Sacc. on *Strophostyles leiosperma*. Waushara Co., near Hancock, September 14, 1957. Coll. M. Spalding. (U. W. Phan.)

PHYLLOSTICTA MINUTISSIMA Ell. & Ev. on *Acer spicatum*. Sauk Co., Parfrey's Glen, Town of Merrimac, September 16, 1959.

PHYLLOSTICTA VIOLAE Desm. on *Viola selkirkii*. Clark Co. near Stanley, June 5, 1948. Coll. M. Bergseng. (U. W. Phan.)

PHYLLOSTICTA DECIDUA Ell. & Kell. on *Myosotis scorpioides*. Ozaukee Co., Thiensville, June 20, 1925. Coll. S. C. Wadmond. (U. W. Phan.)

PHOMOPSIS HIERACII H. C. Greene on *Hieracium aurantiacum.* Columbia Co., Gilbraltar Rock County Park, August 7. Scolecospores were not observed in mounts made from this specimen, but in all other respects it is identical with the type on *Hieracium longipilum.*

CONIOTHYRIUM FUCKELII Sacc. on *Rubus allegheniensis.* Dane Co., near Verona, August 3. Appearing parasitic and similar to material collected many years ago on *Rubus pubescens* at Madison.

ASCOCHYTA EQUISETI (Desm.) Grove on *Equisetum fluviatile.* Sawyer Co., near Barker Lake, Draper Twp., September 1, 1959. Coll. D. Ugent. On a specimen in the University of Wisconsin Herbarium. Many of the acervuli show a microconidial, rather than the *Ascochyta* stage. The writer (Amer. Midl. Nat. 44:639. 1950) also made this combination, overlooking the fact that Grove had done so some years previously.

ASCOCHYTA GRAMINICOLA Sacc. (*A. sorghi* Sacc.) on *Poa palustris.* Dane Co., Madison, July 14. Very heavy infection on the lower leaves, which were entirely killed back. On *Muhlenbergia mexicana* (L.) Trin. Dane Co., Madison, September 8. An earlier report on *Muhlenbergia "foliosa"* probably referred to *M. mexicana,* but this cannot be ascertained from the herbarium specimen.

ASCOCHYTA ASCLEPIADIS Ell. & Ev. on *Asclepias syriaca.* Iowa Co., Gov. Dodge State Park, July 20.

ASCOCHYTA COMPOSITARUM J. J. Davis on *Aster lateriflorus.* Dane Co., near Verona, August 3.

SEPTORIA MISSISSIPPIENSIS R. Sprague on *Muhlenbergia mexicana* (L.) Trin. Columbia Co., near Wyocena, July 18. Host determinations of *Muhlenbergia* are based on the treatment in Fassett's "Grasses of Wisconsin".

SEPTORIA SALICINIA Pack on *Salix serissima.* Dane Co., Madison, September 3. An examination of various specimens of *S. salicina* in the Wisconsin Herbarium indicates no great violence would be done if this species were transferred to *Cylindrosporium.*

SEPTORIA LUDWIGIAE Cooke on *Ludvigia polycarpa.* Milwaukee Co., Milwaukee, August 1884. Coll. E. E. Hasse. On a phanerogamic specimen in the Herbarium of the Milwaukee Public Museum.

SEPTORIA OENOTHERAE West on *Oenothera strigosa,* Dane Co., Madison, August 1, 1907. Coll. J. R. Heddle. Host det. D. Ugent. On *Oenothera caespitosa.* Madison, August 23. On a planting in the University of Wisconsin Arboretum.

SEPTORIA CORNICOLA Desm. var. AMPLA H. C. Greene on *Cornus rugosa* (cult.). Dane Co., Madison, October 4.

SEPTORIA DODECATHEONIS J. J. Davis on *Dodecatheon amethystinum* Fassett. Crawford Co., Prairie du Chien, June 2, 1928. Coll. N. C. Fassett. This is the type specimen of the host, which consists of two plants mounted on one sheet, only one of which, however, bears the *Septoria.*

SEPTORIA HELIANTHI Ell. & Kell. on *Helianthus giganteus.* Buffalo Co., near Mondovi, August 25, 1956. Coll. H. H. Iltis. (U. W. Phan.)

SEPTORIA HIERACICOLA Dearn. & House on *Hieracium scabrum.* Iowa Co., Tower Hill State Park, October 5. On *H. florentinum.* Forest Co., near Cavour, August 27, 1958. Coll. K. S. Snell. (U. W. Phan.)

SELENOPHOMA BROMIGENA (Sacc.) Spr. & Johns. on *Bromus latiglumis.* Sauk Co., near Leland, July 12, 1942. (U. W. Phan.). R. Sprague reports a collection of *S. bromigena* on *Bromus purgans* from Iron Co. near Hurley, August 1959, but the presence of *B. purgans* in this part of Wisconsin seems questionable.

HAINESIA LYTHRI (Desm.) Hoehn. on *Oenothera caespitosa.* Dane Co., University of Wisconsin Arboretum, Madison, August 23.

CRYPTOCLINE BETULARUM (Ell. & Mart.) v. Arx (*Gloeosporium betularum* E. & M.) on *Betula lenta* (cult.). Dane Co., Madison, July 26.

GLOEOSPORIDIELLA VARIABILE (Laub.) v. Arx (*Gloeosporium variablile* Laub.) on *Ribes missouriense.* Lafayette Co., Ipswich, August 15. This was found on cultivated *Ribes alpinum* in Wisconsin in 1960. It seems worth noting that in all five collections of this species in the University of Wisconsin Cryptogamic Herbarium the fruiting is uniformly hypophyllous, in contrast to the normally epiphyllous *Gloeosporium ribis.*

COLLETOTRICHUM GRAMINICOLA (Ces.) Wils. on *Elymus villosus.* Columbia Co., Gibraltar Rock County Park, August 7. On *Paspalum stramineum.* Crawford Co., Prairie du Chien, September 15, 1940. Coll. N. C. Fassett. (U. W. Phan.)

COLLETOTRICHUM VIOLAE-ROTUNDIFOLIAE (Sacc.) House on *Viola affinis.* Outagamie Co., near Freedom, August 16, 1948. Coll. F. C. Seymour. (U. W. Phan.). On *V. septentrionalis.* Vernon Co., near Viroqua, June 2, 1929. Coll. H. P. Hansen. (U. W. Phan.)

SPHACELOMA MURRAYAE Jenkins & Grodsinsky on *Salix petiolaris.* Jefferson Co., Faville Prairie Preserve near Lake Mills, September 20.

MARSSONINA KRIEGERIANA (Bres.) Magn. on *Salix serissima.* Shawano Co., Shawano, September 1, 1921; also Door Co., Fish Creek, September 27, 1919. Both specimens were collected by J. J. Davis as occurring on *Salix lucida,* but later redetermined, no doubt correctly, as *S. serissima,* and heretofore overlooked in the Wisconsin lists.

DIPLOCLADIUM MINUS Bon. on *Polystictus pergamenus.* Dane Co., Madison, May 2. Although Clements & Shear in their "Genera of Fungi" list *Diplocladium* as a saprophyte, specimens seen by the writer strongly suggest otherwise, so the fungus is recorded as at least a questionable parasite.

RAMULARIA AEQUIVOCA (Ces.) Sacc. on *Ranunculus sceleratus.* Dodge Co., near Reeseville, May 17, 1931. Coll. J. W. Rhodes. (U. W. Phan.)

CERCOSPORA BETICOLA Sacc. on *Chenopodium botrys.* Grant Co., near Wyalusing, September 1, 1957. Coll. H. H. Iltis and P. Salamun. (U. W. Phan.)

CERCOSPORA DUBIA (Riess.) Wint. on *Chenopodium berlandieri* var. *zschackei.* St. Croix Co., near Hudson, September 12, 1956. Coll. C. W. Lemke. (U. W. Phan.)

CERCOSPORA VIOLAE Sacc. on *Viola rostrata.* Sheboygan Co., near Ada, August 9, 1959. Coll. H. H. Iltis. (U. W. Phan.). On *V. adunca.* Vilas Co., near Boulder Junction, August 17, 1956. Coll. J. T. Curtis. (U. W. Phan.).

CERCOSPORA GRANULIFORMIS Ell. & Holw. on *Viola novae-angliae.* Lincoln Co., Pine River Dells, August 18, 1952. Coll. F. C. Seymour. (U. W. Phan.)

ADDITIONAL SPECIES

The fungi mentioned here have not been previously reported as occurring in the state of Wisconsin.

CELIDIUM PULVINATUM Rehm in Rabh. on *Lecanora* sp. Lafayette Co., near Belmont, July 20, 1960. Coll. K. G. Foote. Det. J. W. Thomson.

PYRENIELLA LECANORI Keissler on *Lecanora* sp. Grant Co., across Wisconsin River from Bridgeport, July 24, 1960. Coll. K. G. Foote. Det. J. W. Thomson.

NORRLINIA PELTIGERICOLA (Nyl.) Theiss. & Syd. on *Bacidia* sp. Richland Co., near Yuba, July 27, 1960. Coll. K. G. Foote. The large, many celled, muriform ascospores are up to about 70 x 30 μ, mostly two, but occasionally three per ascus. A rarely seen and apparently little-known species.

HYPOCREA SULPHUREA (Schw.) Sacc. on *Exidia glandulosa.* Iowa Co., Blue Mounds, November 1904. Coll. R. A. Harper.

ORBILIA EPIPORA (Nyl.) Karst. on *Fomes fomentarius.* Sauk Co., Devils Lake, July 2, 1904. Probably parasitic. Coll. R. A. Harper.

TAPHRINA DEARNESSII Jenkins on *Acer rubrum*. Douglas Co., near Solon Springs, June 12. Coll. Mrs. R. McMinn; Barron Co., June 10. Coll. W. Klanderman. Both specimens comm. E. K. Wade. The disease was said to be quite severe in Barron Co.

Microthyrium rubicolum sp. nov.

Fructificationibus nigris, orbibus, applanatis, superficialibus, gregariis, ca. 225–450 μ diam., plerumque 350 μ; scutellis compositis cellis nigris, muris crassis, isodiametris vel oblongatis vel irregularibus, fissilibus irregulariter; aparaphysatis; ascis subhyalinis, formis variabilibus, subsphaericis vel clavatis late vel clavatis tantum, 20–40 x 11–17 μ, crassitudinibus muris variabilibus; ascosporis subhyalinis, subcylindraceis, uniseptatis, constrictis leniter, 12–14 x 3.5–4.5 μ.

Fruiting bodies black, rounded, applanate, superficial, gregarious, approx. 225–450 μ diam., mostly about 350 μ; scutellum composed of black, thick-walled isodiametric to oblong or irregularly shaped cells, splitting irregularly at maturity of ascoma; aparaphysate; asci subhyaline, variable in shape from subspherical to broadly obclavate, or merely clavate, 20–40 x 11–17 μ, ascus wall usually moderately to much thicker in one region than in remainder of wall; ascospores subhyaline, subcylindric, uniseptate, slightly constricted at septum, 12–14 x 3.5–4.5 μ.

On still green, early-season fruiting canes of *Rubus allegheniensis*. Madison School Forest near Verona, Dane County, Wisconsin, U. S. A., June 22, 1961.

One of the cells of the ascospore is slightly wider and more obtuse than the other. Arrangement of spores in the ascus is variable, depending on the shape of the particular ascus. This fungus bears little similarity to *Microthyrium rubi* Niessl which has fruiting bodies about 100 μ diam., and asci 48–50 x 7–8 μ.

RHIZOSPHAERA ABIETIS Mangin & Hariot on *Abies balsamea*. Vilas Co., near Eagle River, May 4. Coll. R. F. Patton. Described in the Bull. Soc. Mycol. France 23: 54–61. 1907 as a new genus and species. Shortly thereafter Maublanc made the new combination *Rhizosphaera pini* (Cda.) Maub., asserting that *Coniothyrium pini* Cda. is identical with *R. abietis*. As *R. pini* the fungus is reported, in the U. S. D. A. Index of Plant Diseases, as occurring on *Abies fraseri* in North Carolina, but there seems to be no previous record on *A. balsamea*.

Phomopsis thalictri sp. nov.

Maculis conspicuis, sordido-cinereis vel obscuro-brunneis, orbicularibus vel cuneatis vel elongatis, marginibus fuscioribus, angustis, ca. .5–1.5 cm. diam.; pycnidiis epiphyllis, sparsis vel gregariis, nigris, applanatis vel subglobosis, ca. 150–215 μ diam., ostiolatis latis; A-conidiis subfusoideis, hyalinis, saepe biguttulosis, 9–16 x (2.5–)3.5–4.5 μ, B-conidiis curvis laxe, hyalinis, attenuatis, ca. 18–35 x 1–1.5 μ, raro latior.

Spots conspicuous, sordid ashen to dull brown, orbicular, wedge-shaped, or elongate, with narrow darker margin, approx. .5–1.5 cm. diam.; ostioles wide, delimited by a conspicuous ring of blackish, thick-walled cells; A-type conidia subfusoid, hyaline, often biguttulate, 9–16 x (2.5–)3.5–4.5 μ, B-type conidia laxly curved, hyaline, tapered, about 18–35 x 1–1.5 μ, or rarely a little wider.

On living leaflets (rarely on petioles) of *Thalictrum dasycarpum.* University of Wisconsin Arboretum, Madison, Dane County Wisconsin, U. S. A., August 21, 1961.

The plants bearing this leaf parasite appeared otherwise healthy, but among them and adjacent to them, were current season's plants of *T. dasycarpum* which were completely dead and brown. On their stems and on the branches of the inflorescence are numerous applanate, black pycnidia very similar in appearance to those described on the leaves. However, so far as is shown by examination of a number of them, these pycnidia contain only very numerous scolecospores which are produced on closely ranked, flask-shaped conidiophores, and are quite similar in size and appearance to the B-spores described above. While it seems possible there is a connection with *Phomopsis thalictri,* it cannot be regarded as demonstrated, since no intergradation between the two has been observed. Specimens of the fungus on stems have been filed in the University of Wisconsin Cryptogamic Herbarium as *Rhabdospora* sp. for the time being.

Septoria chaenorrhini sp. nov.

Maculis nullis; pycnidiis subepidermidibus, amphigenis, nigris, globosis, gregariis prope vel confertis, ostiolis indistinctis, muris tenuioribus supra, parvis, ca. 45–75 μ diam.; conidiis gracilibus, hyalinis, continuis, rectis fere vel curvis leniter, raro curvis admodum, (15–) 18–28 x (1.2–) 1.5–2 μ.

Spots none, pycnidia subepidermal, amphigenous, black, globose, closely gregarious to crowded, no distinct ostiole, the wall thinner above, small, approx. 45–75 μ diam.; conidia slender, hyaline, continuous, from almost straight to slightly curved, or rarely strongly curved, (15–)18–28 x (1.2–)1.5–2 μ.

On the leaves and inflorescence of *Chaenorrhinum minus (Linaria minor)*. On Milwaukee R. R. right-of-way one mile east of Juda, Green County, Wisconsin, U. S. A., August 12, 1961.

S. chaenorrhini does not correspond to species of *Septoria* described on *Linaria* from the Old World, and is very different from *Septoria linariae* H. C. Greene (Trans. Wis. Acad. Sci. Arxa Lett. 35:130. 1944) which occurs on *Linaria canadensis* in Wisconsin.

COLLETOTRICHUM VIOLAE-TRICOLORIS R. E. Smith on *Viola tricolor* (cult.). Waupaca Co. near Ogdensburg, September 16, 1960. Coll. L. Hansen. On green stems.

Colletotrichum helianthi J. J. Davis var. **macromaculans** var. nov.

Maculis orbicularibus, marginibus flavo-brunneis, latis aliquanto, centris fusco-brunneis magnis conspicuisque, definitis, 1–2.5 cm. diam.; acervulis amphigenis, sparsis; setis 65–100 x 3.5–4.5 μ, 1–3 septatis; conidiis sublunatis vel falcatis, 18–23 x 2.5–3.5 μ.

Spots orbicular, with rather wide yellowish-brown margins and sooty-brown centers, large and conspicuous, sharply defined, 1–2.5 cm. diam., acervuli amphigenous, scattered but numerous; setae 65–100 x 3.5–4.5 μ, 1–3 septate; conidia sublunate or falcate, 18–23 x 2.5–3.5 μ.

On living leaves of *Helianthus strumosus*. Gibraltar Rock County Park, Columbia County, Wisconsin, U. S. A., August 7, 1961.

This is not sufficiently different from *C. helianthi* to warrant description as a new species, but it does seem to be of varietal rank and has been collected once earlier at the same station in 1952 (Amer. Midl. Nat. 50:503. 1953). In *C. helianthi* the spots, while likewise sharply delimited, are not ordinarily over 3–5 mm. diam. and the acervuli are strictly epiphyllous. *C. helianthi*, aside from the spots it produces, is larger and coarser than var. *macromaculans*, with the setae 80–150 x 3–5 μ, the conidia 25–35 x 2.5–3.5 μ, and often, but not always, somewhat fusoid in shape.

MYCOGONE ROSEA Link on *Cortinarius* sp. Dane Co., Madison, October 10. Coll. M. Hemphill.

BOTRYTIS UREDINICOLA Peck occurred in considerable profusion on leaves of *Panicum virgatum* in the University of Wisconsin Arboretum at Madison in the summer of 1960. This fungus is sadly misnamed, inasmuch as it does not appear to belong in *Botrytis*, as that genus is generally understood, and is not parasitic on a rust, or necessarily even associated with one. Careful examination of ample specimens of the Fungi Columbiani series, Nos. 2907 and 4607, both labeled as indicating the fungus to be on or associated with *Uromyces graminicola* Burr., shows no trace of rust, but excellent development of the "*Botrytis*". No. 2907 is presumably type material. Most of the Wisconsin collections likewise bear no rust, although some leaves do have sori of *Puccinia panici* Diet. which is very common on *P. virgatum* in Wisconsin. The fungus is amphigenous, but mostly on the adaxial leaf surface. It is obviously a strong parasite and sections show it to be very deep-seated in the xeric leaves. The fructification tends to be elongate, probably a response to the spatial situation resulting from the prominent, closely parallel veins. As fall progressed it was noted that the fruiting structures were becoming black and sclerotized, suggesting the development of an overwintering condition and possible formation of a perfect stage. In an attempt to learn some details of the life history of this interesting fungus material, ranging from that of young, new infections to that obviously old and strongly sclerotic, was fixed, imbedded, sectioned and stained. As the accompanying photographs show, from a very early stage, preceding rupture of the epidermis, the fungus is in close contact with the sheath of a host vein and, as development proceeds, in most cases tends to completely envelop the sheath and ultimately to crush the sheath cells. With increasing sclerotization the compacted, isodiametric, but still hyaline inner cells of the fructification display a markedly granular content. In some instances, however, as illustrated in Plate III, Fig. 5, less completely sclerotized overwintering bodies are filled with small, hyaline, rod-shaped microconidia (spermogonial cells?). In the latter part of March 1961 a collection of naturally overwintered leaves bearing the sclerotic structures developed the previous fall was collected in the field. On microscopic examination there was no evidence of an incipient perfect stage, other than the microconidia just mentioned, but some of the leaves were placed in a moist chamber at room temperature to see whether further development could be stimulated. After about two weeks the characteristic snow-white conidiophores and conidia of *B. uredinicola* were produced from the overwintering structures. The spring was abnormally dry and cold, but on June 16 the fungus was observed in the field in full development on overwintered leaves. Thus, it is evident that the fungus may, and perhaps regularly does, overwinter without subsequent formation of a perfect stage. Early in July abundant infection of the new 1961 leaves was noted, completing the cycle. Dr. Roderick Sprague has studied this material and considers that is is very close to, but perhaps not identical with, *Sporotrichum peribebuyense* Speg. which occurs in North America on species of *Setaria* and which Sprague has discussed in his "Diseases of Cereals and Grasses in North America".

FOREST CUTTING AND SPREAD OF SPHAGNUM IN NORTHERN WISCONSIN[1]

THEO. KELLER and K. G. WATTERSTON[2]
University of Wisconsin, Madison

A large total area in northern Wisconsin is now occupied by semi-swamp soils of a rather unusual morphology and uncertain origin. The surface "mor" layer of these soils is largely made up of live bog moss, comprising the "stratum superficiale" or S-horizon or Førsslund (1945). This layer, attains a thickness of 7 inches and is underlain by a narrow zone of dark-brown, nearly black macerated organic remains (H). The substratum consists of a leached, usually water-logged silty clay loam with pronounced mottling (G). Whether these soils are of a "climax' 'nature, or temporary post-logging developments is a matter of conjecture.

A solution to this problem, however, was suggested by observations of effects of partial cuttings of spruce and balsam fir stands on fine textured gley-podzolic soils, initiated in the late forties in the Gagen Forest Management Unit of the Consolidated Water Power & Paper Co., Oneida County. After a few years, the results of these cuttings indicated that a heavy opening of the canopy invites an invasion of mosses, particularly *Sphagnum* spp. Alteration of this kind threatened a deterioration of site conditions and subsequent decrease of increment of the thinned stands. Therefore, as a reconnaissance measure, in the spring of 1955 four 7 by 7 feet plots were staked out on a fine textured gley-podzolic soil, underlain by a ground water at a depth of 2½ feet. The soil was supporting an open, 40-year old stand of volunteer black spruce with sporadic small patches of *Sphagnum, Polytrichum, Hypnum, Hylocomium* and *Dicranum* spp., and a rather dense cover of *Vaccinium myrtilloides, Cornus canadensis, Clintonia borealis, Equisetum silvaticum, Ledum groenlandicum and Maianthemum canadense.* Two of the plots were placed under a fairly dense canopy of trees, and two in small openings where the timber was partly removed. The existing cover of *Sphagnum* was carefully mapped on cross-hatched paper

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[2] Forest Physiologist, Swiss Forest Research Institute, and Research Assistant in Soils, University of Wisconsin. The authors are indebted to Mr. John W. Macon, Dr. J. G. Iyer, and Prof. S. A. Wilde for assistance in different phases of this study.

by subdividing the plots into quadrats measuring 144 sq. inches each.

The results of a re-survey of these plots in summer of 1961 revealed no changes in the distribution of bog moss under dense cover of trees, but an appreciable enlargement of its area in the thinned stand, as shown in Figure 1. This indicated that at least some gley-podzolic soils of northern Wisconsin upon the removal of forest cover are being converted into semi-swamps of "moss-mor" soils in

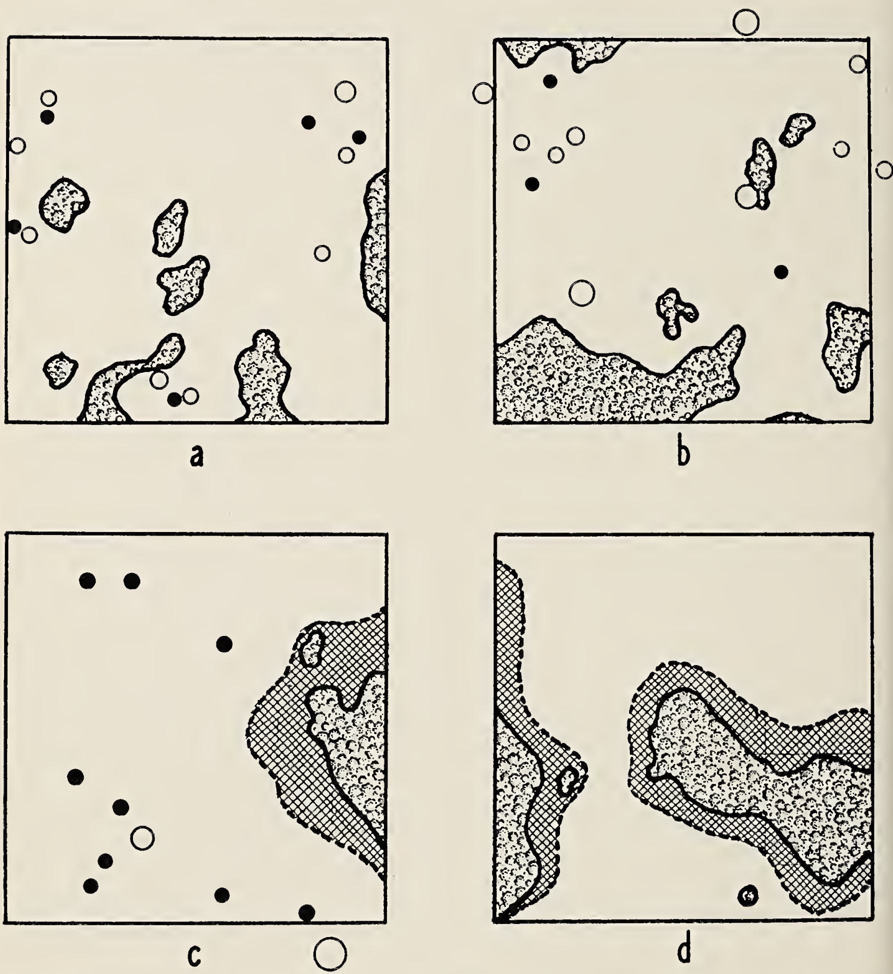

FIGURE 1. Effect of forest cover on the distribution of *Sphagnum:* a and b plots were established under the canopy of trees, c and d plots were established in open area. Cross-hatching indicates the spread of bog moss during the period 7.1955–6.1961. Open and block circles denote live and dead trees, respectively.

a manner similar to soils of Scandinavian countries (Hesselman, 1928; Malström, 1931).

The spread of *Sphagnum* on this site proceeded at a rather slow rate. Within a 6-year period it invaded about 6 square feet in each of the squares and at this rate it would take nearly 50 years to occupy the entire area of 50 sq. feet.

This calculation, however, proved to be in discord with observations made on an adjacent area where the basal area of a dense stand of black spruce was reduced by thinning in 1954 to about 50 sq. feet per acre. Nearly all cut stems and branches, left on the ground, were found to be covered with a 2 to 4 inch thick blanket of *Sphagnum.* This proved that, under conditions favoring its distribution, the *Sphagnum* can take over the area of a heavily thinned stand in a period of less than 10 years.

The different behavior of bog moss may be attributed to the occurrence of much more vigorous ground cover of low shrubs on the study site in comparison with that of the thinned stand. This would imply that the distribution of bog moss is checked not only by the canopy of trees, but also by the competition of ground cover plants; blueberries with their powerful root systems which dry the surface soil layer, are likely to present a particularly formidable barrier to the encroachment of the water demanding *Sphagnum.* Therefore, it can be assumed that areas of dense stands with no understory of low shrubs would exhibit upon a heavy cutting a much faster spread of bog moss than the areas on which its rate of spread has been already slowed by competing plants.

Observations of the ground water level in soils of fully stocked and periodically cut stands suggested that the process of swamp formation or paludization is accomplished by a combined influence of the true or phreatic ground water and puddled or vadose water.

The bog moss is known to exert several unfavorable effects on the growth of most higher plants: it imparts to the surface soil layer a strong acidity, produces a local saturated condition which impedes soil aeration, and impoverishes the invaded soils by storing nutrients in its accumulating tissues; it possesses a high insulating capacity which keeps the underlying soil at a temperature below 60° F even when the air temperature exceeds 85° F, and thus interferes with the normal transpiration of trees. According to previous observations (Wilde et al., 1954), the invasion of *Sphagnum* can reduce the annual increment of black spruce on podzolized soils from 0.4 to a mere 0.1 cord per acre.

Consequently, in localities vulnerable to invasion of bog moss, considerable caution should be exercised in partial cuttings of stands on soils underlain at a shallow depth by the ground water table or possessing inadequate permeability. The higher cost of conservative cuttings, precluding the spread of *Sphagnum,* is likely to be fully compensated by a higher increment and better quality of wood. In some instances, the use of herbicides may attain far-reaching importance in silvicultural management of stands on gley-podzolic soils.

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PRELIMINARY REPORTS ON THE FLORA OF WISCONSIN. NO. 47. THE ORDERS THYMELAEALES, MYRTALES, AND CACTALES[1]

DONALD UGENT
Herbarium of the University of Wisconsin

This treatment includes all the families in Wisconsin with free petals and inferior ovary, or ovary superior and enclosed by a tubular or campanulate persistent calyx, except the Nyssaceae, Araliaceae, Umbelliferae and Cornaceae. The Haloragidaceae and the Hippuridaceae, although included, have been treated in greater detail by Fassett (1930). Nomenclature and descriptions generally follow *The New Britton and Brown Illustrated Flora* (Gleason, 1952) and *Gray's Manual of Botany*, Ed. 8 (Fernald, 1950).

Distribution maps, habitat data, and flowering dates are based on specimens in the following herbaria: University of Wisconsin (WIS); Milwaukee Public Museum (MIL); University of Minnesota (MINN); Northland College, Ashland; Platteville State College; and Saint Norbert's College, De Pere. Other sources of information are cited in the text. Dots indicate specific location, triangles county records without specific locality. Small dots in Lincoln County represent sight records of Frank C. Seymour. Triangles in Illinois counties are based on Jones and Fuller (1955). Numbers in the enclosures on the maps indicate the number of specimens in flower and fruit. Specimens in bud, very young fruit, or vegetative condition are not included. These figures give a rough, though low, estimate of the amount of material that was available for this study and an indication of when a species is apt to flower or fruit in Wisconsin.

Grateful acknowledgement for the loan of their Wisconsin specimens are due to Albert M. Fuller and Emil P. Kruschke, Milwaukee Public Museum; Thomas Morley, acting curator, University of Minnesota; Peter J. Salamun, University of Wisconsin–Milwaukee; Henry C. Greene, curator, Cryptogamic Herbarium, University of Wisconsin; Russell D. Wagner, Platteville State College; and Franklin C. Lane, Northland College. Thanks are also due Mrs. Katherine S. Snell, herbarium assistant, for her cheerful encouragement and assistance; Miss Kathryn L. Wollangk who assisted in the preparation of *Epilobium* scatter-diagrams; Mrs. Janice Paynter for illus-

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Frontispiece. Water-Willow (*Decodon verticillatus* var. *laevigatus*), of the Lythraceae, forming a solid border along Allequash Creek, on Trout Lake in Vilas County, photographed by H. H. Iltis in June, 1962. Later in the summer, the branches elongate and arch into the water, where they root. Eventually they break off, and overwinter to start a new plant next spring. The species is well-known from the Pleistocene fossil record of Europe, but to day only occurs in Eastern North America.

trations of *Oenothera* and *Epilobium;* and especially to Dr. Hugh H. Iltis for his assistance and advice in the preparation of this report as well as for his critical reading of the manuscript.

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ORDER THYMELAEALES

Trees or shrubs with alternate or opposite, exstipulate leaves. Flowers commonly 4–5-merous, perfect or unisexual, regular, perigynous, petalous or apetalous. Stamens usually as many or twice as many as the sepals. Ovary superior, 1-celled, carpels 2-many, with a single suspended ovule. Fruit a nutlet or drupe.

KEY TO FAMILIES

A. Leaves green; flowers perfect, the calyx bearing 8 stamens and free from the ovary, which forms a berry-like drupe in fruit .... THYMELAEACEAE, page 85

AA. Leaves silvery-scurfy with stellate hairs or scales; flowers perfect or dioecious, the calyx bearing 4 or 8 stamens and in the perfect or pistillate flowers becoming pulpy and berry-like in fruit, strictly enclosing the achene .... ELAEAGNACEAE, page 86

THYMELAECEAE—MEZEREUM FAMILY

Small trees or shrubs with simple, alternate, entire leaves. Flowers regular, perfect, perigynous, 4–5-merous. Petals lacking or represented by scales. Sepals often petal-like, united into a tube at least at the base, and bearing usually twice as many stamens as its lobes. Ovary superior, 1-celled, 1-ovuled. Fruit a drupe.

1. DIRCA L. LEATHERWOOD

1. DIRCA PALUSTRIS L. Leatherwood; Rope-Bark. Map 1.

Shrub 1–3 m high; branchlets jointed, the bark fibrous and very tough (hence common name). Leaves alternate, broadly oval-obovate, entire, 2–9 (–11) cm long, on very short petioles 1–3 mm long, *their bases concealing the dark-hairy buds of the next season.* Flowers light yellow, 5–10 mm long, preceding the leaves. Petals none. Stamens 8, exserted, the alternate ones longer. Drupe ellipsoid, pale green or yellowish, often drying red, 5–11 mm long(see McVaugh, 1941).

Throughout the state, though most common north of the "tension zone", in rich mesic Northern Hemlock Hardwood and Maple-Basswood forests, in the east in Oak-Beech and Beech forests, sporadic in southern Wisconsin in rich Oak or Maple woods, occasionally in moist or wet thickets. Flowering from late March through May (mid-June), and fruiting from late April to mid-June.

The remarkably pliable and strong bark was used by the Indians for thongs in making canoes, bow strings, and fish lines. The bark is poisonous, acting as a violent emetic.

ELAEAGNACEAE—OLEASTER FAMILY

Trees or shrubs covered with silvery or golden-brown peltate or stellate scales. Leaves entire, alternate or opposite. *Flowers* small, *perfect or dioecious,* regular, perigynous, in axillary clusters or rarely solitary. Petals none. Sepals often petal-like, 2–4-lobed, alternating with as many or twice as many stamens. Ovary 1-celled, 1-ovuled, becoming fleshy in fruit.

Represented in our area by one native species and two introduced ornamentals: *Shepherdia argentea* Nutt., the Buffalo Berry, an occasionally cultivated shrub, has dioecious flowers, thorny branches and opposite leaves silvery-lepidote on both sides; *Elaeagnus angustifolia* L., the Russian Olive, a small tree, has alternate leaves and perfect flowers.

1. SHEPHERDIA Nutt. Buffalo berry

1. Shepherdia canadensis (L.) Nutt. Soapberry. Map 2.

Thornless dioecious shrub 1–2 m high. *Leaves opposite,* elliptical to ovate, 2–7 cm long, *green and nearly glabrous above, densely silvery-downy with scattered rusty scales beneath.* Flowers greenish-yellow, in small clusters on twigs of the previous season, the pistillate with a 4-cleft calyx, the mouth of the hypanthium closed by dense hairs. Staminate flowers with a 4-parted calyx and 8 stamens. Fruit berry-like, ovoid, yellowish-red, inedible. $2n=22$ (Cooper 1932, ex Darlington, 1955).

Occasional and locally common along the shoreline of Lake Michigan and Lake Superior; on calcareous cliffs and shores, more or less wooded sandy dunes, clay bluffs, or ravines along Lake Michigan, on sandy gravelly moraines (Sheboygan Co., NE of Elkhart Lake, *Shinners 2960* [WIS]), and on wooded sandy or clay shores of Lake Superior, in northern Wisconsin rarely in marshes (Ashland Co., Loon Lake, Mellen, *Bobb 244* [WIS]), Aspen-Paper Birch deeryards, or upland woods. Flowering from mid-April to early June, and fruiting from early June through July (October).

ORDER MYRTALES

Aquatic or terrestrial herbs. Flowers regular, mostly perfect and petalous, perigynous or epigynous, with a well developed hypanthium or "calyx-tube" bearing the flower parts high above the ovary. Stamens usually as many or twice as many as the petals. Ovary superior or inferior, 1-several-celled. Fruit a 1-many-seeded capsule or rarely indehiscent.

KEY TO FAMILIES

A. Ovary superior; flowers perigynous.
    B. Leaves entire, with only one central vein; anthers dehiscent longitudinally ____________LYTHRACEAE, page 87
    BB. Leaves sharply serrulate, prominently 3 veined; anthers opening by terminal pores ____MELASTOMATACEAE, page 93
AA. Ovary inferior; flowers epigynous.
    C. Leaves alternate or opposite, entire to serrate, or whorled and pinnately disected; stamens 2–8; aquatic or terrestrial herbs.
        D. Leaves alternate or opposite, entire to serrate; style 1; mainly terrestrial herbs ____ONAGRACEAE, page 93
        DD. Leaves alternate or whorled, pinnately dissected; styles 3 or 4; aquatic herbs__HALORAGIDACEAE, page 127
    CC. Leaves whorled, entire, never pinnately dissected; stamen 1; aquatic herb ___________HIPPURIDACEAE, page 128

LYTHRACEAE—LOOSESTRIFE FAMILY

Herbs (ours) with simple, entire, opposite or whorled leaves. Flowers axillary or whorled, *4–7-merous, perfect,* regular, *perigynous, with a well developed hypanthium,* dimorphic or trimorphic. Calyx tubular or campanulate, often with appendages between the lobes. Petals present or absent. Stamens usually as many as petals. Ovary completely or incompletely 2–6-celled, the ovules several to many per carpel. *Fruit a capsule enclosed by the persistent hypanthium.*

KEY TO GENERA

A. Calyx with 4 teeth or lobes; stamens 4; petals minute or none.

B. Calyx with appendages between the lobes; leaves narrowed to a petiole .... 1. ROTALA.

BB. Calyx-lobes without appendages; leaves sessile; small aquatic, rarely emergent .... 2. DIDIPLIS.

AA. Calyx with 5–7 teeth; stamens 5–12; petals conspicuous, reddish-purple.

C. Hypanthium cup-shaped; flowers verticillate; leaves opposite or in 3's (the upper rarely alternate), tapered to a petiole................................... 3. DECODON.

CC. Hypanthium tubular; flowers in dense terminal spikes or solitary in axils of upper leaves; leaves all opposite or alternate, sessile .... 4. LYTHRUM.

1. ROTALA L.

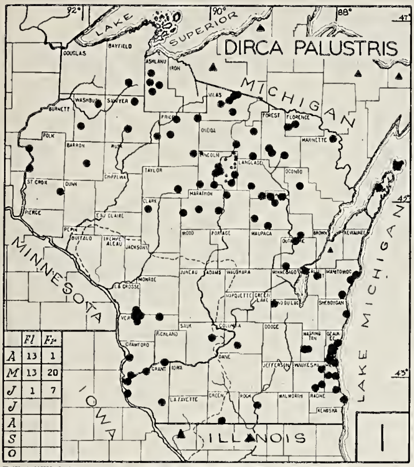
[Fernald, M. L. and Griscom, L., Rhodora 37:169, 1935.]

1. Rotala ramosior (L.) Koehne. Tooth-Cup. Map 3.

Small annual herbs, branched or simple, depressed to erect, glabrous, 5–20 cm high. Leaves opposite, linear-oblanceolate to spatulate, 1–3 cm long, 2–4 mm wide. *Flowers 4-merous, axillary, solitary, sessile. Calyx campanulate or globose, with minute triangular appendages between the sinuses.* Petals minute, white or pink, soon deciduous. *Capsule enclosed by the persistent calyx,* 2–4 mm long, 2–3 mm broad, sessile.

Sandy or muddy open shores of lakes, ponds, or rivers, often on mudflats or sandbars, mostly in southwestern Wisconsin. Along Lake Barney (Dane Co., *Zimmerman 3448* [WIS]) on low edge of cornfield with *Polygonum coccineum, P. pensylvanicum, Eleocharis intermedia, E. engelmanni, Lindernia anagallidea,* and *Scirpus hallii.* Flowering from mid-July through September, and fruiting from late July to mid-October.

Easily confused with *Ludwigia palustris* (p. 94) which has the calyx-tube actually fused to the ovary and only the lobes free. Emergent *Ludwigia* generally roots at the nodes and has prostrate stems.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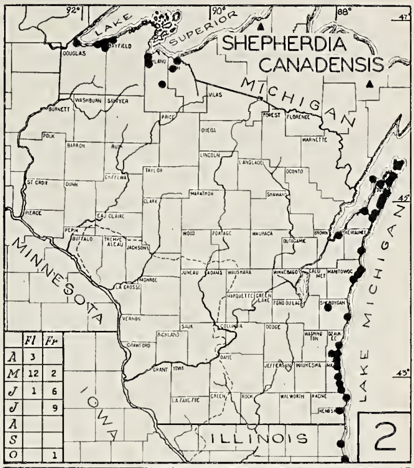
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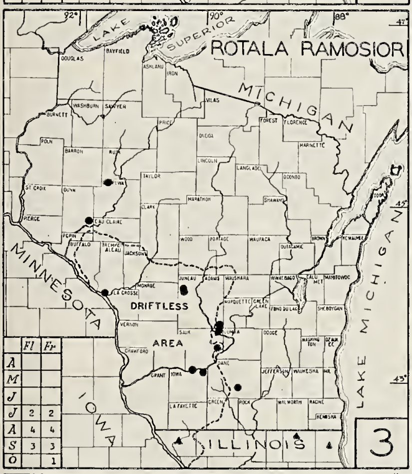
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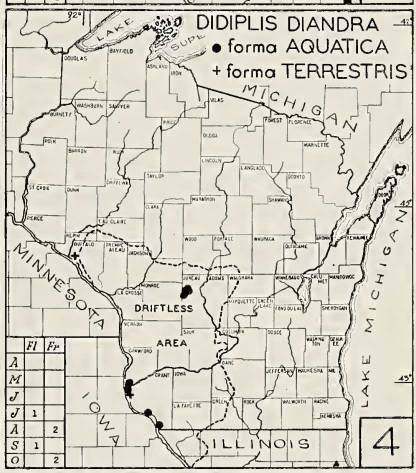
S 3 3
O 1
3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+ forma TERRESTRIS
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MINNESOTA
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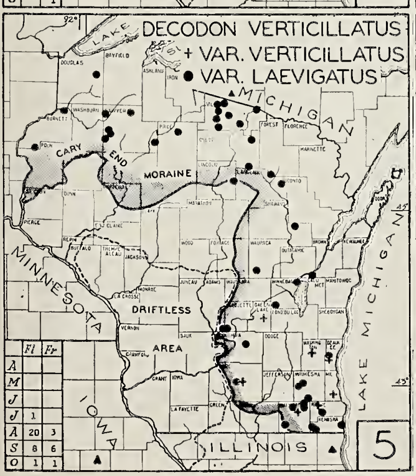
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+ VAR. VERTICILLATUS
● VAR. LAEVIGATUS
MICHIGAN
CARY END MORAINE
MINNESOTA
DRIFTLESS AREA
IOWA
ILLINOIS
LAKE MICHIGAN
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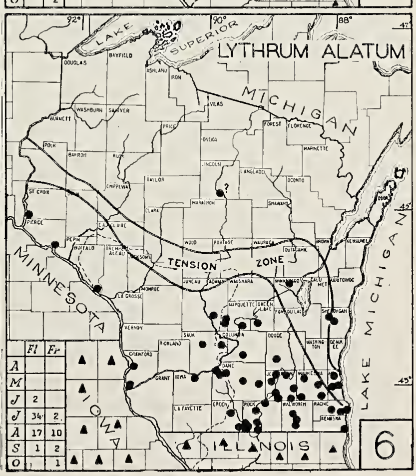
S 8 6
O 1 1
5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MICHIGAN
TENSION ZONE
MINNESOTA
IOWA
ILLINOIS
LAKE MICHIGAN
Fl Fr
A
M
J 2
J 34 2
A 17 10
S 1 2
O 1
6

2. DIDIPLIS Raf. Water Purslane.

[Fassett, N. C., "A Manual of Aquatic Plants." Rev. ed. p. 255, 1957.]

1. Didiplis diandra (Nutt.) Wood. Water Purslane Map 4.
Peplis diandra Nutt.

Small aquatic or mud dwelling herbs with *opposite leaves* and minute greenish axillary flowers. Petals none. *Hypanthium campanulate,* the calyx-lobes triangular, *without appendages.* Capsule globose, indehiscent, about 1.5–2 mm long and broad, sessile. Leaves of submersed plants quite different in aspect from the emersed.

A. Submersed aquatic with ribbon-like, thin, limp leaves not narrowed at base__D. diandra forma aquatica (Koehne) Fassett.

AA. Emersed form with firmer broader leaves somewhat tapered at the ends____D. diandra forma terrestris (Koehne) Fassett.

Shallow water and muddy shores of pools in the Mississippi River bottoms in Grant, Crawford, and Buffalo Counties; in Juneau Co., in reservoir at Potters' Cranberry Marsh, 6 miles S. of Mather. Flowering from July to early September, and fruiting from August through October. A monotypic genus of the eastern United States, resembling and easily confused with *Callitriche,* the Water-Starwort, which lacks a perianth and has flattened and deeply grooved capsules.

3. DECODON J. F. Gmel. Swamp-Loosestrife

1. Decodon verticillatus (L.) Ell. Water-Oleander. Map 5.

Perennial herbs with arching stems 6–14 (–18) dm long, these often rooting at the tip when reaching the water or mud, *the massive submersed parts woody, thickened with conspicuous, spongy and soft, brown aerenchyma.* Leaves short-petioled, opposite or in whorls of 3 or 4, lanceolate, entire, 5–20 cm long, 1–5 cm wide. Flowers trimorphic, verticillate in the axils of the upper leaves. *Calyx cup-shaped,* the 5–7 teeth *with slender appendages between their sinuses.* Petals 5, reddish-purple, lanceolate, cuneate at base. Stamens 10, exserted, unequal. Capsule globose, 3–5-celled, loculicidal, on pedicels ca. 1 cm long. A monotypic North American genus, known in the European fosil record from the Pleistocene, but there now extinct.

In Wisconsin 2 varieties can be recognized differing only by pubescence. Intergrading specimens are occasionally encountered.

KEY TO VARIETIES

A. Stems, pedicels, and leaves glabrous, or nearly so ________________________________ 1a. D. VERTICILLATUS var. LAEVIGATUS.

AA. Stems, pedicels, and lower leaf surfaces more or less downy ____________________ 1b. D. VERTICILLATUS var. VERTICILLATUS.

1a. DECODON VERTICILLATUS var. LAEVIGATUS T. & G.

Northern and eastern Wisconsin, in swamps, shallow pools, edge of streams, lake margins, and cattail marshes with *Zizania* and *Sagittaria,* mostly at the edge and trailing or arching into the water, occasionally rooting in water up to 1 m deep, often forming extensive pure stands (e.g. in Allequash Creek, Vilas Co.). Flowering from late July to early October, and fruiting from mid-August to mid-October. The Sawyer Co. records are those reported by Fassett (1932).

1b. DECODON VERTICILLATUS var. VERTICILLATUS.

Southeastern Wisconsin, on edge of lakes. Flowering dates as in the above variety.

In Wisconsin, *Decodon* is not only completely lacking from the Driftless Area, but appears to be restricted only to those glaciated areas north and east of the Cary End Moraine of the Wisconsin glaciation, which is indicated on map 5 by stippling. The significance of this distribution, if any, is unknown.

4. LYTHRUM L. LOOSESTRIFE

[Shinners, L. H., 1953. Synopsis of the U. S. species of *Lythrum* (Lythraceae). Field and Lab. 21:80–89.]

Herbs with 4-angled stems and opposite, whorled, or alternate leaves. Flowers often dimorphic or trimorphic. Petals 5–7, pink or magenta (rarely white). *Hypanthium cylindrical, striate,* 5–7 toothed, *with slender appendages between the sinuses.* Stamens as many, or twice as many as the petals, inserted on the calyx-tube. Ovary 2-celled, the ovules numerous. Capsule septicidal, enclosed by the persistent hypanthium.

KEY TO SPECIES

A. Leaves alternate on the branches, on the stem either alternate, or opposite, or rarely in 3's; flowers solitary in the axils of the upper leaves; calyx glabrous ________________ 1. L. ALATUM

AA. Leaves opposite, or in whorls of 3's; flowers in long dense spikes; calyx more or less downy____________ 2. L. SALICARIA.

1. LYTHRUM ALATUM Pursh. Winged-Angled Loosestrife. Map 6.

Branched erect perennial 2–10 dm tall, *glabrous*, the stem angled and often slightly winged. Leaves entire, sessile, linear-oblong to ovate-lanceolate, acute, with a rounded or cordate base. *Flowers* short-pedicelled, *solitary*, dimorphic, either the stamens or the style exserted. Calyx-tube cylindrical, striate. Petals purple, obovate, about 5 mm long.

Southeastern Wisconsin and Mississippi River bottoms, in moist or wet sedge meadows, prairies, marshes, lake shores, river banks, bogs, and wet ditches; at Ennis Lake (Marquette Co., *Iltis 12681* [WIS]), on alkaline sedge meadows with *Lobelia kalmii, Gentiana procera, Solidago riddellii, Aster junciformis, Scleria verticillata,* and *Potentilla fruticosa;* and south of Kenosha (Kenosha Co., *Kruschke s.n.*, 1941 [MIL]), on moist sandy prairies with *Pycnanthemum virginianum, Solidago graminifolia, S. riddellii, Liatris spicata, Petalostemum* sp., *Allium cernuum,* and *Lobelia kalmii.* Flowering from late June to early October.

A collection from Lincoln Co. (Merrill, moist shore, not common, *Goessl 2808* [MIL]) cited by Seymour (1960:254) is very likely based on a mislabelled specimen, as are many other records of Goessl. Seymour, who gathered nearly 10,000 specimens in that county, never was able to relocate that species.

2. LYTHRUM SALICARIA L. var. TOMENTOSUM (Mill.) DC. Spiked or Purple Loosestrife. Map 7.

Erect robust *puberulent* perennial 6–13 dm high. Leaves lanceolate, opposite or in whorls of 3's, sessile and cordate or clasping at base. *Flowers in dense terminal, interrupted spikes,* trimorphous in the relative lengths of the stamens and style. Appendages of calyx-tube twice as long as the sepals, or longer. Petals reddish-purple, showy, 7–10 mm long. $2n=30$, 50, 60 (Shinke, 1929; Levan & Love, 1942; La Cour, 1945, ex Darlington, 1955).

Sporadic throughout the state, though often occuring in very large colonies, in moist or wet ground, frequently along muddy lake shores, river banks, ponds, cattail marshes, sedge meadows, and roadside or railroad ditches. A native of Europe frequently cultivated for its showy flowers, and established as an escape, it has been rapidly spreading in recent years, the first record in the state collected in 1928 (Milwaukee Co., Whitefish Bay, *Throne s.n.* [WIS, MIL]). Flowering from late June to early September, and fruiting in August and September.

MELASTOMATACEAE—MELASTOME FAMILY

Herbs (shrubs or trees in tropical regions) with opposite or whorled, prominently *3–9-ribbed* exstipulate leaves. Represented in our area by a single genus and species.

1. RHEXIA L. Meadow-Beauty

[James, C. W., A revision of *Rhexia*. Brittonia 8:201–230. 1956.]

1. Rhexia virginica L. Meadow-Beauty; Deergrass. Map 8.

Perennial herb with tuberous roots, 2–5 dm tall, sparsely glandular-hirsute, with tufts of hairs on the nodes. *Leaves opposite,* ovate-laceolate to ovate, 2–5 cm long, *3–5-nerved, the margins serrulate-ciliate. Flowers* in cymes, *perigynous. Calyx urn-shaped, persistent. Petals 4, showy, dark rose to purple,* spreading, 8–17 mm long. *Anthers bright yellow,* 5–7 mm long, linear, curved. Capsule 6-celled; seeds coiled, papillose.

Central Wisconsin, mainly in the bed of Glacial Lake Wisconsin, in moist sedge meadows, and sandy roadside and railroad ditches, near Mauston (Juneau Co.), growing under Jack Pine along edge of bog, and south of Princeton (Green Lake Co.), on a moist meadow with *Rynchospora* and *Polygala.* Flowering from July through August, and fruiting from late August to early September.

The genus centers in the Atlantic coastal plain. The pine forests of the Glacial Lake Wisconsin area markedly resemble those of the coastal plain, being flat, sandy, and wet!

ONAGRACEAE—EVENING-PRIMROSE FAMILY

Annual or perennial herbs with *(2–) 4-merous,* perfect *epigynous,* and symmetrical flowers. Hypanthium-tube adhering to the (1–) 2–4-celled *inferior ovary,* often prolonged beyond it and bearing the floral organs at its summit. Stamens 2, 4, or 8, often alternately unequal. *Leaves simple, opposite or alternate.*

Key to Genera

A. Petals 4; stamens 4 or 8; leaves opposite or alternate.
  B. Hypanthium-tube scarcely or not at all extended beyond the ovary.
    C. Seeds without a tuft of hairs at the summit; calyx persistent on the fruit; petals minute or absent; stamens 4 ____________________________________1. LUDWIGIA.
    CC. Seeds with a tuft of hairs at the summit; calyx deciduous; petals conspicuous; stamens 8 __2. EPILOBIUM.

BB. Hypanthium-tube conspicously prolonged beyond the ovary.
D. Petals yellow, sometimes pink or white (then more than 1 cm long); capsule eventually dehiscent, containing several to many seeds. ________3. OENOTHERA.
DD. Petals white, pink, or red (never yellow), less than 1 cm long; capsule indehiscent, containing 1–4 seeds __ ______________________________________4. GAURA.
AA. Parts of flower in 2's; leaves opposite; fruits indehiscent, bristly ____________________________________5. CIRCAEA.

1. LUDWIGIA L. False Loosestrife

[Munz, P. A., The American species of *Ludwigia*. Bull. Torr. Bot. Club 71:152–165. 1944.]

Aquatic or marsh herbs with opposite or alternate leaves and axillary *4-merous flowers. Calyx-lobes persistent in fruit;* petals minute or absent. Capsule many-seeded, septicidally dehiscent, often with two bracts near its base.

Key to Species

A. Leaves opposite; stems creeping on mud or submersed ______ ____1. L. PALUSTRIS.
AA. Leaves alternate; stems erect or ascending __2. L. POLYCARPA.

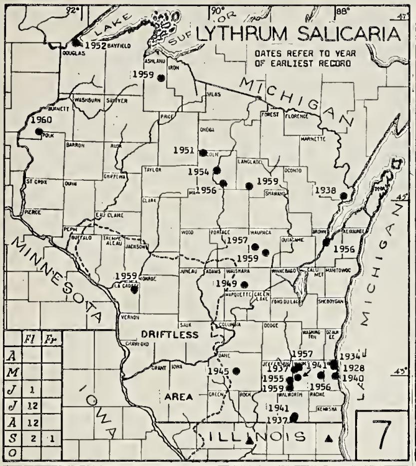
1. Ludwigia palustris (L.) Ell. var. americana (DC). Fern. & Griscom. Marsh or Water Purslane. Map 9.

Plants weak-stemmed, nearly prostrate on mud or growing in shallow water, with roots from all but the upper nodes. Leaves lanceolate to ovate, 1–5 cm long, tapering to slender petioles. Flowers minute, axillary, solitary, and sessile, the petals wanting. Capsule 4-sided; *bracteoles minute or wanting.*

Submersed plants in deep water, with limp sterile stems, and broad thin long petioled leaves, are known as forma *elongata* Fassett.

Throughout Wisconsin, though sporadic, on muddy or sandy shores of lakes or rivers, along wet ditches, in marshes, and submersed in shallow standing water of ponds and lakes. Flowering from July through September, and fruiting from July to mid-October.

Autumnal forms of this species are often minute and may flower and fruit when only 1 cm tall. The aquatic phase of the species is often sold as an aquarium plant.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DATES REFER TO YEAR OF EARLIEST RECORD
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DRIFTLESS AREA
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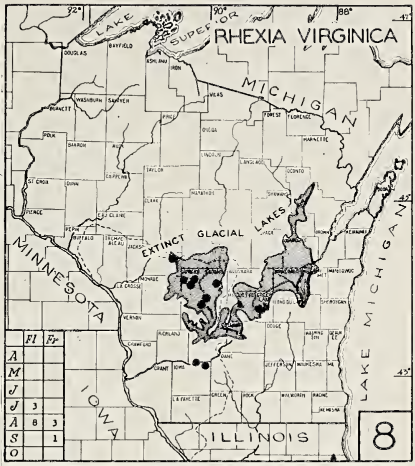
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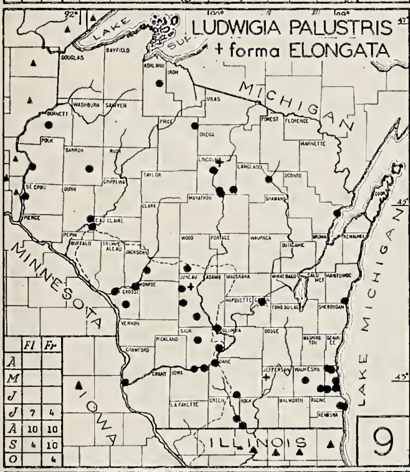
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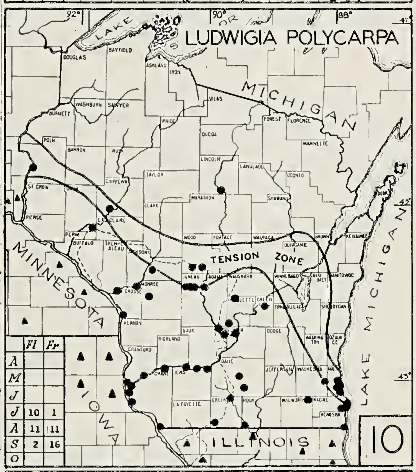
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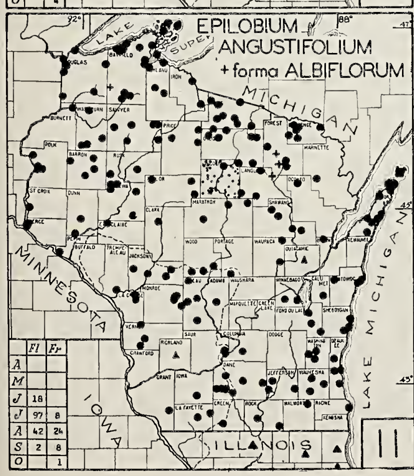
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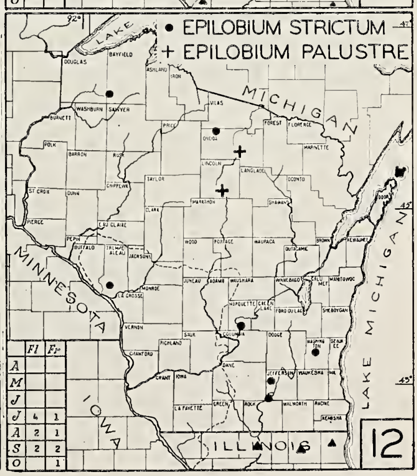
11


• EPILOBIUM STRICTUM
+ EPILOBIUM PALUSTRE
LAKE
MICHIGAN
MINNESOTA
IOWA
ILLINOIS
LAKE MICHIGAN
12

2. LUDWIGIA POLYCARPA Short & Peter. Ludwigia. Map 10.

Stems erect, commonly much branched above, 4-angled, glabrous, 2–9 dm tall, the stem base often in standing water and then swollen with thick soft spongy aerenchyma. Cauline leaves narrowly lanceolate to oblanceolate-elliptic, acuminate to acute, tapering to a sessile or short petiolate base. Petals minute, yellowish, ca. 1 mm long, or absent. Capsule 5–6 mm long, somewhat 4-sided, *with 2 bracts near its base.* Completely submersed plants have thin, narrowly lanceolate to linear leaves, and sterile weak stems.

Southern half of Wisconsin south of the "Tension Zone", on muddy or sandy lake shores, river banks, pond or bog margins, marshes, swamps, and flowages, rarely submersed in stagnant pools or ponds, as on the Kenosha Prairie. Flowering from Mid-July to early September, and fruiting from late July through September.

2. EPILOBIUM L. WILLOW-HERB

[Fernald, M. L., *Epilobium glandulosum* and *E. adenocaulon.* Rhodora 20:31–35. 1918; The identities of *Epilobium lineare, E. densum,* and *E. ciliatum.* Rhodora 46:377–386. 1944. Trelease, W., The species of *Epilobium* occurring north of Mexico. Ann. Rept. Mo. Bot. Gard. 2:69–117. 1891.]

Perennial (rarely annual) herbs with alternate or opposite leaves, and 4-merous flowers in terminal racemes or solitary in the upper leaf axils. Petals purple to pink or white. Capsule slender, many seeded. *Seeds with a tuft of silky hairs (coma) at the summit.*

KEY TO SPECIES

A. Flowers in a terminal raceme; petals 8–17 mm long, very showy; stigma 4-cleft .... 1. E. ANGUSTIFOLIUM.

AA. Flowers solitary in the upper leaf axils; petals 3–8 mm long.

B. Stigma 4-cleft ;stem glabrate; leaves entire, nearly linear, rarely more than 3 mm wide; adventitious annual, rare................................ 2. E. PANICULATUM.

BB. Stigma entire; stem variously pubescent; leaves narrowly lanceolate, ovate-lanceolate, or elliptic, over 3 mm wide (linear and often narrower in no. 4).

C. Leaves entire or subentire, the margins often revolute; stem round, without decurrent lines from the base of each leaf.

D. Stems softly pubescent with straight spreading hairs .... 3. E. STRICTUM.

DD. Stems minutely pubescent or canescent with appressed or incurved hairs.

E. Upper leaf-surface densely pubescent with incurved hairs ______________________4. E. LEPTOPHYLLUM.

EE. Upper leaf-surface glabrous or with few remote incurved hairs ___________________5. E. PALUSTRE.

CC. Leaves conspicuously toothed, flat; stem 4-angled, with decurrent lines, angles, or strips of pubescence running down from the leaf bases.

F. Mature seeds striate or striate-papillose (10X), often with a very short hyaline beak, the coma white, tawny, or brown; stem with spreading (often glandular) hairs as well as smaller incurved eglandular ones, the sides and angles equally pubescent; flower buds rounded or obtuse or with divergent sepal-tips.

G. Mature seeds striate, the coma white or whitish; flower buds obtuse or rounded; mature capsules rarely containing an aborted seed; stem simple or loosely branching (fig. 4) _6. E. GLANDULOSUM.

GG. Mature seeds striate-papillose, the coma white, tawny, or brown, buds rounded, or divergent tipped, or somewhat intermediate; mature capsules often containing many aborted seeds; stem bushy-branched at summit (fig. 4 and 5) ____ ______________________7. E. X WISCONSINENSE.

FF. Mature seeds papillose, beakless, the coma brown (white in immature capsules); stem minutely pubescent with incurved hairs above, tending to be pubescent in lines; flower buds with divergent sepal-tips (fig. 4) __________________8. E. COLORATUM.

1. EPILOBIUM ANGUSTIFOLIUM L. Great Willow-Herb; Fireweed. Map 11.

Erect perennial from creeping rhizomes, 0.2–2 m high, *with numerous flowers in a terminal raceme.* Leaves alternate, 3–20 cm long, lanceolate or linear-lanceolate, acuminate, entire or minutely denticulate, very short petioled. Petals 8–17 mm long, pink to purple or white in forma *albiflorum* (Dumort.) Haussk. Mature capsule 3–8 cm long, canescent. Seeds smooth or nearly so, the coma whitish or tawny. 2n=36 (Michaelis, 1925, ex Gaiser, 1926).

Very common throughout Wisconsin in almost any habitat and often weedy, on roadsides, railroad tracks, abandoned fields, prairies, open woods, bracken-grasslands and edge of swamps and bogs, especially abundant in recently cleared or burned woods (hence the common name). Flowering from mid-June to early September, and fruiting from late-July to mid-October.

2. EPILOBIUM PANICULATUM Nutt. var. SUBULATUM (Haussk.) Fern. Panicled Willow-Herb.

Slender dichotomous-paniculate branched annual. Stem glabrous or glabrate with exfoliating "bark" near the base. Leaves alternate or opposite, nearly linear, rarely more than 3 mm wide. Petals purple, 5 mm long. *Capsule spindle-shaped,* about 2 cm long. 2n=36 (Johansen, 1929, ex Gaiser, 1930).

Widely distributed in the Western States, collected but once in Wisconsin, along a railroad siding in Milwaukee (Aug. 13, 1940, *Shinners 2569* [WIS]).

3. EPILOBIUM STRICTUM Muhl. Downy or Soft Willow-Herb. Map 12.

Epilobium densum Raf.
Epilobium molle Torr., not Lam.

Perennial with erect stems 2–10 dm high, simple or branched above, *pubescent throughout with soft, dense, straight, spreading or somewhat ascending hairs.* Leaves narrowly lanceolate, 1–6 cm long, 2–7 mm wide, entire or minutely denticulate. Petals pink, 5–8 mm long. Coma becoming very pale dingy brown.

Rare and scattered in Wisconsin, in Tamarack-Sphagnum bogs, marshy or springy shores of lakes, at Ennis Lake (Marquette Co., *Iltis 12666* [WIS] in alkaline edge meadows with *Lobelia kalmii, Gentiana procera, Solidago riddellii, Aster junciformis, Liatris spp., Lythrum alatum,* and *Epilobium leptophyllum.* Flowering from late July to mid-September, and fruiting from late July to early October.

4. EPILOBIUM LEPTOPHYLLUM Raf. Linear-Leaved Willow-Herb Map 13.

Epilobium densum, of Gray's Man. ed. 7, not Raf.
Epilobium lineare, of authors, not Muhl.

Slender erect perennial 2–10 dm high, simple to much branched, minutely pubescent with incurved hairs. *Leaves linear or linear-lanceolate,* acute, with entire or subentire revolute margins, *canescent to sparsely pubescent above,* 1–3 mm wide, or in forma *umbrosum* (Haussk.) Fern. the thin and flat primary leaves 4–10 mm wide. Flowers in the axils of the upper leaves; petals pink or whitish, 4–6.5 mm long. Capsules 2–6 cm long, on pedicels 5–25 mm long. Seeds with a minute beak, the coma pale dingy brown.

Throughout Wisconsin though most common in the northern and eastern parts in almost any wet habitat both alkaline and acid, such as Tamarack, Sphagnum or Spruce bogs, swamps, margins of streams, ponds, lakes, *Alnus-Salix* thickets, wet prairies, sedge meadows, cattail marshes, damp sandstone cliffs, roadside and railroad ditches, wet Northern Hardwoods, and Conifer swamps. Flowering from mid-July to mid-September, and fruiting from late July to early October.

5. EPILOBIUM PALUSTRE L. Map 12.

Erect perennial 3–4.5 dm high with stems *decumbent at base*, simple to few branched above, glabrescent below, minutely incurved pilose above. Leaves linear to oblong-lanceolate, 1–4 cm long, 3–12 mm wide, entire to remotely denticulate, *nearly or quite glabrous above.* Flowers solitary in the upper leaf axils, *nodding in bud.* Calyx 3–4 mm long. Petals lilac to pink or white. Capsules 2–7 cm long, on pedicels 15–35 mm long. 2n=36 (Böcher, 1938, ex Löve, 1955).

A widely distributed boreal species extremely rare in northern Wisconsin, forms of which may closely resemble *Epilobium leptophyllum* forma *umbrosum.* The following collections, especially the first, are placed here with considerable reservation.

Lincoln Co.: spruce bog, [flowering and fruiting] Aug. 2, 1953, Merrill, *Seymour 15426* (WIS). Oneida Co.: shady mossy woods, [flowering and fruiting] Sept. 1, 1915, Rhinelander, *Goessl 2626* (MIL).

6. EPILOBIUM GLANDULOSUM Lehm. Northern Willow-Herb. Map 14.

Perennial with stems 0.3–10 dm high, simple to much branched, glabrous below, with spreading (often gland-tipped) as well as smaller incurved hairs above, *the sides as well as the angles pubescent.* Leaves varying from narrowly lanceolate to ovate-lanceolate, 1–10 cm long, 3–30 mm wide, shallowly denticulate to sharply serrulate, sessile or short petioled. *Flower buds obtuse or rounded at the summit.* Petals lilac to pink (white), 1.5–6 mm long. Capsules 1.5–8.5 cm long; *seeds* with a very short beak, *striate, the coma white or whitish.*

Despite numerous integrading forms the following 4 poorly defined geographic varieties are recognized as occurring in Wisconsin (see discussions under vars. "*glandulosum*" and *perplexans*).

Key to Varieties

[Modified from Fernald, M. L., *Epilobium glandulosum* and *E. adenocaulon*. Rhodora 20:34. 1918.]

A. Leaves crowded, not conspicuously decreasing in size into the crowded inflorescence, the larger 6–10 cm long, 2–3 cm wide; stems 4–10 dm high .... 6a. var. "GLANDULOSUM."

AA. Leaves remote, conspicuously decreasing in size into the loose and open inflorescence; stems 0.3–10 dm high.

B. Leaves thin and rather flaccid, light green, 0.5–4 cm long, 3–15 mm wide, broadly rounded at base or tapering to a slender petiole; stems weak, erect or ascending, simple or branching from near the base, 0.3–3 dm high, tending to become crisp-pubescent in lines below .... 6b. var. PERPLEXANS.

BB. Leaves firm, dark green, 1.5–10 cm long, rounded or barely subcordate at base, sessile or with short petioles; stems (except in dwarf plants) erect and strict, freely branching, 1–10 dm high, the pubescence not in lines.

C. Median leaves elongate-lanceolate, 2–6 cm long, 3–13 mm wide .... 6c. var. OCCIDENTALE.

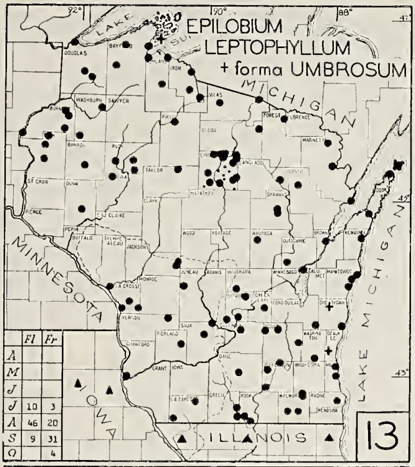
CC. Median leaves narrowly ovate or ovate-lanceolate, 1.5–10 cm long, 4–30 mm wide .... 6d. var. ADENOCAULON.

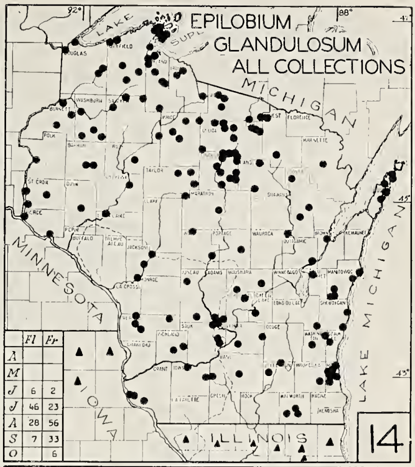
6a. EPILOBIUM GLANDULOSUM Lehm. var. "GLANDULOSUM."
Map 15.

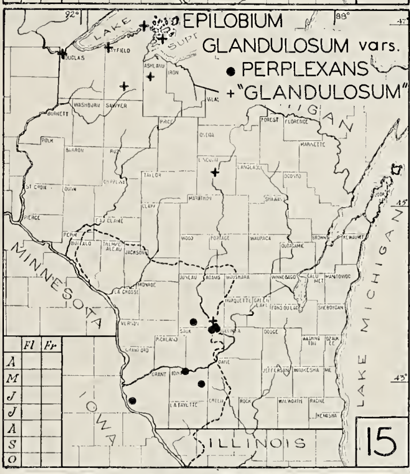
Stems thick (but soft), 4–10 dm high, relatively glabrous below the inflorescence. Larger leaves broadly ovate-lanceolate, 6–10 cm long, 2–3 cm wide, *not conspicuously decreasing in size into the crowded inflorescence.* Mature capsules 4–7 cm long.

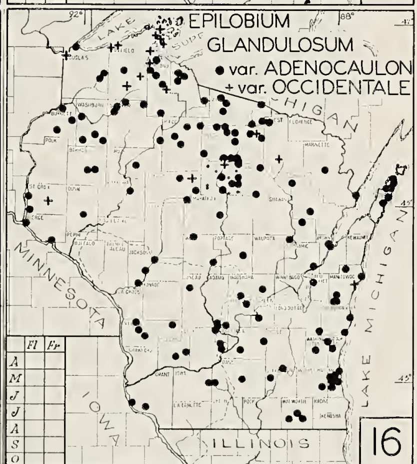
Rare in northwestern Wisconsin, with one specimen from the Dells of the Wisconsin River (Coldwater Canyon); in moist woods, Aspen stands, open low ground, and damp pastures. Flowering from mid-July to early September, and fruiting from late August.

Our plants differ from those described by Fernald in his interpretation of the variety in having smaller flowers (petals 4–5 mm long instead of 6–9) and laxer leaves more like those of var. *adenocaulon*. Fernald (Rhodora 20:32. 1918) discusses a similar situation in the Gulf of St. Lawrence region, where these two varieties freely intergrade. He found that in the colder northern parts of its range, *Epilobium glandulosum* is fairly consistent in its large flowers and crowded leaves, whereas in the more southerly habitats, the plants have smaller flowers and less crowded leaves, or exhibit various other combinations of characters which approach those of


EPILOBIUM
LEPTOPHYLLUM
+ forma UMBROSUM
MICHIGAN
MINNESOTA
IOWA
ILLINOIS
LAKE MICHIGAN
Fl Fr
A
M
J
J 10 3
A 46 20
S 9 31
O 4
13


EPILOBIUM
GLANDULOSUM
ALL COLLECTIONS
MICHIGAN
MINNESOTA
IOWA
ILLINOIS
LAKE MICHIGAN
Fl Fr
A
M
J 6 2
J 46 23
A 28 56
S 7 33
O 6
14


EPILOBIUM
GLANDULOSUM vars.
● PERPLEXANS
+"GLANDULOSUM"
MICHIGAN
MINNESOTA
IOWA
ILLINOIS
LAKE MICHIGAN
Fl Fr
A
M
J
J
A
S
O
15


EPILOBIUM
GLANDULOSUM
● var. ADENOCAULON
+ var. OCCIDENTALE
MICHIGAN
MINNESOTA
IOWA
ILLINOIS
LAKE MICHIGAN
Fl Fr
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A
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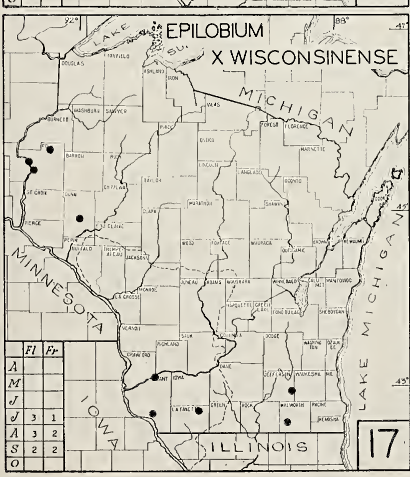
O
16


EPILOBIUM
X WISCONSINENSE
MICHIGAN
MINNESOTA
IOWA
ILLINOIS
LAKE MICHIGAN
Fl Fr
A
M
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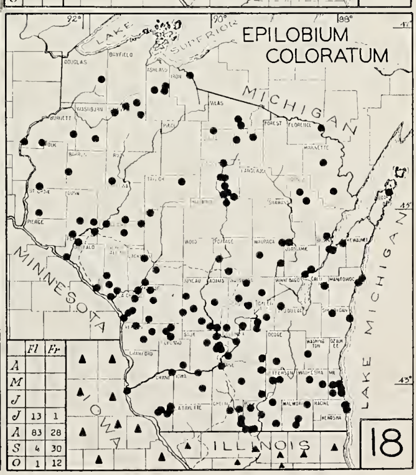
J 3 1
A 3 2
S 2 2
O
17


EPILOBIUM
COLORATUM
MICHIGAN
MINNESOTA
IOWA
ILLINOIS
LAKE MICHIGAN
Fl Fr
A
M
J
J 13 1
A 83 28
S 4 30
O 1 12
18

var. *adenocaulon.* Prompted by the unstable characters of these two taxa, Fernald reduced the *Epilobium adenocaulon* of Haussknecht, and its two varieties named by Trelease, to separate varieties of *Epilobium glandulosum* Lehmann. The present study suggests that Fernald's varieties may well be either "ecotypes," or phenotypic variants whose size and habit differences are due to a combination of soil, shade, and climatic factors. When various morphological characters are reduced to quantitative measurements and graphed, the relationship is seen to be nearly linear, which tends to support this hypothesis (see fig. 1). However, further field and laboratory work is needed in order to establish the true nature of these forms.

6b. EPILOBIUM GLANDULOSUM var. PERPLEXANS (Trel.) Fern.
Map 15.

Epilobium adenocaulon Haussk. var. ? *perplexans* Trel., sensu Robinson and Fernald, 1908.
Epilobium hornemanni Reichenb., of authors.
Epilobium ciliatum Raf., sensu Fernald, 1950.

Usually very small plants 3–20 (–30) cm, *the stems weak,* ascending to erect, simple or branching from near the base, tending to become crisp-pubescent in lines below. *Leaves thin and rather flaccid, light-green,* ovate-lanceolate, 0.5–4 cm long, 3–15 mm wide, broadly rounded at base or slightly tapering to a slender petiole. Petals 1.5–4.6 mm long. Mature capsules only 1.5–4 cm long.

Rare in the Driftless Area of Wisconsin, on damp sandstone cliffs, often in full sun, at the Dells of the Wisconsin River, near Lone Rock and Barneveld (Iowa Co.), and Mauston (Juneau Co.), near North Andover (Grant Co.) reported from a limestone cliff. Flowering from late July through August, and fruiting from mid-July to early October.

The nomenclature and the taxonomy of this taxon are so confused that only special studies beyond the scope of the present could possibly untangle it (cf. Trelease 2:94, 96, and 106, 1891). Therefore, it seemed best to recognize this variety even though its distinctions are weak and often subjective. Concerning this species, the following comments were made by Hugh H. Iltis: "That var. *perplexans* might represent a cliff ecotype is strengthened by the fact that depauperate specimens, with only slightly firmer leaves and sometimes stouter and more pubescent stems, have been collected from sandstone cliffs one yard above the waters of Lake Mendota (Eagle Heights, Madison) and on the St. Croix River (north of Houlton), in the latter case together with normal plants of var. *adenocaulon.* On the other hand, the dwarfness of the plants

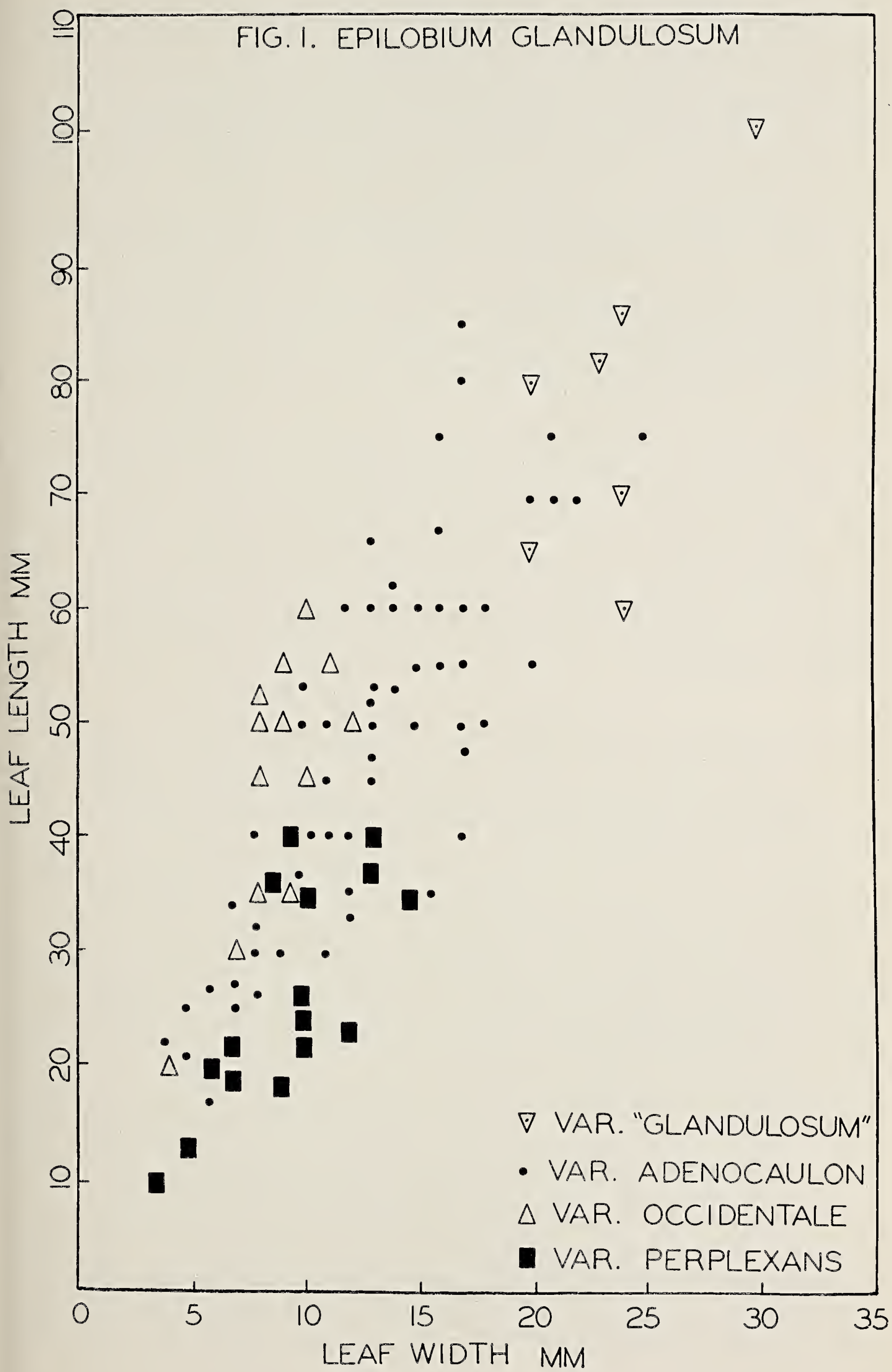


FIG. I. EPILOBIUM GLANDULOSUM
LEAF LENGTH MM
LEAF WIDTH MM
0
5
10
15
20
25
30
35
10
20
30
40
50
60
70
80
90
100
110
VAR. "GLANDULOSUM"
VAR. ADENOCAULON
VAR. OCCIDENTALE
VAR. PERPLEXANS

of var. *perplexans,* their weak stems, and their preference for cliffs may indicate that actually we are dealing with a distinct species perhaps with subarctic or Rocky Mountain affinities. A final taxonomic disposition here will have to await detailed cytological studies and taxonomic monographing. It is, however, significant that these, the most extreme plants are restricted to the Driftless Area (this not too surprising, of course, since nearly all cliffs in Wisconsin are found here!), and that, furthermore, var. *perplexans* grows in moist habitats with other rare, evidently relictual species that have decided western or northern affinities [see Iltis & Shaughnessy 1960:117]. Thus, across from Lone Rock (Iowa Co.), it grows on a vertical north-facing sandstone cliff associated with *Sullivantia renifolia;* at the Wisconsin Dells on a sunny west-facing sandstone cliff, wet with seepage and not 50 feet from the only Midwestern station of the arctic *Rhododendron lapponicum,* both overlooking the waters of the Wisconsin River; while at nearby Blackhawk Island, across the river from famed Coldwater Canyon, it was found with roots wedged in tiny crevices of a sandstone cliff within a few feet of the present level of the Wisconsin River. There, in the dense shade of overhanging vertical cliffs clothed with *Tsuga* and *Thuja,* the cool humid rock faces sheltered in addition such rarities as *Primula mistassinica, Asplenium trichomanes,* and again *Sullivantia renifolia.*"

6c. EPILOBIUM GLANDULOSUM var. OCCIDENTALE (Trel.) Fern. Map 16.

Epilobium adenocaulon Haussk. var. *occidentale* Trel.
Epilobium occidentale (Trel.) Rydb.

Stems 1–8 dm high, simple or commonly branched. *Leaves elongate-lanceolate,* sharply serrulate, 2–6 cm long, 3–13 mm wide. Petals 3–5 mm long. Mature capsules 3.5–6 cm long.

Infrequent in the colder northern regions of the state in damp ground grazed woods, clearing in woods, ledges, and burnt-over land. Flowering from late June to early September, and fruiting from early July through September.

6d. EPILOBIUM GLANDULOSUM var. ADENOCAULON (Haussk.) Fern. Map 16.

Epilobium adenocaulon Haussk. var. *adenocaulon.*

Stems 1–10 dm high, simple to much branched. *Leaves narrowly ovate to ovate-lanceolate,* 1.5–8.5 (–10) cm long, 4–25 (–30) mm wide. Petals 2.6–6 mm long. Mature capsules 3–8.5 cm long (fig. 4).

Throughout Wisconsin, though more common in the northern parts, in swamps, bogs, marshes, moist woods, wet sedge meadows, and abandoned fields, along river banks, lake margins, springs, roadside ditches, and on moist gabbro, limestone, and sandstone cliffs. Flowering from mid-June through September, with a peak in late July (generally about 2½ weeks before *Epilobium coloratum*, with which it may hybridize), and fruiting from late June to mid-October.

7. EPILOBIUM x WISCONSINENSE Ugent, *in* Rhodora. 1963. Map 17.

(*E. coloratum* Biehler x *E. glandulosum* var. *adenocaulon* [Haussk.] Fern.; HOLOTYPE: Polk Co.: edge of road in wet swamp, not common, West Sweden tp. sec. 36, *Johnson s.n.* [WIS]).

Stems loosely bushy-branched, spreading glandular pubescent as well as minutely pilose, the sides as well as the angles pubescent. Larger leaves 3–6.5 cm long, 8–21 mm wide, narrowly lanceolate, acuminate, closely and irregularly serrulate, on petioles 1–3 mm long. Flowers solitary in the upper leaf axils; buds rounded, or with divergent sepal-tips, often somewhat intermediate. Calyx 3–4.2 mm long. Petals purple or lilac, 3.5–6 mm long. Mature capsules 1–3.5 (–4.5) cm long. *Seeds mainly aborted* (fig. 5), the mature ones 1–1.2 mm long, 0.2–0.5 mm wide, *striate-papillose, the coma brown or tawny* (white in immature capsules).

Southern and northwestern Wisconsin, very sporadic in disturbed sedge-goldenrod peat marshes, spring-saturated sedge meadows, and along wet swampy roadsides, river banks, and railroad tracks. Flowering from early July to early September, and fruiting from mid-August to early September.

WISCONSIN: *sine loc.* [ca. 1860?] *Hale s.n.* (WIS). Dunn Co.: railroad tracks, Menomonie, *Bachman & Patrick 7–10* (WIS). Grant Co.: Potosi, *Davis s.n.* (WIS); along streams, Boscobel, *Sylvester 13590* (MIL). Jefferson Co.: disturbed sedge-goldenrod peat marsh, Sullivan tp. sec. 13, *Burger 152* (WIS). Lafayette Co.: Fayette, *Cheney s.n.* (WIS). Polk Co.: St. Croix Falls, *Baird s.n.* (WIS); near river bank, 8 mi. N. St. Croix Falls, *Benner 363* (MINN); edge of road in wet swamp, not common, West Sweden tp. sec. 36, *Johnson s.n.* (WIS). Walworth Co.: spring-saturated sedge meadow, Delavan, *Wadmond 17439* (MINN, WIS).

This hybrid resembles *Epilobium coloratum* in the sharply and irregularly serrulate leaves, the bushy-branched inflorescence (lower branches longer and less crowded than usual), the papillose nature of the seeds, and the often brown or tawny coma (fig. 4). The pubescence and striate character of the seeds are features definitely associated with *Epilobium glandulosum.* Some of the morphological inter-relationships of these plants are shown graphically in fig. 2A. The shortness and slenderness of the hybrid capsules is no doubt due to the abnormally high amount of seed abortion, which on different plants may vary from 27% to 95% (Fig. 3).

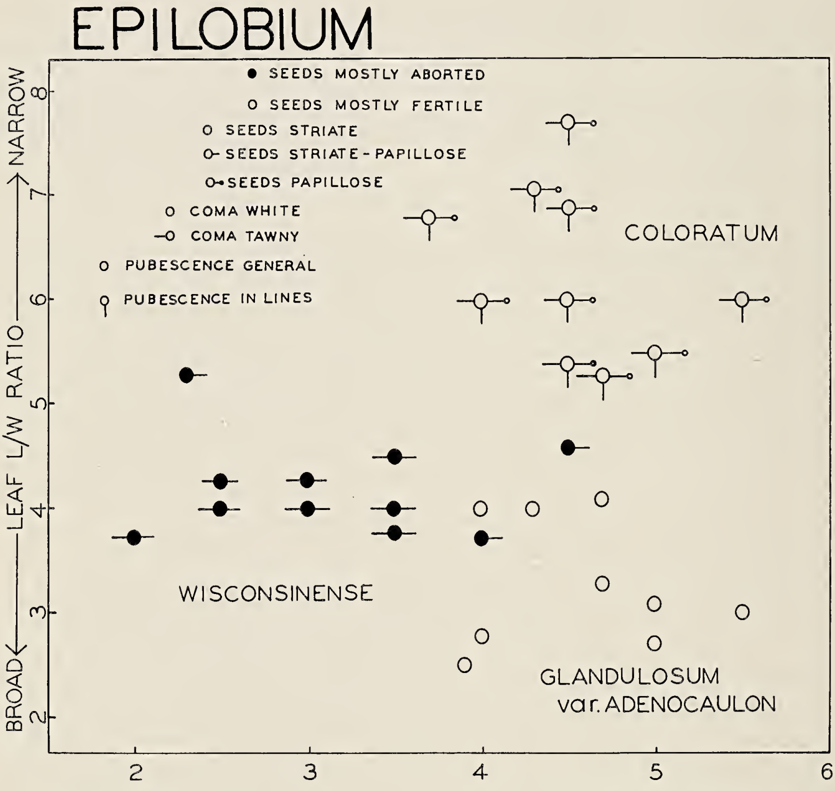


FIG. 2A.

Epilobium glandulosum var. *adenocaulon* is frequently associated with *E. coloratum,* and not uncommonly plants of both taxa have been collected together and mounted on the same herbarium sheet. When comparing the phenology of these plants, one can readily observe that when *Epilobium coloratum* is in flower, *E. glandulosum* var. *adenocaulon* is in fruit. As can be seen from the compiled flowering dates (Maps 14 and 18; Fig. 2B), var. *adenocaulon* flowers about 2½ weeks earlier. This seasonal isolation factor may be important in keeping these taxa relatively distinct. It should be noted that hybrids occur in a region where the ranges of both parental

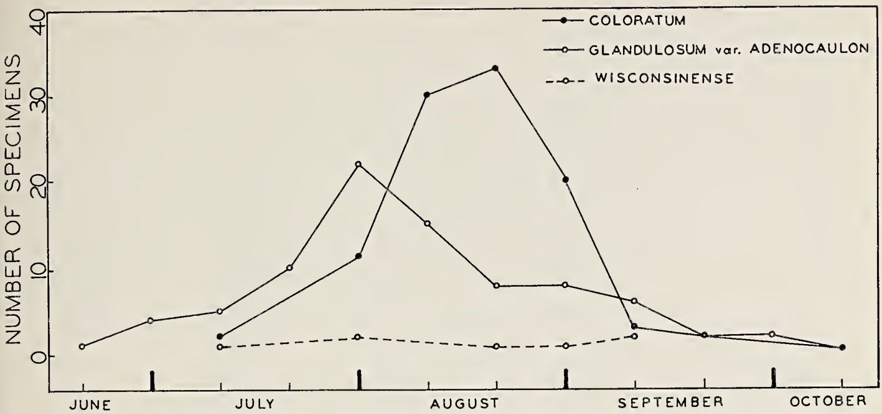


FIG. 2B.

species overlap: *Epilobium glandulosum* var. *adenocaulon* has a wide northern distribution, ranging from Alaska to Newfoundland, south to Delaware and *Northern Illinois*, and extending at higher elevations along the Rocky Mountains to Colorado; while *Epilobium coloratum*, a species with Eastern and Southeastern affinities, extends from Georgia to Kansas north to Minnesota, and across *Northern Wisconsin* to Southern Quebec.

Specimen	Capsule	Number of Seeds		% Abortion
		Aborted	Mature	
Hale, *sine loc.*	1 2 3	49 83 55	10 14 7	85
Bachman & Patrick Dunn Co.	1 2 3	110 84 98	7 5 6	94
Burger, Jefferson Co.	1 2 3	18 20 16	35 45 60	27
Johnson, Polk Co.	1	74	4	94
Benner, Polk Co.	1	92	4	95
	TOTAL	719	197	78

FIGURE 3. Seed abortion in *Epilobium x Wisconsinense*.

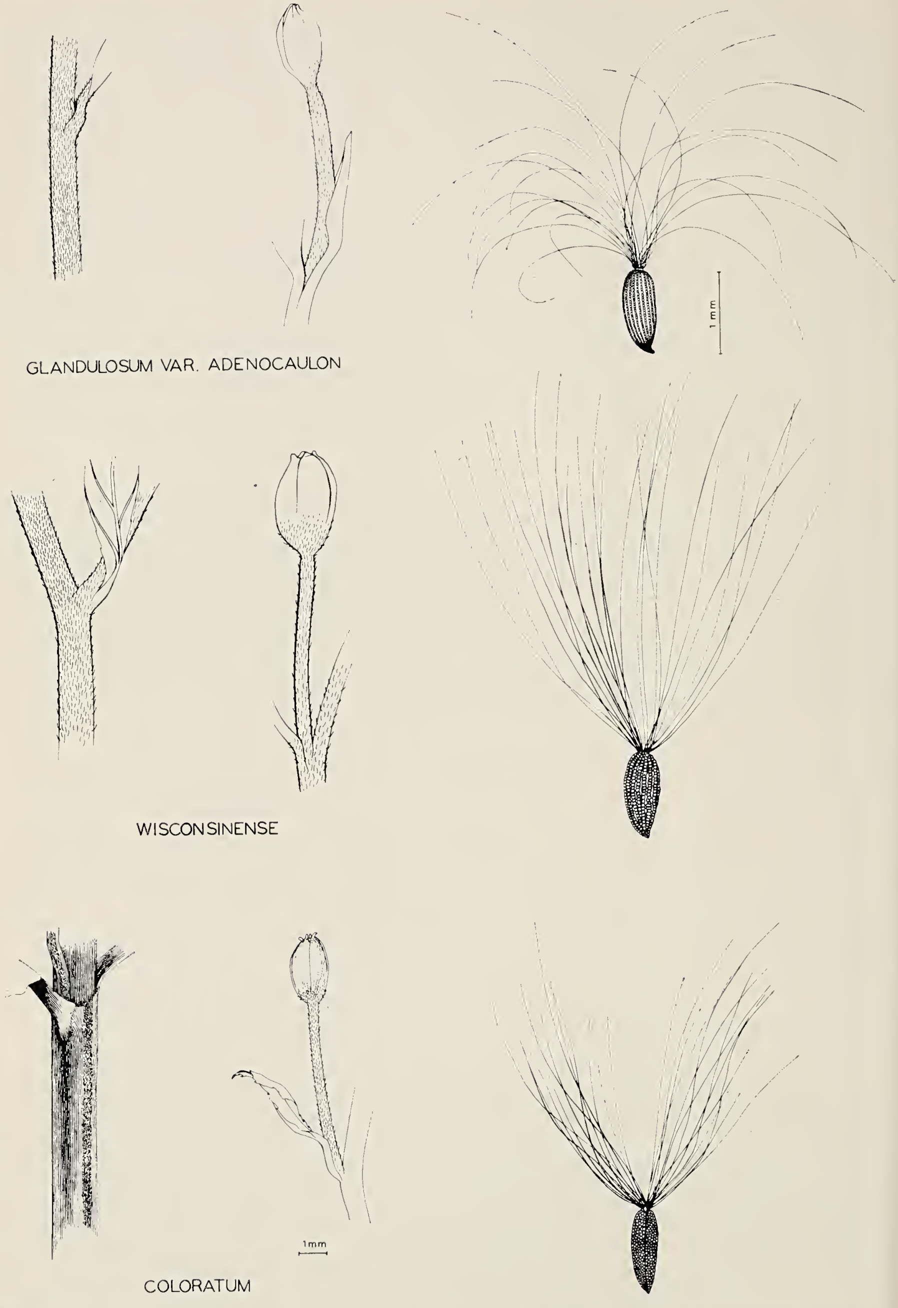


FIG. 4 STEMS, BUDS, AND SEEDS OF SOME WISCONSIN EPILOBIUMS

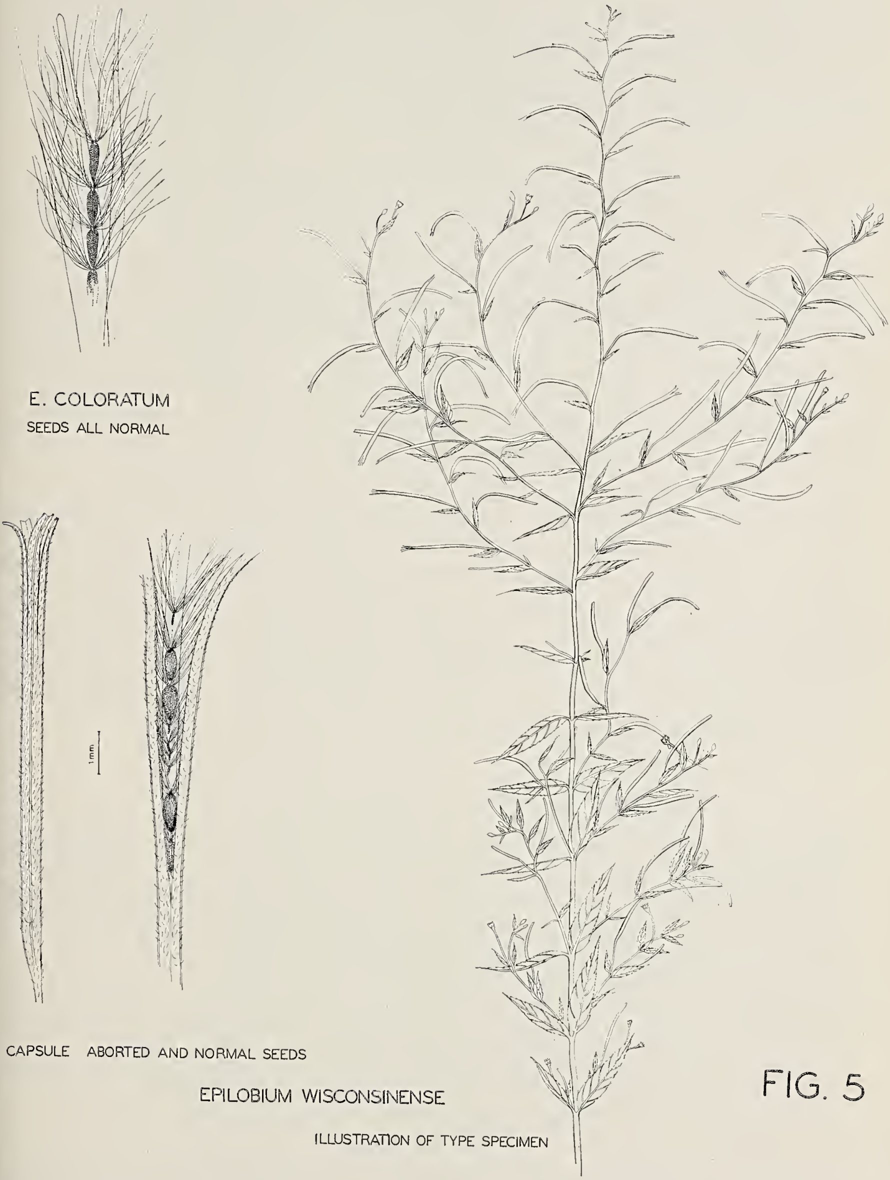

E. COLORATUM
SEEDS ALL NORMAL
1mm
CAPSULE
ABORTED AND NORMAL SEEDS
EPILOBIUM WISCONSINENSE
ILLUSTRATION OF TYPE SPECIMEN

FIG. 5

Epilobium coloratum and *E. glandulosum* var. *adenocaulon* are both known to hybridize with other species. The following hybrids are reported in the Index Kewensis and the Gray Herbarium Card Index: *Epilobium coloratum* X *Epilobium lineare* Muhl.; *Epilobium coloratum* X *Epilobium commutatum* Haussk.; and *Epilobium adenocaulon* Haussk. (*E. glandulosum* var. *adenocaulon* [Haussk.] Fern.) X *Epilobium canadense* Levl.

8. Epilobium coloratum Biehler. Purple-Leaved Willow-Herb. Map 18.

Erect perennial 2–10 dm high, bushy-branched at summit or stems simple in small plants, *minutely pubescent above with incurved hairs (often in lines)*, glabrous below. Leaves elongate-lanceolate, acuminate, closely and irregularly serrulate, the cauline 3–18 cm long, 1–3 cm wide, distinctly short petioled. Flowers axillary, *buds with divergent sepal-tips* (Plate I, fig. 3) petals pink to lilac, 3–5 mm long. Capsules finely pubescent; *seeds papillose, beakless, the coma brown (whitish only in immature capsules!)*

Throughout Wisconsin, though most common in the southern parts, in wet ground along river banks, lakes, springs, ponds, sandy beaches, on damp sandstone cliffs, often in bogs, swamps, moist sedge meadows, marshes, damp willow thickets, wet woods, roadside and railroad ditches. Flowering from early July to early September, with a peak in mid-August (generally about 2½ weeks after *Epilobium glandulosum*, with which it may hybridize), and fruiting from mid-August through late October.

3. OENOTHERA L. Evening-Primrose.

[Munz, P. A., Studies in *Onagraceae:* A revision of the subgenera *Salpingia* and *Calylophis*. Am. Jour. Bot. 16:707–715. 1929; the subgenus *Anogra*. Am. Jour. Bot. 18:309–327. 1931; the subgenus *Kneiffia*. Bull. Torr. Bot. Club 64:287–306. 1937; the subgenus *Raimannia*. Amer. Jour. Bot. 22:645–663.

Cleland, R. D., Chromosome structure in *Oenothera* and its effect on the evolution of the genus. Cytologia (Supplement Vol.): Proc. Internat. Gen. Symp. 1956:5–19; The evolution of the North American *Oenotheras* of the "*Biennis*" group. Planta 51:378–398. 1958.]

Annual or biennial, rarely perennial, erect herbs, with alternate leaves and *yellow (white or pink)* flowers solitary in the upper leaf axils or forming terminal racemes. *Hypanthium-tube prolonged beyond the ovary, deciduous,* its 4 lobes reflexed at anthesis. Petals 4; stamens 8; ovary 4-celled. Capsule dehiscent, many seeded.

Key to Species

A. Capsules cylindric to 4-angled, never prominently winged; stamens equal and plants annual or biennial (except no. 8).

B. Hypanthium-tube prolonged more than 1 cm beyond the ovary; stamens equal; annual or biennial herbs from a basal rosette.

C. Stem pubescent, variously colored; flowers yellow, sometimes aging reddish; seeds in 2 rows in each locule.

D. Capsules 3–8 mm thick, 1.5–4 cm long at maturity, slightly tapering from a thickish base, straight or slightly curved; seeds angled, horizontal in the locules (Subgenus *Onagra*).

E. Sepal-tips of unopened bud strictly terminal (figs. 6A, 6C), closely parallel and forming a tube, or the tips converging (character sometimes poorly preserved in pressed specimens); leaves lanceolate to ovate-lanceolate; petals 9–30 mm long.

F. Calyx glabrous to more or less villous or hirsute, not densely canescent (fig. 6A); leaves broad, thin, crinkled, bright green, mostly with short erect hairs ______________ 1. O. BIENNIS. (see also 2. O. ERYTHROSEPALA).

FF. Calyx densely canescent-strigose (fig. 6C); leaves narrow, thick, grayish-green with a dense pubescence of closely appressed short stiff hairs ___________________ 3. O. STRIGOSA.

EE. Sepal-tips of unopened bud subterminal, the bud apex therefore exposed (fig. 6B); leaves narrowly lanceolate to oblong-lanceolate; petals 6–18 mm long; stems commonly simple and less than 1 m high ___________________ 4. O. PARVIFLORA.

DD. Capsules 1–3 mm thick, 1–3.5 cm long at maturity, cylindrical, straight or commonly curving inwards; seeds not sharply angled, ascending in the locules (Subgenus *Raimannia*).

H. Leaves subentire to remotely denticulate; flowers in a terminal raceme, forming a distinct spike in fruit; capsules 1–2 cm long, 1–3 mm thick, often strongly curving inwards ______________________________________ 5. O. RHOMBIPETALA.

HH. Leaves deeply lobed; flowers solitary in the axils of the upper foliage leaves, not forming a distinct spike in fruit; capsules 2–3.5 cm long, 2–3 33 thick, straight or slightly curving ________________________________ 6. O. LACINIATA.

CC. Stem glabrous, the silvery-white bark exfoliating toward the base; flowers white, turning pink (in pressed specimens often a dingy yellow); seeds in one row in each locule (Subgenus *Anogra*) ________________________________7. O. NUTTALLII.

BB. Hypanthium-tube prolonged less than 1 cm beyond the ovary; stamens alternately unequal; plants perennial; leaves sharply serrulate; flowers sessile in the axils of the upper foliage leaves, not forming a distinct spike in fruit (Subgenus *Calylophis*) ________________8. O. SERRULATA.

AA. Capsules clavate to obovoid, with well defined wings; stamens alternately unequal; plants perennial (Subgenus *Kneiffia*).

I. Petals 4–9 mm long; hypanthium-tube 4–8 mm long, stems strigose-puberulent; leaves subentire _____ 9. O. PERENNIS.

II. Petals 13–30 mm long; hypanthium-tube 13–25 mm long; stems spreading-hirsute, the hairs 1–2 mm long; leaves denticulate __________________________ 10. O. PILOSELLA.

SUBGENUS ONAGRA Ludwig

Because of the peculiar genetic situation in this subgenus, with innumerable true breeding and self-pollinating lines resulting in numerous locally distributed geographic races or "biotypes" (which then occasionally hybridize), delimitation of species has long been a hopeless and confusing matter. The fact that scores of "mutants" or local biotypes have been published as true "species," not only obscured the recognition of evolutionary trends but also made it impossible to establish a useful taxonomy for the group as a whole (cf. Gates, 1957, 1958). The present study takes into account the extensive cytogenetical work of Cleland who considers the subgenus *Onagra* to be composed of relatively few species, each of which, in itself, is of hybrid origin and consists of many races. Concerning the origin of the various species, Cleland (personal communication, 1961) says: "There is a great deal of variation within the major groups that I have found to exist. This is owing, in the first place, to the fact that, when two populations, each possessing internal diversity, met and crossed, many crosses took place, many hybrids were formed and these were somewhat diverse in individual characteristics. In the second place, new "races" have come into existence from that day to this, by crossing between existent "races," thus multiplying the number of races and increasing the diversity . . . there are multitudinous races, often with considerable distinctions, but there are only a few major end-points of the evolutionary process. By calling everything . . . that differs slightly from what has been seen before a new species, completely masks the true picture in *Oenothera*. . . . It is essential to understand, of course, that the *Oenothera* population consists of innumerable true-breeding and self-pollinating lines and hence is compartmentalized by the presence of innumerable reproductive barriers."

1. OENOTHERA BIENNIS L. Bastard Evening-primrose. Map 19.

Erect biennial, the stems stout, 7–21 dm tall, simple or branching, commonly villous or hirsute. *Leaves bright green, rather thin, crinkled,* lanceolate to ovate-lanceolate, 3–20 cm long, 5–48 mm wide, acute, dentate, short-petioled or sessile, *glabrate to sparsely pubescent with short erect hairs.* Flowers in terminal racemes, the bracts often markedly different from the leaves and shorter than to slightly longer than the capsules. *Calyx glabrous to sparsely villous or hirsute, the sepal-tips terminal and parallel, closely adjoining and forming a tube* (fig. 6A). Hypanthium-tube 18–35 mm long. Petals obovate, 9–27 mm long. Capsule 15–40 mm long, glabrate to hirsute. 2n=14 (Cleland, 1958).

The following two races, recognized by Cleland (1956), are proposed as subspecies by Munz (see discussion):

A. Floral bracts subovate ________________ 1a. "BIENNIS I"
AA. Floral bracts narrow-lanceolate _________ 1b. "BIENNIS II"

1a. O. BIENNIS L., "BIENNIS I" race of Cleland (1956). Map 21.

Mainly in southern and western Wisconsin, though sporadic, on roadsides, railroad embankments, river banks and sandbars, lake shores, moist meadows, and woods. Flowering from early June to early September, and fruiting from early August to late September.

Cleland (1958:378–398), in his extensive cytogenetic study of the *Onagras,* found the *biennis* complex to be composed of 3 genetically distinct groups native to the eastern United States. In Wisconsin and throughout the Middle West (extending to the Atlantic Ocean in the Southeast) occurs the race known as *biennis I.* A genetically different population called *biennis II* occurs in the northeastern U. S. and Quebec, and extends west to Wisconsin. The *biennis III* race is confined to North Carolina, Virginia, Pennsylvania, and western New York, and its range overlaps both *biennis I* and *biennis II.* Concerning *biennis I,* Cleland (1958:380) says: "The various lines show considerable diversity, but all races are mesophytic in character, with thin, broad, crinkly, relatively hairless leaves, and a tendency toward delicate, brittle stems."

Dr. Philip A. Munz has kindly examined our collections of *Oenothera biennis* and has been able to determine the majority of them as to race or subspecies. Although the *biennis I* race is of sporadic occurrence in Wisconsin, especially in the southern and western counties, it is quite common in Illinois, Minnesota, North Dakota, Michigan, Indiana, Missouri, Arkansas, and Oklahoma. Munz notes that the *biennis I* race has subovate floral bracts, in contrast to the narrow-lanceolate bracts of *biennis II,* and is about to publish formal subspecies names for these two taxa (personal communication, 1961).

1b. O. BIENNIS L., "BIENNIS II" race of Cleland (1956). Map 20.

O. biennis L., var. *nutans* (Atkinson & Bartlett) Wieg.
O. biennis L., var. *pycnocarpa* (Atkinson & Bartlett) Wieg.

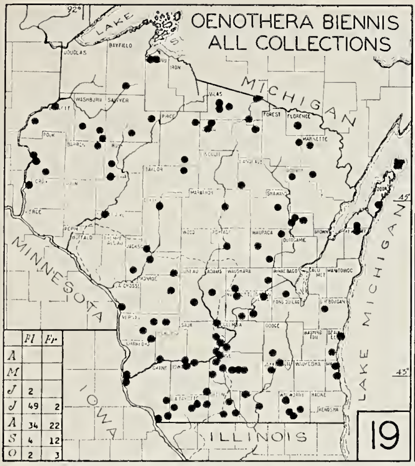
Throughout Wisconsin in a great variety of open, especially disturbed habitats, frequently along roadsides, railroad tracks, abandoned or cultivated fields, lake shores, river banks, marshes, sedge meadows, prairies, and open woods. Flowering from late June through October, with a peak in late July, and fruiting from late July to early October.

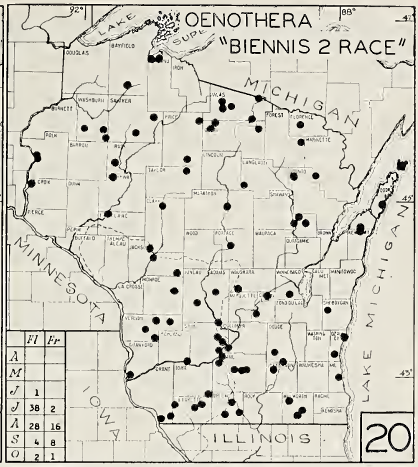
An abnormal plant from Shawano Co. has nearly linear petals only 33 mm wide (*Goessel 4826,* 1916 [MIL]). Such forms have been referred to in the past as *Oenothera cruciata* Nuttall. Concerning this abnormality, Munz (personal communication, 1961) says "*O. cruciata* has in my opinion no taxonomic status. The cruciate character occurs in all the species mentioned above and behaves like a single gene with imperfect dominance. It is conspicuous, but apparently of no more significance than differences in many other characters. For example, see Bartlett in Amer. Jour. Bot. 1:238. What he calls *cruciata* is in *parviflora;* so is *venosa;* so is *atrovirens;* so is *ostreae* of Sturtevant. *Stenomeres* is in . . . ["the Biennis I" race of Cleland]. I have seen cruciate forms in *depressa* [*O. strigosa*] likewise." For statements pertaining to the genetic behavior of the cruciate character consult Renner (1958), and Gates (1936).

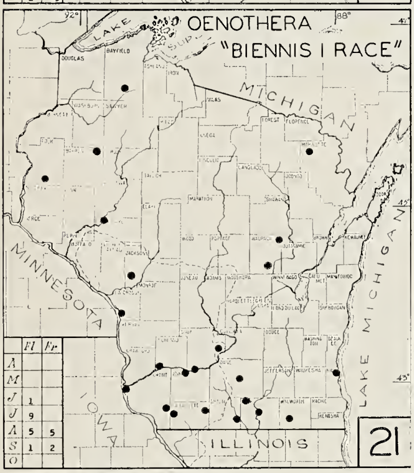
2. X OENOTHERA ERYTHROSEPALA Borbás Map 22.

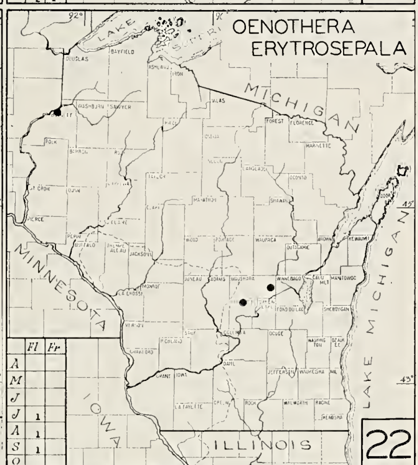
[Munz, P. A., 1949. The Oenothera Hookeri Group. El Aliso 2:38.]
Oenothera erythrosepala Borb., Magyar Bot. Lapok 2:245, 1903.
Oenothera lamarckiana of de Vries, Die Mutationstheorie 1:152–378, 1901; Comptes Rendus 121:124, 1900; not Séringe, in DC., Prodr. 3:47, 1828.

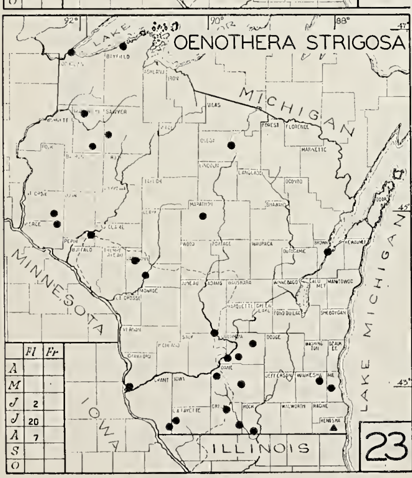
Biennial. Stems erect, simple or branching, rather stout, up to 1 m tall, villous-strigose, and commonly reddish-purple. Leaves lanceolate to ovate-lanceolate, 6–15 cm long, 15–40 mm wide, acute,

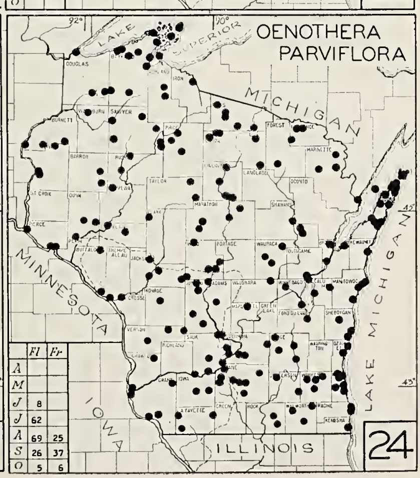

OENOTHERA BIENNIS
ALL COLLECTIONS
Fl Fr
J 2
J 49 2
A 34 22
S 4 12
O 2 3
19


OENOTHERA
"BIENNIS 2 RACE"
Fl Fr
J 1
J 38 2
A 28 16
S 4 8
O 2 1
20


OENOTHERA
"BIENNIS I RACE"
Fl Fr
J 1
J 9
A 5 5
S 1 2
21


OENOTHERA
ERYTROSEPALA
Fl Fr
J 1
A 1
S 1
22

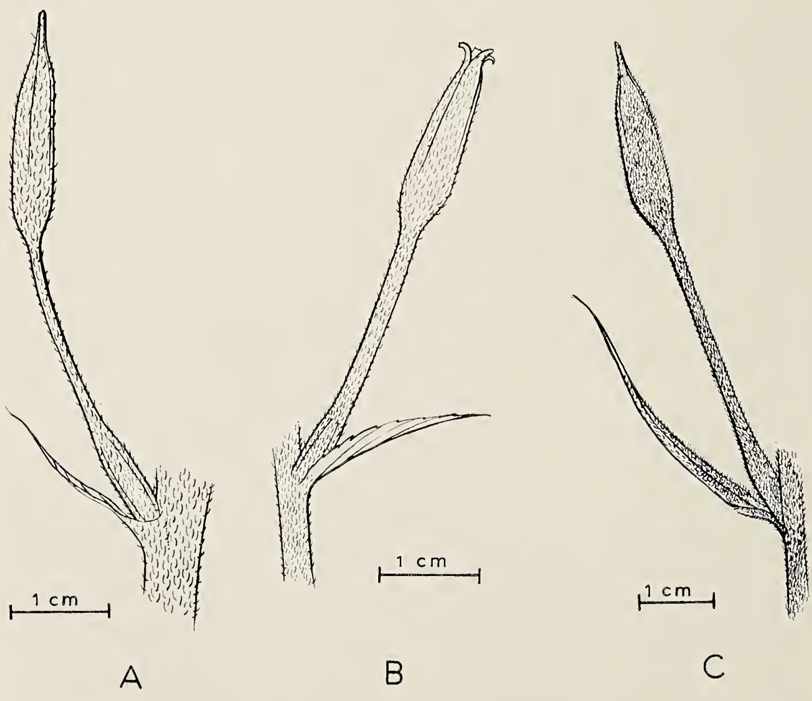

OENOTHERA STRIGOSA
Fl Fr
J 2
J 20
A 7
23


OENOTHERA
PARVIFLORA
Fl Fr
J 8
J 62
A 69 25
S 26 37
O 5 6
24

dentate, passing without evident interruption into the foliaceous bracts. *Calyx reddish-purple* (drying pale green), more or less villous, the sepal-tips terminal and parallel, closely adjoining and forming a tube. Hypanthium-tube glandular, 30–40 mm long. Petals yellow, often tinged with red, subrotund-obovate, *20–30 mm long*. Capsule oblong-ovate, enlarged below, sparsely pilose and glandular, 25–35 mm long.

Differing from *O. biennis* L. in the mostly larger showy flowers and the reddish-purple sepals (a character observable only on living plants). Apparently escaping from cultivation. Our three collections, determined by P. A. Munz, are as follows: Burnett Co.: Danbury, Aug. 26 [fl], 1916, *Baird s.n.* [WIS]. Marquette Co.: alluvial soil along trout stream, township of Newton, 8 mi. n.e. of Westfield, July 29–30 [fl], 1933, *Wadmond 3275* [MINN]. Waushara Co.: marsh and now dry grassland, along Willow Creek, T19N; R12E; Sec. 22, Sept. 30, 1956 [fl], *Hagene s.n.* [WIS].

FIG. 6 OENOTHERA



BIENNIS PARVIFLORA STRIGOSA

3. OENOTHERA STRIGOSA (Rydb.) Mackenzie & Bush Map 23.

Erect biennial, 5–9 dm high. Stem stout, simple or branched, sparsely pubescent below, canescent to strigose-villous above, the hairs mostly appressed. *Leaves* 4–17 cm long, 6–40 mm wide, oblong-lanceolate to lanceolate, acute, remotely denticulate, *grayish-green with a dense pubescence of closely appressed short stiff hairs. Calyx densely canescent-strigose, the sepal-tips terminal and parallel, closely adjoining and forming a tube* (fig. 6C). Hypanthium-tube commonly strigose-villous, 2–34 mm long. Petals yellow, obovate, 10–22 mm long. Capsule 17–40 mm long, often finely pubescent with appressed hairs. 2n=14 (Cleland, 1958)

Throughout Wisconsin, though sporadic and rather rare, on roadsides, railroad ballast, abandoned fields, and dry lime prairies. Flowering from late June to mid-August.

An abnormal form from Kenosha Co. (*Russel s.n.*, 1908 [MIL]) has nearly linear petals only 3 mm wide. The nature of this "cruciate" mutant is discussed under the treatment of the *biennis I* race of *O. biennis* L.

Oenothera strigosa extends eastward from the Rocky Mts. and the Great Plains to the Mississippi River and into Wisconsin, where it is at its eastern limit, and northwestward to Oregon and Washington. It is the predominating *Onagra* of the Great Plains. Cleland says: "Phenotypically the strigosas tend to have thick and rather narrow leaves, strigose hairs, a greyish-green color and thick woody stems." (1956:13). "These plants have . . . balanced lethals and moderately small self-pollinated flowers. They are xerophytic in character, but the various lines or races show a great diversity in foliage characters, in the abundance of anthocyanin pigmentation, etc." (1958:380).

4. OENOTHERA PARVIFLORA L. Small-Flowered Evening-Primrose. Map 24.

Stems simple or rarely branching, 1.4–13 (–20) dm high, glabrate to strigose-puberulent. *Leaves narrowly lanceolate to almost linear* or to ovate-lanceolate, 2–15 cm long, 3–35 mm wide, acute, denticulate, glabrate to strigose, passing without obvious change into the bracts of the fruiting spike. Calyx glabrate to strigose-villous, *the sepal-tips subterminal, buds therefore open at apex.* (fig. 6B). Hypanthium-tube 20–35 mm long. Petals yellow, obovate, 6–18 mm long. Capsule 1.5–4 cm long, 2n=14 (Cleland, 1958).

Common throughout Wisconsin in sandy or gravelly soil, often along lake shores, river banks, roadsides, railroad tracks, and cliffs, frequently in abandoned or cultivated fields, pastures, sedge meadows, and prairies. Flowering from early June to mid-October, with an extended peak lasting from mid-July through August, in latter August and September the predominant *Onagra* in flower, and fruiting from early August to mid-October.

An abnormal plant has nearly linear petals only 3 mm wide (Manitowoc Co.: Two Rivers, *Burch s.n.*, 1885 [WIS]). The nature of this "cruciate" mutant is discussed under the treatment of the *biennis I* race of *O. biennis* L.

Oenothera parviflora extends from New England into eastern Quebec, and along the Great Lakes into Wisconsin. Cleland (1956: 14) divides the *parvifloras* into two distinct groups, their appearance depending upon the particular set of genes carried by the maternal gamete, or alpha complex. Due to the "ring" formation of chromosomes at meiosis (peculiar to the subgenus *Onagra*), only two kinds of gametes are ordinarily formed, and a given set of genes is transmitted intact from generation to generation. The maternal set of genes is termed the "alpha complex," the paternal the "beta complex." The following excerpt from Cleland's paper (1956:14) particularly applies to our Wisconsin plants.

"[The *parvifloras*] share with the subgenus *Raimannia* certain characters not possessed in noticeable degree by other groups of *Euoenothera* [*Onagra*], namely, subterminal sepal-tips and a peculiar type of stem tip structure, the tips bending downward and then, at the very tip, upward again. These characters together with a tendency toward smallness, narrowness and hairlessness of the leaves are borne by the beta complexes. The alpha complexes are of two types—in some races they carry genes for a *biennis*-like phenotype, in others, genes for a *strigosa*-like phenotype. There are therefore two distinct categories of parvifloras—those with leanings toward *biennis*, and those which bear a resemblance to *strigosa*. In all cases, however, the beta complex impresses upon the plant its extreme narrowness of leaf so that there is no danger of confusing any of the parvifloras with *biennis* or *strigosa*."

In Wisconsin *parvifloras* with *biennis-like* and *strigosa-like* phenotypes occur, the latter more rarely.

SUBGENUS RAIMANNIA (Rose) Munz

5. Oenothera rhombipetala Nutt. Rhombic Evening-Primrose. Map 25.

Erect biennial, 2–13 dm tall. Cauline leaves narrowly oblong-lanceolate to lance-ovate, 2–9 cm long, 3–13 mm wide, subentire to remotely denticulate, acute, passing up the stem into leafy lanceolate bracts. Flowers numerous, crowded in a terminal spike. *Buds* *narrowly cylindric, densely strigose.* Hypanthium-tube sparsely strigose, 15–35 mm long. Petals yellow, rhombic-obovate, 10–22 mm long. *Capsules often strongly curved,* 1–2 cm long, 1–3 mm thick.

Southwestern Wisconsin, particularly common in the Central Wisconsin, Wisconsin River, and Black River sand areas, in sandy prairies and open Jack Pine-Oak woods, frequently in abandoned sandy fields, sand barrens, "goat" prairies, river terraces, lake shores, roadsides, and railroad ballast. Commonly associated with *Koeleria cristata, Monarda punctata, Euphorbia corollata, Liatris aspera, Lespedeza capitata, Ambrosia psilostachya, Cenchrus pauciflorus, Arabis lyrata, Helianthus occidentalis, Bouteloua curtipendula, B. hirsuta, Opuntia compressa,* and *Selaginella rupestris.* Flowering from early July through early October, and fruiting from late July to early October.

6. OENOTHERA LACINIATA Hill. var. LACINIATA. Cut-Leaved Evening Primrose. Map 26.

Low annual with villous or hirsute stems 1–3 dm tall, simple to several stemmed and branching. *Leaves* oblanceolate to oblong-lanceolate, *sinuate-pinnatifid,* 2–6 cm long. Flowers solitary and sessile in the axils of upper leaves. Calyx-lobes 5–12 mm long. Petals yellow to whitish, drying red, 5–18 mm long.

Rare in Wisconsin, adventive from further south, growing in railroad ballast, sandy farmyards, roadsides, and fallow gardens, and along the "lake front" at Manitowoc. Flowering from late June to early September.

Oenothera laciniata Hill. var. *grandiflora* (Wats.) Robinson., with calyx-lobes 20–30 mm long and petals 20–35 mm long, a southwestern form, has been collected once in Plymouth (Sheboygan Co., on railroad ballast, *Goessl s.n.,* 1903 [WIS]). This report is questionable.

SUBGENUS ANOGRA (SPACH) JEPSON

7. OENOTHERA NUTTALLII Sweet. White-Stemmed Evening Primrose. Map 27.

Perennial with creeping underground rootstocks. *Stems* erect, *glabrous,* 2–9 dm high, *the white bark exfoliating toward the base.* Leaves linear to linear-oblong, acute, nearly entire, glabrous above, strigose beneath, 2–12 cm long, 2–7 mm wide. *Flowers showy white, turning pink,* with disagreeable odor; buds nodding. Calyx-lobes glandular pubescent. Hypanthium-tube 2–3 cm long. Petals obovate, 1–2 cm long. Capsules glandular, 1–2.5 cm long, *the seeds in one row in each locule.*

Rare and scattered in Wisconsin along railroad tracks, though occasionally forming large colonies, adventive from the Northern Great Plains. Flowering from late June to early September, and fruiting from early August to early September.

SUBGENUS CALYLOPHIS (SPACH) MUNZ

8. OENOTHERA SERRULATA Nutt. Toothed-Leaved Evening Primrose. Map 28.

Perennial. *Stems thin, often woody,* 2–5 dm tall, simple to much branched from the base, glabrous below, the upper portion canescent. *Leaves* linear to linear-lanceolate, 1–6 cm long, *commonly sharply serrulate,* sessile or tapering to a short petiole. Flowers solitary, sessile in the axils of the upper leaves. *Hypanthium-tube 4–8 mm long,* roundly 4-angled, funnelform. Petals yellow, obovate, 5–10 mm long. Stamens alternately unequal. Capsule 1–3 cm long, roundly 4-angled, straight or slightly curved.

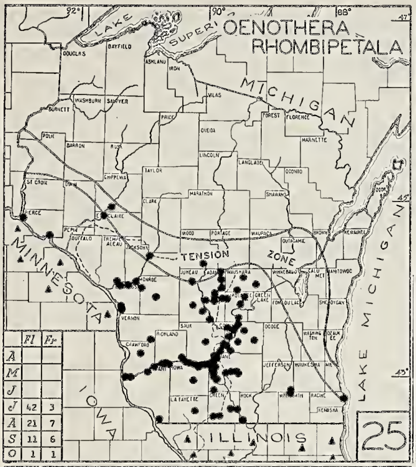
Native in western-most Wisconsin, in dry steep "goat" prairies, open sandy Juniper glades, on sandy prairies, or on sand terraces, along or near the Mississippi River bluffs; near Mondovi (Buffalo Co., *Iltis & Noamesi 8078* [WIS]) in a mesic railroad prairie on deep sandy soil, with *Andropogon gerardi, Hieracium longipilum, Lithospermum croceum, Leptoloma cognatum, Solidago rigida, S. speciosa, Potentilla arguta, Stipa spartea, Helianthus* and *Liatris* spp., *Aster ericoides,* and *A. azureus;* elsewhere adventive mainly along railroad tracks. Flowering from mid-June to early September, and fruiting from July to mid-October.

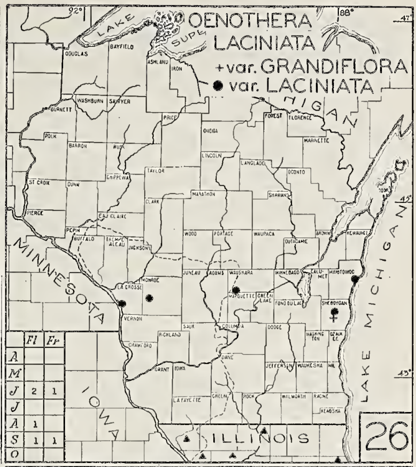
SUBGENUS KNEIFFIA (SPACH) MUNZ

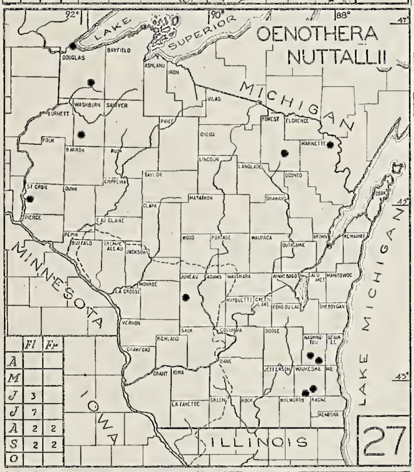
9. OENOTHERA PERENNIS L. Sundrops Map 29.

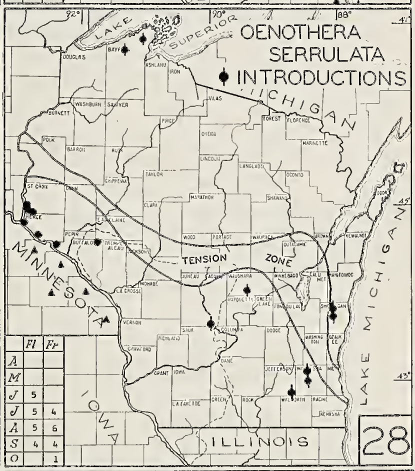
Slender perennial with erect stems 1–4 (–7) dm tall, simple or few branched above, *strigose-puberulent.* Leaves linear-lanceolate to oblanceolate, 1–6 cm long, entire or remotely denticulate. Inflorescence a few flowered raceme, glandular-puberulent, the tip nodding in bud. Sepals glandular-puberulent, reflexed in pairs or in 4's at anthesis. Hypanthium-tube 4–8 mm long. Petals yellow, obcordate, 4–9 mm long. Stamens alternately unequal. *Capsule ellipsoid-clavate or -oblong, winged,* including the narrow stipe-like base 8–13 mm long. $2n=28$ (Valcanover, 1927, ex Darlington, 1955).

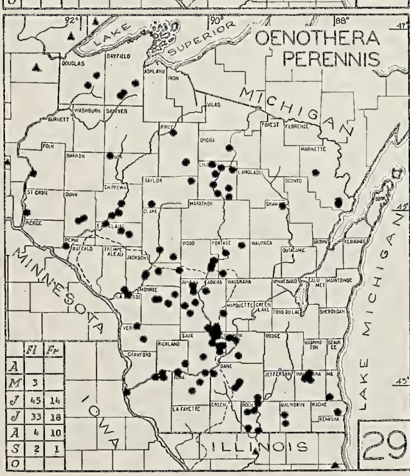
Widespread in Wisconsin, in wet to mesic prairies, sedge meadows, pastures, sandy or muddy margins of marshes, shallow bogs, streams and rivers, moist cliffs, sandy roadsides, and occasionally

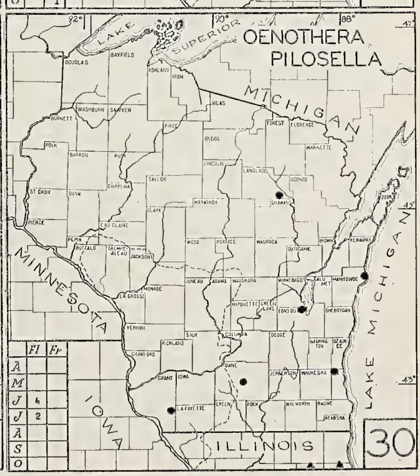

OENOTHERA RHOMBIPETALA
Fl Fr
A
M
J
J 42 3
A 21 7
S 11 6
O 1 1
25


OENOTHERA LACINIATA
+ var. GRANDIFLORA
● var. LACINIATA
Fl Fr
A
M
J 2 1
J
A 1
S 1 1
O
26


OENOTHERA NUTTALLII
Fl Fr
A
M
J 3
J 7
A 2 2
S 2 2
O
27


OENOTHERA SERRULATA
INTRODUCTIONS
Fl Fr
A
M
J 5
J 5 4
A 5 6
S 4 4
O 1
28


OENOTHERA PERENNIS
Fl Fr
A
M 3
J 45 14
J 33 18
A 4 10
S 2 1
O
29


OENOTHERA PILOSELLA
Fl Fr
A
M
J 4
J 2
A
S
O
30

in open Oak-Hickory woods and along railroad tracks. Flowering from late May to mid-September, with a peak in late June, and fruiting from mid-June to September.

10. OENOTHERA PILOSELLA Raf. Meadow Sundrops Map 30.

Perennial. Stems erect, 2–6 dm high, *with spreading hirsute hairs 1–2 mm long.* Leaves lanceolate to almost ovate, 2–7 cm long, obtuse, minutely and irregularly denticulate, more or less hirsute. Hypanthium-tube 13–20 mm long. Petals obcordate, yellow, 2–3 cm long. Stamens alternately unequal. *Capsule* sessile, *linear-clavate, winged,* hirsute, 1–2 cm long.

Commonly cultivated for its showy yellow flowers, and occasionally escaped on roadsides, railroads and old gardens. Flowering from mid-June to mid-July.

4. GAURA L. GAURA

[Munz, P. A., A revision of the genus *Gaura.* Bull. Torr. Bot. Club 65:105–122. 1938.]

Herbs with alternate, sessile leaves, *and small white, pink or red flowers* in terminal spikes. *Hypanthium-tube conspicuously prolonged beyond the summit of the ovary, deciduous.* Petals 4; stamens 8; stigma 4-lobed, surrounded by a ring. *Fruit indehiscent, hard and nut-like, 1–4 seeded.*

KEY TO SPECIES

A. Ovary and spindle-shaped fruit pubescent with spreading hairs; basal portion of fruit 4-angled; plants not ordinarily branched from the base ---------------------- 1. G. BIENNIS.

AA. Ovary and pear-shaped fruit pubescent with appressed or incurved hairs; basal portion of fruit nearly round; plants often branched from the base -------------- 2. G. COCCINEA.

1. GAURA BIENNIS L. Biennial Gaura. Map 31.

Stems branched, 9–11 dm high or more, spreading villous as well as short-pubescent. Leaves oblong-lanceolate to lance-ovate, acute at both ends, remotely denticulate, 3–11 cm long. Flowers in slender glandular pubescent spikes; opening in evening. Sepals often red, reflexed in pairs at anthesis. Petals white, turning pink or red, about 5 mm long. *Fruit with spreading hairs, 4-angled, acute at both ends,* 6–8 mm long. 2n=14 (Bhaduri, 1942, ex Darlington, 1955).

Southernmost Wisconsin probably native from Grant to Walworth County, in mesic to moist prairies, rarely in open woods; in the counties north of the five lowest adventive (?) with all but one collection either from railroad tracks or roadsides; near Monticello (Green Co.; *Iltis & Greene 6747* [WIS]) growing in a rich deep black soil prairie, between R. R. tracks and road, with scattered Willows, Dogwoods, Bur Oak, *Potentilla arguta, Eryngium yuccifolium, Ratibida pinnata, Hypericum sphaerocarpum,* and *Galium* spp. Flowering from mid-July through September, and fruiting from August through September.

2. GAURA COCCINEA Nutt. Scarlet Gaura. Map 32.

Perennial. Stems 2–4 dm high, canescent-strigose, often branched from the base. Leaves oblong-lanceolate to nearly linear, entire or remotely denticulate, finely and closely pubescent, mostly sessile, 1–3 cm long. Spikes simple, nodding at tips. Sepals gray-green, often pink, reflexed separately at anthesis. Petals white to pink, aging red, 3–6 mm long. *Capsule pubescent with appressed or incurved hairs, pear-shaped, tapering from near the base, the body proper 4-angled, basal portion nearly round.* $2n=14$ (Johansen, 1929, ex Darlington, 1955).

Native of the southwestern U.S., a rare adventive in Wisconsin along railroad tracks. Dane Co.: railroad, Yahara, N.E. of Madison, *Thomson & Dailey s.n.*, 1955 (WIS); Madison, *Denniston s.n.*, 1916 (WIS). Outagamie Co.: R.R. ballast, Appleton, *Goessl s.n.*, 1915 (MIL, WIS). Waukesha Co.: Railroad track, Hartland, *Cull 880* (WIS); garden, Waukesha, *Finger s.n.*, 1908 (MIL). Flowering from June through July.

5. CIRCAEA L. ENCHANTER'S NIGHTSHADE

Perennial herbs with opposite, dentate, petioled leaves and small white (pink) perfect flowers in terminal and lateral racemes. Petals 2; stamens 2, alternate with the petals; ovary 1–2 celled. Hypanthium-tube slightly prolonged beyond the ovary. *Fruit indehiscent, 1–2-seeded,* small and bur-like, *bristly with hooked hairs,* readily sticking to clothing and animals like stick-tights.

KEY TO SPECIES

A. Fruit with ridges separated by deep furrows, 3–5 mm thick (inc. bristles), 2-celled; buds prior to anthesis 2.5–4.5 mm long; leaves rounded or barely subcordate at base, shallowly (rarely sharply) sinuate-denticulate; stem firm, 2–10 dm high; rhizome slender. ____________________1. C. QUADRISULCATA.

AA. Fruit smooth, 1–2.5 mm thick (inc. bristles), 1 or unequally 2-celled; buds prior to anthesis 1–3.5 mm long; leaves truncate, cordate, or rarely only rounded to base, sharply denticulate; stem weak, 0.5–5 dm high.

B. Buds 2–3.5 mm long; fruit unequally 2-celled (semi-sterile), 1.2–2.5 mm thick; larger leaves 4–11 cm long, stems 2–5 dm high; rhizome slender ------2. C. "CANADENSIS."

BB. Buds 1–2 mm long; fruit 1-celled, 0.6–1.5 mm thick; larger leaves 1–6 (–8) cm long; stems 0.5–3 dm high; rhizome tuberously thickened --------------------3. C. ALPINA.

1. CIRCAEA QUADRISULCATA (Maxim.) French & Sav. var. CANADENSIS (L.) Hara. Southern Enchanter's Nightshade. Map 33.

Stems firm, 2–10 dm high, from a slender rhizome. Leaves dark green, rather firm, oblong-ovate, the larger 5–13 cm long, 2–7 cm wide, *shallowy (rarely sharply) sinuate-denticulate, rounded or barely subcordate at base. Buds* prior to anthesis *2.5–4.5 mm long.* Stigma shallowy 2-lobed. *Fruit 2-celled, deeply grooved, 3–5 mm thick* including the stiff hooked bristles. Fruiting pedicels 3–12 mm long, strongly reflexed.

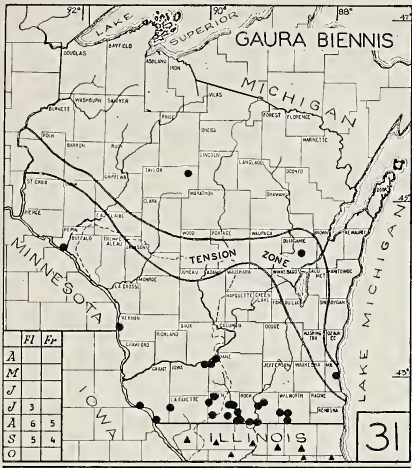
Throughout the state except in the northern-most counties, in a great variety of mesic to moist wooded habitats, especially in mixed Sugar Maple-Basswood forests, often with Bitternut, Yellow Birch, Hemlock, and Balsam Fir, frequently found in Beech-Sugar Maple, White Pine-Oak-Red Maple, and Oak-Hickory woods; as well as thickets, wooded ravines, and roadsides. Flowering from mid-June through August, and fruiting from mid-July through September.

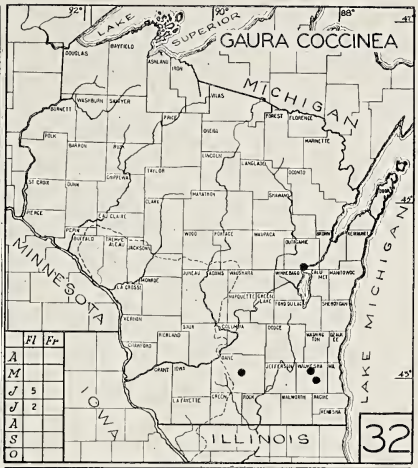
2. CIRCAEA "CANADENSIS Hill."[2] Map 34.

Stems rather weak, 2–5 dm high, from a slender rhizome. Leaves light green, thin, ovate or oblong-ovate, the larger 4-11 cm long, 4–7 cm wide, *sharply undulate-denticulate, rounded to subcordate at base. Buds* prior to anthesis *2–3.5 mm long.* Stigma deeply 2-cleft. *Fruits unequally 2-celled* (mostly sterile), *smooth, 1–2.5 mm thick* including the soft bristles. Pedicels 3–4 mm long, spreading or slightly reflexed.

Rare in Wisconsin, with all our specimens without habitat data: Ashland Co.: Ashland, 1896, *Cheney 4722* (WIS, MIL). Bayfield Co.: Fish Creek Valley, 1932, *Bobb 770* (WIS). Douglas Co.: opposite Fond du Lac, 1897, *Cheney 7906* (WIS). Rusk Co.: Strickland, 1938, *Fassett 22044* (WIS). Flowering in July.

[2] This hybrid has recently been studied by Dr. Peter Raven (Stanford University), who, in a forthcoming publication, will rename it in honor of Prof. M. L. Fernald.


GAURA BIENNIS
LAKE SUPERIOR
MICHIGAN
MINNESOTA
TENSION ZONE
IOWA
ILLINOIS
LAKE MICHIGAN
Fl Fr
A
M
J
J 3
A 6 5
S 5 4
O
31


GAURA COCCINEA
LAKE SUPERIOR
MICHIGAN
MINNESOTA
IOWA
ILLINOIS
LAKE MICHIGAN
Fl Fr
A
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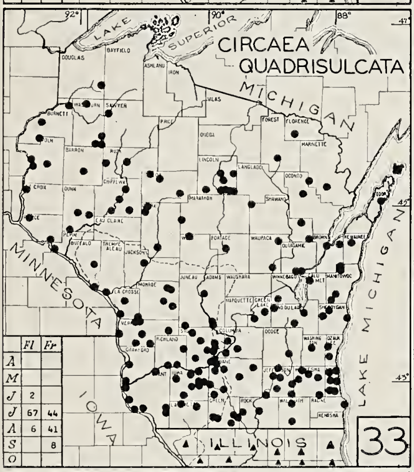
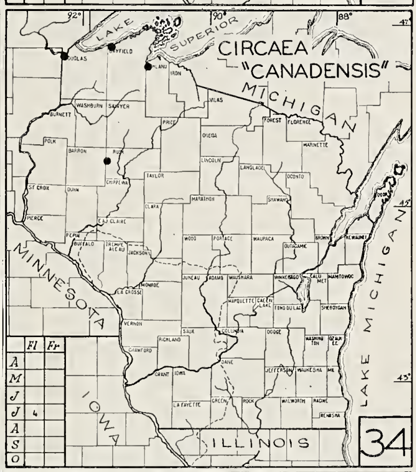
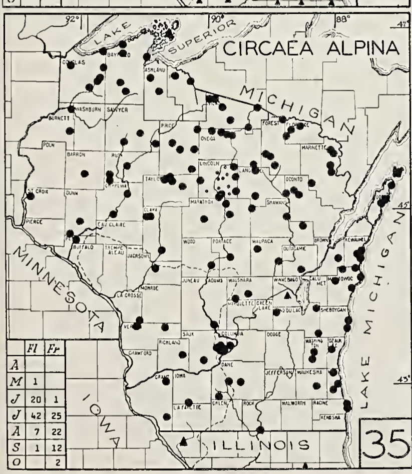
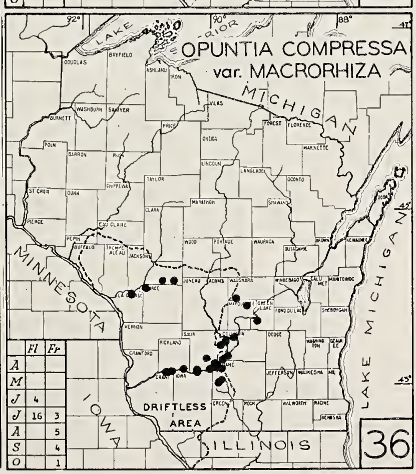
J 5
J 2
A
S
O
32

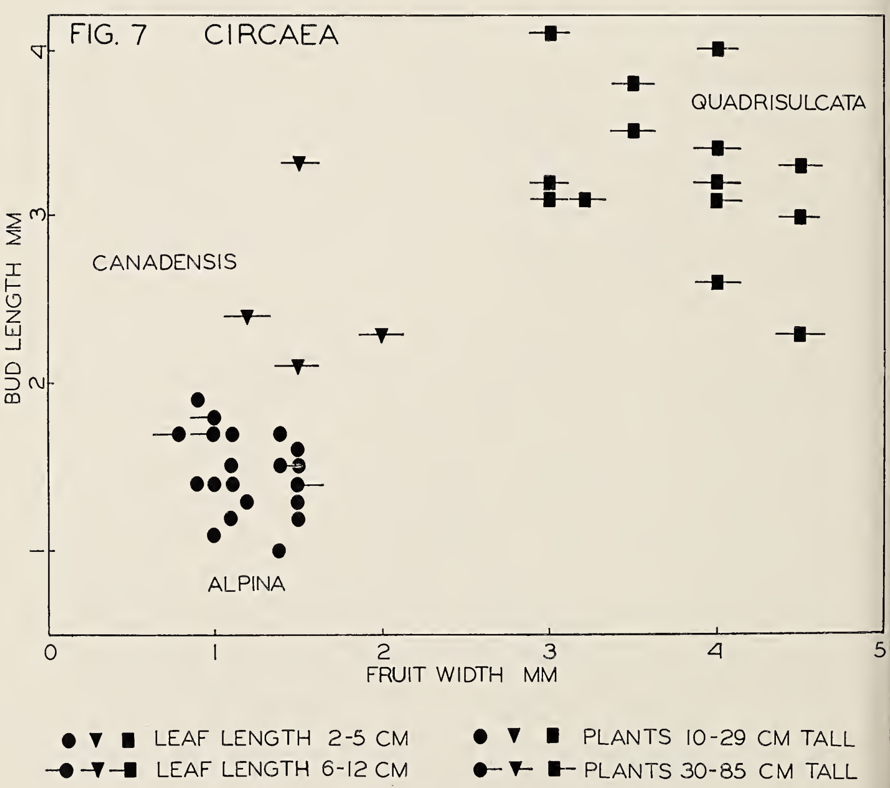

CIRCAEA QUADRISULCATA
LAKE SUPERIOR
MICHIGAN
MINNESOTA
IOWA
ILLINOIS
LAKE MICHIGAN
Fl Fr
A
M
J 2
J 67 44
A 6 41
S 8
O
33


CIRCAEA "CANADENSIS"
LAKE SUPERIOR
MICHIGAN
MINNESOTA
IOWA
ILLINOIS
LAKE MICHIGAN
Fl Fr
A
M
J
J 4
A
S
O
34


CIRCAEA ALPINA
LAKE SUPERIOR
MICHIGAN
MINNESOTA
IOWA
ILLINOIS
LAKE MICHIGAN
Fl Fr
A
M 1
J 20 1
J 42 25
A 7 22
S 1 12
O 2
35


OPUNTIA COMPRESSA
var. MACRORHIZA
LAKE SUPERIOR
MICHIGAN
MINNESOTA
IOWA
DRIFTLESS AREA
ILLINOIS
LAKE MICHIGAN
Fl Fr
A
M
J 4
J 16 3
A 5
S 4
O 1
36

The above plants have morphological characters intermediate to those of *Circaea alpina* and *C. quadrisulcata,* especially in height, size of flowers, and fruit thickness. The sharply dentate leaves and rather short racemes resemble those of *Circaea alpina,* while the size and shape of the leaves are like those of *Circaea quadrisulcata.* Similar eastern plants have been known as *Circaea "canadensis* Hill." (Fernald, 1917). There is a European equivalent of this plant, *Circaea intermedia,* which has long been thought of as a hybrid between *Circaea alpina* and *Circaea lutetiana,* the old world vicariad of *C. quadrisulcata* (Hegi, 1908; Hulten, 1958). Rarity of the intermediate plants, plus semi-sterile fruits, are conditions frequently associated with hybridization. Cooperrider (1962), in "The Occurrence and Hybrid Nature of an Enchanter's Nightshade in Ohio," reports that *Circaea "canadensis"* plants had less than 1% fertile pollen, and were growing in deep "hemlock gorges" or ravines together with *C. alpina* and *C. quadrisulcata.* Cooperrider cites the low pollen fertility of these plants, plus their proximity to *C. alpina* and *C. quadrisulcata,* as evidence of their hybrid nature.



The scatter diagram (fig. 7) reveals some of the subtle morphological relationships that exist between the intermediate forms and the good species. It should be noted that *Circaea "canadensis"* in general has been collected in the broad area where the ranges of both *Circaea quadrisulcata* and *C. alpina* overlap: *Circaea alpina,* a species with boreal affinities, ranges from Alaska to Labrador, south to New York, along the Appalachian Mountains to Georgia, northwest to South Dakota and Washington and along the Rocky Mountains to Colorado; while *Circaea quadrisulcata,* a species mainly of the southern deciduous forest, ranges from Nova Scotia to North Dakota, and south to Oklahoma and Georgia; *Circaea "canadensis"*, has been reported from Southeastern Quebec to Minnesota, south to Pennsylvania and the mountains of West Virginia (Fernald, 1950). However, of the 4 Wisconsin collections, 3 are just north of and beyond the range of *Circaea quadrisulcata*!

3. Circaea alpina L. Northern Enchanter's Nightshade. Map 35.

Stems weak, 0.5–3 dm high, from a tuberously thickened rhizome. Leaves thin, pale green, ovate or deltoid-ovate, 1–6 (–8) cm long, 1–6 cm wide, *sharply undulate-denticulate, truncate or commonly cordate at base. Buds* prior to anthesis *1–2 mm long.* Stigma deeply 2-cleft. *Fruit 1-celled, smooth, 0.6–1.5 mm thick* including the soft hooked bristles. Pedicels 2–5 mm long, spreading or slightly reflexed. 2n=22 (Levan & Löve, 1942, ex Darlington, 1955).

In cool moist woods, swamps, ravines, limestone, sandstone, and quartzite ledges, common in mixed Hemlock-Yellow Birch forests, often with Balsam Fir, White Pine, Red Maple, Sugar Maple, Basswood, Slippery Elm, and Iron Wood. Often in cool moist Arbor Vitae woods, then with Yellow Birch, Black Spruce, and Mountain Maple; or Arbor Vitae swamps with Tamarack, Alder, or Yellow Birch. Frequently growing on mossy rocks, decaying logs, and along streams. Associated with *Mitella nuda, Mitella diphylla, Coptis groenlandica, Oxalis montana, Adiantum pedatum,* and occasionally with *Circaea quadrisulcata;* at Wildcat Mt. State Park (Vernon Co.), in crevices on sandstone cliffs along with *Sullivantia renifolia* and *Cryptograma.* Flowering from mid-June to early September, and fruiting from late June to early October, this species about 2 weeks earlier than *C. quadrisulcata,* the two species to some extent seasonally isolated.

HALORAGIDACEAE—WATER MILFOIL FAMILY

Aquatics (ours) with simple, opposite, alternate, or whorled leaves and small 2–4-merous epigynous flowers sessile in the axils of the leaves or bracts. Sepals wanting or minute; petals small or none; *stamens 1–8; ovary* inferior, *3–4-celled* with a single ovule in each cell. Fruit nut-like, indehiscent.

Represented in our area by six species of the genus *Myriophyllum,* which has 4-merous flowers and whorled or alternate, usually pinnatifid leaves, and by *Proserpinaca palustris* L., with 3-merous flowers and alternate leaves. The family has been treated by N. C. Fassett, in the Preliminary Reports on the Flora of Wisconsin 10 (Trans. Wis. Acad. Sci., Arts, and Letters 25:201–203. 1930).

HIPPURIDACEAE—MARE'S TAIL FAMILY

Aquatic plants with simple, sessile, whorled, entire leaves and minute, perfect or pistillate, epigynous flowers sessile in the upper leaf axils. Sepals and petals wanting; *stamen 1; ovary* inferior, *1-celled* and 1-ovuled. Fruit nut-like.

A monotypic family. *Hippuris vulgaris* L., its only member, has been treated with the *Haloragidaceae* by N. C. Fassett (1930).

ORDER CACTALES

Flowers solitary, sessile, regular, perfect, epigynous. Sepals and petals numerous, inserted on the hypanthium. Ovary inferior, 1-celled, ovules numerous. Fruit a dry or juicy berry. Only the following family.

CACTACEAE—CACTUS FAMILY

Characters of the order. Stems fleshy and thickened, jointed, globular, or columnar, often spiny, mostly leafless.

A large family native (with a few questionable exceptions) mainly to the arid and semi-arid regions of tropical and temperate America and consisting of approximately 124 genera and 1200 species.

1. OPUNTIA Mill. Prickly Pear

[Benson, L., A revision of some Arizona *Cactaceae*. Proc. Cal. Acad. Sci. 25:245–268. 1944; Britton, N. L. and Rose, J. N., "The *Cactaceae*". Carnegie Inst. of Wash. Pub. no. 248. 1919.]

Succulent plants with jointed greatly flattened to cylindric stems. Leaves reduced to awl-like fleshy scales, soon deciduous, with clusters of detachable barbed bristles (glochids) and often elongate spines in their axils (areoles).

Key to Species

A. Joints of stem strongly flattened, when full grown 3–23 cm long; spines 1–4 per areole (more numerous in immature joints), or none; fruit juicy when ripe, spineless ---------- ---------------------------------------1. O. COMPRESSA.

AA. Joints of stem turgid, scarcely flattened, when full grown 1–4 cm long; spines 1–7 per areole; fruit dry, often spiny -------- ---------------------------------------2. O. FRAGILIS.

1. Opuntia compressa (Salisb.) Macbr. Prickly Pear.

Joints orbicular to oblong, flattened, 3–23 cm long, 2–10 cm broad. Areoles 8–18 mm apart, the glochids yellow or brown. Spines from upper areoles only, or wanting, when present 1–4 per areole, of which one is much the larger, white or gray, 4–43 mm long. Petals yellow, the base often reddish, 2.5–4 cm long. Fruit obovoid or clavate, spinless, juicy, green, aging red or red-purple, 3–8 cm long, edible. 2n=22, 44 (Bowden, 1945, ex Darlington, 1955).

Key to Varieties

A. Stems forming circular mats 1–2 m in diam.; central roots tuberously thickened ----1a. O. COMPRESSA var. MACRORHIZA.

AA. Stems spreading for many meters, not forming distinct circular mats; all roots fibrous ------------------------------ ----------------------1b. O. COMPRESSA var. MICROSPERMA.

1a. Opuntia compressa var. macrorhiza (Engelm.) Benson. Map 36.

Opuntia macrorhiza Engelm.

Stems prostrate, the terminal portions ascending, *forming mats 1–2 m in diameter from a central cluster of tuberous roots,* these sometimes 5 cm in diameter and resembling an elongated potato, the peripheral joints frequently with fibrous roots only.

Var. *macrorhiza,* which extends from Arizona and Texas eastward to Kansas and Missouri, and north through Nebraska, and Minnesota, occurs in Southwestern Wisconsin in sand areas and bluffs mainly along the Wisconsin and Black Rivers, in dry prairies, open Jack Pine-Oak woods, and sand barrens. Commonly associated with *Monarda punctata, Euphorbia corollata, Ambrosia psilos-*

tachya, Liatris aspera, Lespedeza capitata, Asclepias verticillata, Oenothera rhombipetala, Koeleria cristata, Selaginella rupestris, and *Cladonia cristatella.* The joint surface is often infected by the parasitic fungus *Perisporium wrightii* B. & C., which forms large black plaques 1 cm or more in diameter. Flowering from mid-June through July, and fruiting from mid-July through October.

The Spring Rose Beetle, *Strigoderma arboricola* Fab. *(Scarabaeidae)*,[3] has been observed by me at several stations to visit the flowers in great abundance, frequently forcing their way through the numerous overlapping petals of the bud. Often, each flower will have a dozen or more beetles coated with yellow pollen struggling to gain access to the nectaries at the petal bases. The flowers are less frequently visited by honey bees, wasps, and ants.

All of our plants grow either on Upper Cambrian Sandstone ledges, or on sand or sandy soil derived from that parent material. Frequently the sandstone ledges are capped by a layer of Lower Ordovician Dolomite, the alkaline seepage of which permeates and cements the underlying sandstone, causing the soil pH to vary from fairly acidic to mildly basic (Table 1).

TABLE 1. Soil pH, dry samples, Beckman meter. Soil samples taken from earth immediately surrounding roots of *Opuntia compressa* var. *macrorhiza.*

Locality	County	pH
Gotham	Richland	4.73
Okee	Columbia	5.00
Black Earth	Dane	6.17
Blue River	Grant	6.18
Pine Bluff	Dane	6.49
Spring Green	Sauk	6.55
Budsin Corners	Marquette	6.99
Troy	Sauk	7.40
Lodi Mills	Sauk	7.49
Marxville	Dane	7.55
Cactus Bluff	Sauk	7.61
Mazomanie	Dane	7.73

Benson (personal communication, 1960) finds that var. *macrorhiza,* in general, has much broader seed margins than var. *microsperma.* The seeds of Wisconsin plants, while somewhat broader margined, are not distinctive enough to be of much value in differentiating between varieties.

[3] Identified by Dr. Roy Shenefelt, Dept. of Entomology, University of Wisconsin.

1b. Opuntia compressa var. microsperma (Engelm.) Benson. Map 37.

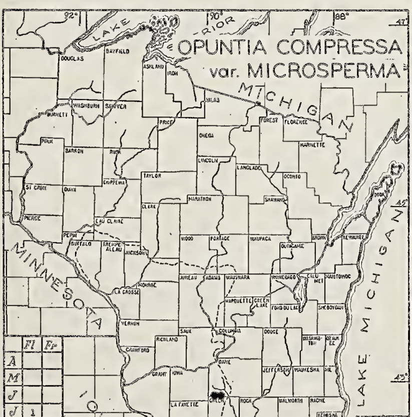
Opuntia humifusa Raf.
Opuntia rafinesquii Gray.

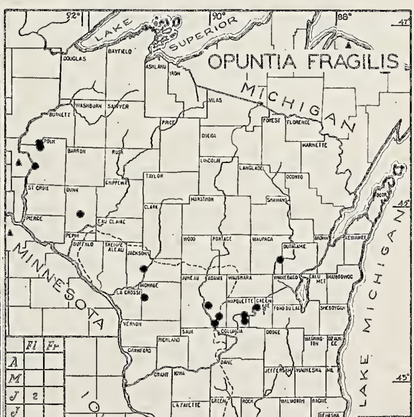
Differing from var. *macrorhiza* by its habit of spreading irregularly over large areas (rarely forming small well-defined mats), *completely fibrous root system,* and somewhat smaller seed margins.

Var. *microsperma,* a wide-ranging Middle-Western form differing from the eastern typical variety only in its more spiny and slightly larger joints and fruits, is apparently very rare in southwestern Wisconsin in dry sand prairies and sandstone ledges. Flowering in early July.

The plant is known from only two localities, both in Dane County. Near Daleyville (*Looman s.n.,* 1960 [WIS]) it occurs on a grazed sandy south-facing slope (pH 6.72) leading up to crumbly ledges of St. Peter sandstone, there thriving on the organically poor soil derived from weathering of the rock, which is encrusted with many lichens, especially *Physcia caena* and *Lecanora rubina.* Near the top ledge, *Opuntia* grows intermixed with spreading mats of *Juniperus horizontalis,* while in the lower grazed slope it is associated with *Oenothera rhombipetala, Rubus* and *Rosa* spp., and scattered *Xanthoxylum americanum.* Near Belleville it has been collected on a crumbling sandstone bluff *(Fassett 3100* [WIS]).

Optunia tortispina Engelm., which extends from South Dakota to Texas and New Mexico, is reported for Wisconsin by Britton and Rose (1:1313, 1919) and other authors, a record evidently based on a misidentified specimen of *Opuntia compressa.* No specimens referable to this species have been seen by the writer.





2. Opuntia fragilis (Nutt.) Haw. Brittle Prickly Pear. Map 38.
Stems prostrate or decumbent, forming loose mounds up to 5 dm in diameter and to 2 dm high. *Joints* dark green, *easily detached. usually turgid, orbicular to obovate, 1–4 cm long, 6–22 mm thick.* Areoles crowded, filled with white wool and yellow glochids, nearly all armed with 1–7 spines, 1–22 mm long. Petals yellow, 24–26 mm long. Fruit dry, spiny, inedible. 2n=66 (Bowden, 1945, ex Darlington, 1955).

Opuntia fragilis, extending from British Columbia eastward to Manitoba, and south to Texas and Arizona, is rare though locally abundant in central and northwestern Wisconsin, on thin rocky soil of granite or quartzite outcrops and occasionally in sandy soil or on sandstone ridges; SE of Grantsburg (Burnett Co.; *Schlising 1647* [WIS]) in dark rich soil (pH 4.6) in cracks and crevices of an exposed grazed granite outcrop with scattered *Quercus macrocarpa, Juniperus virginiana, Rhus glabra, Xanthoxylum americanum, Selaginella rupestris, Rhus radicans, Monarda fistulosa, Campanula rotundifolia,* and *Silene antirrhina,* sharing the rock space with many lichens, especially *Parmelia conspersa, Parmelia stenophylla, Cladonia pyxidata;* near New London (Waupaca Co.: *Fuller s.n.,* 1931 [MIL]) abundant on granite outcrop (pH 4) : and SW of Adams (Adams Co., *Fuller s.n.,* 1925 [MINN]) in sand barrens with *Selaginella rupestris* and *Polygonella articulata.* Flowering in mid-June.

Opuntia polyacantha Haw., which extends from southern Alberta and Saskatchewan to Texas and Arizona, and reportedly to Wisconsin (Gleason 2:570, 1952), has not been seen from Wisconsin, the report probably based on a misidentified specimen of *Opuntia fragilis.* The only specimen that might possibly be included in *O. polycantha* is one Green Lake County specimen, which has tentatively been determined by Benson as *O. fragilis* (on map 38 with a ? mark). Though further field work may resolve this question, it is worth noting that this collection is well within the geographic range of *O. fragilis* in Wisconsin.

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MINERAL DEFICIENCY SYMPTOMS ON TURFGRASS[1]
I. MAJOR AND SECONDARY NUTRIENT ELEMENTS

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It is well documented that the lack of an essential mineral element can cause physiological disease (e.g., chlorosis) in plants. Descriptions of the deficient symptoms in various agronomic and horticultural plants have been reported by numerous investigators, including Bear *et al* (1949), DeTurk (1941), Hewitt (1943, 1944), McMurtrey (1948), and Wallace (1953). However, in none of these publications have the deficiency symptoms for any of the nutrient elements been described using a turfgrass as the indicator plant.

It was the purpose of this study to determine the deficiency symptoms of the major nutrient elements: Nitrogen (N), Phosphorus (P) and Potassium (K) and the secondary nutrient elements: Calcium (Ca), Magnesium (Mg) and Sulfur (S) in three grass species: Kentucky bluegrass (*Poa pratensis,* Merion) Creeping Bentgrass (*Agrostis palustris,* Seaside) and Creeping Red Fescue (*Festuca rubra,* Pennlawn).[2]

Duplicate treatments of each of these grass-nutrient combinations were grown in acid-washed quartz sand under controlled conditions in the greenhouse. A modified Hoagland's solution was used to maintain the plants in a healthy state until each grass was vigorously established. Prior to initiating the differential nutrient treatments, each sand culture (including the controls) was leached under suction with approximately three liters of distilled water to remove any accumulation of soluble salts. The plants were then managed as before except for the withholding of the particular nutrient element under investigation. The harvested tissue from each treatment was saved for chemical analyses.

That the visual symptoms noted in this study were due to a shortage of the major and secondary nutrient elements is evidenced first by the fact that the deficiencies were elicited three times, i.e., twice the deficient nutrient was added to the growth medium and

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[2] A study is also underway to establish the minor element deficiency symptoms in these same grass species.

the grass permitted to recover and secondly by the lower content of the deficient nutrient in the harvested leaves (Table 1). These steps are important because unless verified the possibility exists that the appearance one is diagnosing as a mineral deficiency may in actuality prove to be the result of some disease, lack of sufficient sunshine, too much or too little water, unfavorable temperatures, or some other condition. In all instances the visual symptoms were found to be reproducible.

TABLE 1. MAJOR AND SECONDARY NUTRIENT CONTENT OF VARIOUSLY TREATED TURFGRASS

Treatment	Percent Nutrient Contained in Leaves					
	N	P	K	Ca	Mg	S
			Seaside Bentgrass			
Complete	0.75	0.13	1.25	0.77	0.18	0.19
Deficient	0.40	0.06	0.31	0.27	0.08	0.08
			Merion Bluegrass			
Complete	0.65	0.10	1.05	0.82	0.18	0.15
Deficient	0.38	0.04	0.19	0.05	0.05	0.06
			Pennlawn Fescue			
Complete	0.78	0.09	1.23	0.65	0.14	0.12
Deficient	0.35	0.04	0.25	0.19	0.05	0.04

As in other studies of this kind, it was noted that the mineral deficiency symptoms varied according to the extent of the shortage and the stage of growth at which the deficiency manifested itself. It was found that unless some amount of the nutrient in question was added initially, the small seeded bent- and bluegrass died from starvation either too small to clearly exhibit the deficiency symptoms (this was especially seen in those plants lacking N, P, K) or else without showing the same signs that characterize the deficiency in the more mature stage of growth.

An example of the latter can best be illustrated in grass receiving no additional Ca. In these plants the blades of adjacent leaves stuck to one another in a manner somewhat resembling that in corn as described by DeTurk (1941). The roots were extremely stunted, black and very gelatinous. In no case were these signs observed in Ca deficient plants that were permitted to become established prior to withholding the Ca from the growth medium. That the shortage of Ca in these older plants was critical is demonstrated in the fact that one of the duplicates in the bluegrass series failed to recover after the deficiency was elicited for the second time.

Finally it should be emphasized that while the criteria establishing the essentiality of the nutrient elements have been well outlined by the plant physiologists (Arnon, 1950), describing the visual symptoms of the nutrient deficiencies still remains a matter of individual judgment and, as such, the following descriptions should perhaps best be prefaced by the old admonition: Say not, this is so! But say, so it seems to me to be as I now see the thing I think I see.

Nitrogen Deficiency

Seaside Bentgrass. Plants are thin and erect, with little if any tillering. The leaves are short and small, developing a pale green color in the early stages of the deficiency. As the starvation progresses the older leaves take on a yellow hue until the entire blade is a yellowish-green color. This chlorotic condition is followed by a tanned or fired effect that appears at the tips of the older leaves. The manner in which the firing progresses down the leaf is similar to that seen in oat plants, in a more or less horizontal fashion, as opposed to the v-shaped pattern that characterizes the firing seen in corn.

Merion Bluegrass. Similar to that described above except that there is less copper tone to the firing than is seen in the Seaside bentgrass.

Pennlawn Fescue. Similar to that noted in Seaside bentgrass.

Phosphorus Deficiency

Seaside Bentgrass. The first sign of P deficiency in Seaside bentgrass, as indeed in nearly all plants, is the appearance of a dark green coloration in the leaves. Associated with this is a restriction in growth and while the plants tend to be spindly the shoots are not as short and thin as that seen in plants lacking N. If the deficiency persists, the leaves take on a dull bluish-green color, with purple discolorations appearing along the entire margin of the blade and in the main veins near the base. Gradually these colors give way to reddish-bronze tints which first appear near the leaf tips and progress down the blade. At its climax the entire leaf appears scorched and the leaf tip withered.

Merion Bluegrass. While the initial symptoms of P deficiency resemble that seen in Seaside bentgrass, namely the dark green coloring of the leaves accompanied by restrictions in growth, the foliage of Merion bluegrass does not pass through the dull blue-green to purplish stages that normally characterize the advanced conditions of P starvation in other grasses, including the cereals.

In the case of this grass, the dark green color of the leaves gives way to an intense tanned condition. The latter appears first at the tips of the older leaves and progresses slowly down the blade.

It is at this stage that P and N deficiencies in Merion bluegrass are most similar in appearance. There are, however, several ways of distinguishing these two deficiency symptoms: first, the tanning effect in the case of no P is more intense than that seen in N starvation and secondly, a comparison of the color of the grasses at the base of the blades offers another clue in differentiating the respective causes. In the case of no N, the color of the blade below the firing is a very pale green to yellowish-green, whereas for the same plant part in the case of no P the color is dark green.

Pennlawn Fescue. Similar to that described for Seaside bentgrass.

Potassium Deficiency

Seaside Bentgrass. In the early stages of development, K deficiency in Seaside bentgrass is generally characterized by one or more of the following symptoms: the soft feel and drooping appearance of the leaves, with many blades horizontally inclined; a tendency toward excessive tillering; moderate chlorosis of the intervenal areas in the older leaves; rolling and withering of the leaf tips which retain blotches of green coloring. In the more advanced stages the chlorotic area extends to the midvein which still remains green, while the leaf margins are scorched and the tips severely withered.

Merion Bluegrass. Similar to that noted in Seaside bentgrass except for the early loss of chlorophyll in the leaf tips and the delayed appearance of tip firing and marginal scorching of the blades (note the absence of the latter symptoms in spite of the severe chlorotic condition of the leaf that extends almost to the base of the folded blade).

Pennlawn Fescue. Similar to that noted in Merion bluegrass.

Calcium Deficiency

Seaside Bentgrass. As noted earlier, the symptoms of Ca deficiency in young plants are quite different from those observed in older plants. The first diagnostic sign that characterizes the shortage of Ca in established Seaside bentgrass is the appearance of reddish-brown discoloration in the intervenal tissue along the margin of the blade in the upper (newer) leaves. If allowed to progress, this condition gradually extends inward to the midvein and the


SEASIDE BENT GRASS
All Elements
No Nitrogen
No Phosphorus
No Potassium
No Calcium
No Magnesium
No Sulfur
All Elements
MERION BLUE GRASS
All Elements
No Nitrogen
No Phosphorus
No Potassium
No Calcium
No Magnesium
No Sulfur
All Elements
PENNLAWN RED FESCUE
All Elements
No Nitrogen
No Phosphorus
No Potassium
No Calcium
No Magnesium
Each group of unhealthy leaves show progressive stages of deficiency symptoms
All Elements

colors fade to lighter shades of red, predominately rose red. Terminally the leaf takes on a fired and withered appearance.

Merion Bluegrass. Similar to that observed in Seaside bentgrass.

Pennlawn Fescue. Similar to that observed in Seaside bentgrass.

Magnesium Deficiency

Seaside Bentgrass. The general appearance of Seaside bentgrass lacking Mg closely resembles that seen in Ca starvation and to the casual observer they may appear to be identical. However, a careful examination of the symptoms (together with a chemical test of the soil and/or plant tissue to confirm the visual findings) will generally yield the proper diagnosis. In contrast to Ca deficiency symptoms, those of Mg usually appear first in the lower (older) leaves and the initial discoloring is more cherry red. Also, in approximately 30 to 50 per cent of the affected leaves the coloring is blotchy, giving rise to a banded appearance that was never observed in the Ca deficient plants.

Merion Bluegrass. Similar to that noted in Seaside bentgrass.

Pennlawn Fescue. Similar to that noted in Seaside bent grass.

Sulfur Deficiency

Seaside Bentgrass. As with Ca and Mg, the deficiency symptoms of S in well established turf are late to develop and as a consequence have only a slight effect on growth. However, in appearance the signs of S starvation more closely resemble those seen in plants lacking N or K than in those deficient in either Ca or Mg.

The initial symptoms of S deficiency in Seaside bentgrass is the general paling of the leaves. If the chlorotic condition is allowed to progress, the blades take on a pale yellow-green cast. Accompanying this is the appearance of a faint scorching at the tip of the blade that advances toward the leaf base in a thin line along each margin. Gradually the border enlarges until finally the entire leaf blade becomes fired and withered.

Merion Bluegrass. In Merion bluegrass the shortage of S manifests itself in two distinct ways: first, as the chlorotic condition develops the veins, especially the midvein, remain green, similar to that seen in cotton, giving the leaf a pale striped appearance. Eventually, however, even the midvein loses its color and the entire blade fires. The second characteristic sign of S deficiency noted repeatedly in Merion bluegrass is the enhanced susceptibility of these plants to powdery mildew.

Pennlawn Fescue. Similar to the described for Seaside bentgrass.

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STUDIES ON THE IRON, MANGANESE, SULFATE AND SILICA BALANCES AND DISTRIBUTIONS FOR LAKE MENDOTA, MADISON, WISCONSIN*

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The purpose of this paper is to present some results of unpublished investigations on Lake Mendota. The data presented are taken primarily from reports to the University of Wisconsin's Lakes Investigation Committee and from theses on file in the University of Wisconsin Library.

Since 1948, the University of Wisconsin's Lakes Investigation Committee has sponsored, directed and coordinated investigations on the fertilization of lakes and streams. One phase of these investigations was directed toward finding the amounts of plant nutrients entering Lake Mendota, Madison, Wisconsin. In addition, studies were conducted on the distribution of these compounds in the Lake. This paper summarizes some of the unpublished results of these investigations on the amounts of iron that enter this lake, how iron is distributed in the water and sediments, and the amounts of iron that leave the lake. In addition, data are presented for manganese, sulfate, and silica distributions and balances.

LOCATION AND DESCRIPTION

Lake Mendota is a hard water eutrophic lake located on the northwestern limits of the city of Madison, Wisconsin. The lake has a surface area of 15.2 square miles and average depth of 40 feet with a maximum depth of 84 feet, a volume 15 x 10^9 cubic feet (Domogalla 1926). The lake has a cumulative drainage area of 265 square miles. The runoff from this watershed enters the lake through ten tributaries and leaves the lake principally by the Yahara River. The watershed is devoted principally to farming with the tributaries passing sluggishly through marshes before entering the lake.

The lake occupies a pre-glacial valley system excavated by streams in sand stones and sandy dolomites of upper cambrian age (Hanson 1951, 1952). It has a theoretical detention time of five years based on the mean annual tributary flow of 3 x 10^9 cubic feet (Belter and Calabresa, 1950).

* Presented before the Division of Water and Waste Chemistry, American Chemical Society, Washington, D. C., March, 1962. University if Wisconsin Engineering Experiment Station paper number 565.

Water Balance and Sampling Stations

In July 1948, stream gaging and sampling stations were established on the ten tributaries to Lake Mendota and on the Yahara River at the outlet of the lake. These stations are shown in Figure 1.

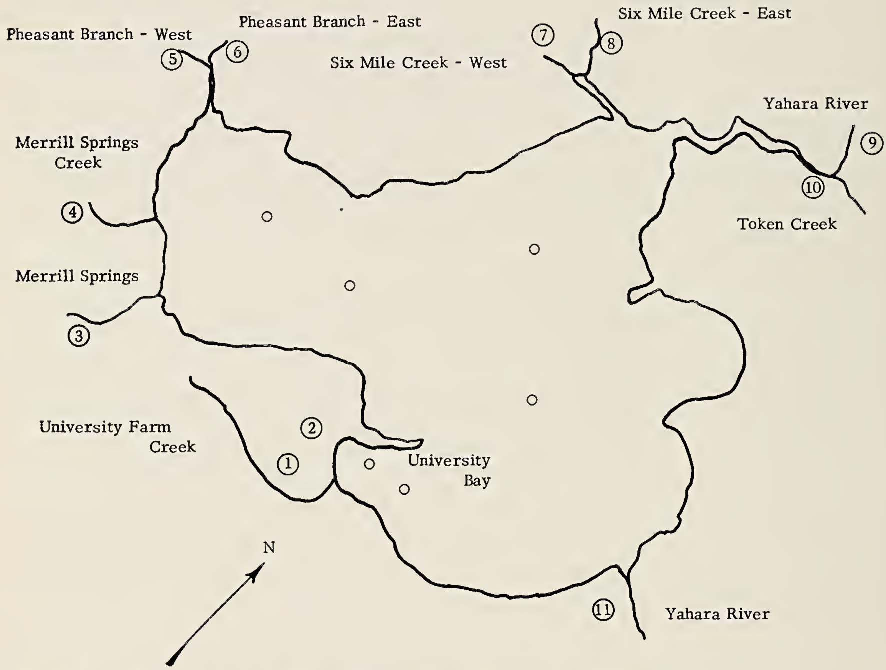

Figure 1. Map of Lake Mendota showing sampling stations.

A water balance for Lake Mendota for the year October 1, 1948 to October 1, 1949 is presented in Table 1 (Belter and Calabresa, 1950).

Chemical Analysis

Grab samples were collected at each sampling station once every three weeks. The chemical analysis performed on these samples included determination of pH, alkalinity, dissolved oxygen, biochemical oxygen demand, nonfilterable and total phosphorous, ammonia, organic nitrogen, nitrite, nitrate, sulfate, silica, manganese, and iron. These analyses were performed according to the procedures in Standard Methods (1946). This paper is limited to a presentation of the results of the analysis of iron, manganese, sulfate, and silica.

TABLE 1. WATER BALANCE OF LAKE MENDOTA—OCTOBER 1, 1948–OCTOBER 1, 1949

	MEAN ANNUAL DISCHARGE
INFLOW	
a. Measured Tributaries—Sta. 1–10 (192.27 sq. miles of drainage basin)	78.4 cfs.
b. Unmeasured Tributary Area (31.87 sq. miles of drainage basin, by computation)	13.0 cfs.
c. Precipitation on lake surface (31.65 inches)	38.7 cfs.
Total Inflow (4,100,000,000 cubic feet)	130.1 cfs.
OUTFLOW	
a. Storage	3.5 cfs.
b. Evaporation (51.17 inches, by computation)	58.2 cfs.
c. Outflow, Station II—Yahara River	70.0 cfs.
d. University—Water Supply	1.5 cfs.
Total Outflow (4,200,000,000 cubic feet)	133.2 cfs.

Unaccounted for 133.2–130.1–3.1 cvs. = 2.33% of outflow. Possibly due to unmeasured inflow from sub-surface springs, or experimental errors. (after Rohlich and Lea, 1959.)

Table 2 presents the relative annual contributions of each of the tributaries. These computed values were based on the assumption that the concentration of the compound remained constant at the mean value between the sampling periods. The mean concentration value for a sampling period was used to convert the concentrations to pounds of compound per day based on the recorded discharge of each tributary.

TABLE 2. SUMMARY OF DATA—OCTOBER 1, 1948–OCTOBER 1, 1949

STATION	PER CENT				
	Flow	Fe	Mn	SO_4	SiO_2
1	0.9	0.9	0.9	0.9	0.6
2	0.7	1.5	0.6	2.4	0.9
3	0.9	0.1	0.4	0.5	0.9
4	0.9	0.2	0.5	0.6	0.9
5	3.2	5.1	5.1	24.7	3.0
6	6.4	3.8	6.4	4.9	6.2
7	1.5	1.1	1.7	1.4	1.4
8	20.1	34.2	27.5	9.5	20.5
9	31.4	22.2	28.0	31.9	30.5
10	34.0	25.5	28.9	23.2	35.1

(Belter and Calabresa, 1950)

Table 3 presents a summary of the iron, manganese, sulfate, and silica apparent balances based on inflow-outflow for Lake Mendota for the period October 1, 1948 to October 1, 1949.

Examination of this table shows that 20,640 pounds of iron entered the lake during this water year with approximately twice as much iron entering the lake during winter flows as compared to summer flows. During the same year, however, only 3,955 pounds of iron left the lake via the Yahara River Outlet. These data show an 80 per cent iron retention in the lake, or that iron was carried out of the lake by some other means.

The data for manganese show that a fairly good balance was obtained with a difference of inflow-outflow or less than 50 pounds for the year. During this same period 18 per cent of the sulfate and 90 per cent of the silica was apparently retained in the lake.

TABLE 3. IRON, MANGANESE, SULFATE, AND SILICA APPARENT BALANCE—LAKE MENDOTA

	WINTER PERIOD OCT. 1, 1948– MAY 1, 1949	SUMMER PERIOD MAY 1, 1949– OCT. 1, 1949	YEAR PERIOD OCT. 1, 1948– OCT. 1, 1949
IRON			
Station 1–10....	14,480 lbs.	6,160 lbs.	20,640 lbs.
Station 11......	2,350 lbs.	1,605 lbs.	3,955 lbs.
Retained in Lake (apparent)	12,130 lbs. = 84%	4,555 lbs. + 74%	16,685 lbs. = 81%
MANGANESE			
Station 1–10....	17,750 lbs.	5,927 lbs.	23,677 lbs.
Station 11......	16,150 lbs.	7,576 lbs.	23,726 lbs.
Retained in Lake (apparent)	1,600 lbs. = 9%	—1,649 lbs. = 28% (loss)	—49 lbs. = 0.2%
SULFATES			
Station 1–10....	1,281,870 lbs.	471,390 lbs.	1,753,260 lbs.
Station 11......	949,650 lbs.	481,950 lbs.	1,431,600 lbs.
Retained in Lake (apparent)	332,200 lbs. = 26%	—10,560 lbs. = 2% (loss)	321,550 lbs. = 18%
SILICA			
Station 1–10....	935,880 lbs.	144,430 lbs.	1,080,310 lbs.
Station 11......	76,530 lbs.	28,590 lbs.	105,120 lbs.
Retained in Lake (apparent)	859,305 lbs. = 92%	115,840 lbs. = 80%	975,190 lbs. = 90%

Stations 1–10 inlet, 11 outlet, (after Rohlich and Lea, 1949)

Emelity and Hanson (1948) present data on the flux of these compounds at the Yahara River outlet station 11 for a period that coincides in part with the previously reported data of Belter and Calabresa (1950). These data are presented in Table 4 for the period July 1, 1948 to April 1, 1949 and grouped according to periods when the flow was reasonably constant. They are based, however, on a grab sample taken every week.

Examination of this table shows that the iron flux has a range of 0.6 to 69 pds/day. Also, that during certain three week periods, particularly in Spring, large changes took place in the amounts of these compounds leaving the lake.

It is of interest to compare these data of Emelity and Hanson (1949)—one sample every week—with that of Belter and Calabresa (1949)—one sample every three weeks—for the winter period October 1, 1948 to May 1, 1949. Belter and Calabresa (1950) reported for this period 2,350 pounds of iron and 16,150 pounds of

TABLE 4. AMOUNTS OF IRON, MANGANESE, SULFATE AND SILICA LEAVING LAKE MENDOTA

Date	Flow, x10^{-6}	Fe	Mn	SO_4	SiO_2
	pounds/day				
1948					
July 1–22	145	1.5	14	1,704	116
July 22–Aug. 7	125	1.2	19	988	7
Aug. 7–Sept. 5	98	0.6	5	1,000	216
Sept. 5–Oct. 2	59	1.5	8	220	225
Oct. 2–Oct. 22	59	15	9	666	42
Oct. 22–Nov. 12	59	5.2	6	546	27
Nov. 12–Dec. 3	59	1.2	8	738	35
Dec. 3–Dec. 31	59	2.2	5	613	54
1949					
Jan. 1–Feb. 8	94	1.4	14	1,053	93
Feb. 8–March 3	498	15	75	5,087	549
March 3–March 18	1,261	6.3	202	13,877	1,123
March 18–March 25	1,101	69	7	16,521	694
March 25–April 11	1,138	57	102	10,816	683
April 11–May 1	942	24	47	11,116	942

(Emelity and Hanson 1949)

manganese leaving the lake with an 84 per cent iron and 9 per cent manganese apparent retention. These same computations based on the data of Emelity and Hanson (1949) show 2,950 pounds of iron with 79 per cent retention and 10,470 pounds of manganese—60 per cent retention during this winter period. The sulfate leaving the lake was 946,229 pounds—26 per cent retention. This same agreement was obtained in the silica data with 72,092 pounds passing the Yahara river sampling point based on a one week sampling period—93 per cent retained as compared to 92 per cent retention based on the three week sampling period. Therefore, the only major discrepancy between the two sets of data occurs with manganese.

It should be pointed out that the comparison of the two sets of data is based on samples taken from the outlet of the lake and that the variability of these data may not be as large as the data from the Lake Mendota tributaries.

The transport of these elements past the Yahara River outlet of Lake Mendota is presented in Table 5 for 1949 and 1950. These data were obtained by Haggerty (1950).

TABLE 5. TRANSPORT OF ELEMENTS—YAHARA RIVER OUTLET—1949–1950

	FLOW GAL/DAY x 10^6	AVERAGE TRANSPORT			
		Fe	Mn	SO_4	SiO_2
		mean pounds per day			
1949					
Autumn Circulation..... (Oct. 13–Dec. 31)	17.6	10.9	10.4	1,262	49
Winter.................	92.8	62.5	108	8,850	84.5
1950					
Spring Circulation....... (Mar. 24–April 17)	225	159	1,525	22,800	188
Summer.................	38.4	15.4	39.1	2,720	159

The data clearly show the importance of the high spring flows and lake circulation on the flux of elements past the Yahara River outlet of the lake.

Data were available for a comparison of the transport of these elements over several years. Table 6 presents these data.

The concentration data for this period are presented in Table 7. Examination of Table 6 shows that for any one season the year to year variation in the amount of an element carried out of the lake by the Yahara River is highly variable even though Table 7 shows that concentrations are essentially constant from year to year for one season. The cause of this variability cannot be explained without further data. However, these data do show that a balance based on one year's inflow-outflow record should not be used to predict the long-term accumulation of an element in the lake.

TABLE 6. SEASONAL TRANSPORT OF ELEMENTS YAHARA RIVER OUTLET OF LAKE MENDOTA

Season	Year	Fe	Mn	SO_4	SiO_2
		mean pounds/day			
Summer	1948	1	19	1,230	113
Fall	1948	5	7	556	77
Winter	1949	8	48	3,070	321
Spring	1949	38	89	13,082	860
Summer	1949	10	54	2,449	150
Fall	1949	11	10	1,262	49
Winter	1950	62	108	8,850	84
Spring	1950	159	1,525	22,800	188
Summer	1950	15	39	2,720	159
Fall	1950	20	....	3,297	60

These data were obtained by Emelity and Hanson (1949, 1950), Fuller (1949), Haggerty (1950), Darrow and Jackson (1949), Levihn (1951).

Based on the seasonal variations in the transport of these elements in the outlet of Lake Mendota, it may be expected that the concentration of these elements should show similar variations in the lake. From July 1948 through May 1949, Belter and Calabresa (1950) and Emelity and Hanson (1950) performed analyses on the element content of Lake Mendota. Sampling stations were established at various locations in the lake. These stations are shown in Figure 1 as circles on the map of the lake. Samples were taken once every three weeks at each of these stations; at the surface, at the thermocline or at a depth of 10 meters, and at one half meter from the bottom.

Examination of these data with respect to horizontal location did not reveal any significant trends. However, when the data are pooled for all horizontal sampling sites for any particular depth and season, significant variations do occur. These data are presented in Table 8. Examination of the table shows that the standard deviations are rather large and, in general for iron and manganese, are of the magnitude of the mean. These data show, as would be expected, low surface iron concentrations during the summer; while in the fall, winter, and spring, the lake is fairly well mixed. Without additional information the low values (0.02) near the bottom during the spring are not explainable. If these data are compared in Table 7 on the mean concentrations in the Yahara River outlet, it is apparent that it is difficult to predict Yahara River Concentrations based on Lake Mendota concentrations.

TABLE 7. MEAN CONCENTRATIONS OF ELEMENTS IN THE YAHARA RIVER OUTLET OF LAKE MENDOTA

Season	Year	No. of Obser's	Fe		Mn (mg/l)		SO_4		SiO_2	
			Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.	Mean	St.d Dev.
Summer	1948	4	0.02	0.02	0.1	0.08	8.4	5.4	1.8	2.2
Fall	1948	4	0.1	0.1	0.1	0.2	10.8	6.5	0.7	0.4
Winter	1948	14	0.06	0.1	0.1	0.06	11.6	4.5	0.9	0.3
Spring	1949	14	0.05	0.05	0.2	0.05	8.1	4.3	0.4	0.3
Summer	1949	19	0.06	0.1	0.1	0.4	8.8	2.8	0.4	0.3
Fall	1949	11	0.07	0.07	0.08	0.06	8.5	3.4	0.3	0.1
Winter	1950	13	0.07	0.1	0.3	0.6	11.3	1.7	0.1	0.1
Spring	1950	11	0.06	0.08	0.08	0.07	12.1	4.4	0.8	0.5
Summer	1950	13	0.05	0.04	0.08	0.04	8.8	5.0	0.4	0.3
Fall	1950	13	0.07	0.01	0.07	0.09	12.0	4.0	0.2	0.1

Table 8 shows that this lake has considerably greater concentrations of manganese as compared to iron concentrations. The seasonal and vertical distribution of manganese is as would be expected.

The sulfate data displays a typical picture of a relatively unreactive compound in the lake with concentrations increasing during the winter during periods of ice cover and decreasing during spring melting and runoff.

The silica data are interesting in that the summer and winter periods display minimums in vertical periods at the 10 meter station.

Other Studies on the Iron and Manganese Cycle. Dugdale (1956) reported in a study of the emergent crops of diptera found, that during the spring and fall of 1954, the net weight of emergent larva was:

Spring	203 metric tons
Fall	632 metric tons
for a total	835 metric tons of emergent insects leaving

Lake Mendota. In comparison, it is interesting to see that the estimated annual crop of perch taken from the lake is 140 metric tons.

Nees (1954) from a knowledge of the amounts of insects leaving the lake and the iron and manganese content of these insects, estimated that the annual loss of iron and manganese due to insects was 1.9 metric tons and 0.15 metric tons, respectively. Therefore, the amounts of iron transported by insects out of Lake Mendota in 1954 was of the same order of magnitude as the amount of iron transported out of the lake by the Yahara River outlet. Nees also estimated that about 5 per cent of the net apparent gain in iron, Table 3, is lost via removal of fish. Therefore, the iron balance for Lake Mendota may be computed from 1948–1949 data on amounts of iron that enter this lake as: loss via Yahara River Outlet, 15%, 1948–1949; loss via Emergent Insects, 15%, 1954; loss via Fish, 5%; Total 35%; net annual retention of iron; approximately 65%.

Bottom Sediments. The previously presented data show that approximately 50–60 per cent of the annual inflow of iron is retained in the lake. Therefore, it is of interest to examine the iron content of the bottom sediments. Hanson (1951, 1952), in a report to the University of Wisconsin Committee on Lakes and Stream Investigation, re-examined and summarized the previous work (Twenhofel 1933) on the bottom sediments of Lake Mendota. Parts of the report are presented here as background information.

The near-shore sediments consist of sand and gravel. The deeper portions of the lake are covered by a black sludge, 1–14 inches thick, which is underlain by a lighter-colored siliceous marl. The sludge is composed of a mixture of precipitated calcium carbonate, organic matter and clastic grains, silica, with smaller amounts of

TABLE 8. CONCENTRATION OF IRON, MANGANESE, SULFATE, AND SILICA IN LAKE MENDOTA—1948–1949

	concentration mg/l							
	Summer 1948		Fall 1948		Winter 1949		Spring 1949	
	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.
IRON								
Surface	0.009	0.01	0.02	0.01	0.05	0.06	0.04	0.04
Therocline or 10 meters	0.007	0.02	0.01	0.01	0.08	0.01	0.03	0.02
0.5 meters from bottom	0.13	0.18	0.1	0.009	0.04	0.08	0.02	0.02
MANGANESE								
Surface	0.10	0.03	0.15	0.05	0.11	0.08	0.12	0.13
Thermocline or 10 meters	0.11	0.05	0.12	0.05	0.10	0.04	0.10	0.04
0.5 meters from botton	0.5	0.34	0.12	0.12	0.33	0.42	0.12	0.06
SULFATE								
Surface	10.2	1.1	10.7	1.8	13.9	7.0	9.6	2.7
Thermocline or 10 meters	10.6	3.4	10.8	4.0	15.7	8.3	8.9	2.8
0.5 meters from bottom	9.8	4.0	10.9	4.1	16.8	8.6	9.6	4.5
SILICA								
Surface	1.1	0.25	0.7	0.3	1.3	0.8	0.4	0.2
Thermocline or 10 meters	0.6	0.4	0.8	0.3	0.9	0.3	0.3	0.2
0.5 meters from bottom	3.4	2.1	0.7	0.3	1.5	0.9	1.5	2.7
NUMBER OF OBSERVATIONS								
Surface	24		21		16		28	
Thermocline or 10 meters	12		9		9		11	
0.5 meters from bottom	11		9		9		9	

magnesium carbonate and alumina. It is highly flocuated and is moved on the lake bottom by wind-generated currents strong enough to destroy any evidence of cylic deposition. The underlying marl, and the organic matter decreases from an average of over 20 per cent in the sludge to 11 per cent in the marl.

Judson and Murray (1956) and Murray (1956) studied in greater detail the sediments in Lake Mendota They concluded that the sedimentation in Lake Mendota has changed abruptly in the recent past. This change is recorded in cores by a buff marl overlain by 1–14 inches of black sludge. They observed that the interface between the two types of sediment is very sharp. The change in sedimentation is ascribed to increased deposition of clastic materials in the lake as the result of drainage from farm lands and urban areas. The black color of the sludge results from the presence of ferrous sulfides deposited under conditions of oxygen deficiency and not from the organic content of the sludge as previously supposed.

Their analyses have shown a hydrocarbon content of the sludge and marl of 120 to 225 ppm with 10–12 per cent organic matter based on three reported analyses.

Iron Content of Bottom Sediments. Kaneshige (1952) and Levihn (1951) collected samples of the bottom sediments with an Eckman dredge and analysed them for the non-filterable and total phosphorous, ammonia, total organic nitrogen, nitrite, nitrate, and total iron of the period, winter 1950 to the summer 1952. The results of their investigations are presented in Figure 2. This figure shows a plot of the isoiron contours for the summer 1951. These contours were established by sampling at 67 different sampling sites. In general, the high concentrations of iron correspond to the deeper parts of the lake. The variations at the mouth of the Yahara River Inlet to the lake may be attributed to suspended material brought in by the river during high flows. Figure 3 compares the iron content of the bottom sediments for University Bay for the winter 1950 and summer 1951. It is readily apparent upon examination of the figure that marked changes take place from season to season in iron composition of this sludge. These changes can be attributed to movement of the floculate sludge by currents in the lake. Hanson (1952) determined that the floculate sediments had a settling rate equivalent to particles in a grain size range of 1/16 to 1/14 mm. and that based on the current meter measurements of Bryson and Soumi (1952), the lake currents near the bottom are sufficient to transport the sludge. The investigations of Bryson and Soumi (1952) found that current velocities up to 3 meter/min. were quite common in the lake with some up to 13 meters/min. Bryson and Kuhn

(1955) made some measurements of the bottom stress in the lake and found an estimated bottom current velocity of 3–10 cm/sec. during the summer of 1951. From their analyses, Bryson and Soumi (1952) and Bryson and Kuhn (1955) conclude that these currents are due to wind-driven circulation of the epilimnion which results in circulation of the hypolimnion. With respect to circulation within University Bay, Bryson and Ragotzkie (1955) found that the wind-driven water replacement time for the bay varied from about 3 hours to more than 600 hours for wind velocities 3 to 15 miles per hour.

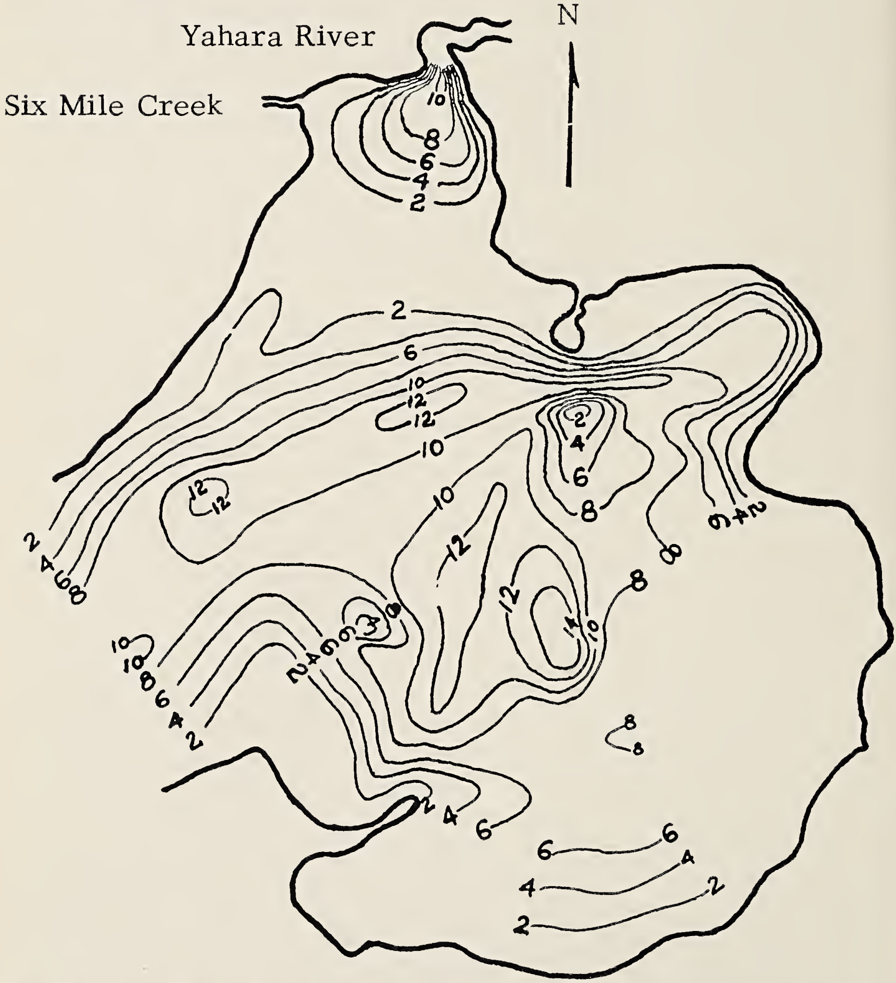

FIGURE 2. Lake Mendota Bottom Muds, Summer 1951. Iron quantities in thousands of P.P.M.

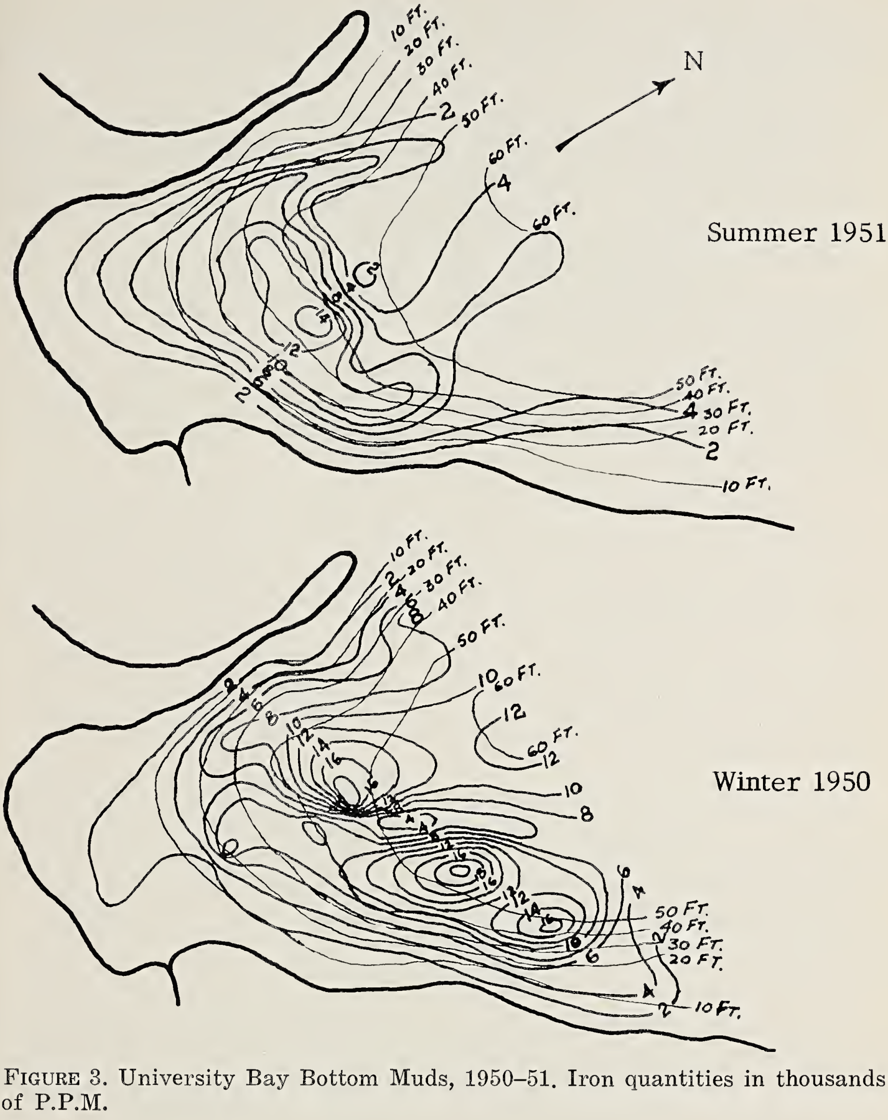

FIGURE 3. University Bay Bottom Muds, 1950–51. Iron quantities in thousands of P.P.M.

In another study by Bryson and Soumi (1951), it was found that following a very rainy period in the summer of 1950, dissolved oxygen temporarily reappeared in the hypolimnion of Lake Mendota. They proposed that this oxygen was introduced by density currents of cold, silt-laden, well-oxygenated run-off water. The highly varying, wind-induced currents and density- turbidity-currents can possibly explain the movement of the bottom sediments and also possibly account for some of the apparent deviation in the data observed in the chemical analysis of the lake water and Yahara River outlet.

Discussion of the Iron Data. The results of the investigation on iron permit a better understanding of the iron cycle for Lake Mendota. These studies have shown that over a one year period approximately 20,000 lbs. of iron entered the lake through the tributaries while only 4,000 lbs. of iron left the lake via the Yahara River outlet. The iron content of the lake water was found to be approximately 0.03 mg/1 with a general pattern of increasing iron concentration with increasing depth.

These investigations have shown that 80–85% of the iron that enters the lake each year settles to the bottom and becomes part of a floculant black sludge. Some 15–20% of the annual inflow iron is carried out via the Yahara River outlet.

Analyses of the bottom sludge have shown that it has a highly variable iron concentration with a range of a few thousand parts per million to 16,000 ppm. A general pattern was observed in which the sludge in the deeper parts of the lake had a greater iron concentration. Considerable evidence exists pertaining to the movement of bottom sludge by wind induced currents. This movement of the sludge eliminates any evidence of cyclic deposition, also causing marked seasonal changes in the iron content of the sludge at any one location.

This iron rich sludge serves as a hatching ground for a large emergent Diptera population. These emergent insects have been shown to play an important role in the iron balance of the lake. Estimates have been made that as much iron leaves the lake by emergent insects as leaves the lake by the Yahara River outlet.

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The author wishes to acknowledge the assistance of members of the Lakes and Streams Committee of the University of Wisconsin, especially Professor Sarles, coordinator of the Lakes and Streams Investigation Committee; Professor Rohlich, Department of Civil Engineering; Professor Hasler and Professor Nees, Department of Zoology; Dr. Fitzgerald, Department of Civil Engineering, Professor Bryson and Ragotzkie, Department of Meteorology; and special recognition is given to former students of the Department of Civil Engineering with the hope that their work presented in part in this paper will bring them their due recognition for the many hours of sample collection and analysis.

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SOCIAL SCIENCES

"BRICK" POMEROY AND THE DEMOCRATIC PROCESSES: A STUDY IN CIVIL WAR POLITICS*

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Marcus Mills Pomeroy drifted to La Crosse in April, 1860, to invest his small capital and his extraordinary talents in a Democratic newspaper which needed an editor and a purpose. He brought with him some newspaper know-how, the sobriquet "Brick," and a devotion to Stephen A. Douglas. He purchased a one-third interest in the La Crosse *Union and Democrat*. Soon "Brick" Pomeroy, champion of Douglas doctrines, feuded with one of the other partners who liked President James Buchanan's views. The feud led to a sheriff's sale, stock transactions, and the birth of the La Crosse *Democrat*, debt-encumbered and with Pomeroy as sole proprietor and editor.[1]

Pomeroy lost no time in gaining the attention of friends and foes. He was witty and fearless, vindictive and vain. He wrote in such a readable and interesting style that "even his enemies could not resist buying his newspaper."[2] He knew the role of the press in shaping public opinion, and he tried to convince his subscribers that they should hate President Buchanan as intensely as he. Irritated by Buchanan's "weak-kneed" policy and "vacillating tactics," Pomeroy waged a campaign of abuse against the President. "What a weak and imbecile old fool Jim Buchanan is," he editorialized. "Buchanan," added Pomeroy, "is a traitor to his Country—a traitor to his party—a traitor to his word." He suggested to his readers that they add a postscript to their prayers: "Save our Country, but damn our President."[3]

Pomeroy's strong language seemed to be due more to his hatred of Buchanan than to his desire to see the federal government coerce South Carolina. In fact, Pomeroy justified his anti-coercion views by quoting Horace Greeley's statement about allowing the erring

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* Paper read at the 92nd annual meeting of the Wisconsin Academy of Sciences, Arts, and Letters.

[1] Marcus Mills Pomeroy, *Journey of Life; Reminiscences and Recollections of "Brick" Pomeroy* (New York, 1890) is the best single source for Pomeroy's early life. Mrs. Mary E. Tucker combines fact and fiction indiscriminately in her *Life of Mark M. Pomeroy . . .* (London, 1868).

[2] Benjamin F. Bryant, *Memoirs of La Crosse County* (Madison, 1907), 116.

[3] La Crosse *Democrat*, Dec. 24, 1860, quoted in Charles Seymour, "The Press," in *History of La Crosse County, Wisconsin* (Western Historical Company, Chicago, 1881), 550.

sisters "to go in peace." "We are opposed," he editorialized, "to forcing a State to remain where she is determined not to." He viewed coercion as "a pretty thing to talk about," but impractical, impossible, and froth with danger.[4]

Like Douglas and most Democrats, Pomeroy hoped that compromise would ease the crisis and reunite the quarrelsome sections. Compromise was an historic American process. The Constitution had been evolved out of a series of compromises. Furthermore, compromise had resolved national crises in 1820, 1832–3, and 1850. When the compromise efforts in Congress and at the National Peace Convention came to naught in 1861, Democrats blamed Republicans for adhering to their no-slavery-in-the-territories principle—no matter what the consequences. There was a genuine fear, among some of Douglas' followers, that an inter-sectional struggle might bring an end to the American experiment in democracy. European civil wars had ended in dictatorships, and there was some fear that a Napoleon or Cromwell might emerge in America.[5]

After Fort Sumter fell, Pomeroy wrote and talked like a zealous patriot. He penned an editorial polemic entitled "The Stars and Stripes Forever." He wanted the insult to the flag avenged and he wanted the rebellion speedily crushed. He endorsed the sentiments of a fellow-Democrat, Stephen D. Carpenter of the Madison *Wisconsin Patriot:* "Let blood flow until the past is atoned, and a long future secured to peace, prosperity, happiness, and honor."[6] Pomeroy even tried to organize a company of volunteers, the "Wisconsin Tigers," to do business in "Marion's style."[7] But Pomeroy had neither the friends, funds, nor influence to make his dream of military glory come true.

His patriotic binge endured for several months. The Union debacle at First Bull Run served as a spirituous stimulant. When some opponents of the war raised their voices in La Crosse, Pomeroy promised vigilante action to quash the talk of "treason."[8] He did not advocate civil action nor educational means to convert the recalcitrants, but threatened to use extra-legal measures as patriotism stirred his spirit.

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[4] La Crosse *Democrat,* Jan. 11, 14, 1861.

[5] Democratic interest in compromise is revealed in such works as: Mary Scrugham, *The Peaceable Americans of 1860–1861* (New York, 1921); Robert Gunderson, *Old Gentlemen's Convention; The Washington Peace Conference of 1861* (Madison, 1961); and George Fort Milton, "Stephen A. Douglas' Efforts for Peace," *Journal of Southern History,* I (August, 1935), 261–75. Kenneth Stampp, *And the War Came: the North and the Secession Crisis* (Baton Rouge, 1950), offers an explanation of why coercion replaced compromise. Robert Schwab, "Wisconsin and Compromise on the Eve of Civil War" (M. A. thesis, Marquette U., 1957), reveals that Wisconsin helped defeat compromise efforts.

[6] Madison *Wisconsin Patriot,* May 4, 1861.

[7] La Crosse *Democrat,* April 26, May 2, 1861.

[8] *Ibid.,* Aug. 19, 1861.

Time tempered Pomeroy's patriotic passions, aided somewhat by political opportunism and the prophecies of the abolitionists. The approach of the fall elections of 1861 gave Democratic editors like "Brick" Pomeroy a chance to substitute partyism for patriotism. The "howls of the abolitionists," who wanted the war turned into an antislavery crusade, also chilled the patriotic passions of Democrats. Pomeroy, ever bold and blunt, put his protests into print:

> There is not today half the enthusiasm in the country there was two months since. . . . A chill has already set in. . . . We are willing to fight till death for the common good of a common people, but will not be forced into a fight to free the slaves. The real traitors in the North are the abolitionists, and they are the ones who will do more to put off the day of peace than all the soldiers of the South.[8]

Republican party strategists, meanwhile, launched the Union Party movement to take advantage of the tidal wave of patriotism. "Brick" Pomeroy, unwittingly, got tangled in the Union Party net. He endorsed a non-partisan slate in the county elections and gradually retreated from supporting bipartisanship on the state level. By September he had reached the conclusion that even in wartime it was desirable to keep the two-party system functioning. He also reached the conclusion that the Union Party movement was really "a Republican swindle"—a political feast in which the Republicans took the loaves and gave the Democrats the crumbs.[9] The Union Party stratagem paid dividends to the Republican sponsors—they elected their candidate, Louis P. Harvey, over Benjamin Ferguson, nominee of the straight-line Democrats. Pomeroy claimed to have learned a valuable lesson. He pledged never to be caught again in a game "where the Republican cat was well concealed under the Union meal."[10]

Pomeroy, erratic on many counts, hewed a steady line in opposing abolitionists and abolitionism. He learned to hate those who favored freeing the slaves and he turned his sarcasm and intemperance upon them full force. He detested Sherman M. Booth, Wisconsin's best-known abolitionist, and applied a string of epithets to him. "He is to respectable people," Pomeroy wrote one day, "what a blooming pole cat would be in a ballroom."[11] Pomeroy also condemned General John C. Frémont for trying to free the slaves of rebels within his military district. Pomeroy did not defend slavery as a desirable institution, but he argued that constitutional guarantees were binding upon the people North and South. He believed that it was unconstitutional for Congress or political generals to tamper with

[9] *Ibid.*, Sept. 6, 20, Oct. 4, 11, 1861.

[10] Sheboygan *Journal*, Oct. 7, 1861; Madison *Wisconsin Patriot*, May 10, 1862; La Crosse *Democrat*, Nov. 15, 22, 1861; Pomeroy, *Journey of Life*, 122.

[11] La Crosse *Democrat*, Sept. 27, 1861.

slavery where it existed. Pomeroy's antipathy toward abolition became more intense with each passing month—it would help to transform him into a violent critic of the Lincoln Administration.

Pomeroy's aversion to abolition also helped him to become a critic of New England. That section of the country was the home of William Lloyd Garrison and Wendell Phillips, the two best-known abolitionists. New England fanaticism had helped drive the South out of the Union. It wanted the Morrill Tariff which was anathema to Western farmers. Pomeroy believed that New England mouthed pious platitudes while stuffing its pockets with money. It furnished fewer soldiers and it pursued a policy which would make the Great West the slave and servant of New England. Pomeroy spoke the language of a Western sectionalist—it was good politics to condemn New England in many sections of the Midwest.[12] One of Pomeroy's fellow Democrats and fellow-editors sarcastically suggested that Republicans could best support a mistaken president by "drinking lots of coffee at thirty and thirty-five cents a pound."[13]

Pomeroy did not hew to a narrow partisan line during the fall campaign of 1862. He considered the Democratic party "Address" of September 3, 1862, too narrowly partisan and too critical of the war. He refused to publish the "Address," the handiwork of Edward G. Ryan of Milwaukee, in his newspaper. He also brought Matthew H. Carpenter, a self-styled "War Democrat" who was both a personal and professional rival of Ryan's, to La Crosse to talk to a "Union rally."[14] He even gave support to the Union Party movement which he had denounced a year earlier—partisan Democrats thought Pomeroy sought a spot on the state Union slate. On the other hand, he denounced Lincoln's preliminary proclamation of emancipation (September 23, 1862) as "indiscreet," unnecessary, and unconstitutional. He believed it "would be powerful in producing evil results." He accused Lincoln of giving way to abolitionist pressure and perverting a war to save the Union into one to free the slaves.[15]

The election returns revealed a strong Democratic trend and emboldened Pomeroy. He blasted President Lincoln's removal of General McClellan, condemned presidential suspension of the writ of habeas corpus, and criticized arbitrary arrests made during the fall of 1862. To Pomeroy it seemed that the President had scrapped the Constitution, had assumed the role of despot, and had "bungled" and "experimented" too much.[16] He even regretted his support of

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[12] *Ibid.*, Feb. 7, 1862.

[13] Sheboygan *Journal,* Feb. 18, 1862.

[14] La Crosse *Democrat,* Sept. 8, Oct. 7, 1862.

[15] *Ibid.*, Nov. 18, 25, 1862, Jan. 6, 1863.

[16] *Ibid.*

the Union Party movement. He told Republicans that they had abused the Union Party principle. "In the past," "Brick" Pomeroy wrote, "they [the Republicans] were not willing to divide their victories—in the future we will not share their defeats."[17]

After the election post-mortems were over, Pomeroy took a three-week trip to St. Louis to see how the war was going in that sector. His Quaker blood curdled at what he saw and he recorded his impressions for his readers. Hospital ships were described as "boat-loads of pain and agony." War produced "mangled bodies," sorrow, and death. War contractors and army quartermasters made money "by the cord."[18] Pomeroy lost some of his enthusiasm for the war.

His three-week tour of the St. Louis sector was followed by a two-month visit to Helena, headquarters of the Army of the Southwest. He held a first lieutenant's commission signed by Governor Edward G. Salomon, but it was little more than a newsman's pass. He was "assigned" to no regiment, company, detachment, or duty and on the margin the Governor wrote: "By request of M. M. Pomeroy no pay chargeable against the State under this commission."[19] Pomeroy sought the commission so he could stay at the headquarters of General Willis A. Gorman, a friend from Minnesota. He occasionally accompanied army units pursuing guerrillas, hunting for cotton on outlying plantations, or sloshing through Arkansas mud. In time General Gorman was assigned elsewhere and General Benjamin S. Prentiss took over command of the Army of the Southwest. Pomeroy wrote exposés of army life for the Chicago *Times*, the Milwaukee *News*, and his own La Crosse *Democrat*. Each week's epistles became more critical of the war, the Lincoln Administration, and the army's Arkansas activities. He called the war "a murderous crusade for cotton and niggers," he plumped for peace, and he insulted his host.[20] General Prentiss, in turn, banished the La Crosse newsman from his sector, threatening to arrest him as a spy if he returned.[21]

Pomeroy returned to the editorial offices of the La Crosse *Democrat*, hating General Prentiss and disillusioned with the war. He wanted political compromise substituted for military coercion. War was a "frightful" thing. "Its glories," he wrote, "are those of death and grief—its pomp and vanities, those of crazed ambition; of sorrow and ruin."[22]

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[17] *Ibid.*, Nov. 11, 1862.

[18] *Ibid.*, Dec .9, 16, 23, 1862.

[19] Pomeroy, *Journey of Life*, 182–83.

[20] La Crosse *Democrat*, Feb. 27, March 3, 1863.

[21] "General Orders, No. 19," March 24, 1863, District of Arkansas, Volume XLIV, Records of the War Department, The National Archives.

[22] La Crosse *Democrat*, April 18, 1863.

Pomeroy became a bitter critic of the Lincoln Administration in the months that followed. He condemned the Conscription Act of March 3, 1863, as a measure which would crush "the sovereign power of the States" and make Lincoln the "permanent ruler of the nation." "The late Conscription act," he editorialized, " . . . is one that elevates Abraham Lincoln to the position of MILITARY DICTATOR . . ." He believed federal conscription violated American principles and tradition. Furthermore, the provision which excused from service those who paid $300 in commutation money, favored the rich at the expense of the poor.[23]

Pomeroy viewed the arrest of Clement L. Vallandigham of Ohio by General Ambrose E. Burnside as an extension of presidential tyranny. He also deplored General Burnside's suppression of the Chicago *Times* as proof that Lincoln was a despot—Burnside was his "western satrap." The President was "intoxicated and entranced by the whirl of the mighty events around him." Pomeroy called Lincoln "a tyrant," and Vallandigham and Storey (editor of the Chicago *Times*) "martyrs" to free speech and free press. It seemed, to Pomeroy, that a despotism was enveloping the government and that civil liberties retreated as Lincoln & Company ruled the land.[24] When President Lincoln set aside August 5, 1863, as a day of fasting and prayer, the editor of the La Crosse *Democrat* composed a "prayer" which he recommended to his readers: "Remove by death the present Administration from power and give us in their place Statesmen instead of clowns and jokers—honest men instead of speculators—military ability instead of conceit and arrogent assumption."[25]

Democratic critics of Lincoln made a distinction between the government and the Administration. They insisted they were loyal to the first, critical of the second. They spoke of the government and the Constitution in the same breath. They viewed themselves as the defenders of the Constitution and of civil rights against the usurpations of a "mistaken Administration." They emphasized the primacy of the Constitution, arguing that "when the Administration violates the Constitution, loyalty to the Administration may become disloyalty to the Union."[26] "We revere the Constitution," wrote Pomeroy, "but we have no faith in those administering it."[27]

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[23] *Ibid.*, Feb. 17, April 14, 1863.

[24] *Ibid.*, June 2, 9, 16, 1863.

[25] *Ibid.*, July 28, Aug. 12, 1863.

[26] "Address to the People by the Democracy of Wisconsin, Adopted in State Convention in Milwaukee, September 3, 1862" (Milwaukee, 1862), 11.

[27] La Crosse *Democrat*, Aug. 25, 1863.

Later Pomeroy stated his mistrust of the Lincoln Administration more boldly and bluntly:

> Abraham Lincoln is the traitor. It is he who has warred against the Constitution. We have not. It is policy—his Administration which has prolonged the war. We have not. It is his proclamations—not our editorials—which have disgusted the country. . . . Abraham Lincoln was elected President by the People; he has been President for the Republican party. He has broken his oath—lent himself to corruptionists and fanatics. . . .[28]

Pomeroy received, in full measure, criticism of the same kind which he dispensed so generously in the columns of the La Crosse *Democrat*. Some Republicans boldly denounced him as a "Copperhead," a "secessionist," and a traitor whose newspaper was "a mouthpiece for damnable treason."[29] The La Crosse *Democratic Journal* condemned "the treasonable doctrines of those who sympathize with the rebellion."[30] Indignant La Crosse patriots threatened Pomeroy with bodily harm and mob action. Members of the Third Minnesota Regiment, while passing through La Crosse, attempted to "clean out the *Democrat* office" via mob action, but prompt action by Mayor Pettibone kept things in hand. Soldiers, writing from the war front, threatened to "get" Pomeroy when they returned home.[31] Patriotic businessmen quit advertising in Pomeroy's paper and some subscribers told the intrepid editor to cross their names off the mailing list. The circulation of Pomeroy's *Democrat* dropped to 360 copies—publishing the paper became a money-losing venture.[32] Members of the Union League, partiotic arm of the Republican Party, even organized a social boycott.

Pomeroy walked the streets of La Crosse defiantly and unafraid—like a true curmudgeon. He returned taunt for taunt. When they called him a "Copperhead," he retorted "Blowsnake!" He carried a gun when he went out at night. He advised his Democratic friends how to react to threats of arson:

> Matches are cheap. If fanatics and fools seek mob law and anarchy, by all means let them have it. Burn down and destroy theirs as they have or may yours. By dark or by daylight—by fire or by powder—feed those who may injure you the dish they prepare. On no account inaugurate violence or excitement, but for every dime of your property destroyed by political opponents, destroy a dollar's worth in return.[33]

Later, when defiant patriots again talked and threatened, Pomeroy repeated his warnings. He would fight fire with fire: "When this

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[28] *Ibid.*, Oct. 27, 1863.
[29] Milwaukee *Sentinel*, April 1, 1863.
[30] La Crosse *Democratic Journal*, July 8, 1863.
[31] La Crosse *Democrat*, October 3, 1864.
[32] *History of La Crosse County, Wisconsin*, 546.
[33] La Crosse *Democrat*, Feb. 19, 1864.

office is destroyed, a hundred buildings in this city will keep it company. Matches are cheap and retaliation sweet. If anyone wants a little riot, they shall have a big one—one to last them forever."[34] "When they ignite the match," he again admonished his fellow Democrats, "let us apply the torch."[35]

Pomeroy and his fellow Democrats insisted that the government could not expect loyalty from its citizens if it failed to give them protection. One prominent Midwestern Democrat, arbitrarily arrested in the fall of 1862, stated that thesis:

> Allegence [*sic*] is that fidelity or obedience which a citizen owes to the *Government. . . . But it is reciprocal.* The Government owes to the citizen or subject *protection.* Without protection, no allegence [*sic*] can be due. Such is the nature of the contract—our allegence [*sic*] is due, where our protection is secured.[36]

President Lincoln countered by contending that critics of the Administration wanted protection from the Constitution which their policy was helping to destroy. He defended arbitrary measures "as indispensible to the public safety." He insisted that the carping critics damaged the country rather than the Administration.[37] There seemed to be a no-man's land between loyalty and treason as defined by the Constitution.

When Pomeroy learned that Lincoln was seeking re-nomination in early 1864, the bumptious editor cut the cords of restraint. His shower of epithets showed that he had discarded moderation for madness. "May Almighty God forbid," he wrote angrily, "that we are to have two terms of the rottenest, most stinking, ruin-working small pox ever conceived by fiends or mortals in the shape of two terms of Abe Lincoln's administration."[38]

As the election campaign of 1864 gained momentum, Pomeroy became more abusive and more intemperate. Entangled in his own web of hate, he spewed forth frothy editorials. He wrote of "widows in black" who were "living monuments of Lincoln's imbecility." He called Lincoln "clown," "buffoon," "teller of smutty jokes," "orphan maker," and "the poorest apology for a chief magistrate the world ever saw." He suggested to Republicans that they "Shout for Abraham—for taxes—for Fort Lafayette—for the draft—for usurped power—for suspension of sacred writs—for a nigger millennium—for worthless currency—for a ruined nation—and for desolate

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[34] *Ibid.*, April 2, 1864.

[35] *Ibid.*, Oct. 10, 1864.

[36] "Dissertation upon Constitutional Rights" (mss.), n.d., in Madison Y. Johnson Papers, Chicago Historical Society.

[37] Letter, Lincoln to Erastus Corning *et al*, June 12, 1863, Robert Todd Lincoln Papers, Library of Congress.

[38] La Crosse *Democrat*, July 5, 1864.

cities." He contended that Lincoln was "hell's viceagent on earth," the "fanatical tool of fanatics," "flat boat tyrant," and "the lurer drunk with madness." He claimed that the people wanted peace in a land filled with "fear and mourning."[39] In the August 23, 1864, issue of the La Crosse *Democrat,* Pomeroy placed a picture of Lincoln on the front page and above it put the caption: "The Widow Maker of the 19th Century and Republican candidate for President." That day's editorial rantings reached an all-time low:

> The man who votes for Lincoln now is a traitor and murderer. He who, pretending to war for, wars against the constitution of our country is a traitor, and Lincoln is one of these men. . . . And if he is elected to misgovern for another four years, we trust some bold hand will pierce his heart with dagger point for the public good.[40]

The intemperate editor even suggested an epitaph for Lincoln's tomb-stone:

> Beneath this turf the Widow Maker lies,
> Little is everything; except in size.[41]

The adamant editor conducted a negative campaign. He seldom said what McClellan (Democratic candidate for the presidency) and the Democratic Party stood for. He just abused Lincoln and tried to scare voters from casting their ballots for the incumbent. He appealed to the spirit of Negrophobia and to Western sectionalism —antipathy to New England. He sought votes in the field of war weariness and he spoke the language of the defeatists. "It can never be done," he editorialized. "The south can never be subjugated"[42]

Consistently he revealed that hating Lincoln had become an obsession. He tabbed Lincoln "a usurper who wears a No. 5 hat and No. 14 boots." He insisted that President Lincoln had ignored his oath of office, spit upon the Constitution, and "woven the chains of slavery about the people." "Lincoln," wrote the self-styled curmudgeon, "has been a worse tyrant and more inhuman butcher than has existed since the days of Nero. He has listened to the counsels of fools; and millions of mourners weep over the result of his incompetency."[43] Pomeroy even turned his wrath against the provost marshal in La Crosse—the representative of the "slaughtering machinery." Pomeroy wrote that the provost marshal was "unfit for duty," a "captain in the widow maker's service."[44]

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39 *Ibid.,* Aug. 2, 9, 16, 24, 1864.

40 *Ibid.,* Aug. 23, 1864.

41 *Ibid.* Pomeroy reprinted the epitaph from the Appleton *Crescent,* but he did not state from what paper he clipped it.

42 *Ibid.,* Sept. 5, 19, Oct. 10, 17, 1864.

43 *Ibid.,* Oct. 17, 1864.

44 *Ibid.,* Oct. 10, 1864.

Pomeroy's putrid propaganda failed to halt the Republican tide which swept Lincoln back into office. The editor, then, appeared dispirited and disconsolate. He wrote that he regretted Lincoln's election "more than words could tell." He blamed fraud and intimidation for Lincoln's re-election, and he refused to accept the verdict in good grace. "For the first time in the history of our country," he rationalized, "a corrupt and ambitious President has abused his office by making it a source of terror and fraud to influence political opponents."[45] He suggested that those who voted for "Lincoln and the war" should volunteer for army duty. "Election being over," he noted, "we look to those who voted for Lincoln and the continuance of the war, to go to the front."[46] He spoke the language of the appeasers, predicting that the Union was "lost forever" and stating that the South could "never be subjugated." He supposed that the Northwest might break away from the East, establishing its own confederacy. He wrote that more "thieving generals" would fill their pocketbooks and that more widows and orphans would be "created." The sullen scribe added a prophecy: "There is no hope for the Union now."[47]

When the editor of the Republican newspaper in La Crosse wrote that Pomeroy talked boldly and sought attention but would not dare assassinate Lincoln, the saucy editor retorted: ". . . if Old Abe ever comes into our office to tell one of his stories, or crosses our path, we'll go for him with a culvereen [*sic*] of corn cider. Dare not assassinate Lincoln! We'd shoot him quick as any man."[48]

When Lincoln met death at an assassin hand there were some who pointed a finger of guilt at Pomeroy, suggesting he was involved in the conspiracy. Some spread rumors of his impending arrest and they quoted from Pomeroy's most vicious editorials.[49]

The editor of the La Crosse *Democrat* shed crocodile tears when he decked his newspaper in mourning grab—he turned the column rules—and reported that the country had lost a statesman. Several months later Pomeroy supposed that "God generously permitted an agent to make a martyr of the late president . . ."[50] He followed with remarks even more villifying. "We deprecate assassination," he wrote, "yet we feel to thank God for calling Lincoln home, wherever that may be." Then the defiant Democrat suggested that the act of assassination "gave the country a statesman for a President" and "halted the advance of usurpation most effectively."[51]

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[45] *Ibid.,* Nov. 9, 1864.
[46] *Ibid.,* Nov. 14, 1864.
[47] *Ibid.,* Nov. 21, 1864.
[48] *Ibid.*
[49] Milwaukee *Sentinel,* May 8, 1865; La Crosse *Democrat,* May 8, 1865.
[50] La Crosse *Democrat,* June 19, July 3, 1865.
[51] *Ibid.,* Oct. 2, 1865.

Having drunk deeply from the cup of self-righteousness, Pomeroy believed that time would vindicate him and would treat Lincoln harshly. "They may denounce me," he wrote of his contemporaries, "but their children will not, for they shall know the truth.[52] Pomeroy's cross-town rival gave posterity an evaluation which found its way into history: "He out-jeffed Jeff Davis in treasonable utterances and out-deviled the Devil in deviltry."[53]

Little did Marcus Mills Pomeroy realize that a century later historians would classify him as a carping critic, a man who preached the doctrine of a free press and ignored the responsibilities such a principle imposed upon editors. He claimed that democratic processes must function, even in times of civil war, yet his practices and preachments did more to endanger the processes than to preserve them.

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[52] Quoted in Tucker. *Life of Mark M. Pomeroy*, 91.

[53] Charles Seymour, "The Press," *History of La Crosse County, Wisconsin*, 545.

THE WISCONSIN IDEA AND SOCIAL CHANGE*

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The Wisconsin Idea

The Wisconsin Idea known as "the boundaries of the campus are the boundaries of the state" is a comprehensive concept. Yet, in stating that a University of the people must be taken to the people, its originator, President Van Hise, identified only one of the areas of concern for enlightenment. Simultaneously, the University of Wisconsin became one of the great graduate schools of the nation and the world. This dual development needs to be kept in mind when considering what became known as the Wisconsin Idea. Many of the state universities around the turn of the century concentrated on services to the people of their states since their financial support depended upon the legislators of these states. In Wisconsin, however, as in the ivy covered private institutions of the East, great stress was also placed upon academic excellence and scholarly research. Therefore one immediate objective of scholarship practiced at Wisconsin was involvement with significant public concerns.

As teacher, researcher, and extension lecturer, the professor's concern with the public interest was intimately intertwined with his academic investigation in his subject area. This integrated approach without sacrifice of vigorous research methodology was possible in the days before specialization and fragmentation. Today, public service is associated merely as extension education.

Under Van Hise, a group of scholars influenced by German Universities with stress on scholarship and participation in decisions of public policy came to Wisconsin. These scholars under the leadership of this great president appreciated the importance of making all the resources of the University available beyond the college walls.[1]

In Wisconsin, Agricultural extension and general University extension became enriched by this broader dimension of the Wisconsin Idea. Around the turn of the century, the spirit of co-operation between the two domes, the Capitol and old Bascom Hall, at each end

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* Paper read at the 92nd annual meeting of the Academy, May 5, 1962.

[1] Cf. Dr. William Cohnstaedt, "Die Universitaet von Wiskonsin," *Frankfurter Zeitung*, Frankfurt-am-Main, Germany, September, 1909; "The great inner and outer modernization of the German professor in both personality and attitude toward life in recent years became surprisingly evident on this side of the Atlantic. The German professor is more 'Americanized' than the American."

of State Street, promoted public service. This emphasis required an off campus extension faculty to supplement the resident scholar who also served as extension lecturer. The later development of an Agricultural Agent in each county was a mere expansion of this concern to be of service. For a longer period of time Agriculture Extension rather than general extension, was able to preserve a closer identification of public service linked with vigorous resident scholarship. Specialization within agricultural subject fields enabled continued public contacts while a separation became sooner inevitable in the humanities and the social sciences. Political and institutional conditions within the College of Agriculture enabled a longer period of direct co-operation between research scholar and public. Even today the role of the College of Agriculture within the University is unique among the University's family of schools.

Social Change in Wisconsin

A Population of Consumers. The majority of the citizens of Wisconsin, once predominantly engaged in farming, are now defined as urban residents by the 1960 census. The services offered to the farming population, the distribution, processing and transporting of farm products and supplies are no longer the predominant services among the state's activities. Consumers irrespective of occupation or residence, dominate the economic scene and demand the major portion of the state's resources. Of course this shift from a producer to a consumer economy in Wisconsin is not unique for it is similar to the national trend.

Technology and Production. Many social changes are directly attributable to the expansion of our industrialized society with its technological improvements and steady increase in mechanization. The change in farming methods due to mechanization is well known. Fabulous improvements in technology now enable a small number of agricultural producers to satisfy the total national food demand creating severe economic, social, and not least of all, political problems.

Metropolitanization. The most complex of all the changes can be traced to the current trend of metropolitanization. Starting as a small tendency concerned with concentration of peoples in cities, it presently is a major problem, both economically and culturally. An additional change, a counter movement of the urban population results in the dispersion of large numbers throughout the adjoining country-side of the central cities. An entirely new pattern of human habitation has come into being with the emerging suburbs. Older, established suburbs, like the city proper, had characteristics of internal organization and community cohesion which are not found in many of these new subdivision developments. In these recently developed areas innumerable physical and material problems now clamor and press for solution. However, the necessary knowledge and information upon which to base social and political decisions are not yet available.

Communication Breakdown as Social Change

Today's society requires scientific knowledge for the basis of intelligent decision making. The presence of a multitude of experts, all specialists in their respective areas of professional training, would seem to assure the availability of all needed scientifically arrived knowledge. Yet, in a democratic society it is assumed essential that all people make the decisions affecting their own way of life. However, the delegation of decision making has now denied many the opportunities for critical thinking. Also, narrow routines which channel men's lives today do not enable comprehsion of the "whole" of society.

In an urban society social contacts are no longer geographically oriented. Place of work and residence are usually in two separate areas of the city, while the man who controls one's employment lives in still a third part of the community. The latter may be more significant to the employee's total life than the neighbor next door. Similarly, friends with whom one shares in common special and significant interests may live in ever widening circles throughout the metropolitan area. The geographic neighborhood seldom represents a meaningful environment, that is to say, becomes significant in the life of families, until their relationships outside this restricted area become meaningful and comprehensible. Successful Neighborhood Councils are found only when the people concerned are adjusted to their larger economic and political environment. The immediate geographic community cannot be "developed" until there is this functional adjustment.

The loss of territoriality, that is the shift of social ties from the geographic neighborhood, and the change of significance of the local community does not necessarily mean the malfunctioning of a pluralistic society. If people were to participate in a plurality of special interest organizations in which they presently hold membership, alternative ties and social relationships would replace those found in a more community-oriented older society. There are sociologists who consider social organization in the existing mass society possible without the presence of community organization.[2] However this may be, the development of a mass society means a

[2] James S. Coleman, "Community Disorganization," *Contemporary Social Problems*, Robert K. Merton and R. A. Nisbet, New York: Harcourt, 1961, p. 591.

withdrawal from responsibility of citizenship. What brings about such withdrawal? The breakdown of communication accompanying "withdrawal" results from the difficulty citizens have in identifying personal or community problems. For instance, the wide-spread abstention from participation in the making of decisions affecting public affairs usually takes place initially as apathetic non-participation in the citizens' associations of special interest groups. Time does not permit an analysis of the causes for the much lamented and little understood reasons for "lack of participation." It is a theoretical presupposition of this discussion that there are lags and maladjustments in the social structure of our contemporary society. To make issues, values, and practices in the community visible to those who need to be concerned is the problem of a mass society. The structure of a social organization needs to provide occasion to those variously located in that structure to perceive the norms obtaining in the organization. Also, it needs to provide relative ease in perceiving the "character of role-performance" by those who run the organization.

The Urban Agent

A clearer perception of the interrelatedness of social structure with institutional requirements of the culture is needed. An inadequate analysis of the existing social structure may account for some of the shortcomings of currently practiced community development, here and abroad. The prevailing practice of "accepting" the local culture and then attempting to get change introduced by "innovators" or "change-agents" leaves institutional adjustment to a "laissez-faire" condition of unguided change. Local institutions and their persistence have proven a chief stumbling block to lasting, that is, not temporary, acceptance of change.

In an "advanced" society the abundance of experts and the availability of professional services have not prevented the disintegration of urban community processes or the breakdown of communication. This has given rise to a recent search for a new kind of adult educator: the Urban Extension Agent.[3]

The agent would serve as a communication link. The results of urban research findings with respect to community-wide activities and problems would be translated by the urban agent into terms meaningful to the various components of the urban population. While thus serving as "implementor," the agent might simultaneously bring the needs of this urban population into focus for the researcher if the two were brought into a relationship, such as a university-based Urban Extension Service.

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[3] Martin L. Cohnstaedt, "Exploring a Model of an Urban Extension Agent," *Adult Leadership*, February, 1962.

The function of the urban extension agent is to clarify, assist and to enable people to function more adequately in a complex, specialized, technically oriented society, of which their community and their neighborhood are parts. With this aid citizens may gain understanding of the forces impinging upon them and an awareness of a fuller life. Fundamental to the work of the urban agent is the assumption that public and private services available will be drawn upon more meaningfully when their potential users have greater clarity and understanding concerning those services.

The agent serves as a communicator between the community and all professions, enabling urban residents to make more effective use of the services offered by professions and organized agencies. With the emerging sense of community, individual citizen will join together to provide for common unmet needs.

The Future

For a people dedicated to democracy there are a number of encouraging trends. Recently a distinguished group of adult educators from throughout the nation, under the chairmanship of Dean Adolfson of Wisconsin, prepared a statement on *Today's Critical Needs and University Extension.* Their document states that University Extension has become an intimate and essential aspect of the total enterprise of the modern public university. As a philosophy, they contend university extension sees the campus as a community of scholars making itself as useful as possible to the total society from which the institution draws its inspiration and support. Due to the high degree of specialization essential for exploring the frontiers of knowledge this philosophy may clash with prevailing pressures of academic life. Advancement in many professions is at the cutting edge of knowledge. This dilemma to be resolved by the universities demands courage and insight. In their statement of critical needs, the adult educators identify the function of university extension in much the same manner as the function of the Urban Agent; University extension seeks to identify public problems and public needs, to interpret these concerns to the university, to focus university skills and resources upon them, and thence to translate university insights into educational progress throughout a state or region. This statement implies that a city can be a more powerful teacher than formal classrooms. Many approaches to urban problems ignore this and become managerial. Much can be lost when educators seek to manipulate people and resources to solve urban problems. When that occurs little attention is paid to human values, whether people understand their problems or participate in seeking a solution.

The Wisconsin Idea was begun by scholars exploring their subject matter within the framework of public policy and the needs of the residents of Wisconsin. Following social change one must go forward avoiding unimaginative revival. Therefore, in our day of extreme specialization it is not possible to expect the contemporary scholar to imitate an earlier generation, however distinguished and successful. However, it may be worth while to identify institutional conditions which prevailed when state-wide university education achieved its fame and made a place for itself. In Wisconsin, few would question the position the University's College of Agriculture has had in the development of the state and the respect and affection earned by it for the state university. It may not be unreasonable to propose that in our day of urbanization the University's urban college, the University of Wisconsin–Milwaukee, may achieve such an enviable place in the minds of the people of the state and the entire nation. In order to learn from the past and to guide widely the future, it should be remembered that the College of Agriculture performed its service not as an independent unit. The Agricultural College was merely one integral unit drawing systematically on all the other resources a great University had to offer. Within the family of colleges on the University campus it had a much closer relationship to the state and its practical problems than the other schools. While it engaged in both pure and applied research in some fields of knowledge it did not aim to duplicate activities and facilities in other parts of the University. The College of Agriculture was dedicated to the constant improvement and development of its constituents. Thereby political support was gained which was of considerable importance to the entire University. With the rapidly expanding political power due to fairer apportionment the urban voter needs to identify his needs with that of his University.

In the past, first through the organizational support of county agents and later through the fiscal policies of direct farm subsidies the American farmer has been assisted in economic and technological adjustments within an ever changing industrial and corporate economy. At this time in our national history very complex social and economic problems arise from ever increasing state and municipal expenditures, as but one example. The rapidly rising costs of urban living stagger the taxpayer. Let it be said in the future that the University found in its Milwaukee unit an institution serving diverse but ever so practical problems of the people in an urban state.

MIDWESTERN "TOWN-MEETING"—AN EVALUATIVE STUDY OF ORAL DECISION-MAKING IN SHOREWOOD, WISCONSIN*

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I. Scope and Framework of the Study

Authors of contemporary textbooks concerned with oral decision-making display marked unanimity. It would not be too much to say that their key assumptions have become articles of faith in American collegiate classrooms. Although generally stated and held, the principles of oral communication in a democratic society are seldom challenged. Even less often is an attempt made to compare speech axioms with oral practice.

The schism between theory and practice is surprising when the first assumption is considered. This primary assumption postulates an *oral communication continuum* for the processes of oral decision-making in a democratic framework.[1] Leaning heavily on the "reflective thinking pattern" proposed by social philosopher John Dewey, the continuum recognizes that "the scientific method cannot be applied, *in toto,* in the solution of public problems."[2] Rather it is the employment of a series of speech activities or functions relying on scientific procedures which should be used "to maintain a free society."[3] As Baird reminds us, we "live under a government of public opinion . . . a government by talk."[4] The threefold oral communication continuum involves (1) *investigation* of public problems through *discussion,* (2) *systematic clash* on specific issues or proposals through *debate,* and (3) *individual advocacy* of solutions or actions through *persuasion.*

A second assumption concerning oral decision-making is less a matter of what processes are followed by those in a democratic government that it is a prescription of *how* the "functions of inquiry and persuasion" can best be served.[5] A conventional list of

* Portions of this study were jointly presented by the authors at the 92nd annual meeting of the Wisconsin Academy of Sciences, Arts and Letters.

[1] Waldo W. Braden and Earnest Brandenburg, *Oral Decision-Making* (New York, 1955), pp. 8–15.

[2] Henry L. Ewbank, Sr. and J. Jeffrey Auer, *Discussion and Debate* (New York, 1947), p. 20.

[3] William A. Behl, *Discussion and Debate* (New York, 1953), p. 3; Ewbank and Auer, *Discussion and Debate,* 1951 edition, pp. 31–34.

[4] A. Craig Baird, *Argumentation, Discussion, and Debate* (New York, 1950), p. 4.

[5] William S. Howell and Donald K. Smith, *Discussion* (New York, 1956), p. 263.

elements or characteristics of "government by talk" would include (1) reliance upon human intelligence and good will, (2) willingness to suspend judgment during the initial phase of inquiry (3) ability to deliberate cooperatively, (4) equal opportunity for participation in all phases of the communication continuum, (5) respect for minority opinions, and (6) acceptance of majority rule determined by voting rather than decree or default.[6]

Method and Data of the Study. This study reports the results of a descriptive evaluation of oral communication practices of the village board of Shorewood, Wisconsin. The writers have compared the theoretical assumptions discussed above with the actual oral decision-making processes of the governing body of Shorewood. In arriving at the conclusions and recommendations stated at the end of this report, the authors have used three major categories of information: official *publications* (including the *Village Code,* agendas and minutes of board meetings, press reports, public notices, studies sponsored by the board, and state statutes); structured, tape recorded *interviews* with Village Manager Robert Duncan and Violet Dewey, a local newspaper reporter; and critical *observations* of nine regular board meeings from August 7 through December 18, 1961.

II. Historical Background and Overview of Village Government

One way to understand the present is to view it in terms of the past. An examination of local government in Shorewood, Wisconsin, therefore, may be better understood if such government is viewed historically.[7] Because many of the early settlers in Shorewood were refugees from political persecution in Europe, the desire for self government was strong among them. When the city of Milwaukee was established in 1846, Shorewoodites joined with other eastsiders in forming the town of Milwaukee. Home rule began in the Shorewood area, then, one hundred and sixteen years ago.

The township form of government must have suited the citizens well for it continued in effect until the end of the century. Perhaps this form of government would still be in effect today had it not been for the presence in Shorewood of a large amusement park known in 1900 as Coney Island.

At the turn of the century, Shorewood was a small rural hamlet with only 345 inhabitants. It was a community whose population had remained almost the same as long as anyone could remember. Although there were four miles of paved street in Shorewood, mud

[6] Four of these six elements of democracy are ably treated in Braden and Brandenburg, *Oral Decision-Making,* pp. 4–8.

[7] The following historical sketch is based upon material found in the first two volumes of the four volume *Research History of Shorewood,* ed. by Ernest G. Henkel (Works Project Administration, 1937–38).

made the main road virtually impassable from spring until late fall. Local citizens recognized the fact that improved streets would attract new residents. The problem was how to finance such improvements. Licensing fees from Coney Island offered a credible solution.

Consequently in March of 1900, a small group of progressive-minded citizens petitioned the court for the formation of a new village to be known as East Milwaukee. To the men of Shorewood, it made no sense that park revenues should be spent on improvements elsewhere. Naturally Milwaukeans did not relinquish this source of revenue without a fight. For five months, city attorneys contested the corporation petition. But in August of 1900, the battle came to an end; East Milwaukee became a legal entity.

Village status brought with it a number of advantages. Coney Island revenue was at once appropriated for local improvements—first streets, and later street lights, water, parks, etc. Village government brought with it also opportunity for hungry office seekers. Whereas the former township government had only six elected officers in 1900, the new Village of East Milwaukee found need for twice that number. As one observer commented, "though these jobs were not highly remunerative, the work in most cases was not to [sic] onerous." Village government also brought with it the power to license taverns. Three such establishments already existed in the Shorewood area. No more need be allowed if the village did not desire it. Prohibiting further taverns would please local innkeepers who wanted things kept pretty much as they were.

Three specific forces appear to have influenced the early development of government in Shorewood. The desire to regulate ones own affairs manifested itself in the formation of the village; thus an earlier tradition of *home rule* was continued. *Progressivism* was evident in the community's emphasis upon local improvements, an emphasis which would in time change Shorewood from a rural outpost of farmers of limited means to a prosperous middle class suburb. Preservation of a *village image* became increasingly important as both suburb and city grew.[8]

Perhaps it is not too surprising to find these same three forces at work in the years since the turn of the century. Home rule was to meet two major tests during this period. In the village election of 1928, an entire slate of annexation-minded candidates for the village board was defeated. And in 1934, a county-wide referendum on

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[8] The village founders rigidly adhered to the provisions of Wisconsin law in establishing their new form of government. Cf. the Shorewood *Village Code—The General Ordinances of the Village of Shorewood,* rev. ed. (published by authority of the Village of Shorewood, Shorewood, Wisconsin, 1957) and *Revised Statutes of the State of Wisconsin, 1878* (Madison, Wisconsin), pp. 291–95.

the consolidation of metropolitan governments was voted down in Shorewood by a vote of nearly three to one.[9]

Civic progressivism emerged from time to time in several different ways. In 1917, for example, officials succeeded in getting the village name changed from East Milwaukee to Shorewood, thereby increasing the sense of local identity while at the same time establishing a more descriptive and attractive-sounding name. In 1928, an important new office was created in Shorewood, that of village manager. This position brought efficiency and order to the government of the swiftly growing community. Most recently, the village board employed a firm of professional consultants to plot the future of Shorewood.[10] Once more an emphasis upon progressive planning was apparent.

Preservation of the village form of government has usually been more prominent in village thinking, however, than either home rule or civic progressivism. When it appeared to the village board in 1932 that the village manager had too much to say in the hiring and firing of employees, the manager's powers were sharply curtailed.[11] In 1939, the Shorewood "image" was described in these terms: "because its development has been recent and frankly suburban, the village has no factories and wants none, limits its business area to a small shopping district, and self-consciously devotes its civic energies to making itself a pleasant place in which residents may live and spend their leisure."[12] This description would be equally appropriate in 1962.

Perhaps the most dramatic example of conservativism in Shorewood was the action taken recently by the village board regarding the consultants' report on the future of Shorewood. When it became apparent that the consultants foresaw grave economic problems ahead for the village, the board insisted on editing the preliminary report before its release to the press.[13]

Home rule, civic progressivism, the conservative preservation of a village image—these are the forces which have been influential in Shorewood village government since the turn of the century.

III. Oral Decision-Making in Shorewood, Wisconsin

Physical Setting for Board Meetings. Regular meetings of the Shorewood village board are usually convened in the courtroom on the second floor of the village hall. When only a few citizens are present for participation or observation, meetings are moved to

[9] *Shorewood* (American Guide Series: compiled and written by the Federal Writers' Project of Wisconsin, 1939), pp. 63–4.

[10] *Shorewood Herald,* January 19, 1961, p. 16. See also "Proposals for Tomorrow: Digest of a Preliminary Plan for Shorewood, Wisconsin," May 9, 1962.

[11] *Research History,* II, n. p.

[12] *Shorewood,* p. 11.

[13] *The Milwaukee Journal,* September 21, 1961, p. 2.

a smaller committee room adjacent to the judicial quarters. When meetings are held in the courtroom, the board members are seated three at a table at right angles to the audience and to the judge's bench behind which are seated the board president and the village clerk. The rectangle of official participants is completed with a table occupied by the village manager, his assistant, and village attorney. These officials face the presiding officer with their backs to the approximately fifty chairs provided in the audience area at the rear of the room.

Elements of decor and placement tend to heighten the status of the board and increase the psychological distance between meeting officials and citizen auditors. The higher elevation of the judicial "stage" and the presence of a wooden railing tend to enhance the atmosphere of aesthetic detachment between the board and visitors. Indeed, many citizens with cause to address the board appear awed as if standing before the bar of justice. Other courtroom appurtenances dramatize the formality of the setting: a large reproduction of a Gilbert Stuart portrait of Washington, a cluster of three small American flags above each door to the rear right and left of the bench, and even the gavel wielded by the board president to punctuate the proceedings.

Roles Taken by Meeting Officials. A. The Village Manager. It is a curious anomaly of village government in Shorewood that the "chief administrative officer of the village"[14] is not legally an ex-officio member of the chief deliberative body but is specifically permitted by law "to participate in all deliberations and actions by his voice but without his vote"[15] as an ex-officio member of all other legal bodies appointed by the board or its president. For it is readily apparent that no single individual exercises as much influence in board meetings as does the village manager. Although technically an administrative functionary whose job is to implement the policies and actions of the board, in practice, the manager has assumed the role of an impartial advocate in the deliberations of the board. The present manager does not attempt to present specific proposals but he does offer recommendations on particular issues when requested to do so by the board. In the majority of these cases, the board accepts the manager's appraisals.[16]

The basis for the manager's considerable impact on board decisions seems to be both quantitative and qualitative. Having prepared the agenda of items to be considered, he is in a strategic position to report the results of his research and evaluation. By virtue

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[14] *Village Code,* Art. 3, Sec. 3–302 (a).

[15] *Ibid., Art.* 3, Sec. 3–302 (c).

[16] Tape recorded interview with Robert Duncan, Shorewood Village Manager, January 17, 1962.

of the broad scope of his knowledge of village affairs in general and in specific problems, the manager occupies a unique position of dominance in board meetings. During the committee of the whole period of a recent typical board meeting, Manager Duncan consumed over half of the entire elapsed time devoted to investigative discussion.[17] During public participation in board meetings, the manager's pre-eminent status as a kind of floor manager and expert witness for consideration of public and private problems is equally evident. For about fifteen minutes before a recent board meeting was convened, the manager circulated among the audience preparing the visiting citizens for participation in the meeting and anticipating possible complications by asking for questions and complaints in advance of the meeting.[18]

B. The President. As chief executive officer of the village, the president presides at all meetings of the board.[19] In addition to his nominal role of ensuring that the ". . . deliberations of this board . . . shall be governed by the manual of parliamentary practice commonly known as 'Roberts' [sic] Rules of Order' . . .,"[20] the presiding officer in practice exercises leadership in promoting consensus on issues and handling public relations during periods of informal consideration.

C. The Clerk. The *Village Code* requires the clerk to record ". . . in chronological order, full minutes of all proceedings . . ."[21] Although the minutes are subject to review and approval by the board, the clerk has sole responsibility for their preparation and does not normally consult with the manager or president in the composition of the content of the minutes.[22]

D. The Village Attorney. By ordinance, the village attorney is ". . . the chief legal advisor to the Village Board and to the Village Manager and shall be responsible for preparing and drafting legal opinions, ordinances, rules and regulations . . ."[23] In practice, he also acts as parliamentarian during formal sessions of the board. The attorney participates in discussion and debate during meetings with comments concerning legal precedents and opinions concerning constitutionality and legality of proposed legislation.

E. The Committees. Members of the board constitute various standing committees: finance and administration; police and fire; streets, plats and buildings; judiciary; and parks. These committees

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[17] Authors' observations, village board meeting of October 16, 1961.

[18] Authors' observations, village board meeting of August 7, 1961.

[19] *Village Code,* Art. 1, Sec. 1–103.

[20] *Ibid.,* Art. 1, Sec. 1–107.

[21] *Ibid.,* Art. 1, Sec. 1–110.

[22] Duncan interview, January 17, 1962.

[23] *Village Code,* Art. 4, Sec. 3–402.

are primarily study groups for further investigation of specific matters referred to them by the board for their consideration. They do not normally initiate proposals for board deliberation and action.[24] Much of the discussion and oral inquiry phase of oral decision-making which might be expected of committees is thus practiced by the entire board sitting as a committee of the whole for informal consideration of matters, *de novo*. In the absence of regularly prescribed meetings or procedures, committees operate somewhat fortuitous upon call or felt need.

Sequence of Acts Followed by the Board. Each board meeting is a public drama in two acts. In the first act, the board meets in an extended committee of the whole session following the historical precedent of the New England town meeting. Time is allocated for the presentation of requests and complaints by citizens and for public consideration of agenda items. The second act is composed of a brief formal business meeting later that same evening. Although no conscious effort to arrive at mutual understanding during the session of the committee of the whole is avowed or admitted, the consistent pattern of subsequent unanimous votes suggests an effort to avoid or minimize controversy. In fact, controversy is taken to imply lack of information and an indication of undesirable internal friction. The net effect of this total deliberative process is to discourage systematic debate on crystalized issues in favor of unorganized discussion.

Recurring Themes in the Dialogue of Board Members. Even a casual examination of recent deliberations by the Shorewood village board will reveal the continued importance of those forces which shaped earlier village development. Concern with community progress, the preservation of a village image, and local autonomy continue to dominate official thinking.

Progressivism, for example, has been apparent recently in a variety of instances. A new organization of business and professional men was formed to supplement the efforts of the Shorewood Neighborhood Improvement Council.[25] A housing code providing minimum housing standards for the village was approved, and recently the village board voted to purchase its first "blighted house" as a prelude to property improvement.[26] Over twelve thousand dollars is being spent to finance a village improvement study by professional consultants. Two winters ago, an editorial appeared in the village newspaper chastising public works crews for snow removal "almost as bad" as Milwaukee's.[27] And recently when a metro-

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[24] Duncan interview, January 17, 1962.
[25] *Shorewood Herald,* March 6, 1961, p. 1.
[26] *The Milwaukee Journal,* February 6, 1962, Part II, p. 2.
[27] *Shorewood Herald,* March 16, 1961, p. 4.

politan newspaper predicted a dim economic future for Shorewood, numerous citizens phoned the village hall offering to help in any way possible.[28]

The preservation of a unique village image has also been important locally. Village squad cars have been painted a distinctive cocoa brown and patrolling policemen have been attired in uniforms to match. Vine-covered lamp posts have been replaced by green street signs as a distinctive Shorewood symbol. Several months ago, the Shorewood Men's Club awarded $25.00 to an art student for designing an emblem which would further the idea of Shorewood as "a community with city comforts and rustic beauty."[29] No article in the village newspaper concerning village matters in 1961 has received such detailed treatment as the defense of Shorewood by village officials, following the appearance of *The Milwaukee Journal's* controversial piece on Shorewood's future.[30] The village attorney has opposed the board's purchase of blighted property on the grounds that state law has not yet been tested in this sphere; nevertheless, the neighboring community of Whitefish Bay has been buying up depressed property for several years now.[31] Perhaps the village board's concern with imagery is most dramatically illustrated in the proposal of one member that "the meetings on the Shorewood plan, while still in the discussion stage, be kept closed not with any intention of hiding the facts but in seeing that the *right facts* are presented."[32]

Home rule is also a substantial and continuing force in board and village thinking. In order to be sure that "everyone" would be in on the planning of Shorewood's future, a variety of steps were taken. Several hundred village residents attended a program at the local high school entitled "Shorewood Through a Microscope." Questions from the floor and answers by village officials were recorded and later printed in serial form in the *Shorewood Herald.* A questionnaire dealing with "likes and dislikes" about the village and its services was mailed to every fourth Shorewood resident. President McLean of the village board joined a county unit of municipal executives only after he had assured himself that Shorewood "would not lose its local autonomy and home rule" by this act.[33] On the occasion of Shorewood's joint purchase with neighboring communities of a garbage crusher, Village Manager Duncan was careful to reiterate his dislike of metropolitan services "we don't want."[34]

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[28] *Ibid.*, May 11, 1961, p. 12.
[29] *Ibid.*, May 25, 1961, p. 1.
[30] *Ibid.*, May 11, 1961, p. 1.
[31] *Ibid.*, May 18, 1961, p. 1.
[32] *Ibid.*, May 11, 1961, p. 12; italics by the authors.
[33] *Ibid.*, January 12, 1961, p. 1.
[34] *Ibid.*, January 19, 1961, p. 1.

A vivid illustration of the importance of local autonomy occurred about a year ago when members of Shorewood's planning committee (a board appointed non-salaried group) agreed to meet in downtown Milwaukee during the noon hour to suit the convenience of committee members. Under the banner heading "Let's Have Meetings at Home" the *Shorewood Herald* alerted readers to the danger of Shorewood's becoming a "bedroom community."[35] "When meetings are held away from the village, it is almost like closing the door to the public," the editor warned. If members meet in the Shorewood village hall, "the planning committee will be more aware that its planning is for Shorewood and not some other community."

Scenes of Oral Decision-Making. As a representative sampling of the oral decision-making practices of the Shorewood village board, the authors have chosen to analyze three specific problems the board acted upon during the past year.[36] Each problem will be examined to determine what actually happened, to evaluate the effectiveness of the communication techniques used, and to estimate the degree to which board members adhered to democratic communication procedures. The problems chosen for analysis include 1) the purchase of fire insurance for village buildings, 2) the regulation of commercial hours of business for chain stores, and 3) the lease by the Shorewood Women's Club of a public recreational facility.

1. Traditionally, the village of Shorewood has handled the problem of fire insurance in a truly democratic manner. Within the boundaries of the village live twenty-four insurance agents, each of whom was alloted an equal share of village coverage. Since the last appraisal of village properties had been made in 1940, everyone agreed that the village was now seriously under-insured.

In mid-March of 1961, one of the local agents presented a new insurance plan for the board's consideration. A "free" appraisal of existing village properties would be made by this agent in exchange for 40% of all village insurance coverage. The new plan stimulated the board to call a meeting of all local insurance agents.

On May 22, twenty-one of the local Shorewood agents met with the village board to discuss the problem of new insurance policies. Since it was obvious to all that splitting coverage twenty-four ways resulted in minimal commissions, the group agreed that only one or two firms should handle the village policies. The *Shorewood Herald* hailed this decision as a change which would lead to easier bookkeeping and easier management. Here was, according to the editor,

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[35] *Ibid.,* May 11, 1961, p. 4.

[36] Communication practices regarding village business do take place, of course, *outside* of the board's regularly scheduled public meetings. An examination of these nonpublic decision-making practices would involve a separate study.

a split with tradition which "will work to the better interests of the village."[37]

On June 8, one of the village trustees asked to have a state insurance fund representative speak to the village board. The matter of fire insurance was then sent to committee for further study and remained there throughout the summer. On October 2, the board voted to place its entire coverage with the state insurance representative.[38]

In terms of the three recurring themes which had previously dominated Shorewood thinking, the affair went something like this. The *village image* was one of equality; policies were split equally among resident agents. This arrangement needed revision because of an outdated insurance appraisal and a feeling among the agents involved that their policy commissions were too small. *Home rule* would have dictated placing the entire village coverage with one or two local agents, a development the assembled agents in May probably assumed would come about. Yet *progress* in a civic sense involved both an immediate reappraisal and minimum insurance rates. When the state fund representative quoted premium rates only half as high as those cited by local agents,[39] the board's decision was greatly simplified; the village of Shorewood is now insured under the state insurance plan.

An analysis of communication techniques used during the consideration of the insurance problem is most revealing. According to speech theorists, the first step in solving any public problem is to inquire into the nature of the problem by means of group discussion. This the board proceeded to do. In May, village insurance agents (those village residents most immediately concerned with the problem) met in open session with the board.[40] In June, the board asked to hear from a state fund representative—an action which would broaden the basis of the board's review of insurance options.[41] Again the board's action was sensible and appropriate. And in October, the board awarded the policy to the lowest bidder, a traditional course of action for a body representing the public interest to follow. In each of these instances, the village board followed sound communication practice; members consulted those persons most closely involved, brought in an outside expert, and based their ultimate decision on economy.

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[37] *Shorewood Herald,* May 25, 1961, p .4.

[38] *The Milwaukee Journal,* October 3, 1961, Part I, p. 28.

[39] *Ibid.*

[40] *Shorewood Herald,* May 25, 1961, p. 1.

[41] *Ibid.,* June 8, 1961, p. 4A.

As for systematic clash through debate—the second step the communication experts recommend—there was none for practical purposes. At no time during the eight months when insurance coverage was being discussed did a public debate over the issues involved in the board's decision occur. Such a debate between state and private insurance representatives might well have occupied the board's attention during either of the two regularly scheduled September meetings.

If debate was lacking, individual advocacy through persuasion was surely not. The local agent who proposed a new village insurance plan in March was strangely absent when the board finally acted in October. Yet even the most optimistic salesman would hardly assume that a persuasive presentation to the board in March would have sufficient lasting power to bring about the desired result in October, seven months later. Another instance of personal persuasion occurred in early June. The village attorney opposed inviting a state fund representative to speak to the board. Attorney Hubert O. Wolfe maintained that "the state has no business in the insurance field;" according to Wolfe, state insurance constituted unfair competition for private agents.[42] Wolfe said further that because the state loaned out its accumulated funds, it was sometimes unable to pay fire losses without a long delay. The village board ignored its attorney's arguments; board members sent for the state fund agent. Again one wonders if the timing of the advocate was sound. A marshalling of these same arguments just prior to the board's action in October would seem to make more sense and to contain greater promise of success.

A third instance of persuasion, even more ill-conceived than the first two, occurred *after* the board had made its decision to purchase its insurance policies from the state. A letter signed by ten Shorewood insurance agents was sent to the board in which the board was accused of raising the "small pink flag of socialism."[43] Aside from personal pique, the letter served no discernible purpose. The board had already made its decision. Persuasion that might have influenced board members should have come before, not after, the decision was rendered.

To what extent was the board democratic in its procedure? A comparison with the six characteristics of "government by talk" listed at the beginning of this report should reveal the answer. Was there reliance upon intelligence and good will? By the board, yes. The decision to purchase the least expensive insurance with a reputable firm was logical enough. The behavior of the Shorewood insur-

[42] *Ibid.*

[43] *The Milwaukee Journal,* October 3, 1961, Part I, p. 28.

ance agents is questionable, however. Their use of name-calling and their assertion that the board's action was taken "under the guise of 'it's cheaper' " was neither accurate nor productive of good will.

Was the board willing to suspend judgment during the initial phase of the inquiry? Apparently so, with one exception. Halfway through the period of deliberation, the village attorney attempted to limit consideration of insurance companies to private firms. According to Village Manager Duncan, board members follow the legal opinions of their attorney "95% of the time."[44] The village attorney is therefore an important figure at board meetings although he, like the village manager, has no vote. The fact that the board did not in this instance accept the attorney's recommendation is beside the point; the incident represented an unwillingness to suspend judgment by a village official whose opinions are normally listened to with care.

Did the board deliberate in a cooperative manner? Indeed they did. They invited local insurance agents to meet with them in order to present proposals and advice. The consideration of new insurance policies involved eight months of careful deliberation. Surely none could accuse the board of hasty action or indifference to local resource experts.

Was there equal opportunity for participation in all phases of the communication continuum? Such opportunity was available, though as noted earlier, there was no evidence of debate whatever, and what persuasion did occur, was poorly timed and poorly adapted to the audience for which it was intended.

Was there respect for minority opinions? The board listened to the village attorney argue against sending for a state fund representative. And the village manager was instructed to read aloud the insurance agents' letter of condemnation in a public meeting of the committee of the whole.[45] There was ample opportunity for one and all to be heard.

The board accepted the will of the majority by adopting the state insurance plan by a vote of 4 to 3.[46] In this respect, again, the board acted in a democratic manner.

2. A second action of the Shorewood village board chosen for detailed analysis involves the regulation of commercial hours of business for chain stores. The problem centered upon the purchase of food on Sunday.

On September 28, 1961, the village manager attempted to persuade the two chain stores in Shorewood, the Atlantic and Pacific

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[44] Duncan interview, January 17, 1962.

[45] Authors' observations, village board meeting of October 2, 1961.

[46] Minutes of the regular board meeting, October 2, 1961, p. 3.

Tea Company and Kohl's, to close their doors on the Sabbath.[47] The A. & P. was willing to comply if its rival did. There was no village ordinance on this matter, however, so the village manager was simply requesting voluntary cooperation. The store manager at Kohl's refused to comply since chain store business was brisk in Shorewood on Sundays.

At the board meeting on October 16, Village Trustee J. E. Palmer asked the village attorney to draw up an ordinance which would prohibit Shorewood chain stores from being open on Sunday. Mr. Palmer was well known as the owner of the local "Palmer House Delicatessen," an independent food store customarily open on Sundays and closed on Mondays.

In the ensuing discussion, the village attorney pointed out that village barber shops and automobile showrooms were restricted from Sunday operation by legislation. Attorney Wolfe noted that Wisconsin "blue laws" had been outlawed in 1933; he predicted that the ordinance requested by Palmer would be held discriminatory if challenged in the courts. Wolfe did say that such an ordinance would be permissible if not contested. The aforementioned laws on barber shops and automobile salesrooms were cases in point.

Mr. Palmer insisted that it was "immoral" for chain stores to operate on the Sabbath. He alleged that he was speaking for all small, independent businessmen in the village, and reiterated his demand for a village ordinance.

Trustee Alvin Meyer asked why Shorewood residents who disapproved of chain stores being open did not simply boycott these stores on Sunday. He went on to reason that if one food store were closed, all should be. As a lawyer, Meyer supported the opinion of the village attorney that the proposed ordinance fell into the category of discriminatory legislation.

Mr. Palmer insisted that the ordinance would be constitutional. "Shorewood is built on independent merchants," Palmer said, "we have the right to regulate things in our own village."

Palmer's ordinance was adopted at the next regular board meeting on November 6. Trustee Meyer cast the sole dissenting vote.[48]

Here was a case in which *home rule* and the preservation of the *village image* won out over civic *progressivism*. Palmer's key argument was that the village had the right to regulate its own affairs; passage of this ordinance would clearly demonstrate the principle of home rule in action. A second argument that open chain stores

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[47] *The Milwaukee Journal,* November 7, 1961, Part II, p. 1.
[48] *Ibid.*

on Sunday were "immoral" illustrated puritan ideals. Sunday was a day of worship and rest, Mr. Palmer maintained. Shorewood had long viewed itself as a "model village." Any behavior which marred this image was behavior to be abolished. Curiously it seemed to matter little to most board members that the main advocate of this ordinance stood to gain from it by himself remaining open on Sunday.

Presumably the progressive-minded citizen would wish to encourage business in the village wherever possible. Yet the closing of chain stores would clearly restrict the hours during which business could be transacted. Government regulation of free enterprise was the pattern the board was asked to follow in this instance.

An analysis of communication techniques used by board members in the chain store dispute is most instructive. The controversy covered a five week period from late September to early November. On October 2, Trustee Palmer called the board's attention to the problem and asked the village attorney for a written opinion on the legality of an ordinance to restrict hours of business. Attorney Wolfe presented both sides of the picture. He explained that such ordinances were usually declared invalid when challenged in court. If the ordinances went unchallenged, as in the case of those regarding barber shops and automobile showrooms, they would be deemed enforceable. Wolfe refused to register an opinion on the constitutionality of the proposed ordinance, a proper stand in view of his non-voting and non-partisan position on the board.

Board members showed little inclination to discuss the closing hours controversy in a regular meeting until the evening of November 6. At this time, a debate occurred between Trustee Palmer and Trustee Meyer. Palmer maintained that chain store activity on Sunday was immoral, and that in his opinion the proposed ordinance was constitutional. Meyer noted the logical inconsistency in Palmer's position—"if you close one food store, why not close all?" —and assailed the ordinance as "discriminatory, bad legislation, and a very bad precedent." The sides were clearly drawn.

On the surface it might seem that Meyer would have the edge for logic and probability were clearly on his side. Yet the vote later that evening showed that Palmer had won the day for he secured all votes except Meyer's.

The deciding factor was Palmer's use of persuasion, particularly his adaptation to the beliefs of his listeners and his personal strength as a speaker. To begin with, Trustee Palmer was a respected board member. Since board members seldom advocated proposals themselves, Palmer could count on an attentive hearing. Furthermore, Palmer maintained that he was speaking for others; small businessmen, he said, had asked him to sponsor the ordinance;

residents, he said, objected to excessive Sunday traffic at chain stores; churches, he said, objected, too, although he refused to identify any specific religious group. Naturally the board would want to cooperate in a venture allegedly supported by so many residents. Palmer himself appeared to be confident and forceful. His insistence that "we have the right to regulate things in our own village" was a direct plea to those favoring home rule.

The Milwaukee Journal declared that Palmer had "put himself in an untenable position by using his public office to advance his personal business interests."[49] Be that as it may, Palmer got his way for chain stores are now closed on Sunday in Shorewood.

A comparison of the elements of democratic decision-making with this decision of the village board suggests intermittent democracy. The board chose to follow an illogical decision rather than the avenue human intelligence would suggest. On the other hand, the good will of a fellow trustee and of village residents was foremost in the members' thinking. Attorney Wolfe scrupulously avoided value judgments during the initial stages of the decision-making process, but Trustee Palmer could hardly do so. Palmer played two roles at once: that of an impartial representative of the people, and that of an advocate for small business. From the time when the question was first introduced until the eventual passage of the ordinance, Palmer was persuasive; he made every effort to convince others. It may even be that Palmer was asked to represent the independent store-owners because these businessmen felt that he would be more persuasive as a member of the board than any non-member. The village manager sought to deliberate cooperatively with the store managers involved. All factions had an equal opportunity to participate in all phases of the communication process. There was little discussion but ample persuasion and debate. The absence of any chain store representatives from any board meetings may have been due to a concern about local public relations and the potential danger of alienating customers. Minority opinion was never actually clear until the time of the vote on the ordinance. Trustee Meyer accepted the decision of the majority without further comment.

The ideals of democratic decision-making were sometimes achieved and sometimes overlooked in this second illustration of board behavior.

3. The third case of board action chosen for analysis involved the lease of a village park facility by the Shorewood Women's Club.

On August 8, 1961, blueprints for a projected addition to the shelter house at Hubbard Park were approved by the village board. For many years past, the Shorewood Women's Club had been with-

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[49] *Ibid.*, November 9, 1961, Part I, p. 22.

out a satisfactory club house. The new addition was designed, in part, to meet this need.

At the next regular board meeting on September 5, the Women's Club lease again came up for discussion. The village manager talked at some length on the connotation of the word "bar."[50] The issues were two: 1) whether or not beer should be served in the new facility; and 2) who would receive concession rights for beverages that were served. Manager Duncan noted that certain Milwaukee parks permitted beer. He said further that the majority of groups requesting use of the Hubbard Park facilities wanted beer. Traditionally the park custodian served beer or "spiked punch" and received the commission therefrom.

The village manager became the focal point for this discussion on alcoholic beverages. All persons participating in the discussion, whether board members or residents, directed their comments to Mr. Duncan. Duncan served as chairman, information-giver, and principal speaker. Comments of board members and residents present were largely confined to praise for the manager's handling of the twenty-eight minute session; "very well explained" and "nice to have an explanation" were typical examples. The Women's Club delegation of eight members frequently talked among themselves but played little role in the discussion to which the board attended.

On September 18, Mrs. Skinner, current president of the Women's Club, asked about the progress of the Club lease.[51] She indicated that her group was anxious to start building the club house addition before the frost set in. Again, everyone deferred to the village manager as spokesman. Mr. Duncan apparently grasped the situation better than anyone else for his presentation was virtually accorded the status of reverence. Again, the Women's Club sent a sizable delegation which took little part in the discussion. The village attorney was instructed to meet with the Women's Club's attorney as soon as an appointment could be arranged.

On October 2, Trustee Abramson, a former president of the Women's Club, revealed a new obstacle in the negotiation of the club house lease. Apparently the ladies desired to employ their own custodian and to serve their own beverages. Mrs. Abramson proposed that the board instruct the village attorney to draw up a further agreement specifically covering the duties and responsibilities of the custodian.[52] The matter of the lease agreement was left in the parks committee for an entire month while the village manager, village attorney and village board members sought to reach agreement with Women's Club officials, officers of the corporate organi-

[50] Authors' observations, village board meeting of September 5, 1961.
[51] Minutes of the regular board meeting, September 18, 1961, p. 1.
[52] *Ibid.*, October 2, 1961, p. 5.

zation of the Women's Club, and the Club's attorney. Construction of the club house was postponed for the duration of this period.

Agreement was finally reached on November 6, thirteen weeks after the board had approved construction plans. There would be no park custodian in attendance when the Women's Club was using the facilities but such a person would be in charge when other groups were present. All concessions would be handled through the park custodian as in the past. A large delegation of ladies again appeared although the Women's Club attorney did all the speaking on their behalf.[53]

The final board action was *progressive* in that a long existing need for a club house was now met. *Home rule* was preserved in terms of village control of a village facility. The *image* of a cooperative, responsive village board was upheld in that board members and villagers reached a compromise agreement, suggested first on September 5.[54]

An examination of communication practices used in this transaction reveals some remarkable shortcomings. Each time the board considered the lease agreement, the village manager did most of the talking. These sessions can better be described as informative speaking and "interviewing the expert" than open and broadly based discussion. Observers in the audience found it difficult to understand why the Women's Club lease appeared on the board's agenda week after week.

There was no evidence of controversy at any of the board meetings. Yet agreement on the lease remained elusive. One problem was the fact that the Club appeared to have no single spokesman since the Club president confined her remarks to brief questions and a plea for a speedy settlement. On October 2, it became clear that at least a dozen people representing the village and the Women's Club had to be contacted, convened, and convinced of a solution. It remains unclear as to why so large a group of active citizens was needed to reach an agreement implicit early in the board's deliberation of the matter. Discussion, debate and persuasion may have occurred on this topic but these processes did not occur during regular board sessions.

Was the decision a democratic one? Largely so. Intelligence would have dictated a much more rapid agreement to be sure. And good will should have paved the way for at least some discussion from the floor by the many interested ladies present. But perhaps the latter feared they might be taking up the board's time unnecessarily.

Mrs. Abramson, who had an obvious interest in the proceedings, refrained from persuasive appeals throughout the inquiry. The vil-

[53] Authors' observations, village board meeting of November 6, 1961.
[54] Authors' notes, village board meeting of September 5, 1961.

lage board met with all the parties concerned and did its best to deliberate cooperatively. There appeared to be an equal opportunity for participation in all phases of the communication continuum, even though, as mentioned earlier, little use was made of this opportunity in regular board meetings. The final decision of the board in this matter was a compromise satisfactory to all. Minority opinions were respected and majority rule reigned: the Women's Club received the right to regulate its liquor consumption during its own meetings while the board protected the concession rights of the park custodian.

IV. Conclusions and Recommendations

In an admittedly incomplete study of the oral decision-making practices of the Shorewood village board, the authors have reached a series of tentative conclusions. Each conclusion presented below is accompanied by a specific recommendation for improving communication practices.

1. For over sixty years, the formulation of public policy in Shorewood, Wisconsin has been dominated by the three forces of civic progressiveness, home rule, and the preservation of a "village image." Preoccupation with home rule and a village atmosphere have at times prevented board members from considering proposals on their own merits. A systematic use of the oral communication continuum for all policy matters requiring board decision would eliminate this problem. For example, if a set amount of time were allocated to debate before the board of the key issues involved in a proposal, the board would be better equipped to reach a logical solution.

2. Although no attempt was made in this study to validate the communication continuum recommended by speech theorists, the study clearly shows that this recommended pattern of speech processes is only partially adhered to in Shorewood board meetings. Provision for the use of these three processes regularly in board deliberations would aid the board members by providing them with a systematic method of procedure. Such a requirement would also help the citizens of the village in their understanding of the deliberative process their representatives would follow.

3. The characteristics of democratic decision-making occur intermittently in the deliberations of the Shorewood village board. A conscious effort on the part of board members and village officials to suspend judgment during the inquiry phase of a question should help in this connection. The prerogative of personal advocacy should be denied board members in regular board meetings but encouraged in committee meetings.

4. Any complete estimate of Shorewood decision-making practices must include studies of oral communication outside of regularly scheduled board meetings. Related studies of the communication practices of persons who are influential in the village, neighborhood conversation groups, committee sessions, and even coffee breaks would help to complete the picture of decision-making in Shorewood.

5. The most influential participant in board meetings is the village manager, who is not officially a member of the board. Apparent efficiency should be sacrificed for greater use of the democratic process. The manager might better make materials available to board members for study than report on them himself. For in summarizing such materials, the village manager must abstract from them; his selection of what is important might be substantially at variance with that which might be selected by the village trustees. The authors suspect that board members take limited part in board deliberations because they feel that their knowledge of specific topics is limited.

6. Methods of recording minutes of board meetings are unsystematic and outdated. The use of tape recordings of both the committee of the whole and regular board sessions should help to eliminate recording problems. Such tapes would serve as a valuable historical record if carefully preserved. Further, the authors recommend that consultation between the village clerk and the village manager and/or the village president in the preparation of minutes should be required.

7. Although this study was not primarily concerned with the Shorewood board's committee system, it soon became obvious that the committee system is in need of review. Committees should meet regularly to initiate studies and draft proposals in their own areas. Thus, recommendations to the board for action would represent carefully phrased group thinking rather than hastily composed ideas of individuals.

8. Board meetings are inadequately structured from the standpoint of arousing interest among citizens as participants in village government. The failure to begin sessions on time or to publicize before the meeting the evening's agenda, the judicial atmosphere and the placement of important village officials with their backs to the audience, inaudibility of board members at times and citizen unfamiliarity with the steps of the deliberative process—all of these factors contribute to a spectator rather than a participant interest in village government. Added to these factors is the discouragement of conflict, an element of natural interest which might attract greater attendance. The village board has at its disposal the positive means for correcting these deficiencies.

THE RETREAT OF AGRICULTURE IN MILWAUKEE COUNTY, WISCONSIN

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Milwaukee County, in common with other principal urbanized counties of the Middle West—indeed of the nation—has experienced the impact of the urban sprawl and its accompanying rural retreat. The impact has been hastened in the county, and elsewhere, by the "discovery" of hedgehopping by subdividers; hedgehopping, the placing of subdivisions in the midst of fields, and some distance removed from continuous urban areas, results in the fracturing of farm land, the shattering and even the elimination of the agricultural zones that surround a city, and in the creation of economic pressures upon the farm land remaining in the interstices between and among subdivisions.

Milwaukee County contains 239 square miles (152,960 acres) and more than a million people within its borders. The post-World War II advent of hedgehopping has resulted in subdivisions in all parts of the county. The percentage of the county devoted to agriculture has dropped, in twenty years, from 50 to approximately 10. More than 1,250 farms were eliminated in the first fifteen years after the War. But 237 true "commercial farms" remained in the county in 1961, as disclosed by a special survey. The 440 dairy farms of 1940 were reduced in number to approximately 50 by 1961, only 26 of which still produced milk for the Milwaukee market; a county that at one time had the largest milk production per unit of farm area in the state now gathers some of its milk supply from points as distant as central Wisconsin. The former market gardens have been virtually eliminated; only 35 remained in 1960, relicts of the nearly 300 of the recent past.

Milwaukee County was among the top 100 agricultural counties of the nation in some items a generation ago. Today all of its area lies within the limits of incorporated places—Milwaukee, the twelfth city in size in the United States, Milwaukee's long-established suburbs, new suburbs, and "new cities", these last the former towns (townships) of the county. Thus every resident of the county, farmer as well as urban dweller, is now a city resident and subject to zoning ordinances of an urban type as well as to city taxes and assessments.

This paper is concerned with the rural retreat, not with the urban sprawl or the advancing contiguous urbanized areas. It is concerned, too, with farmer resistance to rural retreat. The wave of German settlers of the 1840's occupied much of the farm land, although some settlement of Eastern Americans and Irish occurred during the 1830's and 1840's. The thrifty and hard-working German settlers cleared and developed the land. Many Milwaukee County farms are or were "century farms", having been in the same family for 100 years or more. Fathers established their sons in farm enterprises, and a love of the land comparable to that of the Pennsylvania Germans developed. Seven out of every eight farmers are landowners; many of the renters are related to the owner by marriage. Thus, the resistance of many individuals to loss of their land has perhaps been more determined than in urban counties elsewhere where a more speculative and mobile agricultural population resides.

This paper is based upon detailed field work undertaken in 1959–61, upon other field work carried on in the county by the writer during several periods beginning with the early 1920's, and upon various statistical and historical records. The subject matter is confined to Milwaukee County. The writer recognizes that the urban impact and zone of rural retreat extends into three neighboring townships (now cities) of Waukesha County (Menomonee, Brookfield, New Berlin) and into one of Ozaukee (Mequon), and that some townships beyond these are experiencing rural retreat. Waukesha County to the west has had a serious loss of farm land and of farms during the decade since 1950, from 3,049 farms to 1,883; 864 dairy farms disappeared, and but 904 total still operate. The county is no longer near the top of the leading dairy counties of the nation. But for historical, statistical, and field purposes the paper is held to a county which has long contained one of the major cities of the nation and yet has been important in agricultural production as well.

Hedgehopping in Milwaukee County

The principal advent of hedgehopping in the United States has occurred since World War II, even though some of the War-built housing was at a distance from contiguous urban areas. Prior to the War the "greenbelt towns", sponsored by the Roosevelt administration, were placed in an outer ring; Greendale, the "greenbelt" community built southwest of Milwaukee was such a town. At the time it was unique enough so that "tourists" gathered to witness the operation of machines, the demolishment of large dairy barns included within the planned area, and the razing of other farm structures. The urban expansion of the present proceeds, in Milwaukee County as elsewhere, by contiguous growth from the existing urban margin, by growth along major highways, by the familiar "additions" to a city near its borders, and by hedgehopping. It is this last that creates additional economic pressure upon the agricultural land near which the subdivision is placed.

Many real estate developers have adopted hedgehopping wholeheartedly. Land at a distance is less expensive. Taxes, at least originally, are lower in the rural territory. The omnipotent automobile of office and factory workers, coupled with paved and maintained roads, have made hedgehopping feasible and possible. Public transportation need not be considered as a locative factor; the resident provides his own transportation. In fact, his work may follow him as factories, research laboratories, shopping centers, and other enterprises move to a peripheral setting. The drilled well, the electric pump, and the septic tank, ubiquitous features of nearly all hedgehopped subdivisions or linear rows of new rural nonfarm homes, likewise permit selection of site without regard to water or sewer lines. Milwaukee newspapers, especially in their Sunday real estate sections, now carry many advertisements of well drillers, and septic-tank cleaners—types of business whose services are not needed in the city proper.

The hedgehopped subdivisions of Milwaukee County lie in a semi-circle around the city. They extend, also, into Waukesha County to the west, the southeastern corner of Washington County to the northwest, and into Mequon of Ozaukee County to the north. They differ in quality, landscape, and type of resident—differences not within the scope of this study. In general those to the north near Lake Michigan are of higher quality. Northward, too, are the small and large estates, some of them of small-farm size, but not operated as farms. The southern subdivisions are principally for the worker. Westward and into Waukesha County there is a mixture, but much high-quality property in the Lake Border Moraine, and many subdivisions catering to the middle class. An original factor in the westward placement, aside from propinquity to the western urban edge very near the county line, was the existence of far lower automobile insurance rates in Waukesha County than in Milwaukee. Thus, no matter what the county unit the impact on farms is existent. Broadly, the present general subdivision zone coincides quite closely with the milkshed of the 1920's. At that time Milwaukee, of all the larger cities of the United States, possessed the smallest milkshed *in area,* a reflection of the intensive dairying of southeastern Wisconsin; the outer limits were only 25 miles from the city center. The farms of Milwaukee County were then the largest producers of milk per unit of farm area in the state.

The detailed pattern of subdivisions is markedly affected by the mile-square grid of the road system. But, from the earliest days diagonal roads led outward from the port of Milwaukee, for the city was one of the principal points of disembarkment for settlers who arrived from the East or from Europe via the Great Lakes. These roads, originally plank roads, still constitute principal arteries along which, or adjacent to which, real estate subdividers have placed many hedgehopped communities. Southward the straight roads on the section lines, particularly two or three, are principal arteries; one of the section-line roads is the United States Highway to Chicago, and carries an Interstate Highway southward for 24 miles from the southern edge of Milwaukee County to the Illinois state line.

The individual subdivision, within the confines of the original road pattern, is commonly hit-or-miss in specific site. A realtor buys a single farm, and "develops" it. A nearby farm, a mile or more away, is purchased by another developer. Various builders and real estate firms compete for locations; advertisement after advertisement appears in the city papers, farm-read papers or journals, the gist of each advertisement being "lots and acreage for subdividing wanted" or "wanted: farmland suitable for subdividing." Speculators purchase or option other farms, hoping to sell at an increased price to a builder, and meanwhile renting the land back to the former owner. In fact the real estate sections of the Milwaukee newspapers frequently contain articles on this practice: " 'Trading Up' Realty Properties Profitable if you Avoid Pitfalls." These, and associated activities, result in the specific location of many hedgehopped subdivisions—all, however, being within the broader framework of the "subdivision zone" of urban-rural landscape.

The competition of real estate subdividers for farm land suitable for development into hedgehopped subdivisions has bid up the price of such land. Not only do the subdividers bid among themselves, but operators of large farms—located on the outer fringe or beyond it —have been purchasing land to enlarge their farms. This is owing to their desire to provide a buffer zone between themselves and the subdivisions, and to permit expansion and further mechanization of their operations and increase of income. The small to medium-sized farmer thus may have alternative opportunities to sell out. In many cases the larger farmers have offered prices that are competitive with those of the subdivider; then the latter may choose to seek land elsewhere, another factor in the hit-or-miss location of many subdivisions. In any case the rising value of the remaining farm land, a shortage item, results in increased taxes, even the tax rate is not increased. Thus further economic pressures develop, ones indirectly owing to suburbinization, and the competition for land.

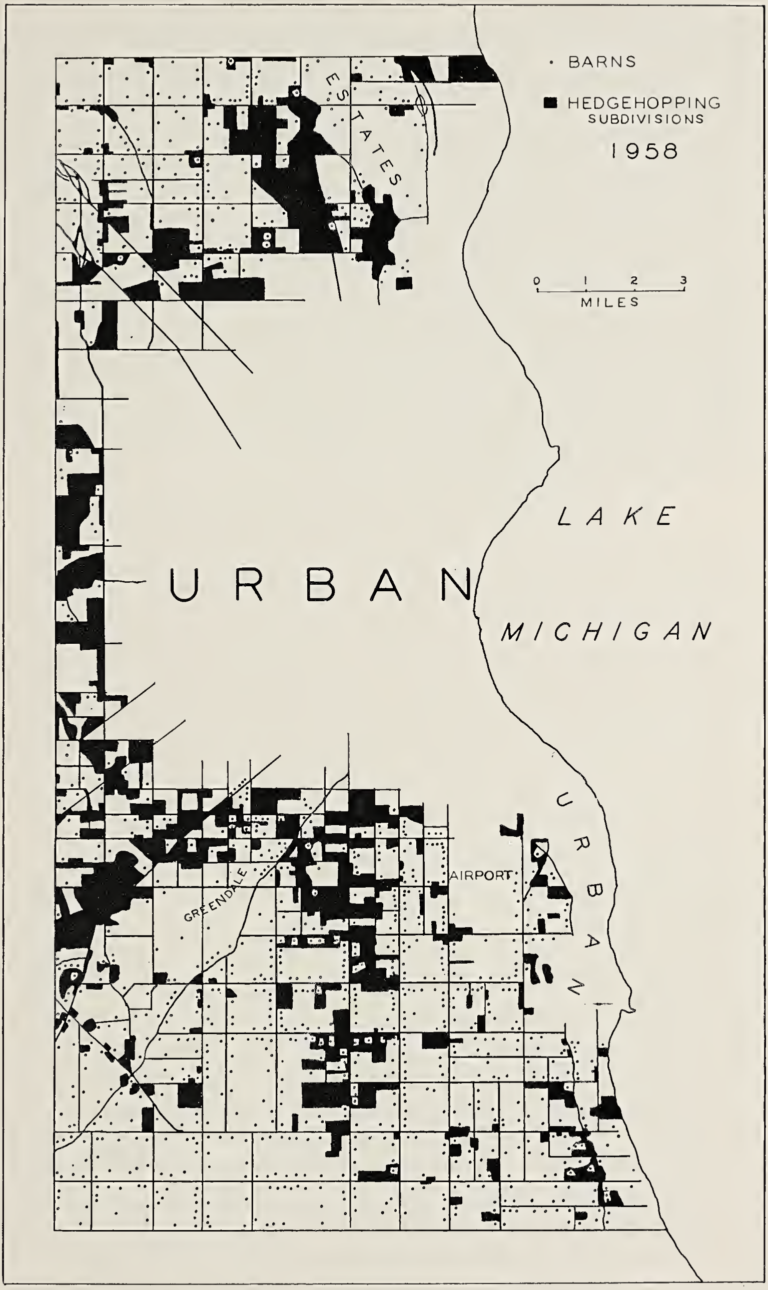

FIGURE 1. The road pattern, location of barns, and the hedgehopping subdivisions in Milwaukee County, 1958.

Subdividers compete with other potential users of land for space. Among these are federal or county agencies purchasing or condemning airport locations, park land, school sites, and institutional sites; churches obtaining land for present or potential use; factories and research centers seeking rural or peripheral locations; country clubs, golf courses, cemeteries, commercial and industrial users; companies building radio or TV towers; dumps, and many others. Each of these users today desires a generous supply of land; in Milwaukee County fringe and rural areas there are 80-acre school sites—one-eighth of a square mile; 40 and 60-acre church sites; 50 to 80-acre sites for towers; paved parking lots of 40 or more acres surrounding shopping centers; and new one-story factory buildings surrounded by extensive parking lots. And, in present and potential Interstate Highways and modern freeways, from one-sixteenth to one-eighth of each square mile through which the road passes is removed from farming or other uses.

The Landscape of the Zone of Rural Retreat

The zone of urban sprawl and hastened rural retreat contains a combination of rural and urban cultural forms. In Milwaukee County the most striking cultural relicts are the large basement dairy barns, nearly 1,000 of which are still standing, inheritances in part from the 2,000 farms of a generation ago, and more particularly from the 1,349 of ten years past. These well-built structures, with field stone (glacial boulders), local Niagara Limestone, or concrete foundations, are too valuable or expensive to demolish as long as some use can be found for them; sheds, cribs, and other out-buildings are removed, however. Many of the barns are 100 to 150 feet long, 40 to 80-feet wide. Some stand in or next to hedge-hopped subdivisions. Some remain next to factories or commercial establishments. Some have been converted to new uses—clubhouse, summer theater, real estate office, headquarters for a contractor. A barn in adjacent New Berlin has been cut down in height and remodelled into a modern ranch-style house. Other barns have been converted into use for storage; some are used for the selling of top-soil, for some of the frugal farmers of German descent gain an income from this before selling space to a subdivider. A relocated market garden may have a large dairy barn upon it, a structure not needed in the new enterprise. Vacant barn after vacant barn stand abandoned on a farm temporarily devoted to the growing of crops alone; the former barnyard is deep in vegetation, and the barn is used, perhaps, only for the overnight storage of an automobile.

Silos are relicts in many locations where the barn has been removed. Some silos still stand in subdivisions. Fields among subdivisions are in effect relicts of a former land use. An occasional abandoned apple orchard is a relict, but on the whole orchards have proved to be especial magnets for subdividers, and orchard acreage was limited in Milwaukee County in any case. Cultivated fields stretch to the back yards of some housing developments; it is not uncommon in the summer to witness a "relict farmer" at work on his tractor on one side of a line fence passing a householder and his power lawnmower on the other side.

Large and substantial frame farm houses, and smaller but well-built yellow-brick farmhouses, each quite usual in the county, remain as relicts. In most cases they have been retained for residences. Where a new subdivision of one story ranch-style houses or hundreds of small and similar box-like frame houses has been constructed, its adjacency to a relic farmhouse of different-style architecture provides a sharp contrast. Equally notable in the scene are the mature trees surrounding the former farm home and the newly-planted "shadeless" small trees of the subdivision.

Dairy cows are becoming relict features in the Milwaukee area. Their numbers, as recorded in the Census, have dropped from more than 7,500 in 1944 to fewer than 2,000 by 1959. Dairy farms have declined in numbers from 603 in 1929, more than 500 in 1939, and 440 in 1944 to only 75 census-reported ones in 1959—and to approximately 50 (only 26 selling milk to Milwaukee) by 1961. In the northern portion of the county only four farmers still maintained a dairy herd during August 1961.

Changes in the Agricultural Zones

The agricultural zones surrounding Milwaukee have been fractured, reversed and turned "inside out," or even eliminated completely by the urban sprawl of the post-World War II period. (1) Market gardens, theoretically closest to a city market are virtually extinct; three dozen remain where there were nearly 300 in the 1930's. In general, they have not been replaced on the present fringe, owing to the hesitancy of making the necessary capital investment because of the certainty of city expansion, and the competition of fresh and frozen vetgetables now produced on truck farms hundreds of miles distant; modern technology and the advent of frozen vegetables, coupled with the housewife's ease of preparation of the latter, have been background factors. There are today only two-and-a-half times the number of vegetable farms in the entire state of Wisconsin that there were market gardens in Milwaukee County alone in 1930. (2) The city milkshed, theoretically in the second zone outward, has been overrun by subdivisions, factories, and fractured by land held for anticipated schools, parks, and other uses. Milk is now transported to Milwaukee from distant counties (Figs. 2 and 3). Even adjacent Waukesha County, which in the past furnished nearly all of the market milk not produced in Milwaukee County, supplied only 19.7 per cent of Milwaukee milk in 1961, and had but 448 farms remaining on the market; during the five years 1954–1959 Waukesha lost 10,000 dairy cows. (3) Field-crop agriculture, the selling of cash crops (mainly small grains and corn now in Milwaukee County), theoretically distant from the city, now appears an activity on the urban fringe. It engages land awaiting "development," on former dairy farms where animals cannot be replaced because of zoning ordinances, by older farmers to ease their daily work-load, by farmers who hesitate to invest in capital equipment for the expansion of other agricultural enterprises, and by farmers renting land which is owned by developers for future subdivisions, by agencies for future park or school use, and other similar land awaiting a future use. The market for the final disposition of these crops is, in many cases, not the Milwaukee market, but one in the reverse direction. (4) The feeding of beef cattle and swine, theoretically not close to an immediate city market, now is an enterprise on certain farms. Former dairymen have shifted to

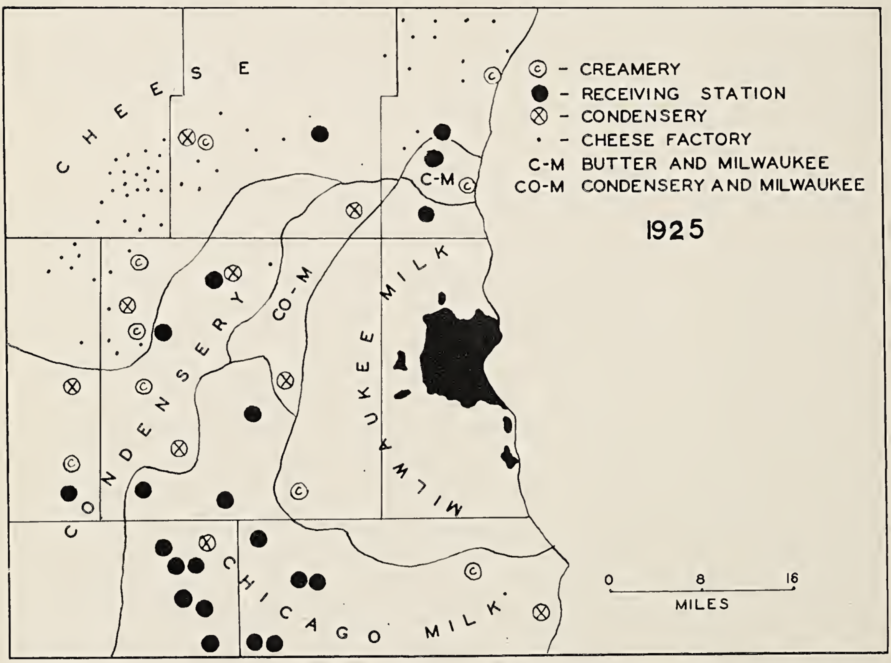

FIGURE 2. Milwaukee milkshed of 1925. The maximum extent of 25 miles from the city reflects the local intensity of dairying.

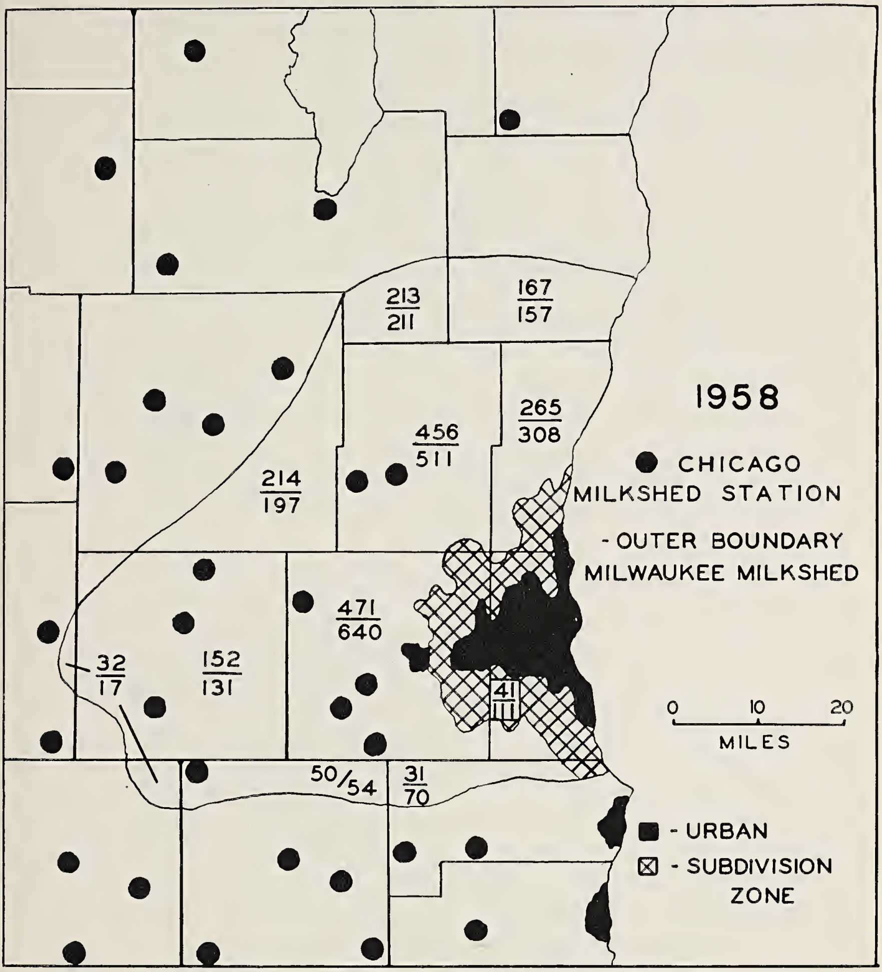

FIGURE 3. Milwaukee milkshed of 1958. The subdivision zone is virtually coincident with the milkshed of 1925 (Fig. 2). The fraction shows the changes in number of farms on the milkshed in two years; the denominator is the number for 1956, the numerator 1958.

beef cattle, in response to labor costs and shortages, the use of their land for crop agriculture during the summer and use of their own labor for feeding animals in the winter, their hesitancy to invest in additional capital equipment for continuance on the fluid milk market, and because the herd can be liquidated quickly if the farm is sold.

Nurseries, greenhouses, growers of ornamental plants, shrubs, and trees and "lawn specialists" have increased in number and importance in urban fringe areas. Their market is the new housing development, an insatiable market considering population growth, the American desire to live in a single house, the prestige factor associated with a landscaped lawn, and the "necessity" factor of a home-owner having his "bare" surroundings seeded and planted.

Other Changes

The activity, if not the function, of the Milwaukee County Agricultural Agent has changed with the times and the urban development. This official now finds a large part of his work (80 per cent) and a large percentage of the questions reaching his office, with the residents of subdivisions or the new rural nonfarm resident. They seek advice on how to grow a lawn on subsoil, for the bulldozer of the subdivider has left the topsoil on the bottom. The activities of the County Weed Commissioner have increased; his problem has been enlarged from concern about weeds on vacant lots to the weed problem on land "awaiting development" and not used for the growing of crops.

The terms *unimproved land and raw land* have assumed new meanings in the Milwaukee setting and elsewhere in urban counties. Today these terms to the subdivider (and no doubt to many urban-reared persons) is land upon which there are no dwellings, factories, man-made parks, or other cultural elements denoting urbanism. "Raw land" is advertised in the newspapers for sale as a building site, the raw (or "undeveloped") land being some of the finest farm land in the nation. Yet one hundred years ago, and even more recently, unimproved land was land that had not been brought into the standards of cultivation of the day. The United States Census recorded improved and unimproved acreage in Milwaukee County through 1860, by which time the county was two-thirds included in farms, on which there were 48,712 *unimproved* acres—land on which there was relict forest or cut-over, was unbroken and unused prairie or oak-opening, was stumpy pasture, marshland, or swamp. By 1870, Milwaukee had 50,000 inhabitants; unimproved acreage in the county was not recorded. In thirty years, 1900, the city of Milwaukee contained 300,000 inhabitants, and its landward edges were semi-circled by more than 2,500 highly-developed farms, whose collective area included more than four-fifths of the county. Only a few woodlots of second-growth hardwood provided any indication of the former dominant landscape-type and fields and pastures occupied the gently rolling to undulating glacial-drift plain.

Thus a little more than a century and a quarter from the 1830's to the present has witnessed marked shifts in the landscape and the geographical scene in the 239 square miles of the county. And the

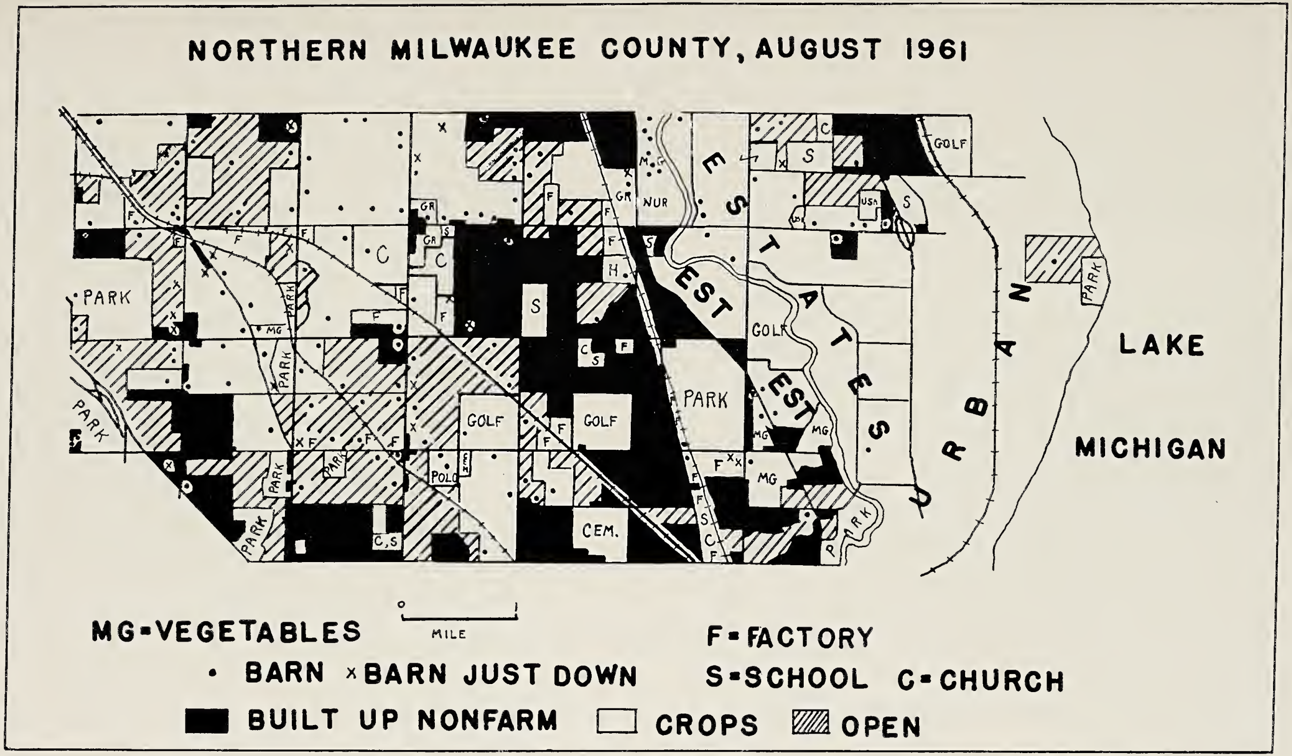

FIGURE 4. Land use in northern tiers of sections in Milwaukee county, 1961. Area shown is from western county line to Lake Michigan. Entire area is in the zone of urban sprawl and rural retreat.

shift in population, not only in this area but in the United States, from predominately rural to principally urban has resulted in marked shifts in the attitude of the majority toward land on the urban fringes of the present. "We must clear the forest and break the prairie to *improve* land" has now become "We must eliminate the farm land (*raw land* to the subdivider) to *improve* the land." The pioneers attacked the forest with axes, to replace it in time with fields and pastures. Their descendants now attack the terrain with bulldozer and concrete to cover it with aspects of urbanism.

Pressures Upon Agricultural Land

The pressures exerted upon farm land in urban counties of the United States are of several origins and types. They involve land uses which are observable in the landscape. The ultimate final decision to sell may be indirect, through the economic pressure of increased taxation of farm land or through a highly favorable price offered. They may be direct in the passage of urban-type zoning ordinances that place the agricultural land in a non-conforming land use; direct when under the "nuisance" application of common law, animals and barnyards may be declared nuisances by the courts should the residents of subdivisions complain and carry a suit successfully through the legal process; or direct through condemnation of a farm for public use such as a park, or municipal airport.

Pressures from Hedgehopping

The presence of a hedgehopped subdivision or a line of rural nonfarm homes creates pressure upon the surrounding farm land, or the farm land remaining in the interstices between subdivisions. The demands of their residents for schools, public garbage collections, other services, and eventually for local water or sewerage systems, local street pavements, fire and police protection, and other services and amenities to which they were accustomed (either in the city, or as young city-reared persons) all lead toward an increase in taxes, of which the farm acreage bears a disproportionate share, considering its size (even though assessed as farm land). The rise in school taxes for new schools is particularly large. Should sewers be provided, the total of sewer-line assessments on the farm property is relatively greater, for the sewer line passes through a longer frontage on the farm property line than on a building lot. Finally, to obtain services or to asure self-rule the residents of the many subdivisions in a township band together and incorporate. All of Milwaukee County now is within incorporated villages or cities; the former towns (townships) have disappeared. The complete incorporation of the county was accomplished during the 1950's, the smaller units competing with Milwaukee to annex territory. Some units moved for self-incorporation for fear that the master city might annex them; in fact, Brown Deer and Milwaukee each annexed the same territory, with a resulting lawsuit. At some point, either before or following incorporation, the tax load on the farm land may reach a point where the farmer is forced to sell to a subdivider. His farm acre is a working acre, and must carry its economic load. An acre-lot, or a fractional-acre lot in a hedgehopped subdivision, does not yield products to help pay the taxes assessed upon it; tax money for it is obtained from the occupier's pay check, whether in the form of wages or salaries. Thus the two adjacent land areas, and the viewpoints of the adjacent farmer and subdivision resident, are reversed. The farm land is devoted to crops or animals, from which enough return per acre must be obtained to pay for the costs of labor upon it, the capital investment, repair of buildings, the charges in taxes, and still yield a profit. The occupier of the house and lot in the subdivision is engaged, in his home at least, principally in the rearing of children.

Other pressures build up on the remaining farm land. Incorporation of a township, or other unit of territory, means concentrated government,—aldermen, city managers or mayors, and other officials. Today it follows that there is planning and zoning of an urban type (rural zoning of farm land has been common in Wisconsin since the early 1930's). The farmer finds his property zoned for a future factory site, shopping center, or some other use. He finds his farm zoned into a non-conforming land use by the planning board, and the zoning ordinance passed eventually by the governing board of the village or city, or by the more-numerous voters resident in the hedgehopped subdivisions. As a non-conforming land user he is zoned out of farming should he cease operations for any reason for a time. In some ordinances his number of animals are set at the time of passage, and he cannot add to them. Thus, added to the pressure of increasing taxes, he is deterred from making capital investments looking to a change in type of operation, modernization of barns or equipment, or replacement of machinery.

Land values have arisen in any case. Between 1954 and 1959 the value of Milwaukee County farm land, as reported by the Census, rose from $684 an acre to $1,049. Even though specific figures are affected by inflation and the purchasing power of the present dollar, both increased value and increased tax rates are operative in providing tax pressure. From this base, the additional school and other taxes, added on with the advent of subdivisions, provide the total pressure upon farm land and help hasten the rural retreat, and filling of the interstices between and among the hedgehopped areas.

And, as subdivisions mushroom, the competition for land bids up its price; the farmer may thus decide to sell because of a highly favorable offer.

Pressure From Park Land

Milwaukee County has an excellent park system; parks, whether within the city limits or the county are administered by the Milwaukee County Park Commission. In 1961 the park acreage was 10,361. Eleven and a half square miles of this, 7,414 acres, is located beyond the closely-built portions of the city and its immediate and long-establishment suburbs. Virtually all of the outlying park land was in farms twenty to thirty years ago; some of it was cultivated as recently as two to five years ago; within the three years of 1958–1960 about two square miles of farm land was added to the system.

The land in parks includes large single blocks and streamside parkways. Plans were drawn in the 1910's and 1920's for the parking of every stream course in the county, and of much of the Lake Michigan frontage. Today there are parkways along nine different streams, and this facet of the plans is nearing consummation. Recent purchases of land for the streamside parkways, however, are of large blocks rather than narrow strips, and remove many farms from the tax rolls, as well as change the landscape from one of fields and pastures to one of planned landscape-planting or of county-owned golf courses. For example, in the southern part of the county the Commission has obtained, in three adjacent sections (square miles) acreages of 93, 45, 250, and 188; of this total area the Root River flows through only three 40-acre plots. Nearby, 280 acres were added to obtain one 40-acre area through which the river flows.

Obviously, *with all considerations of the greatest good for the largest number of people and the wisest use of land for the many put aside,* the park developments have created pressures upon farm land, particularly stream-side land. The acquiring of land originally in narrow strips removed lowland pasture from some farms, made the creeks and rivers inaccessible for watering cattle, access rights-of-way split other landholdings on the periphery of the parkway, and some farms were split in two. The present purchases remove whole farms from agriculture. The farmers owning stream-side land know they have a potential buyer if they wish to sell; however, in effect they have no alternative buyer to turn to. As money becomes available the Park Commission negotiates for purchase in order to obtain the land at "agricultural prices." If Commission and farmer fail to agree on a price the land may be condemned. The Commission now attempts to obtain land before the appearance of competition from subdividers, who might threaten otherwise to buy the non-streamside portion of large farms; thus the "new" buying practice affects, or may affect, the entire farm. It reflects, economically, the fact of competition of land users for the shortage item in the county—land.

The removal of park land from agriculture, coupled with the advent of subdivisions in the vicinity, places increasing tax burdens upon the remaining farm land. In one case the park land is removed from taxation, placing the tax base upon the remaining land; in the other the tax pressures engendered by the subdivisions appear. Offsetting this in many districts is the attraction of parkside land to the subdivider and builder of high quality houses. Several discontinuous hedgehopped subdivisions margin parks and parkways in outlying areas; many streamside parks close to the city are now paralled by houses on either side. Eventually the overall tax base is increased.

From the standpoint of the farmer, the park land hastens rural retreat. A farmer whose acreage contains potential park land, like farmers in the interstices among subdivisions, thus hesitates to invest in improvements to continue in dairying; for example, in 1956 the Milwaukee milk market shifted from the collection of milk in cans and in bulk tanks to its collection alone from bulk tanks installed on the farms. Most farmers along stream courses and in interstices did not invest the $2500 to $3000 necessary for the bulk tanks even though they could receive some aid from milk distributors—the investment might never be returned or amortized. Instead they sold their herds, some sold their farms, and others shifted to a cash-grain crop agriculture.

Pressure From Church-owned, School, and Public Land

Long-established churches and schools occupy small sites in the zone of rural retreat, sites inherited from rural days. Quite in contrast, the sites purchased for new churches and schools are generous.

In the subdivision zone in Milwaukee County the sites purchased by the various Protestant denominations are generally from five to 30 acres. Sites owned by various units associated with the Roman Catholic Church include lands of this acreage, and blocks of larger size. The Archdiocese of Milwaukee owns separate blocks of 38 acres, 39, 75, and 244 acres. The Xaverian Fathers own 58 acres, the Servite Brothers 153, the Sacred Heart Monastery 128, the Sisters of St. Francis 80, and there are several others; the total of larger church landholdings of the Roman Catholic Church in the urban sprawl-rural retreat zone exceeds 1000 acres. Some few are operated temporarily as farms.

School sites of 20 to 40 acres are usual. Seventy and 80-acre "campuses" for public schools have been obtained, such as that for the Granville High School.

The Milwaukee airport of more than three square miles, another airport of nearly three-quarters of a square mile, several smaller airports and landing strips, and a partial ring of United States-owned land for various defense installations are all on former agricultural land, some of it in crops very recently. One of the principal former market gardening areas, comprised of intensively cultivated vegetable farms, is now almost completely obliterated by the Milwaukee airport and the urbanized districts that have grown in its surroundings.

Pressure from Other Uses

The industrial and miscellaneous land uses are highly diverse in character and type. Some of the sites occupied by new factories—long and low buildings surrounded by extensive parking lots—include 200 or more acres; a power company owns nearly 400. Private golf courses, several in number, occupy about a quarter-section (160 acres) apiece. Cemeteries are about the same in size. Shopping centers in the urban sprawl-rural-retreat zone either are using or have reserved from 80 to 100 or more acres apiece. One Drive-In Movie Theater occupies 80 acres. Private schools, Boy Scout camps, outlying railroad yards, dumps, yards of construction companies, gravel pits, a polo club, archery club, curling club, and other organizations are users of land. Collectively some 7000 or more acres beyond the closely-built urban areas are occupied by industrial and miscellaneous land uses. Certain of these users come into competition with projected public use. The Lake Michigan shore property toward the south county line is scheduled for park-use by the Park Commission. Two or three miles are owned presently by manufacturing companies, but not entirely in industrial use; rather they are farmed by renters, and in crops and orchards. The eventual use of this land is thus subject, perhaps, to litigation or condemnation.

Interstate Highways remove land from farming or other uses. The projected continuance of an Interstate Highway from the southern line of Milwaukee County to the city has already at scheduled outlets, included nearly 80 acres of each outlet, and 120 at clover leaf interchanges.

Composite Land Uses

The total pressure upon farm land is owing to the composite of all non-rural uses of land. Although the hedgehopped subdivision receives the bulk of farmer criticism, and is most obvious in the landscape because of its multiplicity of generally similar houses, the competition for land from schools, parks, churches, industries, golf clubs, cemeteries, and a host of other users is severe. But the subdivisions contain the school children, the voters and the vocal element of the population, desiring services. Thus the subdivisions receive the publicity.

Collectively the nonfarm users of land in a township within the subdivision zone may occupy as much area as the remaining farm land—and in time will exceed it. The city (former township) of Franklin, the southwestern unit of Milwaukee County, contained in 1961 some six square miles—out of about 34—of park, school, church, and other public land, including in the last a 752-acre County Home of Correction and associated farm and a 150-acre shrub and tree nursery operated by the City of Milwaukee. In addition to this, the growing number of hedgehopped subdivisions consume acreage annually. When the Root River Parkway plan is completed, three or four more square miles of present farm land (depending on the size of purchases) will be removed. Franklin is the "most rural" portion of the county. In 1944 Franklin contained 327 farms, primarily of the dairy type; ten years later the number of farms was halved. By 1961 only a few more than a hundred *commercial* farms remained (out of 237 in Milwaukee County), and only 18 of these in Franklin still engaged in 1961 in milk production for the Milwaukee market.

The Rise and Fall of Farming in Milwaukee County

Milwaukee County is perhaps unique in the state in that it has long contained both a large urban population and has been very important in agriculture. Its small total size has precluded it from being a major farming county in the state except when measured on a *per unit area* basis. Nevertheless, despite size, the county as a unit has been among the top 100 agricultural counties of the nation in the past in the production of certain items, such as cabbage. The present urban sprawl is to top quality farming land, some of the most productive agriculturally in the state of Wisconsin. The use of this land for crops is well on its way to oblivion.

The southern part of Milwaukee County contained outliers of the extensive prairies farther south. Oak openings—giant oaks growing separately in grasslands— occupied other southern and southwestern areas. The central and northern portions of the county were in the dense hardwood forests. A strip of mixed northern forest, hemlocks and birches mingling with hardwoods, occupied the narrow red clay strip between the Milwaukee River and Lake Michigan. The soils developed on the glacial drift, and in this vegetation and climate setting, were heavy soils of high quality. The environment continued westward into eastern Waukesha County until the more stony glacial drift and the rougher surfaces of the Kettle Interlobate Moraine and the inland lake district was (or is now) reached.

Three broad, smooth-sloped morainal ridges extend north–south more or less parallel to the shore of Lake Michigan. These are separated by shallow north–south trending valleys or broad swales in the glacial drift. Surface-wise no portion of the county, save for wave cut cliffs facing Lake Michigan, was (or is) too steep for cultivation, nor for present land uses and urban housing. Drainage was and is a problem locally in the swales, and in some of the present subdivisions in rural territory certain of the heavier soils are not particularly receptive to drainage from septic tanks.

Agriculture expanded from an almost-subsistence stage at one time, through the wheat boom in Wisconsin during the 1850's to 1870's, to the dairy stage. Dairying was always of some importance, considering the local city market, and in the 1890's and early 1900's even contributed enough surplus milk to support cheese factories in the southern portion of the county.

The Rural Land Use of the Recent Past—Late 1920's

Milwaukee County contained just under 100,000 acres of farm land on more than 2,000 farms in the late 1920's. The acreage of corn and small grains combined was greater than the present total farm acreage included in commercial farms; in the late 1910's it was greater than all present acreage in farms, part-time, residential, and commercial combined. The county was an outstanding center of market gardening, a source of sugar beets for neaby sugar mills, a principal cabbage-producing area both for fresh cabbage and for canners of sauerkraut, contributed peas and tomatoes to canneries, and overall was outstanding in dairying and part of the important region of intensive dairying in southeastern Wisconsin. A leading celery-producing district, specializing in part in celery for the New York market, and located on muck lands where parts of West Milwaukee and West Allis exist at present, had succumbed to urbanization. Although the average size of farm was only 43 acres, this average obscured the extremes of small, intensively cultivated market gardens of about 20 acres each, and dairy farms averaging more than 80 acres in size. Hay, oats, and corn were the leading crops in order of acreage on the dairy farms. The cabbage, sugar beets, peas and tomatoes were cash crops on these same farms. Corn was grown for silage almost exclusively; only about a quarter of the acreage was matured for grain. All home-grown grain, principally oats, was used in the dairy feed, and for horse feed—7,000 horses still were maintained on farms of the county in 1928. Income from the sale of chickens and eggs was a sideline on most farms; swine were very few—grain was fed to cattle and there was no skim milk for pigs, as whole milk was sold to Milwaukee distributors.

Market gardens, nearly 300 in number, clustered near the margins of the city, and along the principal highways leading from it. The gardeners grew a complete array of vegetables in season. And other farms, general and dairy in type, contributed fresh vegetables in season as a sideline activity. Many of the market gardens were on drained muck land at the southern edge of the urbanized areas of the time. Others were prominent on the loamy outwash terraces of the Milwaukee River valley immediately north of the city. A network of radiating electric interurban lines, in operation until the mid-1930's, localized still others on soils of suitable warmth and friability near their stations. The largest numbers of gardeners were of second or third generation German ancestry, and persons of Polish birth. These last were generally immigrants from peasant areas in Poland (or, prior to World War I, of German Poland) who came to Milwaukee as factory workers, and whose prior training and inclination led them back into agriculture when finances or opportunity permitted.

More than 600 dairy farms surrounded the urban and gardening areas. In the late 1920's the northwestern township (Granville) and the two southern townships (Franklin, Oak Creek) were occupied almost entirely by dairy farms; the other townships contained suburban, market gardening, and dairy districts. Although some dairymen were of eastern American ancestry, the majority were third and fourth generation Americans of German extraction, descendents of the German immigrants of pre-Civil War days. Farms were highly developed. Barns were large, painted red, and well-kept. Nearly all were basement barns, the foundations of the older ones were of glacial boulders or blocks of the local Niagara Limestone; more recently-built ones had concrete walls around the excavated basement. Farm houses of wood, stone, or brick were substantial and in good repair. The dairy farms of the late 1920's maintained more than 10,000 cows and heifers, two years of age and over, kept as milkers, and some 14,000 dairy stock in total, counting young stock, calves, and bulls.

The urbanized areas of Milwaukee, of Wauwatosa, West Allis, Cudahy, South Milwaukee and other suburbs, were compact. In fact, there was farm land along the Lake Michigan shore in the southern part of the county, and farm land west of Wauwatosa to the west county line. Northward the high-class residential suburbs of Shorewood, Whitefish Bay, and Fox Point occupied narrow strips along the lake bank and farms lay west of them, mainly market gardens along the Milwaukee River terraces. The one remnant of the level of former Lake Michigan (its glacial-lake ancestor), a flat terrace just above the elevation of the current lake, and below the wave-cut bluff at Fox Point, had been under cultivation as recently as the early 1920's. The estate district in the upper Milwaukee River Valley (now River Hills) was passing from farm land to large county-estate properties. The town (township) of Milwaukee, the northeastern town, although generally impinged between the lake and the river still contained more than 100 farms.

Rural Land Use—Early 1960's

The percentage of the county in farms is now only ten by recent assessor's reports, in contrast to 50 in the early 1930's, and 21 in 1959 as reported by the Census. Milk cows numbered but 1,800 in 1959, fewer now. Only 215 horses remained. Of the 557 farms recorded by the Census of 1960, sixty per cent were "unclassified," principally residential or part-time landholdings. The theoretical (and formerly actual) zones have disappeared or been fractured; only 35 market gardens exist, and except for two small clusters, their pattern is one of dispersal rather than close to the city. Dairy farms number but about 50 only 26 of which shipped milk to the city in August 1961; 16 farmers in the southwestern part of the county shifted to the Chicago milkshed; the others sell class B or manufactural milk to condenseries in the reverse direction from the city market. The acreage of the former cash crops has declined enormously—sugar beets from 1,000 to 12 acres, cabbage acreage from more than 1,000 to but 131. The 237 remaining commercial farms of 1961 are about equally divided in number between the two southern former townships (present cities) of Franklin and Oak Creek at the very southern part of the county. A few remain in the northwestern corner.

Farmers ceased dairying in numbers during the middle and late 1950's. In part this was owing to the urban sprawl and the elimination of farms by presures engendered by the hedgehopped subdivisions, and the resulting tax pressures. The former Town of Greenfield contained 185 farms in 1944, and only eight in 1955. In part, during the middle and late 1950's, the rapid decline in dairying was coupled with the shift of the Milwaukee milk distributors to the collection of milk entirely from bulk tanks installed on the farms of the milkshed. The combination of the costs of installation (even with financial help from the dairy companies), the incurrence of a debt for this capital equipment, and the mounting taxes on the remaining farm land in the county, caused the rapid decline in dairying and the shift to cash-crop agriculture, or the decision to sell to a subdivider. The numbers of Milwaukee County farms on the milkshed dropped rapidly, from 300, to 200, to 111 by 1956, 41 by 1958, and 26 by 1961. The county by 1962 contributed only one per cent of Milwaukee's milk supply, despite its propinquity to market.

Cash-grain farming has appeared and has increased relatively on the remaining farms and on land awaiting subdivision, or on land owned by speculators. It is a response of many farmers—old and young—to their situation with respect to an uncertain immediate future, and to the competition of the nearby city and suburban factories for the labor necessary for an animal enterprise, and to the variety of pressures upon their farm land. Also, the operator can devote part of his time to farming and part of off-farm work, something not too feasible in an intensive dairy economy. Today small grains (oats, wheat, barley, rye, flax for seed) and corn for grain are grown on over half (55 per cent) of the total cultivated acreage; the percentage of the corn acreage now harvested for grain has risen to 80. Ninety per cent of the wheat crop, more than half of the corn crop, and a third of the oats are sold. Half of the remaining farms in the county sell cash grain. And on some two dozen commercial farms the sales in 1959 were of a magnitude to have them classified by the 1960 Census as cash-grain farms. And soybeans have been introduced as a cash crop.

Nursery and greenhouse products from 119 enterprises gross more than three million dollars a year. In value this horticultural activity is now close to half of the total of all "farm" production remaining in Milwaukee County. The activity culminates the rapid shifts in urban counties—in response to the nearby market, the ability to use land intensively, to produce flowers and nursery stock of a value high enough to carry the taxes and other charges, and to persist under the economic situation of location near subdivisions, or at the very edge of urban development, or even within it.

The Future

What of the future of agriculture in Milwaukee County and nearby areas? No doubt most, if not all, of Milwaukee County will become urbanized or rather completely suburbanized in the not too distant future, judging from present trends and the rapid changes of the last fifteen or so years. Each Census reports a larger and larger percentage of the population of the United States resident in a Metropolitan Area, of which the Milwaukee region is one. How far this area will stretch cannot be forecast accurately. Certainly an increasing acreage of some of the finest land in the state will cease to be used for farming.

What of agriculture in the outer fringe area, as westward into Waukesha County or even in the southwestern sections of Milwaukee? Can they be saved for farming? The current usual answers to the problem of rural retreat near major cities (not as yet attempted in the Milwaukee region) are: (1) strictly enforced zoning for agricultural use only; (2) tax adjustments in urban counties to prevent farmers from being forced out of agriculture; and (3) rural incorporation. Loudoun County, Virginia, near the urban sprawl of Washington, and some other counties have passed zoning ordinances for the preservation of farming. Three dairy cities have been incorporated southeast of Los Angeles to keep people out, cows in.

Will these efforts elsewhere—or in Wisconsin—prove permanent? The residents of a subdivision in a township can outvote the farmers. Zoning can be changed by voters or their elected representatives. The present dairy cities in southern California may vote to unincorporate if land values reach astronomical figures. And the voters in urban counties as well as the voters in the subdivisions of the townships of fringe counties are urban in outlook and look with disfavor upon proposals for possible tax relief on farm land of the present, or farm land zoned only for agricultural use. Furthermore, they have been conditioned for most if not all of their adult years by talk and writings about farm surpluses, crop-control programs, soil banks, benefit payments, commodity-storage programs, increasing productivity, new fertilizers, increased yields of crops and animals, government give-away programs, and other items. Therefore it is natural that the milieu is one of apathy on the part of the majority of our inhabitants.

Perhaps in the future high quality farm land may be treated differently, just as forest land received protective and tax dispensations as it became a shortage item in the early years of the present century, and water shortages now engage public attention.

FREEDOM OF SPEECH IN WISCONSIN, 1870–1880

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Wisconsin, like any state, has its contradictions, but in general it has a reputation for being a leader in social progress and social legislation. This reputation has been built up over a number of years through the words and actions of its citizens and we are privileged to be the heirs of a fine tradition.

A look into the past is interesting both from a historical point of view and also because of what it reveals concerning our heritage. The decade, 1870–1880, was a transitional period. The passions engendered by the Civil War were beginning to abate. The isolation of the agrarian culture was still present, but improved means of transportation and communication were beginning to remove it. However, the mobility of the automobile and good highways had not yet begun to enlarge local communities into the more urban and closely related units typical of today.

Citizens of the state in 1870–1880 were particularly conscious of their rights and their opportunities. Many of them were new citizens who had emigrated from foreign countries where the right of "free speech" had been abridged. All of them were anxious to preserve the freedoms granted them under the democratic form of government and they were quick to voice their opinions.

"Free speech" gave them the right to criticize when social conditions were adverse; it gave them the right to criticize when things were going well. Some abused the privilege in speeches and writings, which judged by today's standards would be considered libelous or slanderous. However, it should be noted that "free speech" of the 1870's was not subject to the legalistic refinements of today.

In short, Wisconsin in those days afforded a favorable environment for "free speech", which in turn helped create the tradition of free speech which we enjoy today.

Let us examine, by considering some examples taken from newspapers published in those days, some of the characteristic problems of the day and evidences of how freedom of speech was interpreted.

Then as now, political occasions were numerous and constituted a prime source for the interchange of ideas and viewpoints. Newspapers of the day carried public notices of meetings and partisan editors took pains to invite members of the opposition parties to their functions. They were always careful, however, to credit the success of an occasion to the party of their choice. A meeting reported by the Democratic editor of the Lafayette County Democrat stated that:

> "The meeting was about three-fourths democratic, and consequently the best of order prevailed—no one interrupted the speakers and the contest was fair in every particular."[1]

An Oshkosh editor, with obviously a preference for the Republican point of view was a little more forthright in his analysis of a somewhat similar meeting for he reported it in this fashion:

> "Doolittle (ex-Sen. Doolittle—the Democratic candidate) squirmed and writhed under this torture like an eel on a hot skillet; but Washburne (Gen. C. C. Washburne) was relentless, and answered every charge brought against the republican party, out of the very mouth of his adversary."[2]

Both the citizens and the speakers of the day must have had considerable stamina for the occasions were numerous, the speeches long and numerous, and the newspaper reports of the speeches were almost equally long and numerous.

For example, in the 1871 gubernatorial campaign between Gen. Washburne and Sen. Doolittle a series of nine debates patterned after the Lincoln-Douglas debates was held in major cities of Wisconsin, and occurred within a one month period. In every one of these meetings the candidates spoke for one and one half hours each, plus a discussion period. The La Crosse Leader not only summarized the occasion but carried the complete text of more than 12,000 words of General Washburne's speech and a lengthy summary of Doolittle's remarks.[3]

However, the persuasion was felt to be most effective in oral form rather than printed, for as one editor put it:

> "persons in need of sound political gospel, will listen to a good speech and be impressed and moved by the truths it contains, but they will not bother themselves by reading the same speech in print."[4]

But freedom of speech carried with it some of the same hazards it does today in the form of opposition which is lacking in restraint. For example, a political orator spoke one night at Reedsburg where the Democrats caused considerable annoyance to him by "building a bonfire near his place of speaking, firing anvils and beating pans so loudly . . . as to almost drown the speaker's voice."[5]

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[1] Lafayette County Democrat, August 27, 1871 (Darlington).
[2] Oshkosh Journal, August 7, 1871.
[3] LaCrosse Leader, October 14, 1871.
[4] Fond du Lac Commonwealth, October 18, 1879.
[5] Baraboo Republic, October 18, 1876.

On another occasion in Watertown at a meeting called "for the purpose of taking measure against the present rule of mismanagement and corruption in our city" the meeting "was broken up by a band of Union Leaguers who took this method of showing their appreciation of free speech and the rights of American citizens to quietly assemble and express their sentiments." After attempting to oust the chairman who had already been chosen by the sympathizers "the meeting soon resolved itself into a sort of pandemonium through the League influence, until finally the lights were put out and the crowd dispersed."[6]

In our newspapers today, we normally expect editorial comment concerning the days events to be confined to the editorial sections. Columns devote dto news reports are supposed to be objective, and factual in nature. This was not so with newspapers of the 1870–1880 era and is well illustrated by the following accounts of a political campaign speech delivered in Watertown by Gen. E. S. Bragg. One Watertown newspaper reported that:

> "The political meeting . . . was numerously attended by our citizens, to hear the brave and eloquent General express his sentiments . . . he . . . aroused a good deal of interest, giving his hearers a simple, dignified, and truthful presentation of facts in matters of reform that were beyond question and utterly unanswerable."[7]

Another Watertown newspaper had this to say of the same occasion:

> "The Reform meeting addressed by Gen. E. S. Bragg . . . was a very slim and dull affair, considering the preparations that had been made for it . . . The orator was introduced . . . to an audience of just 250 persons all told, a large proportion of whom were republicans . . . His remarks were rambling and desultory, and he seemed to lose sight of his subject all the way through."[8]

Once elected to a state legislative position, the politician could expect his constituents to be just as interested in what he said in the state legislature as they were in what he said while running for office. State affairs commanded just as much attention as did national affairs and many local newspapers—not just those from the larger cities—maintained a correspondent in Madison during the legislative sessions. He would issue a general report on each week's legislative activities with particular emphasis on the local representative. Knowing they would be called to account for their stewardship, state and local legislative body representatives made it a policy to report to their constituents at public meetings at which the electorate gathered.

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[6] Watertown Republican, March 17, 1874.
[7] Watertown Democrat, October 28, 1875.
[8] Watertown Republican, October 27, 1875.

For example, a "large audience (which) assembled at the Court House" in Chippewa Falls in March, 1876, did so in order to "hear Judge Wiltse" render an account of how he had discharged his obligations. They listened for more than an hour to his "able and forcible" remarks. Approval of his conduct was then voiced through a unanimous vote of thanks.[9]

When the issue was of sufficient importance to warrant direct action Wisconsin citizens of the 1870's did not rely upon lobbyists to exert persuasive pressures, but sent delegations from the local areas to ensure desirable action by their representative. When the proposed Graham liquor licensing bill was before the legislature in 1872,

> "the lobbies and galleries of the Assembly Chamber were crowded at an early hour and soon the floor of the house underwent a systematic packing and presented a very pleasing spectacle of 'fair men and brave women' who came to give courage and sympathy to the great popular reform measure . . . It was a time well calculated to inspire the best efforts of the friends of reform."[10]

Public meetings were widely attended by Wisconsinites and provided both social and educational fare for the people. In addition to that, the tendency toward free and open discussion of topics shaped the course of Wisconsin's growth in some rather obvious ways. Wisconsin's reputation, as a dairy state, is due in part at least, to the widespread discussions held by farm groups concerning agricultural developments. As an indication of this, consider the following frank opinions expressed at a meeting of the Freedom Farmer's club to discuss going "into the so called breeds of cattle".

> "Mr. H. W. Armstrong thought not, believed that by giving his native cows the same care and feed . . . they would yield as much milk and butter and make as fine animals as pure bloods . . . Wm. Sowders thought that native stock was good enough for anybody; thought if people would stay at home and take care of their farms and cattle instead of running around to farmers clubs and fairs they would be better off. Pat. Monahan believed in introducing blooded stock. E. Nye kept two cows, natives; thought the blooded stock too tender for common farmers to keep . . . thought that his wife had as much to do with the quantity and quality of the butter as the cows did . . . F. P. Wolf wanted to improve his cows . . . and meant to improve his stock, wanted better cows than he got . . . T. R. Alvord believed that all this talk was a humbug . . . he was too old to be fooled by such nonsense."[11]

Apparently the remarks of the gentleman who felt farmers' club meetings to be a waste of time were not heeded, even by himself, for according to the records he was present also at the next

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[9] Chippewa Times, March 22, 1876.

[10] La Crosse Republican and Leader, March 2, 1872.

[11] Appleton Crescent, February 3, 1872.

meeting of the club when farm accounts and farm labor were equally frankly discussed.

Ordinarily topics for discussion at this type of meeting were decided upon in advance as when the Greenville Farmers' Club announced its question for the forthcoming meeting to be "Will clover hay give a horse the heaves?"[12] Another common practice however, was to put discussion questions in a basket and draw forth a topic which might be a serious one such as the value of "cooperative labor" or a topic of a less serious nature such as "how does Miss Ella White make her plants look so thrifty?"[13]

As it does today, public opinion changed with almost frightening rapidity during that period 90 years ago, and what was popular one day might before long be condemned—sometimes with good reason as in the case of the railroad expansion and exploitation.

The public road system, being as it was in those days, an alternate series of quagmires or choking dust clouds, it was not unusual that the railroads with their promise of rapid, reliable, all weather communication were eagerly sought. Meetings to discuss railroads were common and well attended. Upon being organized they were addressed by prominent local officials and citizens; resolutions were then proposed and discussed and committees appointed to mature the plans.

When finally the petitioning, memorializing, imploring and pleading were over and the railroad actually arrived, it touched off elaborate celebrations which were as colorful as they possibly could be made. In Green Bay, 10,000 people were on hand to greet the arrival of the first train and hear the speeches upon the occasion.[14] The 3,000 excursionists who arrived in Wausau to inspect the town upon the completion of its railroad connection, were met by 5,000 Wausau natives, the Mayor and the Common Council, the Fire Department, a colorbearer, two bands and the salutes of all the bells, steam whistles and cannon in the city. The procession was then escorted to the Music Hall and Forest Hall where they heard addresses and a banquet was prepared for nearly 4,000 people.[15]

However, with the coming of the financial depression of 1873 the people's joy with their newly acquired railroads sometimes turned to deepest gloom. Scarcely a month after their big railroad jubilee, the Wausau paper noted that the Wisconsin Central Railroad "exhibits as great capacity for ugliness as it does for bond getting and land grabbing."[16]

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[12] Appleton Crescent, November 30, 1872.

[13] Oshkosh Journal, December 3, 1870.

[14] Green Bay Advocate, June 26, 1873.

[15] Wisconsin River Pilot (Wausau), November 14, 1873.

[16] Wisconsin River Pilot (Wausau), December 19, 1873.

The protest meetings following this experience and similar experiences, in which citizens expressed their dissatisfaction culminatd in the passage of the regulatory "Potter Law" which formed the basis for corporate law in Wisconsin. This law, "the elucidation of which . . . occupied nearly four hours" on the part of Chief Justice J. P. Ryan was "pronounced one of the most masterly and scholarly efforts ever produced in our courts."[17]

Another public meeting which left little doubt as to the effectiveness of the free expression of opinion which took place, occurred in Aztalan where the owner of land which had been used for many years as a picnic site decided to fence it off from the public. He dug post holes for this purpose and the citizens filled them up. Then they tried without apparent success to reason with him. Finally they sent word through town about the condition of affairs and requested a meeting that evening. According to succeeding reports:

> "About 120 of the citizens assembled full of indignity for their townsman, and after some not over conciliatory speeches, and an organization . . . they arranged themselves along the fence and lifted it out. The next day Mr. A. rebuilt it and the next afternoon the citizens removed it piling it (very?) carefully on Mr. A's premises and the third day likewise."[18]

Freedom of speech in Wisconsin in the 1870's meant not only wide latitude in what a person could speak or write; it also meant a great amount of speaking and writing on the part of a great number of citizens. One facet of life which provided some distinctive occasions for speaking were the religious meetings.

Camp meetings, revivals, "bush meetings" as well as the regularly organized religious services were common, and were reported in great detail.

Probably the most distinctive were the "camp meetings" which were held out of doors, usually during the summer months and most often in shady groves where good water was available and tents could be pitched. From early morning bell to the final benediction in the evening the campers heard the word of God dispensed in English, Danish, Norwegian, German and several other languages. In between sermons they visited or spent their time strolling through the grove in which the meeting was held.

Revivals were commonly held too throughout the state and had the same purpose as camp meetings, but generally the approach was different. In addition to seeking converts of those who attended the meetings, the revivalists sought also to secure the active participation of the stay-at-homes.

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[17] Superior Times, September 18, 1874.

[18] Watertown Republican, May 26, 1875.

Religion was attractive to the female speakers of the day. One of the most successful revivalists in the state was Mrs. Van Cott, a lady of very large proportions, whose "pleasant, animated features, sparkling blue eyes and a head that would show well in plaster" led one reporter to proclaim her an even greater speaker than the famous Senator Matt. Carpenter. Her prowess was so great that as "she prayed to God to loose the purse strings of the members (of the congregation) so that the outstanding debt of the church might be paid", the debt of $1,500 was twenty per cent oversubscribed.[19]

Congregation members as well as their clerical leaders took part in discussion of social issues as well as religious matters. It may seem strange to us that topics such as attendance at circuses and games such as croquet came under close scrutiny as possible as sources of evil, but discussions of these topics were of serious concern.[20] Questions of individual conduct were also discussed freely as for instance when the Mutual Council of Plymouth Church met to consider the "sufficiency and validity of Mrs. Moulton's reasons for abstaining so long from the services and sacraments of the church."[21]

Of all the causes responsible for discussion perhaps none was as vehemently supported or on the other hand condemned as vigorously as temperance. Nearly all citizens had firmly held beliefs regarding temperance and they were not hesitant to express them.

Temperance meetings were usually sponsored by organizations. Some were organized along denominational lines; others according to nationality groups. Most were general in their membership. Ladies took an active part in the temperance occasions and it was at this time that a Wisconsin woman, Frances Willard, began work in the Women's Christian Temperance Union, and became nationally known from her temperance speaking.

Temperance gatherings called for the same elaborate preparations, parades, welcoming processions, and cannon salutes, as did political and ceremonial occasions.

Not all groups proposed the same solution. The Janesville Ladies Temperance Union proposed to establish a free library and reading room to keep young men out of saloons.[22] Hon. S. D. Hastings proposed a constitutional amendment outlawing liquor,[23] and many favored going into the saloons to hold prayer meetings and afterward, to take direct action. Apparently few speeches which espoused the cause of liquor were delivered, or at least found their way into print.

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[19] La Crosse Republican and Leader, April 6, 1872.
[20] Oshkosh Journal, November 5, 1870.
[21] Chippewa Times, January 5, 1876.
[22] Janesville Gazette, March 7, 1874.
[23] Western Advance (Portage), September 23, 1874.

These then, are but a few of the many evidences of freedom of speech in Wisconsin in 1870–1880. There was little mention of freedom of speech as such, but there was indeed much of it.

Perhaps citizens then, as now, had become so used to being allowed to think and speak as they wished, that they took this freedom as a matter of course. Fortunately for us, they did set a good precedent, even though at times they seemed to go so far as to abuse the privilege.

But we should be grateful to them for their interest and for their willingness to express themselves on matters which have as much relevance and as much importance in 1962 as they did in 1872.

"ALL THE RUNNING WE CAN DO!"—CONTINUING EDUCATION FOR ALUMNI*

ROGER W. AXFORD
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"The man who stands still today is actually slipping backward" chides the abstract covered booklet offered to more than ten thousand University of Wisconsin alumni in the Milwaukee area. "Learning for Living" is the theme of the continuing education program provided late afternoons and evenings for adults. More than one hundred courses each semester are listed to entice the adult to continue to use his brain power.

Most alumni recognize the validity of the admonition of the Dean of Extension at the University of California, Dr. Paul Sheats, who warns, "Learn or Perish" *(Time,* February 2, 1962). The University of Wisconsin–Milwaukee and the Extension Division remind the adult, "Every day brings new advances in scientific and social theories, and each of us to keep pace must do quite a bit of educational running." One of our major objectives in the adult program is to help alumni learn of the new developments in their respective fields. Slowly there is the recognition of the essentiality for educating adults to insure the security, productivity, and adaptability of the individual to a society continually changing. For example, a recent class entitled, "The Utilization of Radio Isotopes in Medical Radiology," was taught by a group of distinguished scientists; and it drew physicians, radiologists, and medical technicians, all trying to keep up with advances in the field. Professor Richard John, Coordinator of Commerce Extension programs, developed a course, "Accounting for Managers"; of the 21 enrolled, 20 were college graduates, but 17 had never before attended an evening adult class.

Wisconsinites are fortunate for the vision of President Charles R. Van Hise, Louis E. Reber, William H. Lighty, and Frederick Jackson Turner, all of whom had a realization that adult education is an imperative for modern man. As early as 1904 Van Hise proclaimed, "I shall not rest content until the beneficent influences of the great University of Wisconsin are made available to the people of the state." The University Extension Division was the outgrowth of his organizational genius, which resulted from the prodding of

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* Paper read at the 92nd annual meeting of the Wisconsin Academy of Sciences, Arts, and Letters.

Dr. Charles McCarthy, that great friend of libraries and adult education. The once "Cow College," as recently described so picturesquely by President Elvehjem has become one af the world leaders in continuing education. The University can be justly proud of the search, and *public service*—the diffusion of knowledge to the people third leg of the milking stool of higher education—teaching, reof the state.

Study of Alumni Education

There has been far too little study of alumni education. In a small volume "New Directions for Alumni: Continuing Education for the College Graduate" Ernest E. McMahon, Dean of University College of Rutgers describes the history of alumni education and many of the programs now being carried on by institutions of higher learning. His concern is with the extent to which American colleges and universities provide educational resources to aid the alumnus to continue his personal, political, philosophical, and social growth.[1]

As early as 1917 President Alexander Meiklejohn of Amherst College made a plea for a closer relationship between the college and its graduates. Meiklejohn stated that the real test of a graduate's loyalty is that of membership in a college community. "If the college has given itself up to the pursuit of knowledge and appreciation, jhilosophic, literary, scientific, humanistic, no man who has ceased from that pursuit is in any genuine sense a member of the college community. I sometimes think that the *only real test* of our teaching is that of the extent to which pupils continue to study our subjects after they leave us . . . I am dreaming of the college community as a body of thousands of men—teachers, graduates, undergraduates—all of whom are engaged in the same intellectual operation, in the same great enterprise of the mind."[2]

In 1956 a survey was made among seven hundred members of the American Alumni Council by Robert J. Ahrens. Only 267 institutions replied. Seventy-two institutions reported current or past programs of continuing education among alumni, and 195 replied that they did not have nor had they ever had such a program. Sixteen reported the programs as unsuccessful, while forty-four rated their efforts as successful. Ahrens found that the highest percentage of continuing education programs was carried on by private women's colleges.[3]

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[1] Ernest E. McMahon, *New Directions for Alumni*, Published by the Center for the Study of Liberal Education for Adults, 1960, 52 pp.

[2] *Rutgers College, The Celebration of the One Hundred and Fiftieth Anniversary of Its Founding as Queen's College* (New Brunswick: Rutgers College, 1917) pp. 118–21. Quoted by McMahon. p. 6.

[3] Robert J. Ahrens, "Working Papers", for the Shoreham Conference on Continuing Alumni Education. (Washington: American Alumni Council).

UNIVERSITY OF WISCONSIN LEADER IN ALUMNI EDUCATION

Alumni education is not new to the University of Wisconsin. Although President Ernest Martin Hopkins of Dartmouth is generally credited with the first call for alumni education in 1916, the records of the *Wisconsin Alumnus* show that William H. Lighty, organizer of the Correspondence Study Department of the University of Wisconsin Extension Division, was urging alumni to continue their education as far back as December, 1907. Lighty wrote enthusiastically of the "NEW UNIVERSITY EXTENSION" which he had helped organize with the help of Frank A. Hutchins and Dr. Charles McCarthy. Lighty reminded alumni that at that time there had been organized one hundred and seventy-five courses offered by correspondence instruction, taught by fifty-eight professors of the University representing twenty-five departments. As early as 1907 non-degree programs were offered alumni. Lighty wrote: "Some special post-graduate work is also offered not for university credit purposes, but as a practical means of keeping abreast of the times in a most effective way through contact with the scholar and specialist." A special course was then being organized for physicians on "Immunity and Infection" . . . "Thus," he says, "the practitioner may be effectively in touch with the newer and established results of research that apply to medical practice."[4] So far as I can find, Lighty was the first in the United States to promote alumni education, and his urging of continuing education was perpetual; his motto until his dying day at 93 was, "Keep abreast of the times."

Today, however, at the University of Wisconsin new programs are being developed especially for alumni. A program organized recently is the Summer Alumni Seminar now to be offered both on the Madison and Milwaukee campuses. Under the able leadership of Dr. Robert Schacht, a specialist on residential adult education, a program of liberal adult education has gained national recognition for the University of Wisconsin. This summer the themes for the six one-week seminars in Madison are "Scientists at Work at Wisconsin," "The Future of Cities and Metropolitan Areas," "The Nature of Marxism," "The Exploration of the Universe," "Africa: A Continent in Transition" and "Political Power in America".

In Milwaukee, a new residential seminar will be held at spacious Marietta House on the Kenwood Campus near Lake Michigan. Leading scholars will discuss their concern over the immersion of the individual in a stream of conformity under the title, "The Role of the Individual in Today's Mass Society." A week will be spent in the residential seminar, not too different from the format of the Danish Folk School, where persons gather for consideration of problems

[4] *Wisconsin Alumnus,* December, 1907, p. 101.

confronting their contemporary society. Living in, there will be lectures and discussion in history, economics, and sociology, dealing with the conditions which produced the kind of society with which alumni come face to face today. Through selected readings and group participation, alumni will examine certain basic concepts of individualism, such as self-reliance and self-assertion, and try to determine whether the loss of these values is an inevitable consequence of our societal and economic systems. Guest lecturers include Dr. Earl S. Johnson, Visiting Professor of Secondary Education, The University of Wisconsin–Milwaukee; Dr. Warren L. Susman, Assistant Professor of History, Rutgers University and Dr. Herbert F. Klingman, Director of the Division of Commerce and Professor of Commerce UW–M. Visitations will be made to interesting places in Milwaukee during the evening hours.

Opportunities Unlimited for Continuing Education

Unlike yesteryears, alumni today have numerous rich programs from which to choose. Study-travel, institutes, conferences, evening classes and correspondence study, all are available through Extension Centers and a statewide service of University Extension. Radio and television add numerous opportunities for continuous learning. The Milwaukee program, like the other adult programs throughout the state, is designed to aid citizens in their pursuit of intellectual interests and in the acquiring of skills necessary for personal achievement and progress. Through the "Learning for Living" program, new theories in the physical sciences, new methods in the arts, and new thought in the social sciences are brought to the greater Metropolitan Milwaukee community. Through University Extension the total resources of the University are made available to the citizens of the state.

It is never too late to learn! Longfellow reminds us:

> "Ah! Nothing is too late
> Till the tired heart shall cease to palpitate.
> Cato learned Greek at eighty; Sophocles
> Wrote his grand Oedipus, and Simonides
> Bore off the prize of verse from his compeers,
> When each had numbered more than fourscore years."

And today, fellow holders of sheepskins, we must admit, it takes all the running we can do to stay in the same place!

THE CROSS-MEDIA APPROACH TO TEACHING AND ITS EFFECT ON THE ACQUISITION AND RETENTION OF SCIENCE AND SOCIAL STUDIES VOCABULARY LEARNINGS AT SELECTED GRADE LEVELS[1]

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Previous investigations in the field of audio-visual education have been largely concerned with the gaining and retention of factual information and of gains in vocabulary directly employed by the media used. The studies described in this paper constitute an attempt to investigate the interactions which appear when, *not one but many,* carefully chosen, wisely used audio-visual materials are selected and used in combination. This interrelated use of audio-visual materials is known as the cross-media approach.

DEFINITION OF THE PROBLEM

The two studies described in this paper were designed to identify the effects of the use of several selected audio-visual materials in a cross-media approach on vocabulary learnings in science and social studies. The classes used in the science vocabulary experiment were selected from grades 5, 6, and 7 while the classes used in the social studies vocabulary experiment were selected from grades 6, 7, and 8. All of the students were from the Shorewood Public Schools and the Whitefish Bay Public Schools.

These studies specifically attempt to find possible answers to the questions: (1) Do children learn more of the vocabulary of science and social studies units when motion picture films and projected still pictures are added to the use of other audio-visual materials? And (2) Do children retain more of the vocabulary of science and social studies units when motion picture films and projected still pictures are added to the use of other audio-visual materials?

The participating classes were rotated so that each served in turn as an experimental and a control group. Blackboards, bulletin

[1] This paper presents the findings of two separate, but closely related studies in the cross-media approach to the teaching-learning situation. The reader will note the similarity of conclusions for both studies.

boards, charts, models, flat pictures, and field trips were used both in the control and experimental situations, but motion pictures and projected still pictures (filmstrips, 2 x 2 and 3¼ x 4 slides, and pictures used with the opaque projector) were used only in the experimental situations and served as the experimental factors. Vocabulary test results, supplemented by the reactions of teachers, and students, provided the means of judging the contributions of the experimental factors.

SIGNIFICANCE OF THE PROBLEM

Vocabulary development has been a source of greatly increased concern recently and much attention has been centered upon the importance of vocabulary usage as a basic skill or learning tool. A high value has been set upon a student's vocabulary as a means of improving his effectiveness in speech and writing as well as in reading. This emphasis on a larger and more useful vocabulary for the student has been in marked contrast to previous practice of severly curtailing the size of the vocabulary to be acquired at each grade level in the theory that such severe restriction would facilitate more effective learning. Witty[2] points out the following:

> As a result of word counts and recommendations by educators, some publishers assumed that vocabularies in reading textbooks should be rigidly controlled and limited. During this period 1925 to 1940, the makers of these textbooks not only tended to restrict vocabulary narrowly, but also to repeat words again and again in order that "basic" vocabularies might be thoroughly mastered . . . Moreover, the repetition of words was so great that monotony resulted and children lost interest in the stories.

Recent investigations have discredited the extreme practice of severe limitations of vocabulary estimates for each grade level. Seashore[3] and others have presented studies which lead one to conclude that most vocabulary estimates have been too low. Stone[4] also voiced his concern as follows:

> In methods and materials in reading, we have tried to go to extremes, of which the presently unjustifiable restriction of vocabulary is an example. We have the problem of providing for adequate vocabulary expansion along with the problem of providing sufficiently easy material at each level.

The provision for maximum pupil growth calls for the use of all effective means for its accomplishment. It is an objective of these studies to determine the effectiveness of selected audio-visual aids in the facilitation of the accomplishment of this task.

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[2] Paul Witty, *Reading in Modern Education* (Boston: D. C. Heath Co., 1949).

[3] Robert H. Seashore, "How Many Words Do Children Know?" *The Packet*, Vol. II, No. 2 (Boston: D. C. Heath Co., November, 1947).

[4] Clarence R. Stone, "A Vocabulary Based on 107 Primary-Grade Books," *The Elementary School Journal*, XLII, 1942.

It is felt that an increase in as basic a skill as vocabulary comprehension is worthy of every consideration for the beneficial effect this increase may have in generally improving learning. A purpose of these studies is to provide information which may be of value in helping to satisfy the need for the improvement of this skill.

It is also hoped that these studies will stimulate thinking in terms of the effectiveness of teaching and will increase an awareness on the part of the teacher of the value of the growing numbers of mechanical aids available for use in improving the effectiveness of teaching-learning situations.

Another important point is that these studies do not attempt to determine the effectiveness of a single audio-visual material over other visual materials such as slides, demonstrations, maps, and the like, or the more traditional classroom procedures using verbal instruction by means of textbooks or supplementary reading. Instead, these studies attempt to determine the effectiveness of an audio-visual utilization in which *several* audio-visual materials are employed over an audio-visual utilization in which a limited number of audo-visual material are used. Dale[5] states that experimentors often neglect to establish normal schoolroom procedures in their investigation which may result in lessening the value of their data. The procedures in these studies seem to follow a realistic classroom situation. Many schools use some audio-visual materials, but according to various surveys many schools do not have an audio-visual program which includes the use of several audio-visual materials in the cross-media approach. If the findings of these studies should point out that better learning is achieved when certain audio-visual materials are employed throughout a unit of study, it might suggest that these materials be included as an integral part of the instructional program.

Limitations of the Studies

These studies attempt to determine the effects of the use of selected audio-visual materials including carefully selected and appropriately used 16 mm. motion picture films, 35 mm. filmstrips, and other projected pictures on vocabulary growth in the science and social studies in specific situations. There were certain inherent limitations in the studies as they were planned. The first limitation concerns the size of the population. The studies were carried on in two villages having a total population of thirty-eight thousand. The total elementary school population in the public schools of these communities is approximately four thousand six hundred students, of whom two thousand four hundred were enrolled in grades five,

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[5] Edgar Dale, Fannie W. Dunn, Charles F. Hoban Jr., and Etta Schneider, *Motion Pictures in Education,* The H. W. Wilson Company, New York, New York, 1938.

six, seven, and eight. Of these students fewer than three hundred eighty have participated in the studies. The size of the number of subjects was limited.

A second limitation concerns the nature of the communities involved in the studies. Both Whitefish Bay and Shorewood are residential suburbs of the City of Milwaukee. Both communities are desirable places in which to live with the socio-economic status of the residents a high one. These communities are composed of a large percentage of professional and business people possessing homes with many advantages for their children, often including a wealth of books, magazines, newspapers, and other reading materials. In addition, many of the parents of the children in the communities have backgrounds of college training. All of these are important environmental factors which would tend to affect the achievement of the children in school and their performance in these studies. In short, the population tested was not a cross section of over-all population but rather a limited segment of it.

Another limiting factor was the availability of suitable materials used in the experimental situation, namely 16 mm motion picture films and 35 mm filmstrips. For the purposes of these studies, a careful survey was made of all these materials which were available and which were pertinent to the studies and selection was made of those which were most suitable for the units involved and appropriate to the grade levels being tested. This survey pointed out the need for more materials of this type for use in our schools today.

An additional limiting factor was the nature of the instruments used to evaluate pupil growth in terms of vocabulary. A multiple choice objective test was carefully constructed for use with each unit of study, but the very nature of the instrument made inevitable inherent limitations. The judgements of the teachers in subjectively gauging progress in vocabulary growth were of value in supplementing the information gained from use of the objective tests.

These points are brought out to emphasize that the results of these studies need to be interpreted in the light of the nature of the studies and that the results of the studies are applicable to this situation.

DESIGN OF THE STUDIES[6]

Rotation Technique. The rotation-group technique of experimentation was used in order to minimize the effect of several uncontrollable factors such as initiative, industry, or study habits. The rotation method ". . . involves an exchange for the groups at intervals, in terms of the procedures followed."[7] This technique was used

[6] A description of the Science Vocabulary Experiment procedures is included in this paper. The procedures used in the Social Studies Vocabulary Experiment were similar.

[7] Carter V. Good and Douglas E. Scates, *Methods of Research,* Appleton-Centruy-Crofts, Inc., New York, New York, 1954.

with both the classes and the teachers. During each unit of study for each grade level, one class was designated as the "control" group while the other class was designated as the "experimental" group. The "control" group was the group which used only the following audio-visual materials: bulletin boards, blackboards, charts, models, flat pictures, and field trips. The "experimental" group not only used the materials listed for the control group, but also used sixteen millimeter motion picture films and projected still pictures.

Selection of Groups Participating. Equal numbers of children in the fifth and sixth grades from the Lake Bluff School of Shorewood, Wisconsin, and from the seventh grade from Cumberland School of Whitefish Bay, Wisconsin were included. These groups were equated within feasible limits on the basis of I.Q. scores and standardized reading vocabulary test scores.

The Selection of the Vocabulary Words and the Construction of Tests. Prior to the experiment, the investigator reviewed all of the science textbooks from the third grade level through the ninth grade level to assemble the vocabulary essential to the understanding of the core ideas to be developed within a unit of study. In addition to looking through the available textbooks, the investigator reviewed each article in the *World Book Encyclopedia*[8] that pertained to a particular unit of study. A review by the investigator of all the available textbooks in each of the participating schools from the third grade level through the ninth grade level, was designed to provide a range of science words from the third through the ninth grade level.

These lists of words were then carefully reviewed by a committee made up of teachers participating in this study. Also, teachers who were especially interested in the teaching of science and had had several years of experience in this field, were asked to check this list of words carefully. After the vocabulary lists were approved by this committee, test items were developed which included all of the words in the list. In each unit approximately 250 words were recorded. This made possible the construction of a 50-item vocabulary test. Wherever possible a word meaning nearly the same as the key word was obtained from the list of 250 words. For example, part of the vocabulary from the sixth grade unit of study, *Sound,* includes the following:

reception	loudness	decrease
range	spread	velocity
transmit	mute	speed
amplitude	intensity	amplify
supersonic	audio	

[8] *The World Book Encyclopedia,* Field Enterprises, Inc., 1952.

From the above list, the committee of teachers selected and designated the word "velocity" as a key word. The test item then included five different words, one being the correct answer. Whenever possible a word which had the same, or nearly the same meaning was obtained from the list of 250 words. This word was considered the correct response.

The tests used as instruments of measure in this study were of the multiple-choice objective type.

Validity and Reliability of the Test Items. A high degree of curricular validity could be assumed since the vocabulary was closely correlated with the curricular content of each unit of study.

Reliability was estimated by administering the vocabulary tests to groups not participating in this study. The split-half method was used. This necessitated obtaining separate scores on odd and even-numbered items. A coefficient of correlation was obtained between these two scores by the product-moment method. By means of the Spearman-Brown formula, an estimate of the reliability of a test as long as the two halves combined was obtained.

Administration of the Vocabulary Tests. Prior to teaching the units of study, tests for each grade level were given to the control and experimental groups. These tests were administered two hours apart so as to reduce practice effect. The scores are designated as the "pre-test scores". At the termination of each unit of study which took five weeks, "final tests" were given. Six months after the "final tests", the participants were given the same test. These scores are designated as "retention test scores".

The Selection of the Units of Study. A committee of teachers selected two units of study for each grade level based on the following criteria: (1) availability of audio-visual materials related to the various units of study, and (2) extent of previous experiences in the particular unit of study. Specific problems to be covered in each unit of study were defined by the teachers so as to insure some degree of uniformity in both experimental and control groups.

The Selection of Audio-Visual Materials for the Experimental Group. The criteria determined by the participating teachers included: (1) Does the audio-visual material contribute to the objectives of the unit of study? (2) Does the audio-visual material suit the experiences, intellectual maturity, and grade level of the students? (3) Is the audio-visual material accurate and authentic? (4) Is the audio-visual material significant? Any audio-visual materials previewed that did not meet the above criteria were not used in this study.

The procedure for showing audio-visual materials was carefully planned by the group. Such procedures were demonstrated in an in-service meeting.

Procedure in the Selection of Pupil and Teacher Responses. Subjective evidence was gathered on the reactions of pupils and teachers to the utilization of audio-visual materials in the classroom. Specifically, teachers were asked to respond in writing to the following question; "What reactions do you have concerning teaching a unit of study in which a limited number of audio-visual materials are used as contrasted with a situation in which several audio-visual materials are used." The reports were then submitted at the termination of a ten-week experimental period.

The boys and girls were asked to react to the following question: "What reactions do you have concerning the first unit of study in science and the second unit of study?" Responses to this question were recorded immediately by the participating teachers, or, when possible, a stenographer was employed.

Presentation of Findings and Interpretation

Science Vocabulary Test Results. The findings for the fifth, sixth, and seventh grade groups using the rotation-group technique are summarized in Table 1.

Table 1 points out that the fifth grade classes in the unit on *Electricity* had a mean score of 7.24 words on the pre-test for the experimental group, and a mean score of 11.45 for the control group. In the final test scores given five weeks after the pre-test, the experimental group scored a mean of 23.62 words while the control group scored a mean of 21.93 words. In this particular unit the experimental group had a mean gain of 16.38 while the control group had a mean gain of 10.48. The experimental group in the unit on *Electricity* had a mean gain of 5.90 words over the control group.

Table 1. Summary of Mean Scores Achieved in Pre-Tests, Final Tests and Gains for Both Experimental and Control Groups in All Units of Study

Grade	Unit of Study	Pre-Test Mean Scores		Final Test Mean Scores		Mean Gains*	
		Control Group	Experimental Group	Control Group	Experimental Group	Control Group	Experimental Group
5	Electricity..	11.45	7.24	21.93	23.62	10.48	16.38
5	Rocks......	17.40	15.06	21.10	29.38	3.76	14.31
6	Astronomy .	14.00	15.68	21.72	34.84	7.72	19.16
6	Sound......	15.00	13.88	21.52	30.72	6.45	16.84
7	Air........	19.80	22.68	24.16	35.68	4.36	13.00
7	Soil........	21.68	22.64	25.48	34.20	3.84	11.56

*Final Test Score Minus Pre-Test Score.

In the remaining units of study the experimental groups had the following mean gains over the control group:

Astronomy: Mean gain of 11.44 words
Sound: Mean gain of 10.39 words
Air: Mean gain of 8.64 words
Soil: Mean gain of 7.72 words
Rocks: Mean gain of 10.55 words

Table 2 summarizes the percentage of gain achieved by the experimental group over the control group in the amount of vocabulary acquired by the boys and girls in these groups.

All experimental groups using the motion picture films and projected still pictures had a range of mean scores from 6.90 to 11.44 words gained over the control groups. This indicated a large increase in words gained over the control groups. Thus it may be concluded that the children of this particular population acquired to a greater extent the vocabulary in a unit of study when motion picture films and projected still pictures were introduced.

Six months following the completion of the unit of study the boys and girls were given vocabulary tests on the particular unit so as to determine the amount of vocabulary retained over this period of time. Table 3 summarizes the results achieved in the re-test vocabulary tests.

A close examination of the retention test and final test scores shows that retention test scores of the experimental group were lower in the *Rock* and *Astronomy* units of study. Retention test scores were higher in the control groups for all units of study.

TABLE 2. PERCENTAGE OF GAIN ACHIEVED BY CONTROL GROUP COMPARED TO THE EXPERIMENTAL GROUP IN ALL UNITS OF STUDY IN GRADES FIVE, SIX, AND SEVEN

Grade Level	Unit of Study	Actual Mean Gain		Percentage of Gain Achieved by Control Group Compared to Experimental Group
		Control I	Experimental II	
5	Electricity	10.48	16.38	63.9%
5	Rocks	3.76	14.31	26.2%
6	Astronomy	7.72	19.16	40.3%
6	Sound	6.45	16.84	38.3%
7	Air	4.36	13.00	33.5%
7	Soil	3.84	11.56	33.0%

TABLE 3. SUMMARY OF MEAN RETENTION SCORES AND MEAN GAINS FOR BOTH EXPERIMENTAL AND CONTROL GROUPS IN ALL UNITS OF STUDY

Grade	Unit of Study	Retention Scores—Means	
		Control Group	Experimental Group
5	Electricity	25.41	27.82
5	Rocks	22.62	27.97
6	Astronomy	26.52	33.08
6	Sound	25.08	31.68
7	Air	31.64	38.84
7	Soil	31.80	39.16

The following may indicate reasons for this increase in scores: (1) the science program did not terminate following the experimental period. All classes continued with the science instructional program, and throughout the instructional program classes utilized many audio-visual materials including films and projected still pictures. An examination of the units of study and the audio-visual materials used following the experimental period show that some of the vocabulary words included in the vocabulary tests were used. This may account for the gains in the retention test vocabulary scores for both the control and the experimental groups. (2) During the period between the pre-test and the final test both science and social studies were taught as part of the daily instructional program. An attempt was made not to include social studies units which were closely allied or related to the science units of study. This procedure eliminated to a certain extent the duplication of terms or vocabulary which might have been included in the vocabulary tests. Following the final tests the social studies and science programs might have been correlated, but in any case both classes received the same or similar activities.

An analysis was done so as to check on the possibilities that the experimental group gains could be accounted for by the presence of key words in the media to which the control group may not have had access. Table 4 summarizes the vocabulary included in the audio-visual materials used in the experimental group for the unit on *Astronomy*. Many duplications of words were found, but only 138 different words were included in the audio-visual materials as compared to 250 words in the vocabulary tests. This is 55 percent of the total number of words included in the *Astronomy* vocabulary tests. Of the 138 words only 14 were key words or only 28 percent of the 50 key words included in the test.

TABLE 4. TABULATION OF VOCABULARY INCLUDED IN THE AUDIO-VISUAL MATERIALS USED IN THE EXPERIMENTAL GROUP FOR THE SIXTH GRADE UNIT ON ASTRONOMY

AUDIO-VISUAL MATERIAL	TITLE	NUMBER OF WORDS IDENTICAL TO WORDS USED IN VOCABULARY TEST	PERCENTAGE OF WORDS IN AUDIO-VISUAL MATERIAL AS COMPARED TO WORDS IN VOCABULARY TEST
Filmstrip	*The Sun's Family* (Jam Handy).............	29	12%
Filmstrip	*The Changing Moon* (Jam Handy).............	20	8%
Filmstrip	*How We Learn About the Sky* (Jam Handy).............	16	6%
Filmstrip	*Earth in Motion* (Jam Handy)	16	6%
Filmstrip	*Interesting Things About the Planets* (Jam Handy)......	26	11%
Film	*Moon* (Encyclopaedia Britannica Films)...............	29	12%
Film	*Solar Family* (Encyclopaedia Britannica Films).........	32	13%
Film	*Trip to the Sky* (Gutlohn).....	27	11%
Filmstrip	*Story of Constellation* (Jam Handy).............	15	6%

Is There a Relationship Between the I.Q. and the Child's Gains in the Vocabulary Tests in the Experimental Group?

The Pearson-Product-Moment Test for correlation was found between the child's I.Q. score and the gains he achieved in the vocabulary tests. The vocabulary test gains were derived by subtracting the pre-test score from the final test score. In each of the units of study, the correlations obtained are shown in Table 5.

In the units of study on *Astronomy, Rocks,* and *Air,* there is no relationship while in the remaining units of study, *Electricity, Sound,* and *Soil,* there is a slight relationship between I.Q. scores and gains achieved in the vocabulary tests. In conclusion, no definite relationship exists as to I.Q. scores and gains achieved in the vocabulary tests in any of the units of study. The foregoing conclusion also means that the bright, average and slow child profited somewhat the same in this study, or stated another way, the gains achieved in the vocabulary tests do not necessarily depend upon the intellectual level of the individual.

Is There a Relationship Between the Standardized Reading Vocabulary Scores and the Gains Achieved in the Vocabulary Tests by the Experimental Groups?

Table 6 shows that in only two units of study, *Rocks* and *Air*, there is a definite correlation which exists between standardized reading vocabulary scores and the vocabulary test scores in this study. In the remaining four units of study there is only a slight relationship.

TABLE 5. CORRELATIONS BETWEEN I.Q. SCORES AND GAINS ACHIEVED IN THE VOCABULARY TESTS BY THE EXPERIMENTAL GROUPS IN THE SCIENCE UNITS, GRADES 5, 6, AND 7

GRADE	UNIT OF STUDY	CORRELATION
5	Electricity	+.38
5	Rocks	—.01
6	Astronomy	—.15
6	Sound	+.21
7	Soil	+.33
7	Air	+.06

TABLE 6. PEARSON PRODUCT-MOMENT TEST FOR CORRELATION BETWEEN READING VOCABULARY SCORES ON STANDARDIZED TESTS, AND GAINS ACHIEVED IN THE VOCABULARY TESTS FOR ALL UNITS OF STUDY

GRADE	UNITS OF STUDY	CORRELATIONS
5	Electricity	+.18
5	Rocks	+.54
6	Astronomy	—.21
6	Sound	+.09
7	Soil	+.18
7	Air	+.69

Pupil and Teacher Reactions to Audio-Visual Materials. The reactions of pupils and teachers represent the subjective evaluation of the use of various audio-visual materials in the classroom. All of the teachers in the study point out the intrinsic value of the use of audio-visual materials in making for a more effective teaching-learning situation. The reports from both teachers and pupils in a situation in which a limited number of audio-visual materials were employed is a negative one. A more enthusiastic learning situation seemed to develop in the classroom situation in which several audio-visual materials were used in a cross-media approach.

Summary of the Findings for Science Vocabulary Experiment

1. In each unit of study, the experimental classes using the experimental factors showed larger unit learning gains than the control groups in the vocabulary acquired. The unit learning gains by experimental groups were doubled as compared to those achieved by the control groups, in all units of study except the fifth grade *Electricity* unit.

2. Retention test scores of the experimental group in the *Rock* and *Astronomy* units were lower than the final test scores while in all the other units of study for the experimental group and for all the units of the control groups, the retention test scores were higher than the final test scores. There was a slight loss in retention for the experimental group in only two of the units of study.

3. No definite relationship exists between I.Q. scores and unit learning gains achieved in the science vocabulary tests in any of the units of study in the fifth, sixth, and seventh grades.

4. There was a definite relationship between standardized reading vocabulary scores and unit learning gains achieved in the science vocabulary tests in one-third of the units. A slight relationship exists in the remaining units of study.

5. Vocabulary unit learning gains achieved by the experimental group were acquired from the vocabulary of the total instructional program rather than solely from the vocabulary of the 16 mm motion picture films and projected still pictures used in this study.

Summary of Findings in the Social Studies Vocabulary Experiment

1. Unit learning gains in the experimental groups using the experimental audio-visual materials were greater than the unit learning gains made by control groups which did not use these materials.

2. Residual learning gains [retention scores over pre-test scores], made by the experimental groups were greater than the residual learning gains made by the control groups.

3. Gains made by the experimental group were not made because of the test vocabulary contained in the films and filmstrips. Gains made by the experimental group were acquired from the total instructional program including the use of films and filmstrips.

4. A definite relationship between standardized reading vocabulary test scores and vocabulary unit learning gains made in this study was found to exist in two units. In the remaining four units there was a slight relationship or none between these factors.

5. As determined by instruments used in this study, there is no relationship between I.Q. scores and vocabulary unit learning gains made by students in five of the six units. In one unit, there was a definite relationship between these factors.

Implications

The implications of the findings of these studies are presented in relation to the role of projected audio-visual materials used in the cross-media approach in science and social studies learnings.

Vocabulary gains achieved by experimental groups which used motion pictures, filmstrips, and other projected pictures in combination with other audio-visual materials in a cross-media approach exceeded those of groups which limited themselves to audio-visual media other than the above named items. An increase in as basic a skill as vocabulary comprehension is worthy of every consideration for the beneficial effect this may have in generally improving learning. This is further emphasized by the fact that the control groups in these studies were not in situations which were barren of of audio-visual materials but were free to make use of any of these except the experimental items. In view of the marked superiority of the gains in vocabulary growth achieved by the experimental groups over those of the control groups, it appears that serious consideration needs to be given by teachers to the carefully planned effective use of films, filmstrips, and other projected pictures in combination with other audio-visual materials for the benefits that may result in vocabulary growth and subsequently in general learning.

One of the major objectives in science and social studies is the development of important understandings or concepts. These concepts are expressed through word symbols, that is, vocabulary. The ability to interpret word symbols may play an essential part in aiding comprehension and understanding of these concepts. These studies may have important implications for the enrichment of the child's basic science and social studies concepts.

There is a need for closer cooperation between the producers of audio-visual materials and the educator so that the needs of our instructional programs are better met in terms of films and filmstrips.

The acquisition of vocabulary, one of the important skills in reading, is a prerequisite to adequate comprehension and interpretation in reading. The utilization of audio-visual materials enhances the acquisition and tention of vocabulary, and these should therefore be included in the instructional program.

A further implication has to do with the training of prospective teachers. Every effort should be made to have these students enroll in audio-visual courses. Too often, beginning teachers limit their instructional program to the use of one or two audio-visual materials rather than a combination of these materials. Learning the simple operation of these tools of instruction is important, but of greater consequence is the knowledge of how to use these materials fully and effectively in the teaching-learning situation.

ALLIS-CHALMERS: TECHNOLOGY AND THE FARM 1925–1940

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Under the direction of General Otto H. Falk, Allis-Chalmers entered the farm equipment field to further diversify the company's products and to make the company name known beyond the area of heavy machinery. This venture was to change the technology of the American farm, particularly during the decade of the 1930's. Broadly speaking, technology is the way people do things. This being the case, patterns of agricultural life and production had changed but little over the centuries until very recent times. It is true that steam power had come to many farms in the last quarter of the nineteenth century, but steam merely supplemented the traditional horsepower—it did not replace it. From 1914 to 1920 about 20,000,000 horses and 5,000,000 mules were used on American farms.[1] However, the horse had been brought to its highest efficiency while the tractor was being markedly improved with each passing year.

The first Allis-Chalmers tractor went into production late in 1914. By modern standards it was a most cumbersome piece of equipment. An unwieldy tricycle type with one speed forward and one reverse, it weighed 4,000 pounds and sold for $1,950. Largely an experimental tractor, it never achieved a wide sale to the American farmer.[2] During World War I and the early 1920's, tractor manufacturers constantly improved their products as engineers simplified design, reduced the weight, and provided greater ease in operation. As farmers became increasingly aware of the advantages of the tractor, the number of horses began to decrease. By 1928 the number of horses had fallen to 15,000,000; one quarter less than eight years before.[3]

One of the most important events in the history of the Tractor Division of the Allis-Chalmers Manufacturing Company was the appointment of Harry G. Merritt as manager on January 1, 1926.[4] His job, as he saw it, was to produce a quality tractor at a price

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[1] Preston W. Slosson, *The Great Crusade and After, 1914–1928,* (New York, 1931), p. 194.
[2] *A–C Views,* July 24, 1952, p. 5; *Pioneer Power,* (Milwaukee, 1942), p. 81.
[3] Preston W. Slosson, *The Great Crusade and After,* p. 194.
[4] *President's Circular Letter,* No. 173, December 29, 1925; W. F. Strehlow to author, June 13, 1961; Malcolm C. Maloney to author, June 19, 1961.

that the depression-ridden farmers of the 20's were willing to pay. As he and Allis-Chalmers engineers set about redesigning the standard 20–35 tractor, non-essential apparatus was stripped from the old model and essential parts were replaced by lighter ones. Concentrating on the tractor's general appearance, they gave it what Merritt called tractor "sex appeal." The finished product was a trim, snappy looking tractor that was more efficient, half a ton lighter, and priced at $700 less than its predecessors.[5]

Under Merritt's direction, change and improvement were constant in the Tractor Division. Engineers were sometimes reluctant to suggest ideas for improvement as Merritt would invariably ask them to proceed immediately. This policy produced greater sales and, consequently, more money for research and development.[6] The willingness of Allis-Chalmers to take a smaller profit had a good deal to do with its success in producing a cheaper tractor and its rapid emergence as the third largest manufacturer of farm equipment.[7]

Administrative change was equally rapid. The appointment of W. A. Roberts as General Sales Manager made it possible for Merritt to concentrate on his primary interest, that of tractor engineering.[8] Allis-Chalmers purchased the well-known La Crosse Plow Company so that it could join the ranks of the "full line" companies and compete on more even terms with other major producers.[9] When it was found that its distribution system was inadequate, Allis-Chalmers purchased the Advance-Rumley Corporation of La Porte, Indiana, which had 24 branch houses and about 2,500 dealers, along with Advance-Rumley's well-known harvesters and threshing equipment.[10] Through expansion Allis-Chalmers put itself in a position to engage in imaginative engineering which would revolutionize American agriculture.

Allis-Chalmers, in common with all other tractor producers, faced the cold fact that the tractor had not been universally adopted for farm use and was not in a position to really replace the horse on

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[5] "Allis–Chalmers; 'America's Krupp' ", *Fortune,* May, 1939, p. 150; W. J. Klein to author, April 10, 1962.

[6] A. W. Van Hercke, W. F. Strehlow, and John Ernst to author, June 13, 1961.

[7] *Fortune,* May 1939, p. 150. Accordingto this article, a report of the Federal Trade Commission indicated that in the period of the 1930's, the average Allis–Chalmers profit on new farm machines and implements in some years was less than 4 per cent, compared to an average of 6.7 per cent for International Harvester, and a whopping 18.1 per cent for Deere and Company.

[8] *Power Review,* September, 1941, pp. 27 f. W. A. Roberts succeeded Harry Merritt as Manager of the Tractor Division in 1941, and in 1951 became president of the company.

[9] *Sales Bulletin,* September, 1929, p. 815; *The La Crosse Tribune,* October 7, 1929; A. W. Van Hercke and W. F. Strehlow to author, June 13, 1961; *The Ace Reporter,* "Silver Anniversary, Allis–Chalmers La Crosse Works, 1929–1954," *passim.*

[10] *Sales Bulletin,* April to July, 1931, p .1049; *Chicago Journal of Commerce,* May 13, 1931; *A–C Line,* "Allis–Chalmers La Porte Works, Silver Anniversary." December, 1956, *passim.*

the farm as the automobile and the truck had replaced him on the highway. This was due to the limitations and inefficiency of the type of wheel equipment used. The lugs on the steel wheels damaged meadows, orchards, and barnyards; and signs stating "Tractors with Lugs Prohibited" were appearing on most well-surfaced roads.[11]

The sheer inefficiency of the lug-type wheel is indicated in the old tractor ratings of 10–18 and 20–35. The first figure represented the useful power delivered at the drawbar and the latter the rated power of the motor. Tests proved that the tractive efficiency, the ratio between the power delivered at the drawbar and the power produced by the motor under field conditions, varied from a low of 40 per cent to a high of about 65 per cent. Very simply, it took power to push the lugs in and power to pull them out. The end result was that even on level ground the tractor was compelled to constantly climb a rather steep grade. As the speed of the tractor was increased, more of the total horsepower was required merely to move the tractor. At higher speeds it tended to approach the total output of the engine, leaving little power for useful work. The consequence of this was that conventional tractor work had to be done slowly, inefficiently and with a high rate of fuel consumption.[12]

Engineers had flirted with the idea of putting rubber tires on tractors. Experiments were conducted with both hard rubber tires and high pressure pneumatic tires, similar to those used on trucks. But when attempts were made to plow with this equipment it was found that the tractor could perform only under the most favorable ground conditions, and it was absolutely useless on wet ground. However, the tractor engineering staff finally arrived at the solution to the problem. They conceived of the idea of a low pressure tire with a flexible casing that would allow the tread to spread out and distribute the load, thus giving the needed traction.[13] The development of the "air-tire" was a significant break-through for the entire industry. As the *Farm Implement News* put it on October 13, 1932, "Just about the time this industry seems to have dropped into a rut and reached a static point with no outstanding developments in sight, something arises to change its course. Rubber may be the pivot of the next turn."[14]

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[11] *Sales Bulletin,* October–November–December, 1931, p. 67; J. W. Shields, *Pneumatic Tires for Agricultural Tractors,* undated mss. Shields was a field engineer for the Firestone Tire and Rubber Company.

[12] J. Brownlee Davidson, "Riding on Rubber," *Successful Farming,* January, 1935, pp. 8, 34; J. W. Shields, *Pneumatic Tires for Agricultural Tractors;* R. A. Crosby to author, June 15, 1961.

[13] *WE,* July, 1947, p. 4; R. A. Crosby to author, June 15, 1961; According to *Fortune,* May, 1939, p .150, Deere and Company offered solid rubber tires for tractors in 1926 and high pressure pneumatic tires beginning in 1928. However, it is generally accepted that Allis–Chalmers introduced the first low pressure, or air-tire.

[14] *Farm Implement News,* October 13, 1932, p. 24.

A program of testing was set up; Allis-Chalmers tractors equipped with air-tires were put on selected farms so that the tests could be conducted under a wide variety of work and conditions. The reports were uniformly enthusiastic. Rubber actually seemed tougher than steel; the tractors rode more comfortably and the air-tires were easier on the tools used. They provided greater fuel economy, presented greater tractive surface, and most important, permitted greater speed of travel in the fields. The farm tractor equipped with air-tires was no longer limited to a narrow field of operation but had become a general utility machine to be used wherever power was required.[15] Harry G. Merritt in 1933 summarized the agricultural advance made possible by the air-tire in these words:

> We regard this new development as marking the dawn of a new era in American agriculture and the most important advancement in Tractor engineering in years. It eases a bit more of the farmer's yoke, making his work easier, shortening his hours and reducing his costs of production.[16]

While one group of Allis-Chalmers engineers was developing the air-tire and thus solving one problem—how to make the tractor an all-purpose machine, another group of engineers was tackling another knotty problem—how to design and produce a practical combine of small size for use particularly on the small Mid-Western farm. A combine is basically a threshing machine with a harvesting attachment which heads, threshes, and cleans the grain as it moves over the field. Crude combines had been devised as early as the mid-ninteenth century and with later refinements they came to be used effectively on the great wheat farms of the Far West and Northwest. These huge machines were drawn by 40 to 50 horses and cut a swath 30 to 40 feet wide. As the conventional combine crept eastward to the Kansas wheat fields its size was reduced to 20 to 30 feet. But it was successful primarily with wheat which could simply be headed and the heads rammed through a small throat into the threshing cylinder. It proved totally unable to harvest such crops as sweet clover, alfalfa and bush beans which inevitably clogged the small threshing cylinder. Eventually, the size was cut to 10 to 12 feet for the Mississippi Valley. Although these 10 and 12 foot combines were a vast improvement over the binder-thresher method of putting up grain, they still cost $1,250 to $1,500 and required a three-plow tractor and the services of two or three men to operate them.

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[15] *Farm Implement News,* June 23, 1932, quoted in *A Decade of Allis–Chalmers Pioneering,* undated mss., pp. 22 f: Also see William A. McGarry, "The Farm Tractor Takes Wings," *The Magazine of Wall Street,* December 7, 1935, p. 198. The original Model "U" tractor equipped with the original Firestone airplane tires used in the first experiments is now on permanent exhibit at the Museum of the State Historical Society of Wisconsin.

[16] Unmarked tractor mss., p. 2.

Allis-Chalmers set out to develop a totally new harvester that could, as one man put it, harvest everything from bird seed to beans. Other specifications were that it had to be light enough to be pulled by a two-plow tractor and operate from its power take-off, and it must sell at a price low enough that a farmer could afford to buy it. To provide a basis for development of such a machine the company in 1930 purchased the rights to a small five-foot combine manufactured in California. While they found it cumbersome and inefficient, it was a basis for experimentation and development. When Advance-Rumley was purchased in 1930, their long experience in threshers was utilized in the continued designing and testing of the proposed combine.[17]

The basic idea that was to make this machine different from and better than its predecessors was having a threshing cylinder the same width as the cutter bar. This permitted the grain to be fed into the cylinder in a thin stream rather than trying to ram a large quantity of grain into the narrow cylinder throat. Behind the threshing cylinder there was a wide rack which allowed the stream of straw to move toward the back of the machine making it easier to shake the grain out of the straw. It was no longer necessary to hammer the straw to pieces. The farmer who was feeding livestock could now save the entire yield of straw as well as the grain. This new concept of threshing also kept the weeds and green stuff out of the grain thus revolutionizing the harvesting of crops on the smaller farms of the United States.[18]

The first demonstration of the "Corn Belt Combine," as this machine was originally named, was described in the *Indiana Farmer's Guide:*

> A new development in high-speed grain harvesting was demonstrated a few weeks ago on a farm in La Porte County, Indiana, when a baby combine, travelling 5 miles an hour cut and threshed wheat and oats at one operation with such ease and speed as to amaze the more than 200 spectators gathered from all parts of the country. This new type machine, the product of the factory of the Allis-Chalmers Company, marks a distinctive milestone in the advancement of American agriculture, quite as much as did the advent of the reaper, more than a hundred years ago.[19]

When the "Corn Belt Combine" was put to the test in 1935, it was found that it exceeded all expectations. By 1936 it had successfully harvested 84 different small seed and bean crops, including even rice and sunflower seed. Eventually it was to harvest over 100 different crops, and the name was logically changed to the All-Crop

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[17] *A Decade of Allis–Chalmers Pioneering,* pp. 41 f; R. A. Crosby to author, June 15, 1961. Mr. Crosby came to Allis–halmers from Advance–Rumley where he worked from 1912 to 1931. *Sales Bulletin,* November–December, 1930, p. 114.

[18] *A Decade of Allis–Chalmers Pioneering,* pp. 42 f; R. A. Crosby to author.

[19] *Allis–Chalmers Milestones in Farm Mechanization,* (Milwaukee, 1953), p. 17, quoting *The Indians Farmer's Guide,* Huntington, Indiana.

Harvester. In 1935, 550 machines were sold. Adverse harvesting conditions throughout the country stimulated sales because it was found that the All-Crop could harvest grain when no other conventional combine could. In 1936 the sales of All-Crop Harvesters jumped ten times, to 5,500. In 1937 the number was 10,500 and in 1938, 16,500 more replaced the binders and threshing machines. In fact, the All-Crop Harvester came to be known as the "successor to the binder," for as Allis-Chalmers production increased to meet demand, total binder production in the United States declined from 66,000 in 1936 to 15,000 in 1939.[20]

But the real merit of the new machine and its revolutionary nature received outstanding recognition when the Allis-Chalmers All-Crop Harvester was awarded the Royal Silver Medal at the Royal British Agricultural Exposition held at Bristol, England. It was held that this machine represented the most notable advancement of the year in agricultural machinery. This was the first time in twelve years that this coveted award had been won by an American manufacturer.[21]

The All-Crop Harvester made the small Mid-Western farmer competitive with the large Western grain grower. By combining his grain the large farmer could put his grain in the bin for about 9¢ a bushel. By comparison, the small farmer found that the cost of binding, shocking and threshing cost him at least 20¢ a bushel. By combining the operations with an All-Crop Harvester he found that he could put his grain in the bin for 10¢ less a bushel than before and could pay for his machine with his new profits in less than two years.[22]

Allis-Chalmers research in a third area met a long-standing need. As early as 1871, Horace Greeley envisioned a small, inexpensive form of power on the farm in these words:

> What our farmers need is not a steam plow as a specialty, but a locomotive that can travel with facility, not only on common wagon roads, but across even freshly plowed fields, without embarrassment, and prove as docile to its manager's touch as an average span of horses.
>
> Such a locomotive should not cost more than five hundred dollars, nor weigh more than a ton.

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[20] *A Decade of Allis–Chalmers Pioneering,* pp. 47 ff; *Sales Bulletin,* October, 1935, p. 33, and July, 1936, p. 64; *Allis–Chalmers Milestones in Farm Mechanization,* p. 18.

[21] *Sales Bulletin,* October, 1936, p. 9.

[22] *A Decade of Allis–Chalmers Pioneering,* p. 47; R. A. Crosby to author. By 1936 the Tractor Division was the largest single division of the company, selling more than 300 different products from four large plants. The West Allis Works manufactured wheel-type tractors, and the engines for the tractors and equipment built in other plants. The La Porte, Indiana, factory built the All-Crop Harvester together with an impressive line of threshers, big combines, clover and alfalfa hullers. The La Crosse Works at La Crosse, Wisconsin, manufactured the extensive line of Allis–Chalmers farm implements, including cultivators, plows, bedders, harrows, mowers, and other power machinery tools.

> It should be so contrived that it can be hitched in a minute to a plow, a harrow, a wagon or cart, a saw or grist mill, a mower or reaper, a thresher or a stalk cutter, a stump or rock puller, and made useful in pumping or draining operations, digging a cellar or laying up a wall, also in ditching and trenching.
>
> We may have to wait several years yet for a servant so dextrous and docile, yet I feel confident that our children will enjoy and appreciate its handiwork.[23]

Allis-Chalmers provided the fulfillment of this dream.[24]

Merritt studied the farm census figures and discovered that of the 6,800,000 American farms, some 4,000,000 were under 100 acres. But most of the 1,200,000 tractors in the country were working farms of more than 100 acres. In order to bring tractors into use on smaller farms, the Model "B" tractor was designed and placed in production in 1938. It was revolutionary in regard to price, weight and adaptability. This 2,100 pound tractor cost only $495. It weighed and cost only one-third as much as tractors of ten years before, but it would do 20 per cent more work with 25 per cent less fuel. It could pull a sixteen-inch moldboard plow at 3 to 4 miles per hour. To haul a load of hay a farmer could hitch a trailer and roll it along (on rubber tires) at about 7 miles per hour. To saw logs, he could attach a belt to the pulley wheel which would be geared to the tractor transmission. The belt could operate a circular saw. Also ,shaft-driven machinery such as a mower could be powered by a take-off on the rear axle. Designated as the "successor to the horse," the Model "B" was all that Horace Greeley had called for, and much more.[25]

For the first time in agricultural history it was possible to operate a completely mechanized farm of 100 acres for an investment of only $10 an acre. The Model "B" cost $495. The next most expensive investment might be the 40-inch All-Crop Harvester with power take-off which cost $345. With these machines the small farmer could thresh all his small grains, beans, and seeds without outside help. For plowing, a farmer could buy an Allis-Chalmers no. 116 Moldboard Plow for $85; it plowed the soil deeper and

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[23] Quoted in *Rubber Invades the Farm,* undated tractor mss., pp. 5 f.

[24] In 1915 Allis–Chalmers engineers developed the radically different 6–12 tractor as a direct substitute for the horse. This unique tractor had two steel driving wheels in front, pivoted by a turning mechanism at the center. The driving wheels were obviously the direct substitute for the horse and the operator sat at the end of a long pole on lighter wheels at the rear. By removing the sulky, the tractor could be attached to any two-row, horse drawn implement, thus saving the farmer a great deal of expense. Although the 6–12 was an ingenious machine it never captured the imagination of the conservative American farmer who was just becoming accustomed to the conventional tractor.

[25] *Annual Review,* 1937, p. 64; Arthur Van Vlissingen, "50,000,000 New Dollars a Year," *Forbes,* June 1, 1938, pp. 34 f; *A Decade of Allis–Chalmers Pioneering* p. 30, also, p. 50 f; *Allis–Chalmers Milestones in Farm Mechanization,* p. 10; *Fortune,* May, 1939, p. 150. The *Fortune* article points out that by 1938 the protests of the Horse and Mule Association had been reduced to the rather obvious fact that tractors were inferior to animals because they produced no manure.

pulverised it better at twice the speed of horses. Finally, he could buy a one-row cultivator for $50.25, which was adaptable to all row crops.[26] If, as some have maintained, the small farmer has traditionally been the backbone of American society, Allis-Chalmers did much in the 1930's to maintain his independence by making him economically competitive.

Allis-Chalmers' engineering and innovation had a profound effect on the agricultural equipment industry as a whole. From a position of relative insignificance as a producer of tractors and agricultural equipment, the company shot rapidly upward to third place in this field during the middle and late 30's. It is estimated that during that decade, Allis-Chalmers had no more than one-twelfth of the salesmen in the field, but by 1937 it was selling 13 percent of the products of the industry as a whole. This percentage increased during the two succeeding years so that by 1939 the company was selling more than one-fifth of the national product.[27]

The Tractor Division had gained a significant, in fact, a predominant position within the company. It had also, through the revolutionary nature and excellence of its products, produced a revitalization of the industry as a whole. But perhaps more importantly it had contributed in a significant fashion to American agriculture and the economy of the nation as a whole. Calvin Coolidge once remarked philosophically, "Farmers have never made money, I don't believe we can do much about it."[28] Allis-Chalmers' tractors and implements in the decade of the 30's helped the farmer in general and the small farmer in particular perform his work more effectively, more efficiently, and more profitably than ever before. In the early days of the American Republic, something like 85 per cent of the nation's workers were actually needed to produce food for themselves and the other 15 per cent of the population. By 1940, 15 per cent of the population could feed themselves and all other Americans as well as export enormous amounts of food stuffs to our allies during World War II.[29] Allis-Chalmers had played a leading role in the agricultural revolution of the 1930's.

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[26] *Allis–Chalmers Milestones in Farm Mechanization*, p. 11.

[27] A. W. Van Hercke to author, June 19, 1961.

[28] Quoted in Arthur M. Schlesinger, Jr., *The Crisis of the Old Order*, (New York, 1957), p. 67.

[29] Stewart H. Holbrook, *Machines of Plenty*, (New York, 1955), p. 224; Bert S. Gitting, *Land of Plenty*, (Chicago, 1959), p. 50.

ARTS AND LETTERS

A HISTORY OF THE WISCONSIN ACADEMY OF SCIENCES, ARTS AND LETTERS

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The organization meeting of the Academy was held in the State Agricultural Rooms in Madison on February 16, 1870.[1] A call for a meeting to form an Academy was issued in December, 1869, under the signature of 105 prominent citizens of the state. About two years previously there was an attempt made to organize "The Wisconsin Academy of Science." Apparently there were too few scientists to support an organization of this nature so the base was broadened to a "comprehensive State Academy of Sciences, Arts, and Letters."

A constitution was adopted at 7:30 P.M. on February 16, and the first formal meeting was held at 9:00 P.M. The by-laws were adopted the following morning. John W. Hoyt,[2] who came to Madison in 1857, was elected President. Prior to his arrival in Madison he taught chemistry at several institutions in Ohio. When the burden of organizing the Academy was on his shoulders, he was Secretary of the State Agricultural Society. On February 12, 1911, he wrote of this task to Arthur Beatty: "I can never forget the difficulty I had in making a beginning—how nearly everybody I approached, while admitting that such an institution, in itself, would be immeasurably useful, thought it yet too early in the history of a new Western State." Thirty-six letters approving the organization of an Academy were printed in the first Bulletin.

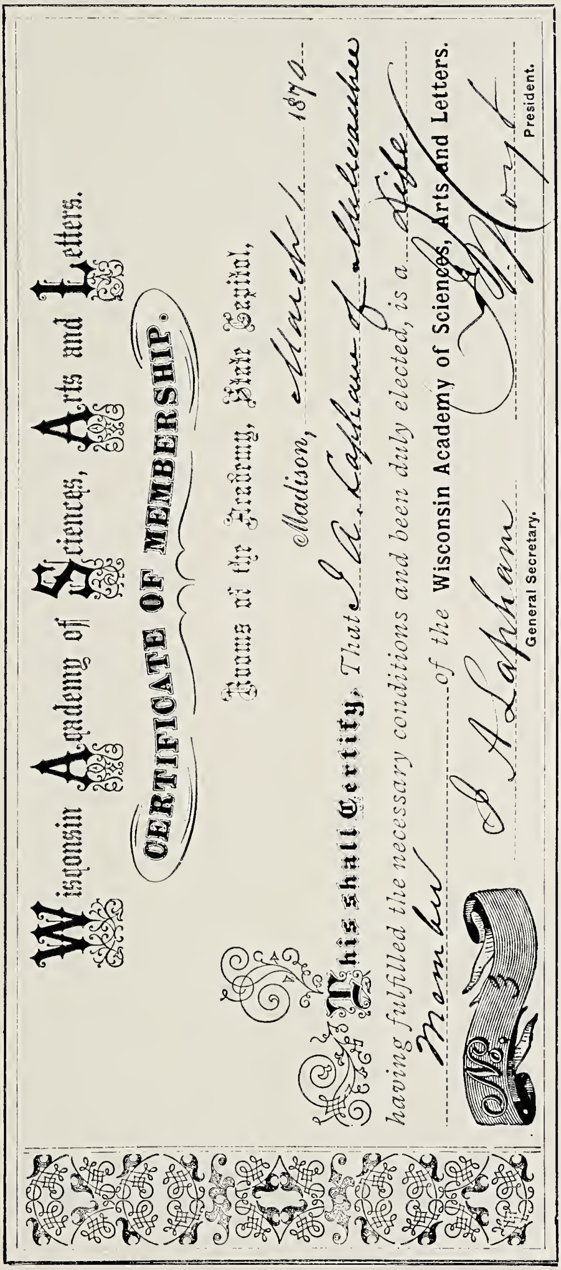
At the preliminary meeting from one-fourth to one-third of the audience consisted of women "as listeners." Hoyt added: "The reason, I suppose, for this absolute silence on their part was that, in Wisconsin, the antagonism to woman suffrage as a political and social measure was at its height. Women sometimes have extraordinary common sense, expressed in extraordinary ways, and this was one such occasion." In spite of this encomium, women were barred from membership. There was even reluctance to admit Catholics.

Ardent support for the formation of the Academy came from Dr. P. R. Hoy of Racine and Increase A. Lapham of Milwaukee. Hoy was the foremost ornithologist, mammalogist, entomologist, and icthyologist in the state. Lapham, who was elected General Secretary, was active in botany, geology, archeology, zoology, and meteorology. His efforts in inducing the United States Weather Bureau to install a system of storm warnings for the Great Lakes resulted in impressive savings of life and property.[3] J. G. Knapp was elected to the important position of Librarian while William Dudley became Director of the Museum. It was ruled that no books were to be taken from the Library or specimens from the Museum without the authority of the General Council. This was not an age of impatience.

The Department of the Sciences only was organized at the first meeting, those of Arts and Letters in 1871. A Department of the Social and Political Sciences came into existence in 1872 and there was a proposal for one on Speculative Philosophy. Each department had its own officers. Lyman C. Draper, "the accomplished and indefatigable" Corresponding Secretary of the State Historical Society, signed the special call for the organization meeting and in 1872 became one of the Counselors of the Department of Letters. Strangely, his name is not to be found in the list of members until 1878.

The charter was approved by the Legislature on March 16, 1870. It provided that the Academy be furnished space in the Capitol for an office, library, and collections, the latter comprising the Museum of Natural History and the Useful Arts. The President reported in 1874 that a large, adequate museum was highly desirable but progress was slow as additions to the collections depended upon the spare time of the officers.[4] On December 29, 1891, a resolution was passed to deposit the collection of fossils in the University, the Academy to retain title.[5] Its library was moved in September, 1900 to the "magnificent fire-proof building" of the State Historical Society, housing the library of the Society and that of the University.[6] At this time the chief geologist was required by law to collect and present to the Academy, State University, incorporated colleges, and normal schools, if they so requested, specimens of rocks, ores, fossils, and minerals.

The ambitions of the Academy were beyond its resources, both human and pecuniary. The Charter states: "The general objects of the Academy shall be to encourage investigation and disseminate correct views in the various departments of science, literature and the arts." The arts were to comprise the useful and the fine. President Hoyt reported in 1874 that there had been no success with the fine arts, a condition that has existed up to the present. Two years later he reported that only the Department of the Natural Sciences was in a flourishing condition. In 1881 an amendment was introduced to abolish the Department of the Arts but it failed to pass at the next annual meeting.[7] Departments, as entities, have ceased to exist. Of the five that existed at one time only those of Sciences and Letters remain active.



Wisconsin Academy of Sciences, Arts and Letters.

CERTIFICATE OF MEMBERSHIP.

Rooms of the Academy, State Capital,

Madison, March 1 1870

This shall Certify, That I. A. Lapham of Milwaukee

having fulfilled the necessary conditions and been duly elected, is a Life

Member of the Wisconsin Academy of Sciences, Arts and Letters.

No. 3

I. A. Lapham
General Secretary.

President.

Certificate of membership of Increase A. Lapham.

For the year ending February 13, 1872, the Academy had 28 corresponding, 12 life, and 56 annual members. Its growth was so slow that thirty years later the Academy had but 12 life and 196 annual members. With this small membership it was impossible to marshal a sufficiently large group to maintain a live interest in philosophy, or the fine arts. The founding of the Academy was due largely to the efforts of scientists and they have constituted the majority of the members. In an address on the founding of the Academy at the 50th annual meeting T. C. Chamberlain stated: "Of the papers presented during the first two years, 35 per cent related to geological subjects, 23 per cent to biological, 17 per cent to physical and mathematical science, 15 per cent to political and sociological subjects, and the remaining 10 per cent to historical and philological subjects or to topics not readily classified."[8] The preponderance of geological papers was due particularly to the charter members, I. A. Lapham, J. H. Eaton, and T. C. Chamberlain. The very useful index compiled by L. E. Noland shows that of the papers published by the Academy, 1870–1932, approximately 80 per cent are on scientific and related subjects. Botany led the field followed by zoology. The Transactions form an ideal medium for papers on the natural resources of the state so that many of the articles are of this type.

Exchanges of the Transactions for the publications of other learned societies has led to the formation of a superb library having approximately 36,000 volumes. President Hoyt reported in 1874: "It is not the policy of the Academy to build up a separate library, but rather to cooperate with the State Historical Society in sustaining and strengthening the Scientific, Art and Literary Departments of its already extensive Library. This it will be able to do in a large degree by securing an exchange of the Academy's Transactions with those of kindred institutions throughout the world, provided its own publications are regularly issued at short intervals—annually, if possible." W. A. Germain,[9] Acting Librarian, in 1878, recommended that a certain sum be made available for binding as the accessions consisted largely of pamphlets and unbound publications, not usable in their present state. A list of the publications owned by the Academy covered eight pages. In 1881 $100 was appropriated for binding. E. A. Birge,[10] then librarian, stated that the library now "*crowds* about 100 feet of shelving." He was able to report that all complete volumes were bound or in process of binding. The cost of binding in 1893 ran from 50 cents to as high as 90 cents for one-half Morocco. The average cost per volume was 68 cents!

The initial caution in loaning books did not last long. A resolution was passed in 1878 that any member of the Academy could borrow books for a period of one year. The librarian's report for

1893 reads in part: "The room should not be left open without an attendant, as we have already suffered too much from depredations."[11] And: "Should the librarian have reason to think the books were no longer in use and retained because of neglect, he might at his discretion call them in." The Academy accepted an offer from R. G. Thwaites, Secretary of the Wisconsin Historical Society to aid in the loan of books by furnishing a member of his staff when the librarian or his assistant could not be in attendance. The Academy would be expected to pay for this service if it proved to be a "considerable burden."

The library was maintained in the Capitol under difficult conditions. W. H. Hobbs,[12] in 1891, had great difficulty in arranging and cataloging the books owing to the use of the quarters for law and history classes. Access to the rooms could be had only on Saturdays and during vacations. This was not the sole trouble. Two years later the librarian complained: "As the cases have no backs, but rest against the rough plaster, it is impossible to keep from the books finely disintegrated plaster which shakes down from the walls. The books become covered with a considerable layer of this material, which is so gritty as to abrade the skin when the books are handled. On opening a book this material gets between the leaves and plates."[11] New tenants, committees of the Legislature and compilers of the state census, occupied the library for most of 1895. The last straw was added in 1897 when the Academy's room was divided by a partition, one part being used as a committee room, the other as a cloak room.[13] The library was now virtually inaccessible. In December, 1898 it was agreed that the library be placed in the custody of the State Historical Society, the arrangements to be left to the discretion of the Council of the Academy.

As early as 1892 a resolution was passed to memorialize the Legislature on the construction of a building for the libraries of the Historical Society, University, and Academy.[14] The building was obtained but was not ready for occupancy until 1900. A year later it could be announced that the Regents of the University had been of great service to the Academy "by placing at the disposal of the Librarian of the Academy the library staff of the University under the direction of Librarian Smith." It was not only logical but almost inevitable that the library of the Academy be combined with that of the University and initial action to this end began in 1909. The University Librarian in 1954 began to reclassify the periodicals and journals of the Academy in changing from the Cutter system to that of the Library of Congress. The integration is now so complete that the library of the Academy has lost its identity; however the Academy retains title.

The Academy has published the *Bulletin, Transactions,* and *Review*. Five Bulletins were printed during the years 1870–1871. The pages are numbered consecutively and total 81. Bulletins 2 and 3, and 4 and 5 are bound together. These Bulletins give information on the founding of the Academy, Proceedings, and abstracts of papers. The *Transactions* consist of original papers, and the Proceedings. The Review is published quarterly, the first volume appearing in 1954. It contains information on the activities of the members, obituaries, brief articles by members of the Academy and those of the Junior Academy, reports on the annual meetings, and book reviews. This publication sustains interest in the Academy between the annual intervals of the appearance of the *Transactions*.

In 1920 the fiftieth anniversary of the Academy was commemorated by the publication of a volume of 776 pages for which the Legislature made a special appropriation of $2000. T. C. Chamberlin, one of the incorporators and presidents of the Academy, and formerly President of the University of Wisconsin was given the honorary degree of Doctor of Science. There was a special exhibit of photographs of former officers and members, correspondence and scrapbooks of the early secretaries, programs of past meetings, and copies of early and recent publications.

A handsome medallion by the artist Leonard Crunelle of Chicago was struck. The obverse carries the figure of Minerva with the motto, *Naturae species ratioque*. On the reverse were the portraits of six eminent members: William Francis Allen, historian; Thomas Crowder Chamberlin, geologist; Philo Romayne Hoy, physician and naturalist; Roland Duer Irving, geologist; Increase Allen Lapham, naturalist and geologist; and George Williams Peckham, zoologist.

The number of meetings held by the Academy varied. Three meetings were held in 1870. The following year there were special and semi-annual meetings. In 1896 only one meeting, the annual, was held, a practice that has been continued. There was the perennial problem of how to make the meetings of greater interest. At that of December 27, 1893, the President asked E. A. Birge to open the discussion of the subject.[15] Most of the members present ventured suggestions. Joint meetings were held at intervals with other societies such as the Wisconsin Archeological Society, the Wisconsin Mycological Society, the Wisconsin Natural History Society, the Wisconsin Section of the American Chemical Society, and others, without apparent benefit. At the present time the Academy does meet with the Junior Academy which it fosters.

Every effort was made to keep the expense of attendance at meetings low. On July 4, 1871, President Hoyt wrote to Lapham that the railroads would carry members to the meeting on the 18th at

60 per cent of the regular rate.[2] Meals and lodging by modern standards were fantastically low. When the meeting was held at Ripon College in 1892, supper, lodging, and breakfast could be had at Wood's Hotel for $1.25. The fare for the excursion to Green Lake was 18 cents. On December 18, 1902, Secretary Ernest B. Skinner sent the Madison members a card reading: "It has been customary whenever the Academy has met in Madison for the resident members to give a complimentary banquet to the visiting members. The banquet will be held this year in the Unitarian Church, Friday evening, December 26, at 6 o'clock sharp. The cost to Madison members will not exceed $1.25 each. Members may bring guests by paying for each guest an amount equal to the actual cost per plate." When the Academy met in Milwaukee the following year the Plankinton House offered to serve a dinner in a private dining room at $1.00 per plate "provided as many as thirty people wish to avail themselves of the privilege."

The original constitution provided for an initiation fee of $5.00 and annual dues of $2.00. The Treasurer reported in 1877 that only 62 of about 200 members had paid dues of any kind.[16] Nevertheless the annual dues were increased to $3.00. In 1880 remedial steps were taken to strengthen the membership. The initiation fee was reduced to $2.00 and the annual dues to $1.00.[17] In addition the old members were given credit for future annual dues to the amount paid in the past in excess of these dues. In spite of these heroic measures 31 members were suspended for non-payment of dues. The initiation fee was subsequently dropped. In 1952 a family membership was inaugurated for the sum of $4.00, the co-member paying $1.00. Only one copy of the *Transactions* went to the family.

The Academy has had financial problems during most of the years of its existence. It is vital that the *Transactions* appear annually for the purpose of exchange. This can not be done by dues alone. President Hoyt[2] wrote to Lapham on February 28, 1870, that he considered it inadvisable to ask the Legislature for pecuniary aid until the Academy had shown that it could do useful work for the state. He soon reached the conclusion that the organization was worthy for on March 22, 1872, he wrote to Lapham that he had succeeded in getting through the Legislature a joint resolution providing for the printing of 2000 copies of the first volume of the *Transactions* to consist of 200 pages. For years afterward the Legislature authorized printing by the state printer of one volume biennially. In 1913, for the first time, a sum of money for printing was placed directly at the disposal of the Academy. Since that date appropriations have varied from zero to $5,000 biennially. The result has been that during the 91 years of the existence of the Academy only 50 volumes of the *Transactions* have been printed. This is far short of the desirable one volume annually.

The constitution provided that life members contribute $100, patrons $500, and founders $1000. At the second meeting of the Academy, July 19, 1870, a resolution was passed to place all monies from life memberships in a permanent endowment, the income from which was to be available for the general purposes of the Academy.[18] The Treasurer reported $807.25 in this fund on February 14, 1872. C. S. Slichter wrote to Secretary Arthur Beatty in 1920: "I think that the Academy is making a great mistake by not soliciting more vigorously the interest of prominent families in the state as patrons of our work. When the Academy was originally started this particular function of its work was 'emphatically emphasized.' "[2] In spite of the long existence of the Academy the endowment fund does not exceed $7500. This is far from the $100,000 contemplated by the founders.

The Academy from the beginning was interested in determining the natural resources of the state including geological and topographical surveys. A resolution was introduced by T. C. Chamberlin[19] at the third meeting that the secretary present an outline of the scientific investigations that have been made in the state and indicate those investigations that were most worthy of pursuit. He was authorized to assign the projects to various members of the Academy. Little or nothing was accomplished in this direction. The President reported in 1872 that "no single county has been thoroughly examined in its relation to all departments of natural history, and much the larger portion of the State . . . has not been favored with so much as a general reconnaissance."[20]

Geological investigations were intermittent. The first State Geologist, Edward Daniels, was appointed in 1853. The following year he was succeeded by James C. Percival who served until his death on May 2, 1856. The Legislature ordered a general geologic survey in 1873. It was commenced under Lapham who served two years, then O. W. Wright took over for two years. T. C. Chamberlin became State Geologist in February, 1876. The field work was published in four volumes between 1879 and 1883. In the latter year the organization passed out of existence. It was not until 1879 that geologic work under state auspices was again resumed.

The Academy was in no position to conduct geological and natural history surveys, but it could influence the Legislature to establish a department for this purpose. At the December 28, 1894, meeting a proposal for establishing a survey of this nature was discussed, and a committee was appointed to draft a bill and secure support for its passage. In Volume X (1895) of the Transactions there appeared the "Report of the Committee on the Proposed Geological and Natural History Survey of Wisconsin." The report was printed as a separate of twelve pages under a somewhat different title. Specific objectives for the survey were outlined. The iron bearing formations were to be mapped, materials for building roads located, and samples of soils collected for examination. Attention was called to the diminishing forest resources and the desirability of knowing what trees to plant on particular soils. Nutritive forage plants should be sought for the large areas of sandy soil unsuitable for agriculture. The zoological investigations would be devoted mainly to the food and enemies of fish. Supporting arguments were: "As an example, we may refer to the whitefish. No one knows anything of the fate of the millions of fry planted in this and adjoining states. No one knows anything of the food, enemies, or habits of the young whitefish." An unsuspected resource were the pearls taken from the Sugar River. This stream during the past six years had produced pearls valued at $500,000 to $600,000. The pearls were removed by killing the clams but they could and should be removed without injury.

The chief supporters of the bill were Charles Van Hise, geologist, and E. A. Birge, zoologist. On January 1, 1895, the following letter, on Academy stationery, was sent to potential supporters:[2]

> Dear Sir:
>
> There are enclosed herewith two copies of the following: the perfected bill for the establishment of a Geological and Natural History Survey in the State of Wisconsin, and a statement of the reasons for the establishment of such a survey, with a map showing the progress of surveys in Wisconsin.
>
> Signed: C. R. VAN HISE, *President.*
> C. R. BARNES, *Secretary.*

In giving their reasons for the survey the pearls were cast aside. A law was passed in the spring of 1897 creating the Survey.

The Natural History Division of the Survey was under E. A. Birge from the beginning. He served without compensation and was paid only for travel and field expenses. His assistant, Chauncey Juday, was employed full time. These gentlemen published in the TRANSACTIONS a long series of papers on the limnology of Wisconsin lakes. Their work is classic.

A few of the minor activities of the Academy may be mentioned. In February, 1874, a committee was appointed to "wait on the proper legislative committee to urge such changes relating to marriage certificates as are recommended in Mr. Holland's paper."[21] Some months later another committee was appointed to investigate an Indian mound near Madison at a cost to the Academy not exceeding $25.00. Resolutions were passed on February 11, 1909, for the conservation of natural resources and copies were sent to the Governor, members of State Board of Forestry, members of the Legislature, and the Public Press.[22] Resolutions were also passed against a proposed extension of the open season for the shooting of ducks in April. Shortly thereafter Congress was urged to pass the proposed bill for the protection of migratory birds.

The latest important achievement has been the establishment of a Junior Academy of Science comprising the Science Clubs organized in the High Schools of the state. For a long time there had been discussion of the desirability of forming a Junior Academy but no concrete plan had emerged. Early in 1944 I discussed with President C. A. Dykstra the potential benefits to be derived from a Junior Academy. The project was placed in the competent hands of E. B. Fred who took the steps necessary to support a junior organization as a University activity. The budget of May 23, 1944, carried an appropriation of $2800 for an unselected person to organize and direct on part time a Junior Academy. The budget was approved on June 15 and John W. Thomson, Jr., was appointed to the position on August 18, 1944. He served until February 1, 1961. Too much credit cannot be given to Dr. Thomson for the organization and supervision of the Junior Academy, and for his long and faithful service. The head of the Junior Academy carries the title Chairman of the Junior Academy Committee. This title expresses inadequately the dignity and responsibility of the position.

The state is divided into seven districts. Each district holds a meeting at which three of the best papers are selected so that there are twenty-one papers presented by pupils at the annual meeting. The meetings of the Junior and Senior Academies are held separately, but at the same time and place. The purpose behind the founding of the Junior Academy was to encourage high school students showing ability and interest in science to follow it as a life profession. This aim has been well realized since 90 per cent of the pupils that attend the district and annual meetings have pursued science in one form or another.

The major accomplishments of the Academy have been the publication of the Transactions ,the building of a science library, and promotion of the Geological and Natural History Survey and the Junior Academy of Sciences. It is doubtful if any other Wisconsin organization has accomplished so much at so little cost to its citizens.

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THE SIGNIFICANCE OF THOREAU'S TRIP TO THE UPPER MISSISSIPPI IN 1861*

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Exactly one hundred years to the day of the time of the last Wisconsin Academy meeting—that is, on May 6, 1862—there died in Concord, Massachusetts, that provocative individualist, Henry David Thoreau. Now the centennial of a man's birth or death—especially of a man of such international stature as Thoreau—often elicits a spate of magazine commentary and academic research. Such seems to be the case in the present instance. However, since the longest trip this stalwart individualist ever made was that taken during the last year of his life to our Upper Mississippi region, and since the general topic of the ninety-second Academy session was the Upper Mississippi, it seemed appropriate that one paper of the conference should deal with this last journey of Thoreau's.

Because contemporary research of that journey had concerned itself largely with summarizing surveys of the records of the trip made both by Thoreau[1] and by his travelling companion, Horace Mann, Jr.,[2] this writer will not attempt a replowing of that terrain but instead will analyze the Thoreau-Mann records from a topical approach, purposing to discuss the significance of the journey from a three-fold aspect: its interest to today's readers for what Thoreau's account reveals of Upper Mississippi cultural and natural history; the probable importance of that trip to seventeen year old Horace Mann, Jr., Thoreau's travelling companion on the two-month Western jaunt; and the significance of that journey to Thoreau himself.

Although Thoreau had originally intended a *three*-month trip for his health,[3] in actuality he was away from home only two months—

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* Paper read at the 92nd annual meeting of the Wisconsin Academy of Sciences, Arts, and Letters.

[1] The first contemporary research in the field was John Flanagan's "Thoreau in Minnesota," *Minnesota History,* XVI (1935), 35–46. This study is based on the Sanborn edition of Thoreau's record, however.

[2] Robert L. Straker, "Thoreau's Journey to Minnesota," *New England Quarterly,* XIV (September 1941), 549–55. This article, based on Mann's letters to his mother, presents the trip as viewed by Thoreau's companion. Walter Harding, ed., "Thoreau and Mann on the Minnesota River, June 1861," *Minnesota History* 37:225–8, supplements the Straker study by giving one more, although uncompleted, letter of Horace Mann's.

[3] See Thoreau's letter to H.G.O. Blake of May 3, 1861, in Walter Harding and Carl Bode, *The Correspondence of Henry David Thoreau* (New York, 1958), p. 615.

leaving his native Concord on May 11, 1861 and returning on July 10—just in time to spend his forty-fourth (and last) birthday with his family. But since part of this two months was used in botanizing in the East (at Niagara Falls on the way out and at Mackinac Island on the return trip), only about five weeks were actually devoted to the Mississippi region—from May 23—when the pair boarded the *Itasca* at Dunleith (now East Dubuque) for the up-river trip to the St. Paul area, to June 27 (when they left the Mississippi at Prairie du Chien to entrain for Milwaukee and thence to sail to Mackinac). Of these five weeks, most of their time—about three weeks—was spent in the then-frontier St. Anthony-Minneapolis-St. Paul section, with the most interesting part of their sojourn (from June 5–June 14) at the private boarding home of a Mrs. Hamilton on Lake Calhoun,[4] exploring what was at that time comparatively wild terrain about Lake Calhoun and Lake Harriet. Since boats were the major means of early public transport in Minnesota before the first ten miles of railroad were laid in 1862, about one week of Thoreau's Minnesota visit was spent aboard the excursion boat, *The Franklin Steele,* with some hundred other passengers, making a winding trip up the Minnesota River to Redwood—there to observe the Sioux Indians receiving their annual payment from the government at the Indian agency;[5] and three days and four nights were similarly spent on the Mississippi boats en route to and from St. Paul. A three-day sojourn in Red Wing, exploring the river bluffs of that region, accounted for the travellers' last time-allotment in Minnesota.

Unfortunately Thoreau had neither the health nor the energy after his return to Concord to organize the jottings of his observations made on this last journey into his usual readable Journal form; so his record remains only in fragmentary jottings. The original copy of these jottings is now on deposit in the Huntington Library, California.[6] The only *published* record of these notes was

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[4] After research through old records and journals in the Minnesota State Historical Society Library, this writer believes evidence points to the location of widow Hamilton's home at the southern tip of Lake Calhoun: Emma Grimes, compiler of *Biographical and Geneological Data of Some Pioneer Families of School District No. 18, Hennepin County, Minnesota,* (1938 typed memoir now in the Minnesota State Historical Society Library) states on p. 3 of the section titled "Mr. and Mrs. Grimes in Minnesota": "One summer Mr. Henry D. Thoreau came to Minnesota to try and regain his health. He boarded with a Mrs. Hamilton who had an exclusive boarding house on the shore of Lake Calhoun, where the residence of the late Judge Ueland now stands." This site is now right near Berry and Lyndale parks, on the strip of land lying between Lake Calhoun and Lake Harriet.

[5] One year later this area along the Minnesota was the site of the bloody Sioux massacres of 1862.

[6] I am deeply indebted to the Museum of Natural History at the University of Minnesota for graciously allowing me access to their photostatic copy of this manuscript for careful study. Throughout this paper, allusion to this document will be symbolized by TM (Thoreau Manuscript), followed by the paging.

made by Franklin Sanborn, Thoreau's editor, in 1905;[7] but this publication was in a limited, private edition, not readily available today; and, even if available, it is likely to be more puzzling than helpful to the modern reader because of Sanborn's usual free editing, haphazard arrangement, and misinterpretation of Thoreau's notations.[8] Since the published Mann letters and the Flanagan study, previously cited, constitute the only accessible printed material on Thoreau's trip but tend toward chronological summary in their treatment, it would seem that a topical presentation, highlighting some of the significant aspects of the trip, is justifiable.

To the contemporary reader interested in the cultural history of the Upper Mississippi area, that aspect of Thoreau's account which undoubtedly would prove most fascinating is the glimpse he gives of life along the Great River in the early 1860's. It was, according to one authority, the heyday of Upper Mississippi boat trade.[9] Immigrants were pouring westward by train as far as the River and then journeying up it to settle in western Wisconsin and Minnesota. The region was also becoming noted for its therapeutic, health-giving qualities—Thoreau's reason for going there.[10] Magazine articles of the 1850's[11] and that popular art creation—the travelling panorama[12]—had done much to acquaint Easterners with the region.

But even before his actual start up the Mississippi, Thoreau had been impressed by the prairie wheat country in Western Illinois—farm land so very different from that of New England! As he described it—

> Distances on prairie deceptive—A stack of wheat straw looks like a hill in the horizon, ¼ or ½ mile off—it stands out so bold & high . . . Small houses—without barns surrounded & overshadowed by great stacks of wheat straw—it being threshed on the ground . . . The inhabitants remind you of mice nesting in a wheat stack midst their wealth. Women working in fields quite commonly. Fences of narrow boards. Towns are as it were stations on a R.R.[13]

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7 Franklin Benjamin Sanborn, ed., *First and Last Journeys of Thoreau*, II (Boston, Bibliophile Society, 1905). This volume will hereafter be cited in this paper as *Journeys*. I am grateful to the Newberry Library for allowing me access to their copy, one of the 492 copies that were printed.

8 Evadene B. Swanson, "Manuscript Journal of Thoreau's Last Journey," *Minnesota History* 20 (June 1939), 169–73, indicates some of the more obvious errors made by Sanborn.

9 Mildred Hartshough, *From Canoe to Steel Barge on the Upper Mississippi* (University of Minnesota press, 1934), pp. 41–108. This author includes, too, interesting historical detail about the three boats on which Thoreau journeyed: *The Itasca*, pp. 132–4; *The War Eagle*, pp. 132 and 140–1; and *The Franklin Steele*, p. 168.

10 See Theodore Blegen. "The 'Fashionable Tour' on the Upper Mississippi," *Minnesota History*, 20 (Dec., 1939), 377–96, and William J. Petersen, *Steamboating on the Upper Mississippi*, (Iowa City, 1937), pp. 298–352.

11 Catherine Sedgwick's "Great Excursion to the Falls of St. Anthony," *Putnam's* 4 (September 1854), 320–5, describing the famed trip of excursionists to celebrate the completion of the railroads to the Mississippi, had doubtless been read by Thoreau, since he published in the same periodical.

12 Thoreau's essay, "Walking," in *The Writings of Henry David Thoreau* (Boston, 1906), V: 224, gives his impressions of one of the Mississippi panoramas.

13 TM, 4.

Later, when actually aboard *The Itasca* headed up the Mississippi for St. Paul, Thoreau gives an impression of the isolation along the great waterway—with the little river towns lining its banks appearing as rather lonely outposts of civilization, tucked in wherever a level resting spot could be found between tall river bluffs. Occasionally, he notes

> a little lonely house on a flat or slope—often deserted—banks in a primitive condition bet. the towns which is almost everywhere—[14]

However, when the daily boats arrived in one of these isolated towns, then the little lonely outpost woke up. Thoreau's description of this awakening is somewhat reminiscent of that famed passage in Mark Twain's *Life on the Mississippi,* describing the steamboat's arrival in the more southerly Hannibal,[15] yet Thoreau's notation was written over twenty years before. It does, however, record the same sudden revival to life of a town when the steamboat approaches:

> Every town a wharf with a storage building or several & as many hotels as anything—& commission merchants. "Storage, Forwarding, & Commission" one or all these words on the most prominent new building close to the waterside—Perhaps a heap of sacks filled with wheat on the natural quay or levee close by—or about Dubuque and Dunleith a blue stacks of pig lead—which is in no danger of being washed away . . . . The steamer whistles—Then strikes its bell about 6 times funereally, with a pause after the 3^{d}—You see the whole village making haste to the landing—commonly the raw stony or sandy shore—the postmaster with his bag—the passenger—& almost every dog and pig in the town—of commonly one narrow street under the bluff—& back yards at angles of about 45° with the horizon.[16]

If the river towns were sleepy and somewhat isolated, the river itself presented much life: Besides the passenger boats which made connections with the railroads on the eastern banks of the Mississippi at Prairie du Chien, Dunleith, La Crosse, etc., there were various lumber rafts floating southward, which Thoreau described in a later letter to Sanborn:

> The lumber, as you know, is sawed chiefly at the Falls of St. Anthony (what is not rafted in the log to ports far below) having given rise to the towns of St. Anthony, Minneapolis &c &c In coming up the river from Dunleith you meet with great rafts of sawed timber and of logs—20 rods or more in length, by 5 or 6 wide, floating down, all from the pine region above the Falls.[17]

The "wooding up process"—so important in those days before coal, oil, or atomic energy were being utilized for boat power—is alluded to in several places. At Fountain City, for instance, they

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[14] *Ibid.,* 5.
[15] See second paragraph of Chapter IV, of *Life on the Mississippi.*
[16] TM, 7–8. Cf. *Journeys,* 26–27.
[17] Letter of June 25, 1861, in Harding and Bode, *op. cit.,* p. 619.

took a wood boat along with them and they "wooded up again before reaching L Pepin taking the boat along with us—now on this side then on that."[18] The actual wood-loading was speeded up by labor co-operation, it seems, for he speaks of twenty men loading "some 9–10 cords of wood in 10 minutes" at one landing.[19]

In regard to the river towns which they passed, Thoreau has a personal notation about almost every one: At Prairie du Chien "the smartest town on the river," exporting the "most wheat of any town bet. St. Pauls and St. Louis", he noted great sacks of this wheat piled up, "covered at night—& all over the ground & the only *bread* wheat."[20] At Cassville he observed "holes in the side of the hills" where lead had been dug, as he had similarly seen the bluffs mutilated for the same purpose near Galena.[21] Winona, "a pretty place" was the spot to which they "towed a flat boat load of stoneware pots from Dubuque."[22] His only comment about La Crosse was that the white pines started half a dozen miles above it; but, knowing Thoreau's love of the white pine, perhaps La Crosse residents can be proud of this memorable association.[23] Below Wabasha he noted an Indian encampment "with Dacotah-shaped wigwams". Here too he saw a loon on the lake and fish leaping.[24]

After leaving the steamer at St. Paul, Thoreau next recorded brief hints of what other frontier communities of the region were like in 1861. Of St. Paul itself he commented that the residents "dig their building stone out of the cellar—but of poor stuff."[25] Although Minneapolis boasted five drug stores, its main streets were "the unaltered prairie with burr and other oaks left;" while of its road over the prairie to Ft. Snelling, he commented that it was "a mere trail more or less broad and distinct."[26] The now-fashionable residential sector of the Lake Harriet-Lake Calhoun area was, in the days that Thoreau and Mann lived at Mrs. Hamilton's, wild enough to reveal pasenger pigeons. The fledgling University of Minnesota, for which ground had recently been set aside in St. Anthony, Thoreau felt looked quite "artificial" in its burr oak setting.[27] Ft. Snelling apparently proved more interesting to Thoreau for the wealth of nature offerings in its vicinity than for its history; but he was fascinated by the mechanical technique by

[18] TM, 8.
[19] *Ibid.*, 5.
[20] *Ibid.*, 5–6.
[21] *Ibid.*, 5 and 7.
[22] *Ibid.*, 9.
[23] *Ibid.*, 6.
[24] *Ibid.*, 7.
[25] *Ibid.*, 8.
[26] *Ibid.*, 16 and 17.
[27] *Ibid.*, 11.

which its ferry utilized the river current to make its crossing and even drew a picture of the ferry's working principle. Yet he devoted a mere two lines to the item that there were 600 volunteers in training at the Fort at the time, with 300 leaving for duty the morning of his visit.[28]

As for the Minnesota river towns which they passed on their three-hundred mile jaunt upstream to Redwood on the *Franklin Steele*, he gives similar brief glimpses: New Ulm consisted "wholly of Germans. We left them 100 barrels of salt, which will be worth something more when the water is lowest, than at present."[29] Near Mankato, the boat "pushed over a tree and disturbed the bats", a fog delayed them for several hours, and the captain ran the boat on a rock![30] Redwood itself, their destination, was apparently more significant to Thoreau because it gave him a glimpse of the open prairie than it was for its Sioux natives on annual display for tourist benefit:

> We were now fairly on the great plains, and looking south, and after walking that way 3 miles, could see no tree in that horizon. The buffalo was said to be feeding within 25 or 30 miles.[31]

But they did not hike toward the buffalo. Nor did they explore Redwood itself—"a mere locality, scarcely an Indian village—where there is a store & some houses . . . built for them." Instead, the travellers made good use of their one-day sojourn at Redwood to investigate prairie botanical offerings.

Red Wing, the pair's last stopping-point in Minnesota, seems to have entranced the two naturalists most. Thoreau had noticed jutting Barn Bluff as an outstanding feature of the community on his way up-river to St. Paul; now on their stay in Red Wing on their return trip they delighted in exploring that bluff for its botanical offerings and Indian artifacts,[32] and in swimming in the Mississippi.[33] In fact, though the community now claims renown for its ceramic offerings, it might also lure travellers by advertising "Thoreau slept here the last three nights he was in Minnesota!"

Modern boat owners of small pleasure craft might find interesting reading in two portions of Thoreau's record for experiencing vicariously, or actually, water journeyings of their own: In one part of his Journal, he gives a detailed listing of the tables of distances between every hamlet along the Mississippi from La Crosse to St. Paul—probably a copy of some steamboat table, such as that

[28] *Ibid.*, 16.
[29] Letter to Sanborn, June 25, 1861, in Harding and Bode, 621.
[30] *Journeys*, 58; TM, 66–7.
[31] Letter to Sanborn, June 25, 1861, in Harding and Bode, 621.
[32] TM 69–74. Cf. *Journeys*, 54–64.
[33] Straker, 554.

of *The Itasca* or *The Franklin Steele*.[34] The second is the graphic description he gives of the 160 foot *Franklin Steele* being maneuvered up the winding Minnesota—sometimes running squarely into the bank, sometimes breaking down trees, sometimes getting "grounded" so that a windlass and cable were necessary to free the boat. Some river bends were so pronounced that passengers even got off the boat and walked across the isthmus to rejoin the slower-moving boat-crowd later.[35]

Although those portions dealing with local river history are perhaps the most readable parts of Thoreau's record, Thoreau himself seems to have been mainly concerned with botanical observations; certainly from the time of his arrival in the St. Anthony area on, he devoted more and more space to these observations—making the account a treasure-trove for botanists but offering, it must be admitted, certain hazards for the lay reader. In fact, one of the difficulties the average reader encounters in examining either the Thoreau manuscript or the Sanborn edition of that manuscript is the constant interruption of Thoreau's daily account by his detailed annotations of flowers observed in different areas, as well as by several summarizing lists he includes, which occupy several pages. One of these lists records plants which Thoreau had known in Concord but which he had also observed in the St. Anthony-Minneapolis area.[36] Another list, consisting of some 113 flower annotations, notes the dates of bloom of various species from the time he began his observations at Niagara up through his sojourn at Mackinac Island.[37] This latter list, which he has labeled "Notes on the Journey West", he may have intended to use later for purposes of comparison with his Concord Calendar, which he had kept for a period of years in recording similar data.

Perhaps someday when the record of Thoreau's last trip becomes more accessible to the general public, naturalists in the Twin Cities' area, the Redwood area and the Red Wing locale will give themselves a "botanists' holiday" by making parallel trips and comparing their present-day findings with those made by Thoreau in 1861.[38] Space limitations, however, will necessitate touching on only a few high points of his findings here:

Thoreau's first botanical observations, on the trip up the Mississippi, had been generalized ones, concerned with comments about the trees that lined the river banks as compared to those that grew

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[34] TM, 61. Cf. *Journeys,* 59.
[35] TM, 67, and Letter to Sanborn of June 25, 1861, Harding and Bode, 620.
[36] TM, 94–7. Note also another list, TM, 40–45.
[37] *Ibid.,* 29–36A.
[38] The Eloise Butler Wild Flower Garden in Minneapolis, devoted mainly to plants native to Minnesota, has a list of its plantings compiled by Martha E. Crone, curator of the garden in 1951. The author of this paper, as a hobby, has been checking Thoreau's listings with the Crone list and finds a high parallelism.

on the tops of bluffs and on the bluff slopes;[39] but afterwards, in the Twin Cities' area, he became more and more committed to detailed observations about flowering plants, although he was still making tree and shrub observations (noting among his findings: the butternut and hickory; American, cork-barked and slippery elm; scarlet, red, white and burr oak; the hop horn beam; white and sugar maple and box elder; various species of poplar, willow and birch; hazel bushes as well as two species of elder; sand-, pin- and choke-cherry; hawthorne; "tree cranberry", hackberry and waahoo).[40]

On the first day of the Mississippi river trip, he had noted at Prairie du Chien particularly the pasque flower (which he termed "*Pulsatilla Nutalliana*"), the bird-foot violet (*Viola pedata*), and the hoary puccoon *(Lithospermum canescens)*—commenting on the root-use of the latter for dye by the Indians. Later, apparently using Gray, Parry, and Wood for sources of reference and comparison in his botanical researchings, he proceeded (with the same zeal he had exhibited in his New England study) to acquaint himself intimately with every living plant he found in each patch of ground he traversed in the St. Anthony-Minneapolis region. While here he recorded many of the flowers that he had known in Concord previously before sighting them in their Minnesota locale, perhaps now recorded as "friends from home" to the nostalgic Thoreau: the marsh marigold *(Caltha palustris)*, blood-root *(Sanguinaria canadensis)*, dutchman's breeches *(Dicentra cucullaria)*, columbine *(Aquilegia canadensis)*, baneberry *(Actaea)*, four species of violet, meadow parsnip *(Thaspium aureum)*, Jack-in-the-pulpit, painted cup *(Castilleja coccinea)*, wood betony *(Pedicularis canadensis)*, blue flag *(Iris versicolor)*, star-grass *(Hypoxis hirsuta)*, bunchberry *(Cornus canadensis)*, wild ginger *(Asarum canadense)*—to mention but a few of those he had located.[41]

Although today congested Nicollet Island in downtown Minneapolis might appear more fruitful for sociological study, as an extension of certain "Skid Row elements" from the nearby depot area across the river, in Thoreau's time it offered more for the naturalist than the sociologist. In fact, it was wilderness enough so that Thoreau sighted a deer there—whether a wild one or one tamed, he does not say. And as for flowers, he spent the first day of his botanical investigations in the St. Anthony area here. On it, and later on nearby Hennepin Island, we find him recording such species as blue phlox (*Phlox divaricata*), prickly ash (*Xanthoxylum*

[39] TM, 5, 6.

[40] *Ibid.*, 10, 12–17, 49–50 and 95–7.

[41] *Ibid.*, 6, 94–7.

americanum), spiderwort (*Tradescantia virginiana*), wild balsam apple *(Echinocystis lobata)* and the frost grape *(Vitis riparia)*.[42]

On his second day of botanical investigation in the St. Anthony area, made on a ride to the Lake Calhoun-Lake Harriet region with his new, naturalist-friend Dr. Anderson, Thoreau seems to have been particularly impressed with the shrubbery; for he mentions noticing the June berry *(Amelanchier)*, the snowberry *(Symphoricarpos occidentalis)*, the wild plum *(Prunus americana)*, and the honey-suckle *(Lonicera parviflora)*; but on closer woodland investigation, they also found such flowering plants as the bell wort *(Uvularia grandiflora)*, the wild crane's bill *(Geranium maculatum)*, and the showy orchis *(Orchis spectabilis)*.[43]

Thoreau's journey to Minnehaha and explorations there and about Fort Snelling the following day revealed to him, among other species: the horse gentian *(Triosteum perfoliatum)*, the blue cohosh *(Caulophyllum thalictroides)*, the common trillium, waahoo, the prickly gooseberry *(Ribes Cynosbati)*, the skunk cabbage *(Symplocarpus)*, and the giant reed ("Arundo Phragmites ten feet high" he records).[44]

Thoreau's ten-day sojourn at Mrs. Hamilton's on the shore of Lake Calhoun, gave him opportunity to observe plants of the lake-shore, woodland, and open prairie—depending on which direction he went for his daily botanical investigations. For the dates from June 5–14, therefore, there are to be found noted among his various plant observations: wild artichokes, the yellow and showy lady slipper *(Cypripedium pubescens* and *C. spectabile)*, the ground cherry *(Physalis viscosa)*, the prairie phlox *(Phlox pilosa)*, the prairie rose *(Rosa blanda)*, the wild hyssop *(Lophanthus anisatus)* —which led him on a tantalizing nose-tingling hunt until he had identified it, the ground plum *(Astragalus caryocarpus)*, and—most note-worthy—the wild apple.[45]

This last discovery, that of the wild apple, was to him the most exciting of Thoreau's botanical findings in the Lake Calhoun region—a discovery which he alludes to later in one of his last, before-death essays: "Wild Apples".[46] Thoreau's botanical "sleuthing" in regard to its discovery reminds one of his parallel excitement in 1853, in tracking down the only pink azalea which grew in the Concord area.[47]

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[42] *Ibid.*, 82, 9, 19, 36, 37, 85.

[43] *Ibid.*, 12–13, 36, 36A.

[44] *Ibid.*, 15, 17, 18, 36A.

[45] *Ibid.*, 92, 49, 51, 52, 53–4, 54–5, 57, 58, 31–2.

[46] Henry David Thoreau, "Wild Apples", in *Writings of Henry D. Thoreau*, (Boston, 1906), V: 302.

[47] See his entry for May 31, 1853 in *Writings, Journal*, V: 203–8.

The first clue that there might be wild apples in the region had come to him on the train through Illinois, where he had noted "flowered, apple-like trees . . . which may be the Pyrus Coronaria."[48] Later, at Lake Calhoun, his landlady—Mrs. Hamilton—informed him that there *had* been wild apples on her premises, transplanted from the wood by her husband but that they had all died. Thoreau went in search of them in the locale where she affirmed that they had grown natively but found only the June berry and wild thorn. Then a neighbor directed him to the home of a Mr. Grimes[49]—then absent, but whose boy

> showed me some of the trees he had set out this spring but they had all died—having a long tap root and being taken up too late, but then I was convinced by the sight of a just expanding though withered leaf—and plucked a solitary withered flower best to analyze. Finally stayed and went in search of it with the father in his pasture—when I found it first myself—quite a cluster of them.[50]

On the road between St. Anthony and St. Paul, just previous to taking the boat-trip up the Minnesota River, Thoreau had been impressed by the profusion of large-flowered beard-tongue *(Penstemon grandiflorus)* and blue harebell *(Campanula rotundifolia)*; while on the trip on the river he noted "acres of roses in the intervales" between the trees, "grape in bloom on a cottonwood," the prairie larkspur *(Delphinium azureum)*, and the great ragweed *(Ambrosia trifida)*, in particular.[51] At Redwood, prairie plants proved an exciting discovery.[52] In fact, he devotes more space to his listings of them than he does his notations about the Indian ritual, although observation of the Indian seems to have been the original intent of the Minnesota River trip.

The traveller's last sojourn in Minnesota—their three-day stay at Red Wing, offered them interesting contrast in plant study between those growing on the river bluff tops and sides and those in swampy areas near the river. Listed among the plants which they observed here were the pale spiked lobelia *(Lobelia spicata)*, another painted cup *(Castilleja sessiliflora)*, the hornless and green milkweed *(Acerates viridiflora* and *Acerates monocephala)*, hairy pucoon *(Lithospermum hirtum)*, black-eyed Susan *(Rudbeckia hirta)*, bladder fern *(Cystopteris)*, the ox-eye *(Heliopsis laevis)*,

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[48] TM, 3–4.

[49] Mr. Grimes owned the Edina Mills in the region and later ran a nursery on the Calhoun road, winning fame both in Minnesota and nationally as a horticulturist. (Eight pages of memoirs of J. T. Grimes in *Biographical and Geneological Data of Some Pioneer Families of School District No. 18, Hennepin County, Minnesota,* previously cited.)

[50] TM, 54–5.

[51] *Ibid.,* 58, 62, 63, 33.

[52] *Ibid.,* 65, 66, 34, 71. Among plants at Redwood he notes *Geum onosmodium,* a sanicle, *Heliopsis laevis,* a Zygadene, and *Coreopsis palmata.*

porcupine grass, bishop's cap *(Mitella diphylla)*, dragon-head mint *(Dracocephalum parviflorum)*, and *Lepidium.*[53]

Thoreau's only comments on Wisconsin plants—which he sighted merely from the train en route from Prairie du Chien to Milwaukee—are a generalized view that a train-observer would necessarily have:

> 1st 60 miles up the Valley of the Wisconsin—which looked broad and shallow—bluffs 2 or 3 miles apart—Great abundance of tall spiderwort—also red lilly [sic]—rudbeckia, blue flag—white and yel. lilly [sic] & white water ranunculus—Abundance of mullein in Wisconsin.[54]

Thoreau's cataloging of birds in the Mississippi region is not as extensive nor as scientific as his botanical listings. However, he takes time out at Minneapolis to enumerate all the birds he had noticed along the way since leaving Chicago; and throughout his botanical observations there are comments, too, of the birds he noted in the same areas.[55] But the two species which seemed most to excite his observation in Minnesota were the wild pigeon and the rose-breasted grosbeak—the first of which is now extinct and the other comparatively rare. Yet at the time of Thoreau's expedition he noted that the grosbeak was "very abundant in the woods of the Minnehaha—and about the fort—singing robin-like all the while;" while at Mrs. Hamilton's he found it "common as any bird in the woods." He even describes the nest of one he had found in a bass wood with its "4 eggs green spotted with brown."[56]

Just as minutely he described the wild pigeon's nest—having located four such nests, all told, in the region near Mrs. Hamilton's: "2 in bass—1 in oak and 1 in hop horn beam."[57] Although the hop horn beam may still be found in the woodland park between Lake Calhoun and Lake Harriet, one will search in vain for the passenger pigeon's nest! Instead, the contemporary naturalist will have to content himself with experiencing vicariously, with Thoreau, *his* discovery of one loosely woven nest in a bass tree (a nest which he describes minutely and even illustrates); or watch with

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[53] *Ibid.*, 69–72.

[54] *Ibid.*, 74.

[55] Among birds in Thoreau's lists were the red-wing black bird ("the prevailing" bird), whip-poor-will, kingfisher, white-bellied swallow, red-headed woodpecker, killdeer, smaller plover, brown thrasher, kingbird, phoebe, "peet-weet," redstart, humming bird, catbird, wood thrush, Wilson's thrush, goldfinch, yellow-throated and warbling vireos, "cherry bird", cowbird, chewink, snipe ("boom on prairie at St. Anthony"), loon, "flocks of cranes, bittern or heron flying up Mississippi", marsh hawk, night hawk, Maryland yellow throat, myrtle warbler, horned lark ("very tame"), bluebird, baywing, white-throated sparrow, tanager, flicker, chestnut-sided warbler, black-and-white creeper, "young eagle eating blue jay in Minnetonaka lake", shrike, cuckoo, passenger pigeon, rose-breasted grosbeak, and meadow lark (TM, 5, 6, 10–16, 50, 52–3, 56, 58, 62, 80, 83, 91–2).

[56] TM, 16 and 50.

[57] *Ibid.*, 80.

him as he peers into another nest and finds therein its young bird "dirty yellowish and leaden with pin feathers"; and, observe, in imagination the distracting antics of the guardian bird as she "slipped to the ground fluttering as if wounded 2 or 3 times as she went off amid the shrubs."[58] But the contemporary naturalist may have twinges of nostalgic regret when he reads that in that long-ago summer of 1861, on the Minnesota River near Shakopee, the "Big Woods" were "alive with pigeons flying across our track."[59]

Besides the wild pigeon and the rose-breasted grosbeak, other birds which engaged Thoreau's special scrutiny were the horned lark, whose song he describes as "a low jingling . . . note—sparrow-like;"[60] the turkey buzzard, which he noted both at Lake Calhoun and along the Minnesota; blue herons and loons. Also, commenting on the difference in song between the Western lark and the common meadow lark, he indicates that the Western lark's note was "very handsome heard at the same time as the common meadow lark—much louder on toodle-em note."[61]

Besides birds, other kinds of wild life that Thoreau included in his annotated comments were bats seen along both the Mississippi and the Minnesota rivers;[62] hyla "cr-a-a-ck" ing in the sloughs of the prairie near St. Anthony;[63] "shad froggs hopping and dripping their water all over;"[64] turtles of various kinds, some of which engaged his attention for that same detailed description that he had recorded in his Concord writing;[65] varieties of snakes, observed on the prairie, at Mrs. Hamilton's and at Red Wing, and which he describes in such generalized terms as—"ribbon snakes," "chicken snakes," "striped snakes," and rattle snakes;[66] "great flight of large ephermae this AM on L Harriet shore & this eve on L. Calhoun;"[67] and, lest Minnesota seem too paradisical in its wild life, tormenting him the first day at Mrs. Hamilton's were "myriads of mosquitoes—wood ticks."[68]

The animal which most intrigued Thoreau, however, was the gopher—presenting a sight novel to his New England eyes. He apparently believed he had noted three different species: the striped gopher, the Missouri gopher, and the Franklin ground squirrel.[69]

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[58] *Ibid.*, 48, 52, 53, 80.
[59] *Ibid.*, 62.
[60] *Ibid.*, 17.
[61] *Ibid.*, 56.
[62] *Ibid.*, 5 and 67.
[63] *Ibid.*, 10.
[64] *Ibid.*, 52.
[65] *Ibid.*, 51, 62, 63, 82.
[66] *Ibid.*, 13, 17, 57, 73–4, 83.
[67] *Ibid.*, 55–6.
[68] *Ibid.*, 92.
[69] TM: 13, 14–15, 57, 82 and 92 for *Spermophilus tridecemlineatus;* TM: 13, 15, 19 and 83 for *Geomys bursarius;* and TM: 91 for S. *Franklini.*

Of these, the striped specimen, "Spermophile Tridecemlineatus erect", most fascinated him. He depicts it as "making a queer note, like a plover over his hole," and graphically describes its stripings as—

> 6 dirty tawny—clay-colored or *very* light brown lines—alternating with broad (3 times as broad) dark brown lines striped—the last having an interrupted line of square spots of the same color with the first mentioned—running down their middle—reminding me of the rude pattern of some indian work—porcupine quills—gopher baskets & pottery—[70]

Before termination of this discussion of the natural and cultural history reflected in Thoreau's jottings, some comment should be made about his notations on the Red Man. When one considers that Thoreau had spent his life studying the Indians, so that at his death he had accumulated eleven volumes of observations for a projected history of this first American,[71] it is disappointing that in his Upper Mississippi record there is a dearth of comment on this native inhabitant. Although when at Mrs. Hamilton's, Thoreau lived in the locale of a former Sioux village on Lake Calhoun, he makes no comment of that fact; however, he does describe the site of the old Pond mission nearby as being then "overgrown with sumac and covered with gopher heaps."[72] True, he had noted the Indian encampment at Wabasha on the way up, and he had discovered some Indian graves—both at Minneapolis and, later, on the top of Red Wing bluff (the chief's grave).[73] But the Redwood trip, probably taken for study of the Sioux first-hand, offers little information except a description of an Indian pipe-lighting ceremony (obtained from the "Illinois Man" on the boat) and some jottings on the Indian dance he had witnessed at the Agency, put on for tourist benefit.[74] In a later commentary to his friends, Sanborn and Ricketson, however, made after the trip was over, Thoreau gave more explicit details about the Sioux gathering in Redwood:

> A regular council was held with the Indians, who had come on their ponies, and speeches were made on both sides thro' an interpreter, quite in the described mode; the Indians, as usual having the advantage in point of truth and earnestness and therefore of eloquence. The most prominent chief was named Little Crow. They were quite dissatisfied with the white man's treatment of them and probably have reason to be so. This council was to be continued for 2 or 3 days—the payment to be made the 2d day . . . . In the afternoon the half-naked Indians performed a dance at the request of the governor for our amusement and their own benefit . . . . In the dance were thirty men dancing and twelve musicians

[70] TM, 13, 14–15.

[71] See Sanborn's comment in *Journeys*, I, xxxvi, and Albert Keiser, "Thoreau—Friend of the Native," in *The Indian in American Literature* (New York, 1933), pp. 209–32.

[72] TM, 91.

[73] *Ibid.*, 7, 82, and 71.

[74] *Ibid.*, 65–66, 66, 68, and 73.

> with drums, while others struck their arrows against their bows. The dancers blew some flutes and kept good time, moving their feet or their shoulders—sometimes one, sometimes both. They wore no shirts. Five bands of Indians came in and were feasted on an ox cut into five parts, one for each band.[75]

It is probable that Thoreau, sincere in his own respect for the Red Man, may have been disgusted with the political tinge of the trip to Redwood. In fact, he also comments in his letter to Sanborn—after first listing the government notables aboard *The Franklin Steele:*

> also a German band from St. Paul, a small cannon for salutes, & money for the Indians (aye and the gamblers, it was said, who were to bring it back in another boat).[76]

Although the space devoted to discussion of the social and natural history of the Upper Mississippi, as reflected in Thoreau's record, may seem extensively treated in this paper, the writer feels that such space-emphasis is justifiable: For, sick though he was, this New England individualist recorded for future citizenry brief but revealing glimpses of life along the Mississippi in 1861; and, even more significant, he included detailed observations of its botany. There remain, however, the two even more important aspects of this journey to discuss—the significance of the experience to Horace Mann, Jr., and its significance to Thoreau himself.

In regard to the trip's importance to the seventeen year old Horace Mann, it seems to this writer that this is one aspect of the journey which has not yet been sufficiently emphasized and explored. What an experience it must have been for the shy, grave adolescent that Sanborn describes to have been with Thoreau—even an ill Thoreau—for two months of botanizing and woodland exploration! In fact, it is the theory of the present writer that this experience may possibly have determined Mann's future vocational career—that of botanist. To prove this statement, let us briefly examine certain facts.

Mann, son of thef amous educator and Mary Peabody Mann and nephew of Elizabeth Peabody of kindergarten fame, was the educator's first child, born in his father's forty-eighth year. In fact, so proudly excited was the father at the birth of this first child that he put aside those famed journals in which he was wont to record edu-

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[75] *Journeys*, II: 55–6. Compare this account to portion from Thoreau's letter to Sanborn, in Harding and Bode, pp. 621–2, noting that Sanborn has added to the original Thoreau letter his own description of the native dance—probably based on Thoreau's manuscript jottings (TM:66) and his own recollection of Thoreau's oral account to Ricketson and Sanborn.

[76] Harding and Bode, 621.

cational philosophizing and recordings and started a new, leather-bound volume whose first page entry bore the news:

> February 28, 1844
>
> Yesterday at 1/2 past 10 o'clock P. M. a male child was born to me. Another Spirit was ushered into being. . . . Whether it shall soar or sink, whether it shall rejoice or mourn—or how much of this depends upon the guidance he will receive. . . . What a responsibility.[77]

That Mann, his wife, and Aunt Elizabeth took that responsibility seriously there is ample evidence. True, at the age of three the child was disappointing his father because he had not yet learned to write; but then he had "made some progress in reading . . . taught by the phonetic method."[78] Fortunately at five the precocious lad was doing better; for he had begun the study of Latin and soon could tell one of Aesop's fables—that of the wolf and the lamb—in either English or Latin.[79] No wonder that in later years he could handle Latin botanical names with facility!

After the elder Mann's death at Antioch College in 1859, Mrs. Mann had returned to Massachusetts, bought a home in Concord, and enrolled the three Mann boys in Franklin Sanborn's school.[80] It was at this time that the friendship between Thoreau and the young adolescent had begun.

Now if one examines Thoreau's Journal entries for 1860 and 1861—the years of their growing acquaintance—a curious fact is revealed: Although Thoreau makes several entries concerning young Horace and the natural history specimens he was bringing in at the time to show the ailing Thoreau, not one entry exhibits any botanical interest on Mann's part! Instead, the youth was either describing or bringing samples to Thoreau of—"a painted turtle," mussels, " a skeleton of a blue heron," "a stake-driver . . . freshly killed," a crow, a screech owl, the eggs of *Sternothoerus odoratus,* a bull frog, hermit thrush, buffle-headed duck, etc.[81] And if one examines the contents of Horace Mann's letters written home to his mother while on the Minnesota trip, the reader will note that many of his early comments concern the collecting of animals: shells, fossils, a prairie gopher and some bird specimens—including a rose-breasted grosbeak. But when the two travellers were at Redwood, it was Mann, not Thoreau, who was bringing in specimens

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[77] Louise Hall Tharp, *Until Victory: Horace Mann and Mary Peabody* (Boston, 1953), p. 199.

[78] *Ibid.,* 212.

[79] *Ibid.,* 238.

[80] *Ibid.,* 317–8 and Straker, 549–50.

[81] See Thoreau's *Journal* entries for October 6 and 10, 1860; and January 11 and 14, February 5, April 16, 20, 22, 25 and May 4, 1861 in Henry David Thoreau, *Writings* (Boston, 1906), XIV: 102, 110, 309, 313, 314, 337 and 338.

of prairie plants; and by the time they had arrived at Red Wing, he exhibits a definite interest in plants.[82] [An ironic sidelight of this botanical interest at Red Wing deserves notice: According to Mrs. Tharp, biographer of the Mann family, there is now in the possession of the Houghton Library at Harvard the leather-bound volume that Horace Mann Senior had used for recording the birth of his son and which later that son apparently used for a flower-press on the Western trip with Thoreau. One of the pressed flowers therein still bears the label "Pulsatilla Nutatalliana, Redwing Bluff, Redwing, Minn., June 24, 1861 (Journey with Mr. Thoreau)"][83]

Whether the Minnesota trip marked the turning point in young Mann's life from emphasis on animal-study to botany, one can only theorize; but upon his return from the West, he entered Harvard that fall—there later to take botany from Gray, under whom he afterwards served as an assistant in the department. Mann was graduated from Harvard with a Bachelor of Science degree—his Bachelor's thesis being a study of Hawaiian plants, based on a research expedition to Hawaii one summer even before getting his degree. At the time of his death at twenty-four (from tuberculosis contracted on a botanical trip to Brazil), he had not only served as curator of the Harvard Herbarium for two years and was being groomed for the head of the botany department subsequent to the retirement of Gray, but he also had some noteworthy publications to his credit: two studies of Hawaiian plants, and a botanical catalog describing the ferns, ground pine, and horsetail east of the Mississippi.[84] Somewhere along the line, perhaps in Minnesota with Thoreau, Mann's interest had shifted from a study of bird and animal life to that of botany.

In regard to the third point under consideration in this paper—the significance of the Upper Mississippi journey to Thoreau—it might be pertinent to our analysis to examine the content of his Western record to see what it reveals of the writer as compared to that earlier Thoreau who had penned *Walden* and revealed himself therein as a composite Man—one who was Poet, Naturalist, Humorist, Philosopher, and Practical Economist. In making such a comparison, we discover that the Poet-Naturalist of the *Walden* era has almost disappeared; in his stead the itemizing Naturalist has taken over—one pre-occupied with plant and animal listings.

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[82] Straker, 552–4, and TM, 66.

[83] Tharp, 336.

[84] Straker, 555 and Tharp, 317. Mrs. Tharp names *Revision of the genus Schiedea, and of Hawaiian Rutaceae* and *Enumeration of Hawaiian Plants* as the product of Mann's Hawaiian research; and *Catalogue of the phaenogamous plants of the United States east of the Mississippi and of vascular cryptogamous plants of North America, north of Mexico* as the other study.

True, the imagery used in describing some of the animal and river life has, at times, some of the poetic tinge of his earlier period; but, particularly toward the last of his Minnesota jottings, Thoreau seems to be resolving himself from some inner turmoil by a very objective preoccupation with these natural history listings. And the Humorist that is so delightfully reflected from the *Walden* pages, seems to have vanished almost completely, except for a wry comment or two in regard to the white Man's treatment of the Indian. As for Thoreau, the Philosopher, he too seems to be definitely absent from the pages of the Western Journal. Perhaps had time and energy permitted, however, these jottings, too, might have been reworked into the philosophical vein of his earlier writing.

One will find evidences, however, of that Thoreau the Economist, who delighted many readers in his first chapter of *Walden;* for several pages of the Minnesota manuscript are devoted to an exact itemization of just how he spent the nearly $180 he had with him on the trip—with listings of each expenditure down to the very last cent used in each locale, whether it be the 50¢ to $1.00 for a night's lodging to the 5¢ he spent for apples on the train.[85] In one place, the ever-honest Thoreau, apparently noting that his accountings for the day didn't total up correctly, even tabulated "cheated 5¢!" Besides this list of expenditures there is an inclusion of just how he was dividing up his travelling money for safe carriage while on the trip: "Left pocket, $78.10; right, $60; bosom, $40"—totalling $178.10.[86]

Now if one considers the purpose for which Thoreau took the Western trip—to recover his health—the manuscript of his upper Mississippi journey becomes highly illuminating: For, although he never mentions his health in it, there is in his itemized list of expenditures and equipment the revealing fact that he spent 50¢ for "trochees" and $1.00 for "pectoral"—both medications for relief of chest congestion.[87] So, indifferent though his Journal appears to make him about health matters, here is a clue that he was willing to spend as much for medicine as for a night's lodging, in the vain hope of relieving his chest congestion.

The manuscript of the journey is also revealing of some definite change in Thoreau's physical and mental state after arriving in the St. Anthony area, for the penmanship becomes more and more irregular—particularly from the recordings of the Minnesota River trip on; and the content of the manuscript also changes, as we have noted, from graphic observations to mere listings of plants, animals and artifacts found in various localities. It is apparent that some-

[85] TM, pages B and C.
[86] *Ibid.*, page A.
[87] *Ibid.*, B, C.

thing had happened to Thoreau during the course of the trip—whether it was a worsening of his physical condition because of primitive boat-travel conditions, homesickness (for he was never happy long from his native Concord), or a traumatic experience. Whatever the causative factor, Thoreau decided to curtail his trip at the end of two months instead of the three he had originally planned.

Although we cannot discount completely the several disappointments at the beginning of the trip which together may have had a traumatic effect on Thoreau—the fact that his plans for both Channing and Blake as his travelling companions fell through so that the seventeen year old Mann became their substitute,[88] and the fact that on his arrival in St. Anthony, he found Thatcher, a Maine friend and distant relative, seriously ill from the after-effects of a carriage-accident so that social recourse in that direction was truncated[89]—yet it is more probable that homesickness and physical illness were the prompting factors in his decision to shorten his trip. For, although Horace Mann's letters to his mother indicate his belief that Thoreau's health was improving or at least remaining about the same,[90] these are the observations of a seventeen year old; Thoreau himself, in his June 25 letter to Sanborn, admitted that he had "performed this journey in a very dead and alive manner."[91] Also, there is the evidence that when his friend, Daniel Ricketson, saw Thoreau in late August—a little over a month after the latter's return from the West, Ricketson was alarmed at his friend's physical condition.[92]

Now if a summation is made of the internal and external evidence revealed in Thoreau's manuscript—the change in penmanship, the shift to a pre-occupation with objective listings, the nota-

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[88] Sanborn's comment in *Journeys,* II: 8–10.

[89] Thoreau's letter of May 27 to his sister, Sophia, on Thatcher's illness (TM:1; Harding and Bode, 617) is more revealing for what it does *not* say than what it does. He asks that letters be continued to be directed to Thatcher's, "for I cannot see where I may be a fortnight hence." But Thatcher's serious illness ("He is much worse in consequence of having been recently thrown from a carriage—so as to have had watchers within a few nights past") precluded any friendly visiting. Fortunately Thatcher gave Thoreau a letter of introduction to Dr. Anderson, the physician and naturalist, so that Thoreau had other social recourse. Thatcher, a merchant in St. Anthony, died that August. He was the brother of the George Thatcher of Bangor, Maine, at whose home Sophia Thoreau died in 1876. (Ricketson, cited below, pp. 181–2). Both George and Samuel of St. Anthony were sons of the Hon. Samuel Thatcher, who had married Sarah Brown, originally of Concord. (One of *their* children, Elizabeth, had been born in Concord.) George Thatcher's wife, Rebecca Jane Billings, was the daughter of Nancy (Thoreau) Billings. (George Thomas Little, *Geneological and Family History of the State of Maine,* New York: 1909, III: p. 1493, is the source of this information on the Thatcher family.)

Since Thoreau's several letters to George Thatcher of Bangor were addressed "Dear Cousin" (Harding and Bode, 229–30, 240–1, 321–2, 485–86, 495, 502–3, 555–56, 630), we can assume he also regarded George's brother, Samuel Thatcher, as his kinsman.

[90] Straker, 551, 552, 553.

[91] June 25, 1861 letter to Sanborn, in Harding and Bode, 618.

[92] Anna and Walter Ricketson, *Daniel Ricketson and his Friends,* (Boston, 1902), pp. 317–22, 16–17, 115–7.

tions of medical purchases for chest trouble, the several allusions to New England people, both in the manuscript and the Sanborn letter (possibly indicating homesickness)—and we add to this evidence Thoreau's own statement of his "dead and alive" condition on his journeying, together with Ricketson's impressions of Thoreau after his return, certain conclusions may probably be drawn: Although Thoreau had taken the Western trip for his health, sometime during the Minnesota sojourn he doubtless realized that purpose was in vain; his health was not improving but worsening. Therefore the significance of the Upper Mississippi trip to Thoreau was that it taught him its uselessness as a health-restorative! In fact, he had learned the meaning of the Emersonian statement on travel preached in "Self-Reliance"—that your Giant goes with you on your journeyings. Ill Health was Thoreau's Giant; and evidently there was to be no release for him from this companion—in Minnesota or on this earth. Instead, Thoreau may even have felt that his time was running out and that Death stood around a near corner.

One can understand, therefore, why the Western trip was truncated at the end of two months. Knowing Thoreau's philosophy of economy—which meant saving one's time, money and energies for the great significant experiences—one can guess why he made an earlier return to Concord. What to him were the flowers and fauna of Minnesota when his own time was so limited? He undoubtedly preferred spending what little remained of life in his beloved Concord. And there were so many things to do in that remaining time:

The only man left in the family as provider for his mother and sister, Thoreau may have decided that publication comprised the "nest egg" on which they could depend. Certainly it is significant that an examination of the extant letters of the last year of his life reveals how few of these letters were friendly epistles and, instead, how many were devoted to business matters.[93] Perhaps those critics who have made Thoreau out as lacking in family responsibility may have wronged him![94] The evidence seems to point otherwise. For, in the limited time and energy that remained to him, we find a man using that time and energy for the future welfare of his family: There were arrangements to be made with Ticknor and Fields concerning the publication of a second edition of *Walden* and a rebinding, for sale, of some 596 copies of *A Week on the Concord and*

[93] See Harding and Bode, pp. 618–45.

[94] Note Edward Emerson's comments in his *Henry Thoreau As Remembered by a Young Friend* (Boston, 1917), pp. 32–8, that it was Thoreau's research on black-lead manufacture that made the family's pencil and graphite manufacture more successful. Evidence seems to indicate, too, that after his father's death in 1859, Thoreau took charge of the family industry. (Note numerous letters for payments on graphite by business firms to Thoreau, in Harding and Bode, 553–5, 570, 576, 586, 595, 602, 605–6, 629, 630, etc.)

Merrimack.[95] There was the feverish readying for publication in *The Atlantic* of several essays enlarged from previous lectures—essays which one critic (Sherman Paul)[96] regards as significant for their revelation of Thoreau's ripening philosophy: "Autumnal Tints," "Walking," "Life Without Principle," "Wild Apples," and "Night and Moonlight."[97] Toward the last, working against time and too ill to hold a pencil, Thoreau was forced to dictate his ideas to his sister, Sophia, who prepared them for *Atlantic* publication.

One other final preparation remained—the readying of that reddish-stained pine chest, built as a repository for his thirty-nine journals and into which they exactly fit—so that the "record of his days and thoughts . . . which cover a quarter of a century"[98] could be preserved for future readers.

From an earlier river trip with his brother John, Thoreau had gathered material for his first book—*A Week on the Concord and Merrimack Rivers.* From his last trip—that to the Upper Mississippi region—there remains no book, only fragmentary jottings. A longer journey lay too close at hand—that universal one which all men must take. Yet, according to all reports from family and friends, his attitude toward this final journey was one of serenity.[99] He had accepted its inevitability earlier, when he wrote in the second chapter of *Walden:*

> Time is but the stream I go a-fishing in. I drink at it; but while I drink I see the sandy bottom and detect how shallow it is. Its thin current slides away, but eternity remains. I would drink deeper; fish in the sky, whose bottom is pebbly with stars.

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[95] Letters to Ticknor and Fields, in Harding and Bode, 637–38 and 638–9.

[96] Sherman Paul, *The Shores of America: Thoreau's Inward Exploration,* (Urbana, 1958), pp. 400–17. Note especially p. 403.

[97] Letters to Ticknor and Fields, in Harding and Bode. pp. 636–7, 638, 639, 640, 645–6.

[98] Perry Miller, *Consciousness in Concord* (Cambridge, 1958), pp. 3–7 and Edwin Way Teale, ed. of *Walden* (New York, 1946), p. 1.

[99] Sophia's letters to Ricketson of Dec. 19, 1861; April 7, 1862; May 20, 1862 in Ricketson, 137–42. See also Edward Emerson, *op. cit.,* 117–8; and Annie R. Marble, *Thoreau: His Home and Friends* (New York, 1902), p. 177.

HENRY JAMES ON THE ROLE OF IMAGINATION IN CRITICISM*

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Henry James's critical writing extended over a full fifty years from 1864 to 1914, and reached its high point in the Prefaces to the New York edition,[1] a unique body of self-analysis. The Prefaces, however, stand apart from the more conventional reviews and essays which reveal the evolution of James as a critic. Two factors are important: Jame's changing conception of the nature of criticism and the duty of the critic, and his gradually evolving conception of the role of imagination in all creative work.

James was at first more the reviewer and critic than the writer of fiction, but the balance shifted and reviews gave place to extended critical essays. In his early reviewing, James announced positive principles. The critic, he held, was "opposed" to his author, bound to consider the work within the limitations of subject imposed on him, without reference to extraneous theory or critical dogma.[2] James distinguished between "great" criticism, which touched on philosophy in the fashion of Goethe, and "small" criticism, such as Sainte-Beuve's. The critic's duty falls somewhere between the philosopher's and the historian's; he is to "compare a work with itself, with its own concrete standard of truth,"[3] and to rely on his reason rather than his feelings. Matthew Arnold, James felt, possessed "the science and the logic" of the good critic.[4]

This intellectual, judicial view did not mean that James was entirely content to "compare a work with itself." From the first he considered imagination a universal standard. His earliest critical essay discussed George Eliot, and on principle James felt himself bound to seek in her work "some key to . . . method, some utterance of . . . literary convictions, some indication of . . . ruling theory." He found it in George Eliot's comprehensive concern for life and her realistic portrayal of average humanity; but he considered her

* Paper read at the 91st Annual Meeting of the Wisconsin Academy of Sciences, Arts and Letters.

[1] Collected and edited as *The Art of the Novel* by R. P. Blackmur (New York, 1934).

[2] *Notes and Reviews by Henry James*, ed. Pierre de Chaignon la Rose (Cambridge, 1921), p. 102.

[3] *Ibid.*, p. 103.

[4] *Views and Reviews*, ed. Le Roy Phillips (Boston, 1908), p. 87.

deficient in imagination, though in comparison with a writer like Trollope who was totally destitute of it she might be considered richly endowed. As compared with decidedly imaginative writers, George Eliot was "exclusively an observer."[5]

Since James somewhat later spoke admiringly of George Eliot's "rich imagination" and commended Anthony Trollope's "purity of imagination," some account must be taken of these striking reversals. In the early 1860's, James made a Coleridgean distinction between imagination and fancy. Imagination would enable the writer to present recognizably living figures, to whom the imaginative reader would respond. The merely fanciful writer could produce cheap and easy effects because he recognized no standard of truth or accuracy. " As in the writing of fiction there is no grander instrument than a potent imagination," James declared, "so there is no more pernicious dependence than an unbridled fancy."[6] In default of acute observation, he noted, a gifted writer might find a standard of truth and accuracy in his moral consciousness. Fancy alone might convey the impression of physical surroundings; the reconstruction of feelings and ideas required imagination.

Within a very few years, James had notably modified his stand. He began by taking a sterner view of the function of imagination, which he now held should "hold itself responsible to certain uncompromising realities."[7] After examining the practice of a number of writers, he concluded that the imagination must conform to facts, but must also provide a degree of sympathetic penetration into its subject to convey the very color of reality. He reassessed his estimate of Sainte-Beuve, whom he found to be a little of the poet, the moralist, the historian and the philosopher, with the littleness of each detectable in his "flagrant default of imagination, depth and sagacity." At the same time, Sainte-Beuve's passion for literature seemed to James "immeasurable, original and delightful."[8]

By 1868 the dogmatic tone has disappeared, to be replaced by an earnest search for justness of characterization of the authors James discussed. His first remarks on George Sand, for example, discuss her "vast imaginative and descriptive powers." Her imagination seemed to him "an immortal imagination, indefatigable, inexhaustible; but restless, nervous, and capricious . . . in short, the imagina-

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[5] *Ibid.*, p. 35 f. "The Novels of George Eliot" appeared in the *Atlantic*, Oct., 1866. In reviewing *Felix Holt* for the *Nation* in August of 1866, James had commented that a myriad of George Eliot's "microscopic observations" failed to equal a single one of "those great sympathetic guesses with which a real master attacks the truth." *Notes and Reviews*, p. 207.

[6] *Notes and Reviews*, p. 32.

[7] "Novels by the author of *Mary Powell*," *Nation*, V (Aug. 15, 1867), 126.

[8] Review of C. A. Sainte-Beuve's *Portraits of Celebrated Women*, *Nation*, VI (June 4, 1868), 455.

tion of a woman."[9] Justness of characterization, it is clear, depended for James upon proper appreciation of George Sand's powers of imagination. When he shortly afterward discussed the role of the critic once more, he ignored his more youthful distinctions and declared that the day of critical dogmatism was over, and with it "the ancient infallibility and tyranny of the critic." It now seemed to him his duty to detach from a work under discussion "ideas and principles appreciable and available to the cultivated public judgment."[10]

He proceeded to attack didacticism and sentimentalism in the novel on the grounds that life is too serious for spurious and repulsive solemnity. On the other hand, levity in the novelist is deplorable, for the reader's imagination is likely to be more in earnest than the author's.[11] The imagination James speaks of by 1870, however, includes the notion of artistic arrangement of material, and its working is connected with questions of both realism and morality; "analytic imagination," presenting a scene with "hard material integrity," can leave behind "a certain moral deposit."[12]

In the early 1870's James began the criticism of painting, with interesting results. The use of terms from painting in his general criticism is less important than the extended discussion of imagination which accompanied his observations. His premises for the arts of painting and of writing were so similar that he at times spoke of books as though they were pictures and of pictures as though they were books. He kept his old distinctions between imagination and fancy, but more and more spoke in terms of the artist's purpose. For he now declared that the fanciful artist who recognizes no standard of truth or accuracy does so in pursuit of effect; the man of imagination, on the other hand, deals in the recognizably real and true, bathed in the light of his own great faculty. On the one hand there is "skill . . . invention . . . force . . . [and] *insincerity*," on the other, "something closely akin to deep-welling spiritual emotion. Imagination is the common name for it."[13] He discovered at about the same time that the composition of a work of art could in itself be a work of imagination, as when, examining a canvas of Tintoretto's, he found that the scene had "defined itself to his imagination with an intensity, an amplitude, and individuality of expression, which makes one's observation of his picture seem less an operation of the mind than a kind of supplementary experience of life." To contrast this artist with Titian was for James to measure the distance between imagination and observation. Tintoretto

[9] Review of George Sand's *Melle. Merquem, Nation,* VII (July 16, 1868), 53.
[10] Review of Rebecca H. Davis's *Dallas Galbraith, Nation,* VII (Oct. 22, 1868), 330.
[11] Review of Benjamin Disraeli's *Lothair, Atlantic,* XXVI (Aug., 1870), 250.
[12] Review of Gustave Droz' *Around a Spring, Atlantic,* XXVIII (Aug., 1871), 251.
[13] "The Bethnal Green Museum." *Atlantic.* XXXI (Jan., 1873), 72.

seemed to James to have "*felt*, pictorially, the great beautiful, terrible spectacle of human life very much as Shakespeare felt it poetically."[14]

The imagination, then, had come to be for James at once the power to conceive greatly and to feel greatly, to organize irreproachably the work of art of whatever kind, and to make it "a kind of supplementary experience of life." Without the quality of life there could be nothing, as he felt the paintings of Domenichino showed.

James's notion of the serious function of criticism was undergoing a gradual change, one indication of which was his increased preference for the method of Sainte-Beuve over the supposed scientific method of Hippolyte Taine. Taine might attempt to knock loose chunks of truth with the blow of his critical hammer, Sainte-Beuve rather disengaged its diffused and imponderable essence by patient chemistry, by dissolving his attention in the sea of circumstances surrounding the object of his study. James found Sainte-Beuve's "frankly provisional empiricism more truly scientific than M. Taine's premature philosophy."[15]

He began to remake his own critical practice, and a sympathetic essay on Turgenev in 1874 reveals something of the critical empiricism he had praised in Sainte-Beuve. He found Turgenev a searching observer, but even more a man of imagination, universally sensitive; he could surpass the French realists in appreciation of sensuous impressions and at the same time appreciate impulses outside the realists' scope. Turgenev's view of human life seemed to James "more general, more impartial, more unreservedly intelligent" than those of other novelists.[16] To express his sense of Turgenev's philosophy, James discussed Turgenev's imagination, which he found it impossible to praise too highly for its "intensity and fecundity." No novelist seemed to James to have created a greater number of living figures, to have had so masterly a touch in portraiture, or to have mingled "so much ideal beauty with so much unsparing reality."[17]

This essay coincides with James's revulsion from criticism as he had practised it. His examination of paintings in Italy had convinced him that the whole history of art was the "conscious experience of a single mysterious spirit." He felt he had worked off his juvenile impulse to partisanship, and he now perceived a certain human solidarity in all cultivated effort. "There comes a time,"

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[14] *Transatlantic Sketches* (Boston, 1875), p. 92.

[15] Review of Taine's *English Literature, Atlantic,* XXIX (April, 1872), 469 f.

[16] *French Poets and Novelists* (London, 1878), p. 275.

[17] *Ibid.,* p. 318.

he wrote, "when points of difference with friends and foes and authors dwindle, and points of contact expand. We have a vision of the vanity of remonstrance and of the idleness of criticism."[18] Within a year he was referring to criticism as "deep appreciation."[19]

At the same time he was enlarging his conception of the imagination. Flaubert in *Madame Bovary* revealed what the imagination could accomplish under "the powerful impulse to mirror the unmitigated realities of life."[20] Another writer's "cultivated imagination" gave out in his work "a kind of constant murmur of appreciation—a tremor of perception and reflection."[21] The "true imaginative force" enabled Howells to give his readers not only the mechanical structure of a dramatic situation, but also "its atmosphere, its meaning, its poetry."[22]

There were negative examples as well: Charles Kingsley's imagination died a natural death when the author turned didactic historian.[23] Bayard Taylor's lacked warmth and could not kindle the reader's.[24] Swinburne's was so completely for style that his criticism was worthless.[25] After the Swinburne essay, James apparently realized that he had at times used "imagination" as a term for the making of poetic imagery. Thereafter he sometimes spoke of "the larger sort of imagination" or "the higher imagination," to mark his distinction.

When James discussed Balzac in detail for the first time in 1875, his chief concern was the quality of Balzac's imagination, and in later essays he returned to it again and again. It was for James the great explanatory fact behind Balzac's reality, his vividness, and his systematizing of the *Comedie Humaine*. Its deficiencies explained Balzac's failures of portrayal whenever he attempted to touch the moral life. He lacked moral depth, which James conceived as no commitment to a specific moral code but simply respect for moral questions and a moral ideal.[26]

This sense of morality was henceforth inseparable from James's thinking on the general role of the imagination. The absence of it led to strictures on Charles de Bernard, Flaubert, and Baudelaire, and to criticism of the French realists at large for being deficient in simple understanding of human nature and human experience. With all their gifts they left too much out of account, and actually seemed inexpert whenever they attempted to touch the inner life.

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[18] Review of Victor Hugo's *Quatrevingt-trieze*, *Nation*, XVIII (April 9, 1874), 238.
[19] *Views and Reviews*, p. 55.
[20] *Nation*, XVIII (June 4, 1874), 365.
[21] *Nation*, *XIX* (July 23, 1874), 62. He was discussing Emile Montegut's *Souvenirs de Burgogne*.
[22] Review of *A Foregone Conclusion*, *Nation*, XX (Jan. 7, 1875), 12.
[23] *Nation*, XX (Jan. 28, 1875), 61.
[24] *North American Review*, CXX (Jan., 1875), 193.
[25] *Views and Reviews*, p. 59.
[26] *French Poets and Novelists*, p. 114.

The *Hawthorne* of 1879 is James's most considerable critical production, and in it he was guided by the practice of Sainte-Beuve: he established the background for his portrait of the man and interpreted the background through his central figure. Reviewing Sainte-Beuve's correspondence this same year, he cited the Frenchman's views with approval. "The critic, in his conception, was not the narrow lawgiver or the rigid censor that he is often assumed to be; he was the student, the inquirer, the observer, the interpreter, the active, indefatigable commentator, whose constant aim was to arrive at justness of characterization."[27] He now termed Sainte-Beuve "a man of imagination."

What he meant at this point appears in the discussion of Hawthorne, who was in most respects a man of fancy, but who could give glimpses into "the whole deep mystery of man's soul and conscience" and deal with "something more than mere accidents and conventionalities, the surface occurrences of life. The fine thing in Hawthorne is that he cared for the deeper psychology, and . . . tried to become familiar with it."[28] *The House of The Seven Gables* seemed to James to be "pervaded with that vague hum, that indefinable echo, of the whole multitudinous life of man" which is the sign of a great work of fiction.[29] This same extensiveness James now attributed to the interests of Sainte-Beuve. By 1884 he declared, "the measure of my enjoyment of a critic is the degree to which he resembles Sainte-Beuve."[30]

James's extensive experience as a writer inevitably altered his criticism; he spoke more and more from his own authority and experience. "The Art of Fiction" (1884) was a thoughtful declaration of principles which in part points out that the novel is a direct impression of life and that its value depends upon the intensity of the impression. The writer must work from reality and experience, but reality has myriad forms, and experience is never complete; ". . . it is an immense sensibility . . . it is the very atmosphere of the mind; and when the mind is imaginative . . . it converts the very pulses of the air into revelations."[31] "Imagination assisting," the artist can deal with anything. Experience is practically constituted of the gifts which are designated as imagination, ". . . the power to guess the unseen from the seen, to trace the implications of things, to judge the whole piece by the pattern, the condition of feeling life

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[27] *North American Review*, CXXX (Jan., 1880), 56.

[28] *Hawthorne* (New York, 1887), p. 65.

[29] *Ibid.*, p .130.

[30] "Matthew Arnold," *English Illustrated Magazine*, I (Jan., 1884), 242. He held that Arnold resembled Sainte-Beuve, with a larger horizon on the side of religion. But he was on the whole "less complete, less inevitable."

[31] *Partial Portraits* (London, 1888), p. 387.

in general so completely that you are well on your way to knowing any particular corner of it."[32]

This declaration of principles explains why in James's criticism the imagination is so emphasized, why it is the ground of so many of his discriminations, and why he insists upon a description of the artist's imagination as part of the discussion of his work. And with his enlarging view of criticism as practised by Sainte-Beuve, James was shortly to remark that works of art grow more interesting as one studies their connections; indeed, the study of connections is a function of intelligent criticism.[33]

When he again defined the purpose of criticism (1891), he made everything depend upon the qualifications of the critic. "Curiosity and sympathy" form his equipment. "To lend himself, to project himself and steep himself, to feel and feel till he understands and to understand so well that he can say, to have perception at the pitch and passion and expression as embracing as the air, to be infinitely curious and incorrigibly patient, and yet plastic and inflammable and determinable . . . these are fine chances for an active mind."[34] This is complete reversal of the early stand, and James characterized himself when he spoke of "the critic . . . who has, *a priori*, no rule for a literary production but that it shall have genuine life."[35]

The later critical essays frequently reconsider figures James had discussed. All of them emphasize the importance of the artist's imaginative penetration of his subject in ways which parallel James's view of the importance of a sympathetic, flexible approach in the critic. But the essays are now the technical criticism of "a man of the craft," as James termed himself. Flaubert seemed to him now the artist "not only disinterested but absolutely dishumanised"; his failure was not that he went too far, but that he stopped short and refused to listen at the chamber of the soul.[36] Yet James praised *Madame Bovary* as a triumph of the artist's imagination; Flaubert had made the form of the novel interesting, without making the form obtrusive.[37] James's criticism of the erotic novels of Serao and d'Annunzio was not a quarrel with subject matter, but with artistic disproportion and incompleteness; they ignored too much of life. Zola was deficient when it came to private subjects; he could deal only with "the promiscuous and the collective." The great lesson of Zola was that without taste, the imagination could it-

[32] *Ibid.*, p. 389.
[33] *Essays in London* (London, 1893), p. 160.
[34] *Ibid.*, p. 276.
[35] *Views and Reviews*, p. 227.
[36] *Essays in London*, pp .132, 156.
[37] *Notes on Novelists* (New York, 1914), p. 80f.

self break down, as in Zola's later novels. Appeal to "science" seemed to James no mitigation of Zola's folly; for the artist, "science" is his consciousness of life.[38] In the best of his novels, Zola was saved by his immersion in his subject, not by his theory. But beyond a certain point, like Balzac, he failed; neither could deal effectively with the life of the mind, or with the "cultivated consciousness."[39]

All the last critical essays bear a family resemblance; the artistic problem is always the general subject, as it was of the great series of Prefaces written between 1907 and 1909 for the New York edition of James's own work. Nothing essentially new was added to the definitions of criticism or of the imagination until a final statement of the effect of criticism showed an entirely different concern. It was a plea for appreciation of method from the reader and an implied demand that the writer satisfy a cultivated interest in it, the final development of James's concern for composition and dislike of everything loose and formless.

> The effect, if not the prime office, of criticism, is to make our absorption and our enjoyment of the things that feed the mind as aware of itself as possible, since that awareness quickens the mental demand, which thus in turn wanders further and further for pasture. This action on the part of the mind practically amounts to a reaching out for the reasons of its interest, as only by its so ascertaining them can the interest grow more various. This is the very education of our imaginative life . . . we cease to be instinctive and at the mercy of chance.[40]

James's criticism reveals the growth of an artistic mind of high quality, and the evolution of his standards explains the changed estimates of writers he repeatedly considered. This itself is sufficient ground of interest. But there is further enrichment in seeing the advocate of "science and logic" turning from judgment to "justness of characterization" and at last to "deep appreciation," with a final word that the very education of the reader's imaginative life must be a prime office of criticism.

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[38] *Ibid.*, p. 54. James put the matter succinctly in his Prefaces. "With a relation *not* imaginative to his material the story-teller has nothing whatever to do." *The Art of the Novel*, p. 106.

[39] *Notes on Novelists*, p. 156f.

[40] *Ibid.*, p. 315.

TRANSACTIONS OF THE WISCONSIN ACADEMY OF SCIENCES, ARTS AND LETTERS

LII — 1963

GOODWIN F. BERQUIST, JR.
Editor

NEW EDITORIAL POLICY FOR THE ACADEMY *TRANSACTIONS*

(Effective Vol. LIII, to be issued in 1964)

The *Transactions* of the Wisconsin Academy of Sciences, Arts and Letters is an annual publication devoted to the original, scholarly investigations of Academy members. Sound manuscripts dealing with the state of Wisconsin or its people are especially welcome, although papers by Academy members on topics of general interest are occasionally published. Subject matter experts will review each manuscript submitted.

Contributors are asked to forward *two copies* of their manuscript to the Editor. The manuscript should be typed and double spaced on 8½ x 11" bond paper. The title of the paper should be centered at the top of the first page of the manuscript and should be *typed in capital letters throughout.* The author's name should appear in capital and lower case letters, and should be *underlined* and centered directly below the title. A note identifying the author by institution or background should be placed at the top of a fresh page, immediately after the text of the article. Upper right hand page notations from the second page on should read 2—Brown, 3—Brown, 4—Brown, etc.

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TRANSACTIONS OF THE WISCONSIN ACADEMY

Established 1870
Volume LII

Earlier this year, a special monograph entitled THE WISCONSIN ACADEMY LOOKS AT URBANISM was issued. This publication was catalogued as *Transactions* Volume LII, Part A. Further copies of the monograph may be obtained at $2.00 per copy by writing to: The University Bookstores, University of Wisconsin–Milwaukee, Milwaukee, Wisconsin 53211.

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Please note that the enclosed publication entitled THE WISCONSIN ACADEMY LOOKS AT URBANISM is Volume 52 of the TRANSACTIONS OF THE WISCONSIN ACADEMY OF SCIENCES, ARTS AND LETTERS, Part A.

THE WISCONSIN ACADEMY
LOOKS AT
URBANISM

A special monograph based upon a series of invited papers on urbanism presented at the 93rd Annual Meeting of the Wisconsin Academy of Sciences, Arts and Letters, Milwaukee, Wisconsin

May 3-4, 1963

Goodwin F. Berquist, Jr., Editor

Vol. LII, Part A

This publication is financed through the joint support of the Wisconsin Academy of Sciences, Arts and Letters, the Ford Grant for Urban Studies of the University of Wisconsin, and the University of Wisconsin-Milwaukee.

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Preface

The Wisconsin Academy of Sciences, Arts and Letters is a remarkable organization. For one thing, it is an interdisciplinary society as the varied departmental affiliation of several of its present officers demonstrates. It is also an association widely supported within the state of Wisconsin. Present membership includes business and professional men, prominent public officials, high school and college students, high school and college teachers and administrators, and a large group of interested citizens. Moreover Academy publications reach a national as well as an international audience. Individual articles in the annual *Transactions* are catalogued by the Library of Congress in Washington, D.C. and copies of the entire publication are mailed to 642 libraries located on six of the seven continents.

From its beginning in 1870, the Academy has focused its attention upon original investigation and the dissemination of new knowledge both in and outside of the state. Naturally the interests of Academy members change from time to time. New questions motivate new research and new articles; new fields of specialization evolve from old academic divisions. One of the most recent of these changes felt in the state, the nation and the world is a new interest in urbanism, in the unique problems of heavily populated metropolitan areas. It was with this interest in mind that the Academy program committee decided in February of 1963 to devote a significant portion of the annual May meeting to a special conference theme, "The Urban Scene."

Eleven persons were invited to address the Academy on specific phases of urbanism. Each was a specialist in the area to which he was assigned. The texts of these eleven addresses appear here.

The editor hopes that in printing this, the first special monograph in Academy history, he may be setting a worthwhile precedent soon to be duplicated in other fields of investigation.

Goodwin F. Berquist, Jr. Milwaukee, Wisconsin

The Wisconsin Academy Looks At

Urbanism

Cover Design by Professor Helmut Summ

School of Fine Arts

University of Wisconsin - Milwaukee

Wisconsin Academy Presidential Address

EUROPEAN UNIVERSITIES: URBAN AND URBANE *

J. Martin Klotsche

I.

In marked contrast to the American pattern of higher education the great tradition of the European university has been urban. Our early colleges were located in the countryside and this pastoral image has persisted until quite recently. But Europe's ancient universities originated in medieval towns such as Bologna and Paris, while in more recent times such cities as London, Birmingham, Manchester, Berlin, Hamburg have established universities that have gained international renown. There are, of course, notable exceptions to this urban tradition in Oxford and Cambridge, a tradition that conditioned the development of American higher education during its early period. Harvard, of course, is the most notable early example. But even the great state universities of the Midwest established in the 19th century were not located in what were to become the major urban concentrations of their respective states. Such cities as Urbana, Illinois; Ann Arbor, Michigan; Columbia, Missouri; Madison, Wisconsin; Bloomington, Indiana; and Boulder, Colorado, illustrate the point.

Why American universities followed the pastoral rather than the urban pattern is not the purpose of this paper. Frederick Rudolph in *The American College and University* suggests that

> the development of the English pattern in the New World was not simply a conscious effort to adapt the collegiate system to American circumstances. It was at first the only solution to the absence of large concentrations of population. Not to have the collegiate

*The materials for this address were gathered during the author's tour of fifteen urban universities in Britain, Germany, France and Italy in August and September of 1962.

way would have required cities—cities that could offer up sufficient numbers of students attracted to the college from the surrounding countryside. In the absence of cities and knowing the English pattern, the founders of Harvard and other colonial colleges naturally subscribed to the collegiate way. By the time that the colleges in Philadelphia and New York were under way, the collegiate pattern was not a necessity, for there were cities. But by then what had been a necessity had become a tradition, and from then on the founders of American colleges either adhered to the tradition or clumsily sought a new rationale.

But, in contrast, most of Europe's distinguished universities are in cities. Thus every one of Britain's ten largest cities, with one exception, has a university. This is all the more significant since there are only twenty-one universities in all of Britain. In Italy, where there are thirty-one universities, every city with a population of over 250,000 has a university. Turin, in fact, has two and Milan has four. In West Germany the same is true. While Tübingen, Marburg and Erlangen come to mind in listing great German universities (all three of these cities have less than 100,000 people), yet with the exception of such Ruhrcities as Essen and Düsseldorf, all of West Germany's large cities boast of a University or a Technische Hochschule. Even the deficiency in the Ruhr will soon be remedied with the creation of a new university in Bochum. France, long noted for its educational concentration in Paris at the expense of the provinces, with one half of the students attending French universities studying at the University of Paris, has few large cities that do not have a major university.

II

European universities located in cities generally have grown haphazardly, accumulating buildings and property in many parts of the city, scattering their holdings and often their faculties over wide areas. Yet, by and large, they have accepted the limitations implied in such growth and have accommodated themselves to the fact that the university and the city bump and elbow each other at many points. There are exceptions such as Birmingham and the Free University of Berlin, but generally a homogeneous, expansive campus such as is common in this country is seldom to be found. In most cases, in fact, it is difficult to determine where the university quarter really begins. Faculties are often dispersed over a wide area. In Milan the law and letters faculties of one university are in one location, and the science faculties elsewhere. In London, with thirty-three self-governing schools and a dozen institutes, faculties are scattered all over the city. In

Paris, the University is scattered through the Sorbonne district with other centers also being established elsewhere. The University of Aix-Marseilles is located in two cities, Aix and Marseilles, twenty-five miles apart.

Tremendous damage to Europe's urban universities resulting from the second war has compounded many of their problems. Many buildings were completely destroyed and beyond repair, while library and scientific equipment deteriorated rapidly through lack of care and use. Those that escaped destruction were often requisitioned as hospitals, or used to quarter troops. Thus, after the war, in the face of physical destruction and with universities badly overcrowded, considerable thought was given to the future location and development of universities. Partially as a reaction to the war, which led to widespread interest in decentralization and diffusion, and partly because of the heavy congestion and high land costs in the center of the cities where universities were located, there was considerable sentiment to leave the city and locate on the outskirts. There was established, for example, a second branch of the University of Paris at Orsy, a Parisian suburb about twenty-five kilometers from the center of the city. In operation now for about five years, it hopes to use its 160 acre campus to draw off the pressure of the 80, 000 students now attending the University of Paris in the heavily congested Sorbonne district. Similar experiments with the split campus are being tried elsewhere. In Marseilles, for example, the concept of the American campus is being developed on the outskirts of the city in Luminy. Yet, for many universities, the pressure to remain in the center of the city is strong. Tradition is hard to break, while the European student is more at home in a café, on a busy boulevard or in a bistro than on a shaded walk or on a spacious campus with ivy-covered buildings.

Thus, the tendency now is to rebuild in present locations, to make piecemeal acquisitions of land as it becomes available, and to build high within permissible limits. (In Paris the Committee for National Monuments keeps a tight rein on building heights to preserve the historic skyline of the Eiffel Tower and Notre Dame.) The Technical University of West Berlin, badly damaged by the war, decided after considerable thought to remain downtown. Thus its old buildings are being rebuilt while new high rise buildings, that match the surrounding massive skyscrapers which house West Berlin industry and commerce, are being added. The University of Frankfurt, with eleven thousand students on a campus originally designed for two thousand, has plans for a twenty-one story building, and plans to move its medicine and natural science faculties to another part of the city. It has reached this decision not only because land is expensive to acquire, but also because the University has full responsibility for the relocation of dispossessed families. The University of Paris, fantastically overcrowded, is now building new and high in the Sorbonne district within limits set by the authorities. But here we have the grotesque example, in order not to incur the wrath of property owners through dispossession, of new facilities for science faculties being built on stilts over the archaic and antiquated buildings of the venerable Parisian wine merchants. In Munich, where great havoc was wrought to University buildings during the war, rebuilding is going on at a rapid pace, with the old buildings being rebuilt with an exact duplication of the original facade. Thus, in one building, to preserve the original outward appearance, there are three floors in the front of the building but five in the back with a "wailing wall" in between to separate the two parts.

Characteristic of the urban university in this setting of central city congestion, high land costs, and difficulty in relocating dispossessed families, is the absence of sports and playing fields, and limited provision for residence halls. Occasionally land has been acquired some distance from the university for recreational use by students or for residence hall development. A notable example of the latter is the Cité Universitaire in Paris, a student town which is not part of the University in the sense that colleges are at Oxford and Cambridge, but which provides housing for 4, 000 of the 80, 000 students attending the University of Paris. The Cité is located at the southern edge of Paris, and while separated from the Sorbonne district, provides a living and social center for many of Paris' students.

Occasionally a university has an opportunity to start from scratch unhampered by a city that envelops it on all sides. The new plan for Bremen University is a case in point. This University, which is in the city of Bremen (eleventh largest in West Germany with a population of 500,000) will consist of over 600 acres with all facilities including dormitories, playing fields, clinics and laboratories in close proximity to each other. Even adequate provision for parking is being made, something that does not concern a university administrator in Europe to the extent that it does here. But Bremen is the exception. In most cases the die has been cast. The university will remain where it has historically been, will make every effort to expand in its present location, build as high as it can and hope for the best.

III

What about the establishment of *new* universities to take care of increasing enrollments caused by high birth rates and by a higher percentage rate of university attendance? Several such universities are being planned in West Germany. Reference has already been made to Bremen and to the projected new university at Bochum in the Ruhr.

Italy contemplates no new universities. It probably has more than it needs now. Some thought is being given to this matter in France, although the greater emphasis is being placed on expanding existing institutions. It is in Britain that the planning of new universities to meet future demand is making greatest headway. Here, however, the plan is not to locate such institutions in the large cities where the people are to be found. Thus, new institutions recently established or being contemplated are located in Brighton (population - 156,000); Canterbury (population - 28,000); Colchester (population - 57,000); Coventry (population - 260,000); Norwich (population - 121,000); York (population - 105,000). There are reasons for this. Since 200 acres is considered the minimum needed to accommodate a student body of 3,000, a location away from the center of the city is almost inevitable. The recruitment and retention of staff will also become more and more difficult in future years. Hence the amenities of life, such as adequate housing at reasonable rates, good schools for children and pleasant surroundings for families are important considerations.

But perhaps of greatest importance in the location of the new British universities is the concept that they are national rather than local or strictly urban institutions. Thus, a new university is being planned for Coventry, even though a major university already exists at Birmingham, ten miles away. Britain's civic universities, such as Birmingham and Manchester, historically began as urban institutions responding primarily to the needs of the specific community in which they are located. This, however, is no longer the case. Already two-thirds of the students at the University of Birmingham and one-half of those attending the University of Manchester come from beyond 30 miles, and plans are now underway to substantially augment residence hall facilities at these universities to make them truly national rather than local universities. The same will be true of the new universities that are to be established. Thus their urban location is no longer as critical as would be the case were they being primarily designed to provide educational opportunity for the young people in the immediate area.

IV

Yet the continent's urban universities differ markedly from American institutions of the more collegiate type and their British counterparts—Oxford and Cambridge. For most European students who attend universities in large cities, there is a noticeable absence of organized social and collegiate life. Students are considered a part of the city. Here they find their recreation and stimulation whether it is in the libraries and bookstalls or in the bistros and beer cellars. Hence little effort is made by the university to provide cultural or recreational opportunities. Students either live with their parents or in lodgings whenever they can be found. Often they are scattered all over the city. Dining halls or skeleton student unions provide the chief meeting place and are nearly always crowded and congested. Thus the spacious setting, the architectural magnificence and the community life of such universities as Oxford and Cambridge are not to be found in Europe's more urban institutions. Missing particularly is the opportunity for the student to come into direct contact with scholars representing a wide range of interest and intellect. In the collegiate way of Oxford and Cambridge, students and teachers live together under one roof with the fellowship of men of different backgrounds and dissimilar views creating an intellectual ferment not possible in the typical urban universities of Europe.

The most essential function of a university, Hastings Rashdall concluded in *The Universities of Europe in the Middle Ages,* was "to make possible the life of study whether for a few years or during a whole career, and to bring together that period face to face in living intercourse teacher and teacher, teacher and student, student and student." Such opportunities for varied and stimulating personal contacts, characteristic of the ancient universities, is not possible for the many now engaged in university education in the large urban centers of Europe. Writing about the University of London at the beginning of the century, Sidney Webb argued that the high degree of affluence and social privilege on which the older universities rested was not and never could be provided by London conditions and even if they could, students might hesitate to take advantage of them. To study in order to be able to engage in leisure pursuits is contrary to the bias of many of Europe's university students who have no financial security, can enter the university only with considerable financial subsidy and who must earn their living in a competitive world as soon as their university work is finished.

Yet there are compensations for the student attending Europe's urban universities. Devoid of the collegiate life of the ancient university, there is nevertheless stimulation and variety of many kinds. "In loco parentis," in which the university assumes parental functions as is so often done here, is foreign to the European university. Not only does the student have more freedom of choice in the selection of his courses and in class attendance, but his interests are broader and more urbane. He feels a great responsibility for active participation in the political life of his community, and has an unusual awareness of his opportunities in this regard. Large numbers of students are associated with university political units of national parties, and tend to continue the intellectual activities of their university days throughout their adult lives.

Nor is the city without its attractions to the university student. Henry Commager, writing in the *Saturday Review* of September 16, 1960 [issue], points out that when Americans go abroad for study or teaching, they do not seek out the universities in the smaller towns. Rather

> they head for the big cities. And this is because they know they can count on an exciting relationship between university and community in almost every country of the Old World. What lures the American student is the life of the boulevards, the cafés, the bistros; it is the Latin Quarter; it is the opera and the ballet, the theatre and the experimental film; it is the bookshop on every corner, the dozen newspapers in every city; it is the mature student body, educating itself, joining in the risks of life, taking an active part in literature, journalism, art, and politics. It is, too, the beauty of the cities that they know they can count on—not just the beauty stored away in museums, but the beauty of houses that have been allowed to grow old, of parks and squares instead of parking lots, of riverbanks not given over to industry but to pleasure, of gardens in the heart of town, of bridges that you can walk across without risk of life, of bicycle paths that parallel busy boulevards, of sidewalk cafés, and of carnivals on street corners.

If this is true of the American student who goes abroad, it is equally true of his European counterpart, who finds the atmosphere of the city with its pulsating life and its vitality and individuality congenial and suited to his needs and requirements.

Writing in 1930 on the occasion of the University of Manchester's 50th anniversary, the *Manchester Guardian* concluded that no doubt should any longer exist about the wisdom of having established the university in this industrial center.

> The day has long gone by when it could be doubted if a great industrial center like Manchester were the suitable or the best place for a University. Such doubters forgot the active life of Florence, where Galileo lived and Leonardo and Michelangelo. Where the pulse of life is highest, in the great congregations of men, and men's energies in manufacture and trade are at their highest strain, there also the other energies have their likeliest play. Science and the arts are the flowering, and, in one sense of that vague word, the romance of life. True romance is not,

however, remote from the daily life; it is rooted in it. It is a dull eye which cannot penetrate through the dirt and fog of Manchester to its underlying poetry. Indeed Lancashire may claim to be, even in the face of Yorkshire, the most romantic of English countries and yet a vast field of industrial work.

V

What of the university's relationship to the community in which it is located? Many of Europe's leading universities whose origins date to the Middle Ages, came into being when urban life was conditioned and controlled by self-regulatory and self-perpetuating corporate guilds. In the case of the university, these guilds were composed of scholars who established their own curricula, set their own standards and controlled their own appointments. In terms of their later development, this fact established a tradition of academic freedom that became institutionalized and tended to nurture a hands-off tradition by outsiders. Quite the reverse was the case in this country where private groups of citizens or legislative bodies organized colleges and universities and materially influenced the course of their development in terms of their objectives, functions and scope. But in Europe, with the exception of the provincial universities established in Britain in the 19th century, where civic influence made itself felt from the very beginning, universities were nurtured in an atmosphere of detachment that is zealously guarded by these institutions, even to this day. Thus, the lay board of control as we know it here, which often decides matters of major academic policy, is not known in Europe, and because decisions of an academic nature are made by faculties and not by governing boards, universities are less affected by pressure groups or by special interest organizations.

As for financial control, the state, of course, assumes a central role. While universities maintain considerable freedom in their operation, yet a substantial portion of their fiscal support comes from the national government. Even in Britain where institutions are independent and self-governing, a major portion of their financial support comes from Parliament through the peculiarly British mechanism, the University Grants Committee. Appeals are made from time to time to private and local groups for financial support. Businessmen and industrialists in Milan, for example, have recently shown considerable interest in institutions located there. Thus Italy's largest chemical industry, Montecatini, sponsors scholarships totalling $10,000 annually for students studying industrial chemistry at the Polytechnic Institute. In Florence, the local chamber of commerce recently equipped a laboratory for the Faculty of Agriculture and provided funds for an additional position in the Faculty in Law. But these are exceptions rather than the rule. The universities, steeped in a tradition of detachment, and receiving heavy financial support from the national government, have not exploited the resources of their cities or of private citizens in the manner that is often done here.

Most notable exceptions to this pattern are the civic universities established in the last century in Britain in new centers of industry and population. They were from their inception created to meet local needs, were supported by local benefactions, and interested themselves in local industries. The emphasis on metallurgy in Birmingham, steel at Sheffield, textile technology at Manchester and Leeds, marine engineering at Liverpool and Southhampton illustrate the point. Here there was a strong desire to link the universities with the practical life of the community, with training for work rather than education for leisure a prime consideration. Thus, shortly after the establishment of the University of Birmingham, its first chief administrative officer urged it to

> Keep in close touch with the community, do not seek for independence or isolation, encourage the leading men to take a living and personal interest in college government and give them plenty of real power. Welcome civic control, do not attempt to found an isolated institution for imported scholars to continue their researches and to train youth in learning out of touch with the life and activity around them. Keep in close touch with that life and activity and in any new departure carry the community with you.

Yet it goes without saying that European universities, including those located in large cities, are less responsive to public opinion or local pressures than is the case here. No doubt there are some advantages in such a detached relationship. It gives the university a much better opportunity to focus constantly and continuously on its primary function—the transmission and extension of knowledge. However, a price is paid for this detachment, for often the universities lose by virtue of their failure to understand the social milieu in which their institutions operate, thus neglecting the legitimate needs of the society that supports them.

European universities thus take relatively little interest in the practical aspects of professional and vocational life. A substantial portion of the curricula found in our universities would be considered outside the jurisdiction and scope of European universities. Such programs as home economics, journalism, commerce and accounting, applied arts, elementary education and physical education are rarely found on the continent. Instead these are considered the domain of special technical institutes or training institutions, which bear the major burden of what would be called vocational training. This is true not only of those universities that date back to the Middle Ages and are heavily encrusted with tradition. Even the newer ones, perhaps in their anxiety to achieve status and respectability, place heavy emphasis upon the classics and on the theoretical rather than the practical aspects of subject matter.

The innate conservatism of Europe's universities also discourages innovation and experimentation. Thus a concern with the field of urban studies which is now being carried forward at a number of American universities would not be embraced with equal enthusiasm abroad. Such an emphasis would be considered "beyond the pale" and scarcely a proper program to include in a university curriculum. Even the study of economics is considered in many quarters a radical departure from tradition, often existing as an offshoot of the faculty of law.

VI

Thus Europe's universities by tradition and inclination seldom relate themselves to the immediate city in which they are located. Even though jostled by the city, there is little disposition to assume responsibility for rebuilding, beautifying or assisting it in dealing with the overwhelming problems which it faces. European cities have great traditions and a rich history which the universities respect and admire. But the problems of the contemporary city are not of immediate concern to the university scholar. In a sense this is unfortunate for the presence of a university in a major city presents opportunities not always to be found in the more ancient establishments removed from the influence of an urban environment. Sir Walter Moberly in delivering a lecture at the University of Manchester in 1950 commented that

> A civic university cannot, if it will, have all the virtue of the cloister; it should therefore make the most of the virtues of the market place. It cannot be entirely shielded from all that is ugly, sordid or raucous, because it is in the midst of the hurly burly, of the rough and tumble of human life; but for that very reason it can do certain things better than 'Oxbridge.' It is easier for it to preserve a sense of proportion and to avoid self-importance. In a university that is not too remote from 'men unblessed,' it is easier to preserve a sense of reality.

Sir Walter was suggesting that an urban university can play a unique and distinctive role in relating itself to the city in which it is located. It can hold up to the view of the community a profile of itself that has the vantage point of perspective and reason. It can examine the metropolis in its totality, seeing one problem in its relationship to the whole of the urban scene. It can identify both the shortcomings and the accomplishments of the community. It can rise above the local prejudices that stand in the way of progress. It can be a constructive critic, a standard setter, a balancing force. It can blaze new trails, it can stand over and above the tumult and shouting of the market place. It can speak out boldly on matters of principle and bring clarity to community thought in a climate free from bias and emotion. It can identify not only what is and can be, but what should be. Thus by its very nature, it can bring urbanity and sophistication to the metropolitan area it serves. In short, a university must be both a part of and apart from its city. Thus, one might view the university and the city as represented by two overlapping circles which cross at certain points. At the point at which the two circles overlap, there the common concern of the city and the university intersect. But there are also large areas of each circle that are the special domain of the university and the city and in which each can make its own special contribution.

On the one hand Europe's urban universities have successfully withstood the pressure of being all things to all people. They have consistently aimed to be respected rather than popular. And because they have pursued this goal relentlessly, the cities in which they are located have viewed them not only with pride but as the focal point for the preservation and transmission of the intellectual accomplishments of mankind. But on the other hand, they have not successfully related themselves to their urban environment using the special skills available to a community of scholars as a source of strength to assist the city in its search for a better life. Our society is urban and will become more so in future years. But if there is to be an urban civilization worthy of the name, the universities must play their part in making cities centers of civilization, regaining their historic place at the center of the community and assisting in its regeneration not only as a market place and workshop, but as a human abode and as the center of cultural and intellectual energy. For the city will always be needed as a nerve center of artistic and intellectual development and urban universities can play a strategic role in achieving this goal.

URBAN PROSPECTS: 1970 AND BEYOND

Robert C. Wood

I approach my assignment tonight with mixed emotions. I am of course honored to participate in meetings of an Academy that represents arts and letters as well as sciences and welcomes professionals and laymen alike to consider important topics of the day. Yet simultaneously, I confess to considerable feelings of anxiety.

One source of my anxiety relates to the locale. No outside urban "expert" undertakes a Wisconsin engagement lightly. At least since the days of John Gaus, the University of Wisconsin at Madison and now at Milwaukee has been such a center of distinguished scholarship and teaching in urban studies as to evoke the admiration and occasionally the envy of other institutions similarly engaged. In recent years you have added to your historic strength. The presence of Coleman Woodbury, Henry Schmandt, Leo Schnore, Kirk Petshek, Henry Fagin on your campuses—to name only old friends—multiplies your resources, attracts new and able scholars and makes possible research of variety and depth. Moreover, your academic talent is powerfully supported by Wisconsin's illustrous tradition of practicing urban political leadership. So Frank Zeidler, to single out but one example, served not only this city long and well but contributed significantly to the national field of urban policy-making. It is natural, then—to plagiarize from one of my colleagues—for me to feel like a lion in a den of Daniels.

A second course of anxiety stems from the general state of the field of urban studies today. To those of you in other disciplines, let me briefly characterize our current circumstances. We are completing almost a generation of intense activity and ferment in areas of the social sciences once assigned to the backwaters of our respective disciplines. In the immediate post-World War II period, to be labeled a student of state and local government, of urban sociology or of regional economics, was equivalent to having an epitaph placed on an otherwise promising academic career. Of lectures and sermons in the field of local affairs we were well endowed. Of systematic empirical investigation we depended primarily on the fragile foundation of the muckrakers and the Chicago School of urban sociology.

Yet in the last twenty years, a minor revolution in scholarship took place. Victor Jones broke new ground for political science, to be followed by Coleman Woodbury's classic analysis of the process of urban redevelopment. In the 1950's, a national flood tide of research occurred, spearheaded by the massive St. Louis, Cleveland and New York surveys. To be sure, to our colleagues in the natural sciences the financial basis of these efforts may seem puny—some twenty or thirty million dollars in all. But to the social scientists, not yet accustomed to the lavish ways of the National Institute of Health, the Department of Defense or the National Science Foundation, the magnitude still seems impressive. Books, surveys, recommendations for reform tumbled after one another until today a graduate student in our fields only has to *think* he might major in urban studies before a contract to write a textbook is thrust into his hands by an eager publisher.

Now, however, if I read the signs of the times rightly, this initial burst of energy is past, the bloom is off the rose, and we are in that hard and tough position of sciences slowly maturing. New models are increasingly hard to come by; conceptual and policy advances alike appear more marginal; stubborn problems of methodology beset us. As a "soft" science trying to come of age, we have passed the stage of alchemy and the dialectic in our analysis of urban phenomena; yet we have not yet achieved the status of a genuine science.

It is in this context that I want to analyze American urban prospects, and essentially in three parts. First, I want to recall the popular prognosis for urban life in the latter part of the twentieth century, the forecast of urban culture which is generally accepted in the Sunday supplement. Second, I would like to comment briefly on the academic dissent to these predictions which has emerged only in the last two or three years—a dissent that often seems to approach a rejection of the value of continued scholarly work in the field. Third, let me suggest another view of the future, built upon our new empirical findings, dissenting just as vigorously from the present conventional wisdom, but still persuaded that there are puzzles and policy problems aplenty to justify continued and renewed academic efforts.

The Civic Cassandras

Let me begin by recalling briefly the popularized interpretation of the urban experience in postwar America. In broad strokes, the lines of analysis that predominated in the 1950's rested on two assumptions. First, they held that the pattern of American urban settlement was undergoing a dramatic transformation touching almost every aspect of our social and political behavior. In a sentence, the common version was that at some time between 1940 and 1960 the United States passed a watershed where the compact, visible industrial cities of the nineteenth century exploded into new "spread" cities, vast new metropolitan regions, themselves blending into great linear megalopoli. Second, the more straightforward versions of this thesis promised catastrophe ahead. Our urban community, our polity, even our national character were held to be in the process of rapid and unhealthy decline.

The departure point for these prophecies of domestic doom and gloom was the disappearance of the classic American city, which, as it was recalled, may not have been admirable but was understandable and seemed manageable. For all its faults, the Victorian city had clear boundary lines, sharp demarcations between open countryside and densely settled city. One knew the limits of the phenomenon. Moreover, the underlying factors of urban growth seemed obvious. Cities were established to do business—to produce goods, to conduct commercial transactions. Hence, a fortuitous physical location, ready access to transportation facilities or to raw materials important for industrial processes, with a capacity to attract skilled labor, were the simple essentials of urban development. The city's predominant symbol was likewise business in character—the Horatio Alger entrepreneur, the millworker, his dinner pail, and his weekly trip to the beer parlor on payday.

Not only simplicity of purpose but optimism and vigor of spirit characterized that city of song and story. It was the land of opportunity and assimilation, for the immigrant from abroad or from the depressed farm lands. Even its politics after World War I offered challenge for the righteous, a cause for the middle class, if not always easy victories. There were bosses and political machines to be fought, cynical land speculators, and transit and utility companies to be subdued. Though the old city was often corrupt, sometimes cruel, its benefits seemed clear, its problems, obvious. Toward the end of its existence, practical policy solutions, especially to journalists and some scholars, were at hand.

The watershed after World War II, according to the popular version, fundamentally changed the properties of urban life. More important, the transformation introduced new and large uncertainties—in analysis and prescription. The spill-over of population to the suburbs seemed enormous. The sudden diffusion of population, industrial and commercial establishments, were initially hard to comprehend. The resulting metropolitan sprawl, first into spread cities, then into

Jean Gottman's megalopolis, was difficult to visualize and even harder to conceptualize. The new pattern of American urban settlement was ripe for the mournful laments of Lewis Mumford and Jane Jacobs.

Even the more factual analyses were disturbing. The classic formula of urban location no longer explained differential growth patterns among cities. As transportation costs fell rapidly, new synthetic materials replaced native resources, decentralization of industry accelerated, market considerations became increasingly significant. So Raymond Vernon could conjecture after directing the New York "metropolitan region" study that continued metropolitan growth was a function of a city attaining a critical mass of consumers. In place of the image of the worker in the beer parlor or the sturdy entrepreneur, the symbol of the new spread city seemed more feminine than masculine. To David Reisman's discerning eye, a new American character was born, outer-directed, driven by the tastes of others. The new picture of the national urban life was of a suburban family hitching its new motorboat to its station wagon, in front of the ranch house on a Sunday, after-church together.

As the boom in metropolitan commentary continued, other aspects of our urban progress seemed alarming. The core city no longer accommodated immigrants who could with surety believe that soon they would join the middle class. Instead, it became the receptacle for persons and activities other parts of the metropolitan area did not care to support: Skid Row, the permanently disprivileged, and the southern Negro and Puerto Rican who faced a much harder journey up Samuel Lubell's old tenement trail. New suburbs came to take on the character of garrison states devoting much of their time to acquiring the "right people" and the "right industries" and keeping out the wrong ones. Urban politics was no longer a simple issue of black hats against white hats, bosses versus reformers. Instead, as the spread city grew, so, too, grew the number of separate decision-making centers. Power became diffused in many municipalities, many special districts, many elites, many authorities. To many observers, the critical problem of public policy was how to assemble sufficient political power of whatever variety to make meaningful and rational local political decisions. In the metropolitan world of fractionalized government, the search for a man or an elite who "ran the town" was increasingly fruitless.

Given a predominant analysis that emphasized the disappearance of the old form of urban life, radical change stimulated by a rapidly advancing technology, new styles in economic, social and political behavior, it is not surprising that urban prospects beyond 1970 to many took on the aspects of catastrophe. Where would we find new community facilities and services for the mushrooming suburbs? How could we save downtown? What would we do with the new immigrants? How would we relieve traffic congestion and save the commuter railroad? What did the man in the gray flannel suit represent? To some scholars and to more journalists the conviction grew that the American urban structure was spinning out of control, pushed on relentlessly by the geometric expansion of automobiles and the unscrupulous designs of land speculators and mass housing developers. The metropolitan problem moved up sharply on the agenda of public affairs. Government officials, universities and businessmen alike buckled down to the task of somehow establishing mastery over the metropolis.

The Academic Dissent

It is paradoxical (but in some ways reassuring) that just as the new spread city was discovered, its properties identified and contrasted to those of the city which preceded it, and public and political interest pushed to new heights, the academic students of urban affairs grew suspicious of the interpretation their own work had stimulated. What is impressive about the literature of the last few years in contrast to that of the decade just preceding it, is the new spirit of skepticism. In sharp contrast to the popular themes of change and revolution, scholars now emphasize first that the new spread city is susceptible to the techniques of traditional analysis. Second, they have come to view our present circumstances and future direction as little more than the continuation of long-established trends in American social, economic and political behavior.

Sociologists, for example, now often point out the development of the metropolitan region is principally a function of expanded population and income, of conventional ideology which honors family life in America, of the predictable consèquences of technology. Above all, they are persuaded that the location of households and the development of settlements within metropolitan areas are best explained by the time-honored model of class structure. What they see is not the homogenization of all Americans into an all-inclusive middle class. Rather, they search for and find a process of sharp, though subtle, class stratification at work in a larger spacial context.

In the same vein, many economists find nothing worthy of special attention in the functioning of our regional economics. To them, the decline of agriculture, the relatively slow growth of manufacturing and the rapid expansion of service industries provide an adequate explanation of changes in the size and composition of the urban labor force. The movement of the large manufacturing plants to the suburbs in search of space and easy access to express highways seems to them a natural occurrence. Though they acknowledge the new market orientation of the large metropolitan areas, this seems essentially a function of size. It requires few adjustments in their traditional tools of the trade. So, too, the discovery of the new mix of activities in downtown—as the preferred location of the home office, the confrontation industries, the small manufacturing plant just beginning—is the continuation of historical developments that appear both explicable and predictable in the years ahead.

Even the political scientist, the analyst initially most agitated over the behavior of ancient local political institutions and processes in the new metropolitan environment, now appears much less alarmed than in the decade just past. New research has demonstrated that the continued popularity of autonomous suburban governments is both normal and natural. Simply put, these small units provide more access to local officials and more representative government to the small constituencies involved than do mammoth metropolitan units. They provide the continuation of grass-roots values embedded in our national ideology, and these values are at least to the public more important than the administrative ones the earlier metropolitan reformers espoused. In spite of their earlier concern, political scientists these days find that law and order still prevails in the spread city, that community facilities and services are still somehow provided. Indeed, some are not persuaded that the existence of many small jurisdictions within a metropolitan area provide an element of choice in neighborhoods, schools, and public programs which never existed before. In short, they see a functioning political system in being, however much its multiplicity, contentiousness and fragility may offend advocates of strong, tidy and rational governments.

A New Model

If the line of reasoning employed so far seems plausible, we have arrived at a curious position so far as the analysis and manipulation of our new urban regions is concerned. Just at the time when thinking laymen and policy-makers are finally persuaded that we have a metropolitan problem, the best academic minds in the field are increasingly doubtful that there is much to concern the nation. Established methods of analysis are sufficient to explain the phenomena they investigate; genuine reasons for advocating major policies of reform are hard to come by. The drift of affairs is both explicable and by the values on which their disciplines are grounded, apparently satisfactory. Urban prospects 1970 and beyond for them are simply prospects for larger and larger areas and larger and larger economic, political and social urban systems. A great increase in the scale of organized community life has occurred but there are few indications that a radical reordering of these systems is likely or desirable. In short, the result of a generation of effort at new analysis seems to be that we have researched the problem away.

Yet a case can be made that we have scarcely begun either to understand or to come to responsible policy conclusions about our vast new metropolitan areas. It is possible to suggest a new model not based simply on the more manifest properties of the spread city but rather on more basic forces at work in the metropolitan transformation. These forces our first research efforts ignored, or at least gave scant attention to. A case can be made that the new urban regions are not the result of traditional forces at work, to be analyzed by the traditional tools of empirically-oriented behavioral social sciences. Instead, they can be seen as representative of new aspects of a nation now propelled increasingly by the process of sustained scientific and technological innovation. In such a context they pose new problems for social science analysis and for policy prescription.

Let me begin with the poorly understood and vexing problem of differential growth rates among urban regions. When one tries to account for the explosive growth in southern California, southeast Michigan or even the limited resurgence of the Boston metropolitan area, for example, the classic economic analysis, balancing market, transportation and resource considerations, is not an entirely persuasive explanation. Rather, one begins, as Richard Meier has done, by positing that the key element in our labor force now is the pool of scientists and skilled personnel necessary to operate the complex technological enterprises represented by the growth industries. Here a different set of considerations come into play. The new engineer graduates from college with choices, and on his choice of location turns the future of many an urban region. Further, in these days of the cold war, the companies bidding for his talent are more likely than not to be dependent on government research and development support for the expansion of their activities. It is the interaction of these two factors, government decision-making in contract awards and preferences of the critical manpower pool, that may dictate the fate of many a city.

What does the new engineer look for? Reliable studies have only just begun on his preferences and behavior, but what information we have suggests at least three criteria are relevant. One is his desire for family amenities. Schools, recreational opportunities, the cultural and aesthetic character of neighborhood development, the environment in which he chooses to live, are often as important as his working environment. Second, the need to be able to change jobs quickly and yet stay in the same house, as one company rises and another falls, beholden to the changes in the Federal research and development budget, is relevant. So easy access to an express highway in southern California where one can move annually from one plant to another but not uproot the family becomes an advantage. Third, and perhaps most important, the close proximity of the great university where new innovations, new techniques, new discoveries can quickly be translated to the alert and expanding firms seems increasingly essential. Urban regions possessing these properties are more likely to attract the new engineer than those which do not.

From a company point of view, in the new age I have been describing, another set of special facilities are relevant. One is the existence of research parks, in contrast to industrial parks—what Meier calls breeder building flexibly designed to house initially many types of small companies just getting started. Later on, the successful will grow rapidly into facilities of their own, but in the beginning cheap, adjustable structures—more than tax concessions—may be a critical location factor. From the company point of view, too, the availability of communication facilities, great libraries with ample technical reference service, other companies making related products to offer external economies, are also compelling considerations. Finally, the existence of educational institutions equipped to provide specialized training and retraining of skilled and semi-professional portions of the labor force may be vital.

The needs and preferences of scientific manpower and scientific industry suggest some new forces at work shaping urban regions today and for the future. They indicate that the character and quality of public facilities—good schools, recreational opportunities, good highways—have an importance they never possessed in the earlier city. No longer is it sufficient for urban governments to provide only the basic structure of social capital, underwriting the private sector of the economy. Now they need to play a far more conscious role in community development. The future is fashioned from the stuff of public policy rather than private enterprise. In short, the behavior of the public sector becomes a determinate of growth rates, of the relative attractiveness among urban regions to the new industries. We are faced with the urgent question of determining the appropriate scope and character of the urban public sector and traditional approaches of welfare economics offer few ready answers.

Take a second component of our new regions, often acknowledged but only recently seriously considered. That is the behavior and aspirations of the new minority, the Negro. This year has dramatically revealed the special thrust of that group's drive for status and acceptability. This is a dimension in the urban American experience which cannot easily be accommodated by conventional class analysis. Especially in the great metropolitan regions of the North and West, a more accurate understanding of the urban Negro experience is both badly needed in academic terms and close to an imperative in public policy terms. One simply cannot assume that the traditional process of assimilation associated with rising income and changing occupations that characterized the Irish, the Italian, the Pole, the German, the Jew will take place. Nor can one assume that the Negro will accept as satisfactory, his present opportunities for housing and schooling. This is a dimension of the new urban region which both scholar and policy-maker will have to come to grips with before 1970 has arrived.

Finally, the political scientist has a new task before him. To date he has analyzed the metropolitan area basically in terms of formal institutions and formal procedures of government. It is doubtful that these institutions will be readily manipulated into new formal structures of metropolitan government. But this does not mean that a new metropolitan political system is not appearing or that new and more sophisticated mechanisms do not need to be fashioned. Today the political scientist has to think not in terms of the formal government agency or formal boundary lines but of new enterprises of a quasi-public, quasi-private character which serve to knit the region together. Just as our national defense program now goes forward under arrangements that join public agencies and private corporations together in a complex web of contractual relations, so the new metropolitan areas will probably have ultimately to be governed by far more subtle and sophisticated processes.

In all probability, these mechanisms will not bear the formal name of governments. They will weave together state and federal programs as well as local. Sometimes they may take the form of planning commissions with no formal statutory authority and involve decision-makers who hold no formal office. The seeds of this new enterprise are already visible. The urban renewal program and the planning grants of the Federal government to metropolitan regions, the new relationships established between state agencies and their local counterparts, these are prototypes of the new institutions. How to make them operational and produce decisions, how to equip them with regularized procedures and visible deliberations, how to make them popularly responsible, is the great challenge of urban political science today.

In sum, the arrival of the spread city and the demise of the old city of the industrial age means neither catastrophe, as popular commentators would often have us believe, nor acceptance of things as they are. Urban prospects in the United States beyond 1970 depend not on secession of scholarly activity but on its intensification in new directions of inquiry and investigation. We know enough now to have learned that simple diagnoses and simple prescriptions will not be sufficient to guide and shape trends in the complex systems governing urban human behavior. Now we need to know how to detect the truly new dimensions of our life, how to perceive choices offered us in the direction and manipulation of the current trends, and how ultimately to control the forces which are at work.

THE ROLE OF GOVERNMENT IN THE DEVELOPMENT OF THE METROPOLIS

Frank P. Zeidler

There is an intense interest these days in the rapid growth of cities and in the concentration of population in urban places. Dr. Philip Sundal, who made a study of Wisconsin's population for the Department of Resource Development, has noted that

> Approximately 84 per cent of the national growth between 1950 and 1960 took place in standard metropolitan statistical areas (SMSA's). These are entire counties containing cities of 50,000 or more—in some cases more than one county. The 212 SMSA's in the nation increased by 23.6 million out of a total of about 28 million; of this 17.9 million occurred in the outlying parts of the SMSA's, and 5.6 million in the central cities. The growth of suburbia, then, is the main feature of current growth patterns. The last decade largely repeats the experience of the 1940's.
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> The Wisconsin SMSA's (Milwaukee, Madison, Green Bay, Racine, Kenosha and Superior—that part in the state only) grew from 1,456,157 in 1950 to 1,828,871 in 1960. Thus, the seven counties that make up our six SMSA's obtained 372,714 out of the 518,196 gain in the last 10 years—72 per cent of the state's growth.[1]

Dr. Sundal also says that

> Between 1950 and 1960 the entire national population gain was credited to urban areas—basically places of 2,500 or more, plus fringe areas of cities of 50,000 or more. The rural population, which includes places of less than 2,500 plus the countryside, declined by about one per cent.

[1] Philip Sundal, *Wisconsin's Population, 1962.* State of Wisconsin Department of Resource Development (Madison, 1962), p. 11.

In a paper prepared for this Academy's annual meeting in 1961, I described the heavy increase in the seven southeastern counties of Wisconsin, in which the counties had 64.4 per cent of the total population increase in the state the preceding year. The three standard metropolitan areas of Kenosha, Milwaukee, and Racine, had an increase of 54.9 per cent of the state total, while the increase in the Milwaukee metropolitan area alone represented 44.4 per cent of the state's total increase.

As most of you know, the population of the nation is expected to increase by about 30,000,000 (barring catastrophe) in the next decade. If the trends of the past continue, this population increase will be represented largely by an increase in the suburban fringe of the standard metropolitan statistical areas.

The question arises as to what is the role of government in overseeing this expansion of an urban population in the next decade.

The concentration of a great many people in a relatively small area of land produces the phenomenon of urbanism. Urbanism requires special controls and special arrangements in the social economic and governmental order if people are to survive when they are crowded so closely together. This much is obvious. Urbanism also produces special benefits and privileges which become prizes to contest for, as for example favorable land sites, or access to water rights, or just the opportunity to enjoy fresh air. Obtaining of special benefits produces monetary and political power.

Under the twin pressures of the need for laws to control the physical, economic and social development of cities, and of the powerful demands of urban political and economic leaders, national and state governments have granted charters and special laws to cities and urban places for the maintenance of physical, social and economic order of some kind inside the legal boundaries of the city.

In the past century in Wisconsin, the state was fairly generous in allowing cities to expand and to obtain new powers and new laws of regulation and control. During the first decade of this century, however, this attitude began to change. The expansion of cities, and in this state, of the city of Milwaukee in particular was something which was not completely to the liking of the legislature. The urban fringe and surrounding townships of Milwaukee began to exert more influence on the legislature, so that the growth of the city of Milwaukee which was the heart of the state's largest urban area did not keep pace in boundaries with the growth of its urban fringe. If one looks at a map showing the annexations of the city of Milwaukee, he finds that these annexations of the last century were in sizeable blocks. In the 1950's, however, the annexations were often no larger than a few lots, or perhaps, a few acres. Only the consolidation of Milwaukee with two townships provided a major growth for the city in the decade of the 1950's.

This pattern of state suspicion of the growth of the central city of our metropolitan areas has not been limited to Wisconsin alone. Arthur W. Bromage in his book, *Municipal Government and Administration* notes that

> State legislators, jealous of their powers over local units, were reluctant to invest discretion in state officials who were either independent or semi-independent of the legislature. Moreover, decentralization of power among thousands of units of local government served with the states' purposes for many decades.[2]

However, the interest of the states in getting into the problems of metropolitan growth was also checked by the attitude of the municipalities, based on their previous experience. Once given their charters, municipalities have tended to resist state interference with or without regulation of their internal processes. Special laws enacted by state legislatures to regulate one or another function of municipal governments were usually resisted, whether just or unjust, on the grounds that they interfered with the right of cities to govern themselves under their charters. Groups pressing for an advantage under local government, when defeated by the local council, would request the legislatures to overrule the local councils, and were successful often enough. This condition set up the cry of "home rule"—the right of cities to govern themselves without legislative interference. The demands for home rule have brought some kind of home rule legislation to substantially more than half of the states. Such laws may be in the form of new legislation or of amendments to the state constitution.[3]

The twin effects of state opposition to growth of central cities, and the local demand for home rule, has led to a situation of much friction and trouble in metropolitan areas. States promoted fragmentation of governments in such areas, and the advocator of home rule did likewise.

The situation would not have been so bad if each of the governmental units themselves were absolutely self-sufficient, and the people living under them did not cross the boundary lines of their own communities for business and other reasons. But the very essence of

[2] Arthur W. Bromage, *Introduction to Municipal Government and Administration* (New York, 1957), p. 127.

[3] Harold F. Alderfer, *American Local Government and Administration*(New York, 1955, pp. 178 ff.

metropolitan areas is the homogeneity of municipal problems, and the interconnection of social and governmental arrangements. To paraphrase the scriptures, "No local government liveth and dieth unto itself."

The pressure of urgent problems, or even the belief that certain municipal problems are urgent even if they aren't, brings on pressures for the solution of metropolitan governmental problems. Under the doctrine of home rule and under the fear of the growing political influence of the central city in a metropolitan area, states and the national government should not have so largely abdicated their joint responsibilities to provide better governmental arrangements in these areas earlier in the century. They have begun to remedy matters.

Because of the increased complexity of metropolitan areas in some places of the United States where such areas are multi-state or international in character, I see an increased role being played in such areas by the federal government. The solution of multi-state metropolitan problems may have to be through state compacts, ratified by the Congress. In the matter of water supply, control of sewage, air pollution, public health matters, and public transportation, the federal government certainly will have to play an important role in setting up standards and objectives, and in encouraging local governments to try to attain these standards by the twin efforts of grants-in-aid and enforcement of federal laws against practices which are destructive of the natural resources on which metropolitan areas must draw for survival.

I do not limit the types of federal grants-in-aid to metropolitan areas which will be necessary only to these types mentioned above. Other types of federal aid now exist, and still other types, such as federal aid to education, or federal aid for home defense, will undoubtedly be necessary.

Such federal aid will be necessary because as the urban population grows, only the federal government will have access to the proper funds which can be taxed. States and local governments will be too limited in these powers to reach the most fruitful sources of taxation.

This type of grant-in-aid I am talking about *now* is for problems that exist now and need to be remedied *now* in our urban areas.

There is another kind of role the federal government will have to play in the metropolitan areas—the federal government will have to answer the question as to whether it wants to allow the continued concentration of the large majority of the nation's population in urban areas where that population is an easy target. The Congress of the United States has had a chance to look at this problem a number of times and has decided not to institute any major policies which would prevent this trend or reverse it. This issue presents too many difficult decisions and is being settled by default. Thus, concentration will be allowed to build up if that is the way things "naturally" develop.

Perhaps this is wise. It may be that the close proximity of man to man which urbanism promotes will cause interaction resulting in new scientific marvels which will provide new weapons of defense against the overwhelming advantage of the current weapons of offense pointed at cities.

Perhaps the restriction on further migration to cities would adversely affect commercial interests of the big cities and this is a price too high to meet. Whatever may be the reasons for the Congress of the United States not taking a position on the growth of metropolitan areas at the expense of more even growth throughout the nation, I believe a grave mistake is being made. It is my opinion that eventually this nation, for its own protection and for the preservation of the natural resources upon which metropolitan areas depend, and because of the mounting cost of government of urban areas, will have to embark on some kind of industrial zoning to prevent excessive concentration of vital facilities and people in too few metropolitan areas of the nation.

To some extent, however, the policies of the federal government in highway building are tending to diffuse the population, commerce, and industry of metropolitan areas along interstate highways. We are only just beginning to see the effects of these roads on urban and metropolitan configuration and shape. It is probable that the central cities will become less dense, empty out (with a concomitant decay of land values), and that the population will spread out for ten or fifteen miles along the express highway within easy reach of it.

This portends unhappy futures for the central cities and for the small crossroads along which earlier highways ran. People will desert them for the new areas, and to this extent, lessen perhaps their own vulnerability as urban targets. But this leveling will create new problems of public utilities, schools, roads and public services of all kinds, in the new places where people may now make their habitation.

The role of the states in dealing with the problems of the growing metropolitan areas ought to be a more positive one. States ought to scrutinize carefully these areas, and by legislative action provide one appropriate government for all the metropolitan problems in a given geographic area. Whether this type of government would be a new multi-purpose metropolitan government, or a new unified municipal government, or an urban county government is a matter which I will not discuss now. Any of these three types would be better than the fragmentation of governments which now exists in metropolitan areas, and which are unable to come to agreement on several important area-wide functions. Prof. Manuel Gottlieb of the University of Wisconsin-

Milwaukee has offered the novel idea that charters to local governments in a metropolitan area ought to be reviewed by the state government periodically. If the governments in the area are deficient in services and ability to cooperate, the charters ought to be rescinded and a new charter ought to be issued for a unified government in the area. There is merit in this idea.

However, around the nation, I do not expect many state governments to pioneer; first, because of the vehemence of the adherents of suburban communities (which enjoy favorable advantages over their neighbors) to the ideas of home rule; such persons will discourage legislative inquiry. Second, state legislators in many states, confronted with the decay of the rural districts and small towns which they represent, will not do much to try to reverse the trend. Instead, they will seek to keep the legislative representation of the metropolitan areas from exercising any considerable increase of voting power in legislatures because of numbers.

The existence of the decision of the United States Supreme Court in the case of *Baker versus Carr,* on the subject of proper apportionment for people from urban areas, has sparked a revolt in some state legislatures which aims at nothing less than the nullification of the supremacy of the federal government. As long as this attitude prevails in legislatures among representatives of rural communities, small towns, or the suburbs of the bigger cities, it is too much to hope for the kind of positive leadership from state governments that is required in urban areas to meet the pressing problems. This continual unwillingless of state governments to face up to the implications of urbanism, may in the long run, lead to the serious diminution of the role of state government in American life. The states may become vesitigial remnants of legislative authority as more direct relationships develop between the federal government and metropolitan area governments.

It may be that in the long run, metropolitan districts and the areas over which they exert economic dominance, will receive some kind of special recognition from the federal government making them more viable administrative units. Take the situation here in our own state as an example. The pull of the cultural and economic influence of the metropolitan area of Minneapolis and St. Paul is much more dominant in the northwestern counties of this state than the influence of southeastern Wisconsin where the bulk of the state's population is.

States can remedy their deficiencies by giving proper legislative representation to urban populations, and by troubling themselves to study what is going on in the metropolitan areas, and providing guidance for the solution of the physical, economic, and social problems that arise there.

An especially important role that states can play is in the developing of regional plans for metropolitan areas that are not merely advisory, but which have teeth in them to enforce the proposals of the plan. Regional planning with enforcement of a properly prepared plan is needed to prevent pollution of water resources, pollution of air, and the despoliation of the land into a multitude of unsightly parcels, currently the chief characteristic of land use around our great metropolitan areas. Regional zoning is needed to check the destruction of the resources upon which a metropolitan area must live.

The role of county government in metropolitan areas is likely to grow. Except in a few places in this nation such as at Baton Rouge and Nashville, attempts to create special types of metropolitan governments dealing with metropolitan problems have uniformly failed, sometimes for one reason and sometimes for another. Such specially formed metropolitan governments are not easy to create. It is much easier to transfer metropolitan functions from local governments and municipalities to county governments, because the county governments have strength in every legislature which local governments do not possess. Consequently the development of the urban county in the United States is a movement of considerable importance in metropolitan areas. The urban county is often not coterminous with the urban central area and urban fringe, but transfer of functions to county governments tends to alleviate pressure for metropolitan problem-solving.

However, among the counties and county officials there is no uniform drive to assume urban responsibilities. Throughout the United States, rural counties are suspicious of officials in urban counties and often refuse them the right to modernize their county governments to fit urban needs.

The role of local governments in solving metropolitan area problems is almost wholly dependent on the policy decisions of the Congress and the state legislatures. There is some pressure for voluntary meetings of the heads of all urban governments in a given area, such as is now taking place around Detroit, and in the New York City area. Such meetings may be fruitful of small gains, but when it comes to such substantive matters as providing an equal tax base throughout a metropolitan area, and equal sharing of the metropolitan load of services, I do not see the favored communities among the urban fragments of government yielding any advantage at all.

Moreover, as has been noted by others who have spoken on the metropolitan problem in the Milwaukee area, notably Alderman James J. Mortier, there is a built-in system of defense of each local government for the privileges held within its own domain, and each public official by his oath of office is sworn to defend the advantages his community may enjoy vis-a-vis another community. Voluntary cooperation cannot be expected to go to the extent that one set of local officials will readily yield advantages to another set and thus help solve metropolitan problems except in the case of the bigger central cities.

In the bigger central cities, certain phenomenon, I think, are observable which are going to compound the problems of these areas. For one thing the flight of the upper income people to the suburbs near and far is draining the central city not only of technical and professional talent, but also of its tax base. The concentration of low income people in the central city at the same time as its tax base is fleeing to the suburbs, means higher taxes for the remaining industries, which in turn will be compelled to flee. Only copious federal grants-in-aid in the future may be able to save parts of the central city from becoming a vast unrelieved slum of physical and social decay resulting from economic depression.

In central cities where a non-white minority is concentrated and growing, as in Chicago, this group as it gains political power, may resist being incorporated in an area-wide government, to prevent the voice of its demands from being muffled in a government in which the minority fraction diminishes still further.

In other places where this problem may not be so acute, there is the tendency of the suburban leaders to become dominant in control of the affairs of the central city. This is because the cost of campaigning for leading office in a large central city is now so great that the chief financial sources for supporting a winning candidate come from the suburbs, and the policies of the winning candidate therefore reflect what suburban leaders want. I am not aware of any current studies on the true power structure which controls central urban cities, but I am under the impression based on what I know of several cities that the suburban influence predominates in critical issues, especially those affecting the lower income people of the city who are struggling for the basic needs of shelter, jobs, and family stability.

Another debilitating factor in the health of local governments in dealing with their own ills, is the rise of control over the politics of the cities in some places by the gangster element. The power of this element in some states, notably Illinois, reaches into the legislature, to work adversely to the best interests of the metropolitan area.

Because of the incapacity of city governments in metropolitan areas to work out effectively equitable solutions for their own problems, I see the definite need for the creation of state and federal departments of urban affairs, with functions similar to the Ontario municipal board which made the recommendations creating the Municipality of Metropolitan Toronto. We must not allow the concept of "home rule" to cause the disorganization and disruption of local government into such warring factions as to make all metropolitan progress impossibly slow.

I also see the need for citizen groups to become more interested and informed on local problems both by formal education and by participation as interested parties in the affairs of the metropolitan area. What is mostly needed in metropolitan areas is the development of a broadly represented citizen council which will press at the state legislature for solution to the metropolitan development problems apart from the creation of ad hoc or single purpose governmental districts.

Citizen groups addressing themselves to solving particular deficiencies in metropolitan areas also are needed, especially in such areas as housing, planning, community relations, crime prevention, education, cultural development and transportation.

These citizen groups are required to give local government officials the knowledge that they will not be jeopardizing their political careers if they act to meet the problems of the metropolitan areas. From such citizen groups can come the future leadership of elected representatives in the representative bodies of government at all levels. There must not be a decay of the quality of representation in legislative bodies if government is to be both democratic and effective.

The means by which effective citizen groups can be established to allow government to play an effective role is another subject in itself, but certainly a principal source of leadership must come from the universities and colleges of the nation, especially those which are situated in metropolitan areas. It has become apparent in some studies of medium sized Illinois communities that there has been a loss of citizen leadership and initiative in those communities which had led to their stagnation. The restoration of such leadership in many communities throughout the nation might well be the objective of the extension divisions of our land grant colleges and universities.

CIVIC INFLUENCES AND FORCES IN THE GROWTH OF THE AMERICAN CITY

Coleman Woodbury

The basic premise of this paper is that local communities are intricate social systems and subsystems that develop and change in response to the interplay of a fascinating, at times almost a bewildering, complex of forces or influences. Every school boy who has been taught the elementary facts about the human body as a physiological system or about a forest as an ecological system, knows that significant changes occurring or induced in one part lead to other changes, often whole chains of them, in the same or other parts. So it is, too, with social systems. In this paper, these secondary changes following certain measures or programs are usually referred to as by-products or spill-over effects. In local communities, they and the interplay of forces that account for them are often very involved and often not too well understood. It seems only fair, therefore, to remind you at the outset that in any brief discussion of urban communities and their growth, one must work with a very broad brush and in bold strokes. He simply hasn't time for the qualifications, exceptions, footnotes, and outright hedging that would be in order in any more thorough or systematic analysis.

Let me add one other warning: The forces or influences in urban affairs, to which I referred a few sentences ago, are often discussed in conventional terms as economic, governmental or political, social and socio-psychological. I don't object seriously to these terms; we seem to have to use them in this kind of discourse. At least, however, we should recognize that in local community affairs almost no major operative force is solely or purely economic *or* political *or* social *or* psychological in the common meaning of these terms. They are hybrids. Also, for the purposes of this paper I assume that no category of influences is set apart from the others as above and beyond analysis or evaluation or modification.

Perhaps it will be useful to identify at the outset three major classes of civic influences or forces in American urban life. To be sure, this is only one of many possible schemes of classification, and not all of the influences fit easily and neatly into one of the classes. For whatever value it may have in our discussion, however, here it is: (1) First, we should note a number of service or activity or, in the non-technical sense, functional programs in behalf of, for example, schools, public health, recreation, youth activities, family welfare, race and inter-group relations, mental health, adult education (including public libraries), transport and parking, housing, renewal or redevelopment; (2) Promotional efforts to stimulate economic activity and to attract new industries and other sources of employment and purchasing power; and (3) Less frequently *ad hoc* attempts to reorganize the form or structure of local governments and of quasi-public institutions, such as welfare councils or community chests.

Of course these are not the only forces shaping urban communities—nor even the only major ones. Others that come readily to mind include actions of national, state, and local legislative bodies and administrative agencies, the decisions of appellate courts, grants-in-aid and other inducements offered by the national and state governments, as well as changes in the organization and management of economic life and in the technology of our culture, increases in the amount and the wider distribution of leisure time, the continual and pervasive pressure of the media of mass communications, changes in religious outlook, even the teachings of institutions of higher education, and the less formal but continuous interaction of smaller, informal groups. I suggest, however, that we concentrate on those in the three categories named. They seem to me to fit fairly well under the general heading of civic influences—the first and third clearly; the second probably with some question.

At the risk of elaborating the obvious, let me comment briefly on the first of these three categories of community-shaping programs.

Many, although not all of the service or activity programs have gone through rather similar courses of evolution. Often they have been proposed first by non-official groups or organizations. Often the actual starts of the programs themselves have been made by such organizations. Later they have been taken over as parts of the activity of general purpose local governments or entrusted to *ad hoc,* special authorities or districts of one kind or another. Thus, in Madison some of the finest open and recreational spaces were acquired decades ago by a private group operating under the good, Victorian-sounding title of the Madison Park and Pleasure Drive Association. Incidentally, many of the early city planning efforts had a similar origin. It is well known that, a few years before, Mr. Burnham had prepared a similar plan for San Francisco. There the sponsor was "The Association for the Improvement and Adornment of San Francisco."

Often after the service or activity has been taken over by local government, the private group continues in the same or altered form as the supporter, watchdog and gadfly of the service. Quite often, of course, one service or program has had more than one group of backers and particularly in smaller communities, the supporting groups of two or more services often overlap considerably in membership.

In total, these various services or activities, their proponents and administrators, have done much for and to urban communities in this country—much more, in fact, than most of us today fully recognize. We take them too much for granted. Of course, they, too, have had their weaknesses. One is the obverse of the urban planners' former but not disappearing fixation on physical development; the service-oriented groups, with some exceptions, have belittled or underplayed the place of a decent, pleasant physical setting for family, group, and community life. At school or in a boys' club, a boy is told that American democracy's cornerstone is respect for the worth and dignity of the individual. Within the hour, he goes to his home in a slum area and encounters there little or nothing that seems to accord with this fine phrase. Sooner or later he may begin to wonder who is kidding whom, and why. This sort of thing happens not once but many times over the years. If, following this and many other experiences, he and his friends set up or join some street gang with its own and, to us, distorted value system, why should any intelligent person be astonished?

Also, too many of the service-oriented groups, despite their close and symbiotic connections with local governments, have been inclined to be harshly and even unfairly critical of governmental agencies and officials, particularly when, as is inevitable, they do not or cannot do everything that the partisans of a service think should be done for their pet cause. The non-official proponents often contrast "citizen groups" with government officials or "bureaucrats," as if a man or woman ceased being a citizen when he was elected to office or employed by an agency of government. Perhaps these antagonistic attitudes that crop out so frequently are traceable in part to the difficulties of communication across the social and educational strata of our society. Certainly, however, they often detract from the contributions these groups make to community life.

Another weakness in this private *cum* public process of developing and administering community services has been the very considerable degree of competition and even mutual interference among them. Some competition certainly is unavoidable and even desirable, but quite as clearly it can become harmful or dysfunctional. It *tends* to make the proponents of any one service, public officials and non-officials alike, narrow partisans in a no-holds-barred struggle for attention, publicity, money, and even for competent personnel and spokesmen. Of course, lip service is commonly paid to cooperation and the genuine article is often seen, but too often it is cooperation in the spirit of the man who said that although in general he was in favor of cooperation, just as he was in favor of virtue and motherhood, in specific instances he would like to know who was going to do the "co-ing" and who the "operating."

In short, all three of the kinds of programs I listed earlier as well as Director-Mayor Zeidler's governmental factors and activities have contributed notably to shaping local community life and affairs. In my opinion, however, in only a very few localities do their total contributions add up to, or even approach, an effective grand strategy for making our urban communities the kind of social entities that we could reasonably expect them to be. We are not getting optimum results from the time, effort and money that we are expending through private as well as public channels, let alone the results that would be realized if we tapped all of the talent and other resources that are at hand. This, of course, is a value judgment, a "subjective judgment"—and a sweeping one at that. I would guess, however, that many of you would agree with it.

Change in Outlook

If this were all that is to be said on this front, you could fairly say, yes, yes, of course—and let it go at that. But it isn't all. In my opinion, the most significant recent events in urban community life are the signs that *some* of the proponents and administrators of both governmental and civic agencies and programs are beginning to look beyond their self-imposed, traditional boundaries, to recognize the connections and dependencies of their work on that of others equally concerned with the community welfare, and to see that in urban communities, as in other systems, the whole is greater than the sum of its parts. To be sure, these signs so far are not too numerous, but they do seem to be increasing in number and in strength. Let me cite just two examples.

For some years past, the scope of urban public planning has been widening in several directions. What is sometimes called the orthodox view (planning *only* for physical development) is gone in some communities; it seems on the way out in most others. Just one illustration: In many localities capital programming, which is essentially planning in terms of time, money, and priorities instead of space, is now an accepted and significant part of the process. Many professional planners now approve the remark by the late Hugh Pomeroy, one of the leading planning practitioners of the past generation, that urban planning without capital programming is the adult equivalent of writing letters to Santa Claus. And as planners get into this field (and concomitantly into the hair of some municipal finance officers) they soon see that capital and operating budgets are inextricably interrelated. If local governments plan for and produce more playgrounds or school space, they must maintain and operate. Here any additional annual expenditures called for have to be considered in relation to those now on the books for the same and different services. This clearly means that any major recommendation of an urban planning agency may have repercussions throughout a wide range of community programs—public and civic alike.

My second example: Despite some early warnings, enthusiasts for redevelopment or renewal long looked upon their activity as primarily the replacing of obsolete and substandard buildings with new ones. The crucial aids needed were eminent domain in the assembly of sites and the federal purse in reducing acquisition costs to reasonable use values. To be sure, some families and others would have to be relocated, but, in this earlier, simplified view, this was a minor detail that would be adequately taken care of by minimum payments for moving expenses and by hiring a social worker or real estate man to help the less enterprising residents of the areas to find other quarters. Today, many, many people know better. Experience and some reflection have made clear that redevelopment, even on a fairly modest scale, is surgery that cuts deeply into the social fabric of neighborhoods and larger communities. It drastically affects churches, schools, the clientele of professional and business men, local political organizations, and even sometimes fairly deep attachments to districts, neighborhoods or other area groupings that may seem from the outside to be formless and disorganized. Consequences of this nature are not limited to areas to be rebuilt; often they are only less serious in other areas to which the displaced families and small businessmen go or would like to go. This earlier view of redevelopment is now largely a thing of the past in many localities.

If time and your patience permitted, it would be easy to pile up more illustrations of this point, but these must suffice. Do the issues cited seem very, even painfully, obvious? To those accustomed to think of local communities as social systems, the answer probably is yes. But the record is quite clear that many well-intentioned persons active in local affairs either have only begun to think in these terms, or in the past have shrugged off the by-products or spill-over effects of the programs and measures they advocated, probably on the grounds that these were the concerns of someone else—presumably the George of "let-George-do-it." What I wish to emphasize, however, is that, more and more, the separatism or particularism of many persons concerned with the various facets of urban affairs is giving way to a much more inclusive and defensible outlook.

Quite possibly we are on the verge of one of these "breakthroughs" that we hear so much about in other fields. The institutional cocoons woven so firmly in the embryonic stages of various local community services and activities do seem to be bursting. More and more, thoughtful people in community affairs are groping their way toward some crystallizing idea more useful and fruitful in urban life than more or less blind addition to physical planning *or* adult education *or* industrial promotion *or* a streamlined local government structure. What seems likely to be that crystallizing concept or idea?

Before suggesting an answer to that query, we should consider briefly two other questions: (1) What influences seem to account for this incipient change in outlook on the parts of some local community leaders and activists? (2) Do these influences seem likely to prove strong enough in the middlerange future to break most of the cocoons wide open? Let me try to answer these questions very summarily.

Factors in These Changes

First among the influences making for recognition of local communities as social systems are the tides of population growth and redistribution in our age. Not only is the nation's population growing substantially, but it is probably the most physically or geographically mobile major population in the history of the world since the days of essentially nomadic societies. Ever since World War II, roughly 20% of the people in this country have been changing their places of residence every year. About two-thirds of these moves are within the same county, one-sixth from one county to another within the same state, and one-sixth from one state to another. The net of these flows and counterflows is concentrating a very large and increasing proportion of the total population in metropolitan areas and in the smaller, but otherwise similar, urban areas. Within these areas, the central cities, by and large, have been growing very slowly or actually declining in numbers; the suburbs, the nucleated settlements outside the central cities, have been increasing substantially; the rural-urban fringes, those outlying, less densely populated areas that in pattern of settlement and ways of life are neither urban or rural, have been growing most rapidly of all—both in rate and total numbers. A strong in-migration to urban and urbanizing areas is made up in considerable part of the poorer and even the depressed rural areas. Not only are they poor; they are unskilled in urban ways of making a living and equally unskilled in the ways of living in an urban environment.

As these population changes, in various combinations and mixes, affect urban areas, they spell stress and strain on local institutions and individuals, and often considerable bewilderment and even fear. This is true not only in the areas of rapid increase, but also in those of stagnation and decline. The old ways of looking at and doing things in community affairs just don't seem as adequate and as unquestionable as they used to.

Closely linked with these population increases and shifts are the ever tightening financial straits in which most urban communities now find themselves. Since World War II, the aggregate number of housing units built is more than 50% of the total stock of non-farm housing in this country at the beginning of this period. In most localities, therefore, excess capacity in schools, water supply and sewage disposal systems, hospitals, and other community facilities has long since been absorbed. Additions are being made at the highest construction costs in the history of the country. The aggregate volume of local government debt outstanding in 1959 was 250% of that in 1950, and higher interest rates have added measurably to its burden. One estimate is "that in California approximately $13, 000 of public capital facilities must be provided for every new family coming into the State."[1] Projections of future needs are even more ominous.

In short, when finances are straightened and community capital goods are in short supply, the by-product, spill-over effects of additions to or major extensions of services or facilities can more quickly and more readily be seen. The futility or even danger of the single-track mind in such affairs becomes ever more apparent.

Of course these are not the only influences making for the changing view of urban programs and policy, but they do seem to me pervasive and significant ones. Do they or other factors seem likely to continue the pressure away from the segmented or particularistic toward the social system conception of urban community policies? My answer is yes—these forces seem very likely to persist for some time to come and their consequences on this front quite probably will continue. Another possibility, of course, is that these pressures of population growth and shift and the tautness of present financial resources and physical facilities might lead to a loss of nerve among many of those individuals and agencies, both civic and public, that so far have supplied most of the motive power for local community programs and development. Conceivably, they might conclude that their hopes

[1] James Gillies in *Metropolitan California*, a study prepared for the Governor's Commission on Metropolitan Area Problems, 1961—as cited by Catherine Bauer Wurster in *Government in Metropolitan Areas: Commentaries on a Report by the Advisory Commission on Intergovernmental Relations* (Washington, 1961), p. 118.

and objectives have been too high, and that all local programs, including their own, must be cut to the bone, "frills" eliminated, the three R's re-enthroned, etc. Surely some persons will go in this direction, but the history of local community activities over the past century or so, in prosperity and depression, suggests that this would not be the major trend.

In Conclusion

Let me try to restate the argument of this paper and add my answer to one unanswered question:

(1) Civic agencies and programs have made and are making many substantial contributions to urban life. To the not uncommon but cheap sneer about "do-gooders," for me the sufficient answer is that I'd rather be a "do-gooder" than a "do-badder" or a "do-nothing," which would seem to be the other major possibilities.

(2) For decades past, a persistent if somewhat uneven trend can be noted in the role of civic organizations *vis-a-vis* governmental agencies. Programs started by and often administered by civic groups are taken over, in considerable part, though usually not completely, as public or governmental activities. The civic groups then tend to become primarily supporters and critics. Within very broad limits this seems to me a natural and desirable evolution.

(3) The principal weaknesses in these programs, both those primarily in civic and those in public hands, have been particularism and the kind of competition among them that often amounts to mutual interference.

(4) More recently, frequent signs indicate that this brand of particularism or segmentalism is giving way to a recognition that urban communities are social systems, the principal parts of which are closely and intricately interconnected—as one of my friends likes to say—"inextricably intertwingled."

(5) The emerging idea or concept that quite possibly may replace particularism, mutual suspicion and interference in the civic-*cum*-public life of American urban centers, is the *process* of community planning. To explain and defend this suggestion would take considerably more time than my total allotment this morning. May I simply point out two things: (a) For me, community planning is *not* an *ism*. It is the process of preparing, in advance, in a reasonably systematic manner and with careful attention to by-products or spill-over effects, recommendations for courses of action to achieve accepted objectives in the common life of communities. (b) Although the scope of this planning would take in both capital outlays and physical facilities as

well as the principal features of operating programs, I am advocating a *process*, *not* the centralization of all or nearly all planning in one agency or office. The forms of organization, the machinery, undoubtedly will vary greatly from city to city.

What basically American cities need on this front and what community planning of this kind could assure, is a grand strategy to make optimum use of the money, facilities, brain-power and good will that are now going into civic and governmental programs plus the additional amounts of these valuable components that an effective, inclusive strategy undoubtedly would attract.

Man does not live by bread alone—nor even by bread plus civic organizations plus community planning. For healthful community life, one element is even more basic. On this let me read you, in a translation by Professor Agard of The University of Wisconsin, a well-known statement made centuries ago in another and markedly different culture:

> Our government is called a democracy because power resides, not in a few people, but in the majority of our citizens. But every person has equal rights before the law; prestige and respect are paid those who win them by their merits, regardless of their political, economic, or social status; and no one is deprived of making his contribution to the city's welfare. We are equally fair-minded in tolerating differences in people's private concerns; we do not get irritated with our neighbors when they do what they like or show those signs of disapproval which do no great harm but are certainly unpleasant. In our public dealings we have respect for our officials and the laws, especially those laws which protect the helpless and those unwritten laws whose violation is generally regarded as shameful.
>
> But we do more than this. We have provided for the happiness of our people many recreations: athletic games, contests of various sorts, festivals throughout the year, and beautiful buildings to cheer the heart and refresh the spirit as we see them every day. Also we enjoy imported goods from all over the world, which add to the attractive variety of our life. . . .
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> We love beauty without extravagance, and wisdom without weakness of will. Wealth we regard not as a means for private display but rather for public service; and poverty we consider no disgrace, although we think it is a disgrace not to try to overcome it. We believe a man should be concerned about public as well as private affairs, for we regard the person who takes no part in politics not as merely uninterested but as useless. We reach decisions on public policy only after full discussion, believing that sound judgment, far from being impeded by discussion,

> is arrived at only when full information is considered before a decision is made.
>
> To sum it up, I claim that our city is a model for all Greece and that here more than anywhere else a man can become independent in spirit, versatile in accomplishment, and richly developed in personality. The proof of our greatness is the way in which we have made our way into every land and sea, establishing memorials of our hostility and our favor.
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> Such is the city for which these men died, exulting in their determination that she should not perish. It is fitting that we who survive should likewise spend ourselves in her service. We may pray to be spared their suffering, but we cannot be less brave than they. We must not be content with words—how fine a thing it is to defend Athens against her enemies—but must fall in love with our city as we see her engaging in her everyday activities, and remember that it was men like these who made her great because of their courage, their understanding of their duty, and their self-discipline in performing it...[2]

In short, it seems to me that civic forces, as well as those of government and industry, can make their proper contributions to American urban life only if their activities are imbued with that intangible, elusive, little understood, but powerful set of attitudes that we sometimes call a sense of community.

[2]From Pericles' "Funeral Oration" as translated in Walter R. Agard's *The Greek Mind* (Princeton, 1957), pp. 118-20.

THE ROLE OF INDUSTRIAL RESEARCH IN THE DEVELOPMENT OF THE CITY

Jack T. Wilson

At the beginning of the 20th century, many leading industrialists and scientists all over the world began to see that the great technological problems which grew out of their rapidly advancing industries, could no longer be solved by even the most gifted and hard-driving layman experimentors and inventors. These men observed that a continued flow of the many products which stimulated and filled the demands of increasing markets, must be supported by an increase in scientific knowledge and also by new techniques of application of this knowledge to industry.

In the United States of America, many industrial giants, who molded and shaped the growing corporations which supplied the basic commodities such as steel, copper, cement, and mineral oil products, looked to Europe for men who had been trained in science because American schools at the turn of the century had not yet evolved the great experimental training centers which could produce the industrial scientist and also give him the facility in which to work and teach. The need for a program of active research and development, dedicated to the support of industry, and the investigation of basic science, was fortunately understood by many American industrialists who had the foresight to act effectively.

Andrew Mellon was among the first men to establish a non-profit organization designed to teach American industry an advanced technology. At the dedication of his Mellon Institute, he spoke as follows:

> As the result of my reading and observation, it seemed to me that improvements in the standard of living of the human race could come about in the future only by reason of new discoveries and inventions, just as, in the past, the steam engine and other inventions had been responsible for many improvements in the standard of living enjoyed by the average man today.

> It was these things, and not governmental or political action, that had increased production, lowered costs, raised wages, elevated the standard of living, and so had brought about a greater participation of the human race in these benefits.

This statement was made in 1913, and in 1963 we find it is many times proven. The community of Pittsburgh, Pennsylvania, has profited greatly by Mr. Mellon's gifts and the entire United States now has many industries which have been fostered and improved by the science developed in the facilities of the Mellon Institute.

The title of my subject this morning indicates that I will organize my remarks around the subject of the development of the city as it may be influenced by industrial research. It is perhaps easiest to illustrate graphically the influences of centers of technological investigation upon urban growth by using one of two outstanding examples.

Example number one may be found and observed by a close scrutiny of the city of Boston, Massachusetts. At the turn of the century, this city was strong in character as a cultural center of the United States. It had been, and continued to be, a thriving seaport and a great center of the textile industry. Banking and finance were well-established and the insurance businesses of many types had grown so large as to control many of the invested interests of great fortunes throughout the United States. Boston could look forward to a steady growth and needed very little help from anyone or any single institution to fortify its industrial capacity.

Boston furnished the most natural environment to foster great educational institutions. Colleges and universities were established in this city, and a few of them became great leaders in the rising role of educational institutions in the United States. The Massachusetts Institute of Technology, Harvard, Boston University, and others have awarded many thousands of degrees to worthy students and some of these men and women have stayed at home after graduation and built industries of such magnitude as will support the total population of popular products which enjoy world-wide distribution.

Take a drive in your motor car on belt highway 128 (which girdles the parts of the city of Boston which do not serve the harbor and face the waterfront). You will find new and old industries, housed in a variety of exciting architectures. Today in the Boston area, perhaps one-fifth of the population of the most outstanding scientists of industry in the United States now make their homes. The past twenty-five years have seen the growth of a science of electronics which has become the main blood stream of associated industries.

The Boston fever for research spread to near-by Worcester. There, at the end of the nineteenth century, the fervent dream of a Yankee peddler, John Boynton, created the Worcester Polytechnic Institute. Out of this fine school came many great builders of science, including Robert H. Goddard, who fathered modern rocketry and opened the space age. We may conservatively estimate that industrial research in the Boston area has been responsible for a population increase of more than a million people in the first sixty-three years of this century.

Many factors completely independent of industrial research could have stimulated population growth in the Boston area. However, unique to the environment created by such research, will be found a number of elements which flavor the basic cultural pattern of the urban community.

Scientists as a group have a fairly broad educational background. The curiosity which made them scientists has frequently led them to explore literature, drama, music, and art. Sports and gardening are also usually found to be of great interest to scientists, and in the community structure in which they live, these arts, sports, and husbandries will prosper. In such a community will probably be found a symphony orchestra, an art center, and sports-sponsoring organizations.

Industrial research in the city of Boston promotes leadership in placing a high value on education in colleges and secondary schools. Surprisingly few scientists in a community may spark the effort to provide better teaching faculty for high schools, colleges and universities. These are the elements which I feel are the strong characteristics of scientists; the Boston area illustrates my point.

Example number two can be drawn from a study of our own city, Milwaukee, Wisconsin. Here on the shore of Lake Michigan, large basic industries have become leaders in world trade and furnish machine tools, earth-movers, material handling equipment, agricultural tools, electrical controls, and prime power apparatus. We are leaders in beer production, and all of the sciences of steel fabrication and welding procedures find advanced development in Milwaukee. With all of this wealth of industrial production, the basic concept of research in the larger companies of Milwaukee is now in danger of becoming only a glorified technique of quality control.

Let us make no mistake and minimize the importance of quality control. Milwaukee is fortunate in that many of her citizens have come from Europe where traditions of fine craftsmanship have become ingrained and dominate the sense of values which govern their individual behavior and productive effort. We must continue to devote our best effort to improve quality control, and in order to make a profit, we must offer a better product at a lower price.

Quality control and the analysis of trouble in manufactured processes, must not be mistakenly called research. I speak now of research in terms of innovation and the imaginative creation of *new* products and *new* systems. Earlier in my remarks this morning, I mentioned the great strides in electronic components development which has taken place in the Boston area. Milwaukee has a waterfront which by means of better marine engineering can become a most important port of entry for world trade. We are now the leaders in the manufacture of materials handling equipment. Industrial research in Milwaukee can reap the reward of developing new dock facilities which could make obsolete all primitive docking procedures which over all the world continue to slow down the transfer of goods from vessel to overland transport or warehouse.

Milwaukee was here the potential research and development groups to bring about a renaissance of highway and road construction. Time required to build streets and highways may be reduced, and permanence of roadway surface may be greatly improved. New materials, unthought of now, may make safer driving under all weather conditions.

The laws which govern the evolution and development of a cultural pattern of a nation or a city are probably as inflexible as the laws of gravity and quantum mechanics. With each new decade of research in sociology and the dynamics of cultural evolution, we come to see more clearly the mechanism of periods of ascending development in urban experience wherein the tone and morale of a community is full of energy and optimism and the industrial activities are characterized by growth and profit. To a degree, the citizens of a community can control the cycle which may oscillate between ascending and descending periods of prosperity. One of the ways to prescribe this control is to make favorable the climate which fosters industrial research. The best utilization of natural resources which favors any urban area will come from a body of enterprising research personnel if they are free to make innovations and derive new systems. These men must also be given the essential financial sustenance for their work and personal income.

Perhaps I have shown one very interesting characteristic of the Boston area in these remarks. I would like to point out the close relationship between the advanced educational institutions in a community and its program of industrial research. Boston has its M. I. T. and Harvard. From these schools have come many men who have built large industries in Boston.

Milwaukee has its campus of the University of Wisconsin, Marquette University, and a number of other colleges. In this city we are guilty of neglect of generous sponsorship of our universities. If we do not remedy this condition, we will miss a most important opportunity to advance our industrial research. This can be planned without wasteful duplication of facilities on the campuses of Madison and Milwaukee.

I opened this discussion by stating that the world's industrial problems could not be solved by gifted and hard driving laymen. I want to make it very clear that I believe that only a gifted and hard-driving individual will be a great and successful research scientist or engineer. I also want to state that it will be the individual and not the group who will make the greatest advances in science and in research. Please remember the individual must have the mechanics of a research center in order to be a scientist who may make a great contribution. Industrial research can be the vehicle for maximum development of the individual. The urban community will clearly reflect the qualities of its individuals.

HOW EUROPEANS MOLD THEIR CITIES

Joseph F. Mangiamele

"Why is it that Americans, who lead the rest of the world in so many fields, find themselves lagging behind Europe when it comes to the development of their cities?" This is a question I have often been asked in Europe by many in responsible positions. In spite of all that European planners have read about the United States, when actually visiting the cities of this, "the richest country in the world," they have often expressed their amazement at the extent of decay and the amount of slums. They have been surprised to see the "helter-skelter" way in which our urban areas have developed.

Perhaps this general European attitude can be better understood by looking at the way Europeans mold their cities. It seems that tradition alone gives Europeans a confident basis from which to start planning their cities and it seems to provide them with the full knowledge of what cities are and what they ought to be. Because European planners are backed with centuries of civilization and tradition, they are not asking themselves what cities are—or what they ought to be—questions we often ask ourselves. For they know what cities are.

But as Americans—of European ancestry—we lack that feeling and the understanding of city civilization and urban character. Perhaps the reason for this is that each generation of immigrants, in the process of making themselves American citizens, has lost sight of the old world culture. So that if they knew what urban life was in the old country, it has become something of the past to them. And now they have obviously settled for the ways of the frontier town—which grows unceasingly on its gridiron pattern, impelled by social values based on the cost of the land. I do not mean to say that land values have no significance in the development of cities in Europe. Neither do I mean to imply that decay and slums do not exist there, especially in southern Europe. For I am not going to give you a romantic view of Europe. We all know that many European cities are congested, and that they have slums. But at least one country in northern Europe does not have poverty and slums in the traditional sense. But before I talk to you about this country, which is obviously Sweden, I would like to talk to you about European cities in general.

The cities of Europe are still alive with traditional treasures of architecture, music, literature, paintings, sculpture, history, and customs. They have their opera houses, dramatic theaters, museums, historical buildings, ancient bridges, and in some cases, portions of old city walls. It is true that all these buildings are not beautiful; but many are historical or house a cultural function. And it is not rare that these structures are both historical, or cultural, and beautiful. There are hundreds of churches, cathedrals, and ancient universities. Europe is still rich with folklore and folk music and associated activities, legends and tales, festivals, traditional foods, and entertainment. It is the recipient of royal, noble, and aristocratic legacies. Castles, many of them with moats still surrounding them, formal gardens and parks, and boulevards are among some of these.

Superimposed upon these ancient heritages are the democratic governments and republics of modern Europe, the latest technology, and commercial and industrial development. The city is the center of contemporary life in Europe, and it is a living record of its living history.

The traditions of American cities are measured in terms of a short few hundred years and are based first on eighteenth century liberalism and seventeenth century religious beliefs and strifes, and later, on an advanced technology, a militant internal commercialism, and a relatively rapid industrialization.

While our cities are primarily frontier towns, laid on a grid system and on virgin soil, the European cities are old towns made up of ancient elements, which are actual physical parts of today's Europe. Among other things are their narrow streets for example; they are the factor which has influenced the size of their cars. But there are many other residual factors which influence the development of their cities.

Some parts of the European cities, through their very compact form and tight pattern, repel the extensive use of the car and yet the open space of their squares and piazzas invite and crowd them in. But the formal gardens, parks and boulevards, and courts, still are inviting to the pedestrian.

In Europe the culture of the street still survives. It exists architecturally, in the social attitude, in the customs and in the everyday lives of European. In America, the culture of the street is almost non-existant. To some extent, the social culture of the street is less prevalent in the northern cities of Europe, for example in Sweden, Norway, England, and Holland. But the architectural culture of the street is very much alive in the cities of all these countries, and especially in their capitals.

Of course in America we do not have all these ancient urban elements. Some Europeans find these ancient elements a disadvantage in developing modern cities, so they are not always to be considered treasures. People living in congested communities do not find these ancient structures as picturesque as tourists find them, but many of these physical obstacles prevent European cities from growing and spreading at random as most American cities do.

So the Europeans have taken new approaches in solving these problems of growth. They have been ingenious in the methods which they have employed in both decongesting their cities and in handling their growth. Most of the methods that have been used have involved close relationships between planning and actual development. This has meant an application of various types of controls. One of the reasons why planning has not been as successful in this country as it has in Europe is the innate fear that we as Americans have of controls, regardless of their beneficial character.

One of the controls generally exercised throughout European cities is architectural control. Few buildings can be built in Europe without a regard for other buildings in the area. European city designers almost naturally talk about town-scape and street-scape. Street-scaping is the arrangement of a portion of the total street so that it can be comprehended by the eye in a single view of from various points of view. It not only takes into consideration the best esthetic effects but includes within its scope the harmonious relationships of buildings to the space which they enclose. A street is considered to produce order, and intimacy; thus, the planners are working constantly in the human scale—that is, relating the human being to his urban environment.

In America, the freeway, for example, or the expressway robs us of our human scale and our relationship to our surroundings. The freeway is primarily a mechanical or engineering device; it is not a social device necessarily in harmony with the human being. The real physical urbanity of European cities is stimulating, delightful, both visually and socially, and the individual finds himself in harmony with it and feels he belongs there. One of the lessons that we can learn from European cities is that they have developed and are still being planned on the ancient precept that a man can walk on his own legs. Ancient developments within European cities are constant reminders of that precept, reminders that man is still capable of walking on his own legs. And it is perhaps for this reason that the Europeans have given greater stress to the street culture approach in the development and expansion of their present cities.

Now I would like to talk to you about some of the controls I mentioned earlier which are being applied in the development of cities in Europe today. I would like to discuss these controls in relation to the development of new towns as well as to existing urban areas. In democratic societies, controls must have democratic reasons for their existence. Keeping this in mind, I would like to talk to you first about planning in Holland because their controls are more simply related to specific problems of development.

The Dutch do not have the same problems of urban sprawl as we have in the United States. For unplanned suburban construction cannot take place at the fringe of the city. Contrary to American procedure, urban extensions are made by annexing land before the suburbs are built up. The reason for this is that most of the towns and especially the new towns in Holland are built on reclaimed land, and the area must be built up with about seven feet of sand and permitted to settle for 2 years before any building can take place.

Therefore, drainage, sewers, and street layouts must be planned before thousands of tons of sand are distributed. For this reason, few towns in Holland have fringe development problems. Because of its grand scale, reclamation of land is a public enterprise; however, all the land does not remain in public ownership. Residual areas are prepared for private development for builders who enter into agreements with the municipality. The local authority then carries out the necessary public works in accordance with the contract or in accordance with the extension plan. Without the cooperation of the municipality, urban extensions on private land are practically impossible.

Reclamation projects and canal development go hand in hand in Holland. The public nature of this type of operation has therefore made planning essential; so the Dutch have had some very basic reasons for planning their cities for quite some time. Because of their careful use of land, they are probably one of the countries which has made the greatest strides in regional planning.

Rotterdam, Holland's second largest city was almost completely destroyed during the war. The debris was almost immediately cleared away after the devastation. While visiting Rotterdam, I was told that the planning for the new center began only four days after the bombing. After the people of the city went through an initial desire to reconstruct a replica of the old Rotterdam, they made a break with the past. Their whole planning approach did not become one of reconstructing an old city, but that of developing a city for today and of tomorrow. But the ancient precepts of what a town is, were there to guide them. The former prewar shop-lined streets gave way to traffic-free promenades. Wide streets were designed for modern traffic and narrow streets to provide an intimate and popular atmosphere for shoppers.

Rotterdam, with an improved version of its 19th century shopping area, became the postwar model for the development of new towns throughout the world. I was told that the heart of the city has become even more important than it was before the war. It is now, not only the main business center, but the shopping center and the center of the city's cultural and civic life. At night, when I visited there, the center was alive with gay music flowing out of the dance restaurants and cafes. It was beautifully lit with pedestrians strolling in the intimate atmosphere of the gay promenade. The planners have succeeded in preserving and even adding to the life and attraction of the city center, something that we in America are still struggling with.

The architectural realization of this redevelopment was made possible because of the simple procedure of an extensive program of land expropriation. The planners of Rotterdam attribute the success of their plan mainly to the fact that the city was the sole owner of the developed property. Ownership of land is one of the essential elements of redevelopment and renewal, whether in Europe or in America. The expensive and time-consuming manner of collecting property under one ownership is one of the biggest stumbling blocks to planning today. In America we have as yet been unable to come to simple terms with this problem.

On the other hand, the farsighted Swedish authorities of Stockholm began buying up adjacent agricultural land as the opportunity arose. This has been done since the beginning of the century and has permitted Stockholm to expand within the limits of its own land holdings. The City of Stockholm has, therefore, been fortunate enough to plan and direct expansion. But now it has more or less reached the limits of land which the City owns. This does not mean that the development has not been contiguous to the City proper. For Stockholm has built new towns as far as five miles out; that is, within this area of land which is owned by the City; yet a certain portion has developed as green belt, i.e. open agricultural land.

The planners expected to run out of land in 1960, but nine years earlier in 1951, a regional planning board was established. By the end of 1955, a regional plan for the greater Stockholm area was produced. This region includes other towns beyond Stockholm's ownership. The regional plan introduces six regional districts. The smallest district will allow for 78, 000 population, the largest for 340, 000 population. One of these districts includes a group of suburbs each between 10,000 and 15,000 population and built around a local center (or shopping district), served by subway stations.

Most of the apartments are built within a quarter of a mile of these centers, usually around pedestrian squares, with parking areas to serve both the shopping center and the subway station. The row houses are built within about half a mile of the subway station. One of these local centers, Vällingby (which was planned as a new town), serves as a main center for one of these areas of about 100,000 people, although Vällingby is itself about 50,000 in population.

The centers have a sufficient number and type of commercial establishments to encourage competition; this in spite of the many misconceptions of the Swedish system. Cultural pursuits and entertainment have been provided to give competition to Stockholm's traditional center of culture. Attempts have been made to give as independent a life as possible, with jobs being created in new industries in these towns. One of the important things to remember is that all the districts within the region are being developed according to a plan, each centered around a main pedestrian shopping center, made accessible by pedestrian lanes as well as by vehicular roads.

Stockholm is about the size of Milwaukee, and those of you who have been there will probably support the statement that Stockholm has more of the urban qualities than does Milwaukee. Of course this is not a fair comparison, because Stockholm is the capital city. It has 700 years of tradition behind it. Furthermore, it is surrounded by water, for the City has developed on a group of islands.

For some years now, Stockholm has been developing a new center within its downtown area. Two subway stations empty out over 200,000 people each day onto a pedestrian piazza or square, and the same number arrive to return to their homes. This new center called "the city" has been built on land acquired as the opportunity arose since before the turn of the century. Five so-called skyscrapers have been built as part of this center, each built by a private developer. The shopping is on several levels. It is one total complex and all buildings are related to each other around open pedestrian space. Swedish planners have learned a great deal from American experience. One of the things that they have learned is to plan their suburbs and regions, but at the same time, not to permit the core of the city to decline.

To discourage people from other parts of the country from gravitating toward Stockholm and toward one or two of the large cities, the government is helping to finance the improvement of most of the business centers of towns throughout the country. Even towns of 400 to 500 are getting new and modern town centers. Some are getting new Stadshotels (these are usually first-class type hotels, which serve as the centers for many social activities), and these certainly add to the desirability of living in small towns. Of course new housing is going up in most of the towns throughout Sweden—much of it in connections with the renewal of the town center and designed to stabilize nearby residential areas. Other houses are being developed throughout the towns generally and according to plan. There is little or no private speculation, although a good portion of the housing is provided privately.

Generally the Swedish government is concerned with how industry and population distributes itself around Sweden—and this in a country which has lots of space in relation to a small population. But in spite of its space, most cities and towns, new and old alike are built around one main center, a center which is usually surrounded by a district of apartment houses. The density decreases as the distance from the center increases. The development of single family houses takes place at the outer edges of the town toward the planned green belt area. Consequently, even the smallest towns seem to have an urban appearance. Towns of 50, 000 often appear to be, and are, more urban in nature than towns of 100, 000 in either England or the United States.

Holland, too, has been greatly interested in the distribution of industry in its towns. Although the Dutch have had extensive planning controls, primarily because their government is engaged in reclaiming a great deal of land, they have also been genuinely interested in proper population distribution. Planning controls apply to existing cities as well as to the new towns being developed in Holland. It might be said that Holland became interested in planning quite early because of the scarcity of land. On the other hand, the Swedes have an abundance of land, but as indicated earlier, they too are interested in the proper distribution of population and industry, and in the planned growth of their towns. Great Britain which is from six to seven times greater in population than Sweden, and about half Sweden's size in area, is showing the same sort of logical interest in population and industrial distribution. The new towns which have been built around London and other parts of Britain are the direct result of this type of thinking.

London, including the surrounding area, has a population of about 10, 000, 000—more or less in the class of New York City. Therefore, the London region accounts for about 20% of Britain's total population. For this reason, London is not only trying to control its size, but is in fact attempting to reduce it. It is doing this for the same reason that the Swedes are trying to keep their people from moving to the larger cities en masse. For it means, first of all, that more houses must be built in an already crowded city, while houses in smaller towns go vacant. This is more true of England, of course, than it is of Sweden. London has not only drawn away industry and people from the rest of the country but it has sucked away most of the culture from the provincial cities. While there are symphony concerts held in London almost every night and many times in the afternoons, there are only one or two symphony orchestras outside of London worth mentioning. London has many art galleries. It has the National Film Theater and it is going to have the National Art Theater. It has the best and largest department stores in the country. It has the Queen and Her Majesty's Government. The City of London, which is the financial center of the country, is located within the heart of London.

Shortly after the war, Britain's government decided that London was too big and that it must not grow larger—in fact, it was decided that about 500, 000 people were to be moved out of London. To those of you who are not familiar with the London plans, it may sound strange to hear that industry, with some exceptions, is not permitted to move into the London area without government approval.

In the United States, where cities are busily engaged in attracting industry to themselves, it may sound stranger still to hear that some industry is being moved out of London. It may also sound slightly dictatorial that 500,000 people are to be moved out, but this is merely a voluntary migration of Londoners to the eight new towns being built within 25 miles of London. They are presently in various stages of development, with two or three of them near completion. Industry is being steered from London to these new towns and to various other parts of the country. Yet this is being done in a typically British, democratic manner.

This plan aims at preserving the world's largest metropolis as a commercial and cultural center, permitting it to operate as one great urban unit and restricting its area growth by instituting a green belt around it. At the same time, attempts are being made to achieve modern standards of density and open space within the urban area. This is being done through the redevelopment of overbuilt areas within London proper.

In an attempt to control its growth, Paris is initiating what might be described as a payroll tax. This is meant to discourage industry and offices from adding to the present congestion of Paris and the surrounding area. The success or failure of this type of control is still to be ascertained. On the same point, more recently the British government has put out a white paper indicating that it will control the location and development of offices as well as industry.

One of the things I have attempted to point out is that in renewing the center of their cities, Europeans are conscious of their tradition. They are reinstituting the street culture and pedestrian areas. They are also building their new towns in relatively small scale and attempting to bring a human scale to their large towns. I have concentrated on one or two important elements of planning and development in Europe today. This by no means exhausts the methods being used by Europeans in molding their cities. I have tried to point out the concern that European planners have for relating the scale of their cities to the human being, and, that their ancient cities are constant reminders of precepts that still apply to modern living. I also have tried to point out that public land acquisition is an important aspect of planning and developing and that the Europeans have not found this incongruous with democratic life. They have found methods for controlling the development of peripheral expansion. At the same time they have tried to discourage this growth by renewing the inner core of their cities and by making the city proper an attractive place in which to live. Concern for regional and national distribution of population and industry is not only something that is desirable, but something to be planned for, so actual policies have been established which are aimed at bringing about a better distribution.

I am sure that I haven't answered the opening question, "Why do we find ourselves lagging behind Europe in the development of our cities?" But perhaps, by describing what the Europeans are doing with their cities, I have succeeded in pointing out why *they* are inclined to ask that question. I have tried to relate these few planning and development aspects to our own attitudes and to the manner in which we plan and develop our cities in order to show that we may need some new approaches to our existing problems.

Although Europe's problems may be overburdened with custom and tradition. planners there have not been unimaginative. On the other hand, unobstructed by tradition, we in the U.S. have lacked direction and guidance, shown little imagination along these lines and still hesitate to learn lessons from abroad.

MILWAUKEE'S SOCIALISTS AS URBAN REFORMERS

Frederick I. Olson

Milwaukee's Socialist movement constitutes the single most widely known episode in the city's political record of a century and a quarter, possibly even the most significant in the city's history.[1] This movement came into being as a formal political organization in 1897, although there had been manifestations of local socialist activity, largely non-political, for most of the preceding half century. Under the leadership of Victor L. Berger, the first Socialist congressman, and of Daniel W. Hoan, for 24 consecutive years mayor of Milwaukee, the party was well organized for both propaganda and campaiging and developed a most effective and efficient use of grassroots party membership.

Milwaukee's Socialists must be judged as a local third party with state and national political affiliations rather than by the standards appropriate to the Democratic and Republican parties.[2] Their electoral

[1] This paper is based largely on the writer's unpublished doctoral dissertation, "The Milwaukee Socialists, 1897-1941" (Harvard University, 1952). A detailed account of Socialist party development in Milwaukee appears in Marvin Wachman, *History of the Social-Democratic Party of Milwaukee, 1897-1910* (Urbana, Illinois, 1945). Both Wachman and the writer drew on the official party records in the Milwaukee County Historical Museum. The community in which the Milwaukee Socialists operated is described in Bayrd Still, *Milwaukee: The History of a City* (Madison, Wisconsin, 1948).

[2] The history of the Socialist party nationally is documented in Howard H. Quint, *The Forging of American Socialism: Origins of the Modern Movement* (Columbia, South Carolina, 1953); Ira Kipnis, *The American Socialist Movement, 1897-1912* (New York, 1952); Daniel Bell, "The Background and Development of Marxian Socialism in the United States," in Donald Drew Egbert and Stow Persons, editors, *Socialism and American Life* (Princeton, 1952), I, 213-405; and David A. Shannon, *The Socialist Party of America: A History* (New York, 1955). For an interesting local Socialist study with suggestive comparisons to Milwaukee, see Henry G. Stetler, *The Socialist Movement in Reading, Pennsylvania, 1896-1936: A Study in Social Change* (Storrs, Connecticut, 1943).

successes were indeed spectacular. Beginning in politics in 1898, they increasingly set the tone and made the issues locally. Their candidates won office for the first time in 1904. Thereafter, until the 1940's, Socialists sat in the Common Council, the County Board, both houses of the state legislature, and Congress; and they held other city-wide and county-wide offices—mayor, city attorney, district attorney, sheriff, judge, to name only the most important. They swept to a spectacular victory in the 1910 election in three-way voting, and for two years controlled, at least in name, the administrative and the legislative machinery of the city and county. In each of the next three decades they came close at some point to their 1910 achievement, most notably in the city election of 1932. For reasons which need not detain us here, the party was adversely affected by state and national events of the 1930's, and could not survive the defeat in 1940 of its seemingly perennial incumbent in the mayor's office, Dan Hoan. Frank P. Zeidler restored the mayoralty to a Socialist party member between 1948 and 1960, but he did so through a new political vehicle, and the party itself ceased to wield any power. For our purposes, indeed, the period of significant Socialist ascendancy would be the first four decades of the twentieth century.[3]

Before we examine the Milwaukee Socialists as urban reformers, we should ask ourselves: who and what were they? Not surprisingly they had strong antecedents in the European socialist movement and in foreign-born groups. First and second generation Germans always formed the strongest single element in party leadership, party membership, and as nearly as can be determined, in voting strength. Smaller foreign language elements in Milwaukee were always represented in party activities, but the primary objective of the party's ethnic appeal was to Milwaukee's large Polish population. Despite serious deterrents, particularly the party's reputation for being anti-religious (anti-Catholic in particular) and strongly German, many Poles gravitated to the Socialist banner. As local Socialists acquired for themselves, and to some degree for their movement, a respectability and a reputation for accomplishment, it became more difficult to distinguish their followers and opponents by simple ethnic, class, social, or even political lines. Even the constant provided by an early alliance with the local labor union movement, perfected by an extraordinary interlocking directorate, was not quite so pervasive as it seemed; some labor leaders and considerable working class segments opposed the Social-

[3]Frederick I. Olson, "Milwaukee's Socialist Mayors: End of an Era and Its Beginning," *Historical Messenger* (Milwaukee County Historical Society), March 1960, pp. 3-8.

ists at all times.[4] Conversely, Berger, Hoan, and the Socialists generally obtained some support from time to time from small business and professional people, not unlike their Populist antecedents; they also received financial assistance and votes from prominent local capitalists.

Foremost among their intellectual characteristics was the fact that Milwaukee's Socialists were not really revolutionaries and did not expect to overthrow capitalism. While many of them paid lip service to Karl Marx and scientific socialism, they were actually committed to political action and gradual evolution toward a more perfect social order. Had they wished to institute public ownership of the means of production on the basis of their local victories, they would have confronted a series of legislative, constitutional, and judicial obstacles far beyond their powers. They clearly preferred to obtain and hold local public office in order to effect as far as possible those immediate gains toward ultimate socialism that had come to be known as revisionism. Successful in local politics over a long period of time as none of their colleagues in the national party in other cities and states were, they inevitably became alienated from the more radical Socialists in the nation. Some of their New York brethren applied to them the derisive term "sewer Socialists." Only in the depths of the depression of 1929 did a segment of Milwaukee Socialism again flirt with the gospel of revolution.

Milwaukee's Socialists were therefore not revolutionaries prepared to overthrow an established social order by violence but local reformers or perhaps evolutionaries who hoped to move steadily toward a better world in their own community. As such they differed in emphasis and perhaps in ultimate objective, but not in major immediate goals, from other urban or municipal reformers of the Progressive era. A major commitment of the progressives of fifty years ago was to reform the city, and Milwaukee's Socialists form an interesting variant on such Progressive era reformers as Hazen S. Pingree, Seth Low, Golden Rule Jones, Tom Johnson, and their followers. In Milwaukee as elsewhere the reform movement benefited from public reaction to the growth of big business and monopoly, the struggle over public service corporation franchises, the warning of Lord Bryce and others of the dangers from widespread corruption in local government, the manifest evils of working and living conditions in larger cities; in short, from popular shock and shame over the economic, social, and political health of modern society. Add to this, the new tendency of the magazine

[4] Frederick I. Olson, "The Socialist Party and the Union in Milwaukee, 1900-1912," *Wisconsin Magazine of History,* 44: 110-16 (Winter 1960-61).

and newspaper press to concentrate on exposure of the raw side of life; the new winds of doctrine blowing over the land, some of European origin and some indigenously American, but all critical of the present order; and the appearance of the new academic disciplines in the social sciences with methodologies useful in studying the city.[5]

Parenthetically I would like to point out a few of the significant differences between the approach of the Progressive era city reformers and our present attack on urban problems. Note immediately that half a century ago one was disposed to "reform," that is, to try to restore to an earlier, more virtuous state of affairs, whereas today, less hopefully, we simply aim at a treatment of "problems" with little optimism that permanent solutions are possible. Today, moreover, almost every candidate for local public office admits there are problems and frequently agrees with his opponent in identifying them, differing at most over the solution to be sought and not always over that. But half a century ago the reformer sought to throw out the rascals and thus wrest control of government from corrupt economic and political forces. This concept was, incidentally, of substantial assistance to Milwaukee's Socialists in 1910. The voters, convinced that the ascendant Democrats were corrupt, and disillusioned by an experiment with a Republican administration in 1906, turned to the only remaining alternative, the Socialists. Whereas in other American communities, as Lincoln Steffens discovered to his dismay, the voters soon returned the rascals to power as the reform impulse waned, in Milwaukee the strength of the Socialists brought about a political equilibrium in which they shared with their non-partisan opponents for 30 years a reputation for honesty, administrative efficiency, and above average civic progress.[6]

Although only philosophically committed to socialism, Milwaukee's Socialists were serious about the more limited objective of public ownership and operation of public utilities, and in general favored an expansion of governmental activities and services short of taking over the means of production. Many other Progressives favored public ownership of utilities, and even of steam railroads, because of their monopolistic and franchise aspects, but they usually settled for state regulation on the Granger pattern. Milwaukee's Socialists gained power after a decade of belaboring the public utilities, especially the

[5] On the Progressive movement, see Eric F. Goldman, *Rendezvous with Destiny: A History of Modern American Reform* (New York, 1952); Richard Hofstadter, *The Age of Reform: From Bryan to F. D. R.* (New York, 1955); Samuel P. Hays, *The Response to Industrialism, 1885-1914* (Chicago, 1957); and George E. Mowry, *The Era of Theodore Roosevelt,* 1900-1912 (New York, 1958).

[6] Frederick I. Olson, "Milwaukee's First Socialist Administration, 1910-1912: A Political Evaluation," *Mid-America,* 43: 197-207 (July 1961).

street railway and electric company. Their city attorney from 1910 to 1916, Hoan, used all of his legal skill and that of his excellent staff to employ against the utilities and the railroads the regulatory powers of the Railroad Commission, for the city had to all intents and purposes been divested of such authority by state law. Reasonably successful but disillusioned by the experience of dragging cases laboriously through commission and court proceedings, Hoan continued to argue for public ownership.[7] He finally carried the case for municipal ownership and operation of the electric utility to the people in a referendum in 1936 and was badly beaten, thus contributing to his own and his party's early demise.

Milwaukee's Socialists were keenly aware of criticism from within their party and amusement from without over their failure to bring about public utility ownership. Only the waterworks was municipal, and that had been so for more than forty years before the Socialists came to power. On the other hand, they did expand in modest ways the scope of government activity whenever the opportunity presented itself. Most of these were minor, such as production of street and traffic signs, and direct employment rather than contract work, and became so acceptable that only the most doctrinaire anti-socialist has seriously suggested a change.

While Socialists generally proclaimed the need for establishing a new social order based on production for use and the brotherhood of man, non-socialist Progressives hoped to regenerate America by proposing new political devices. Among the most important such devices on the local scene were the initiative, referendum, and recall, the direct primary, non-partisan elections, short ballot, small council, home rule, and the commission and city manager forms of municipal government. The objectives were to increase popular as against partisan control over public officials, reduce corruption and increase efficiency, and divorce local from state and national politics. The Socialists, while seldom opposing any of these openly, found little to commend them. They scorned such political tinkering as a diversion from important social and economic questions. But they also valued partisanship and worked hard to instill it in their own members. Their position was subsequently vindicated. The outstanding Milwaukee attempt to employ the recall was aimed at Socialist Mayor Hoan in 1933 and was thwarted by the organizational efficiency of his party.

Borrowing from European practice and ignoring the American preference for "good men," the Socialists insisted upon party discipline for all members and office holders. They selected their candidates

[7] Daniel W. Hoan, *The Failure of Regulation* (Chicago, 1914).

for office by intraparty methods, bypassing the public primary. They promised the voters that their candidates would perform according to platform pledges and party decisions, and they sought to enforce discipline through party financing of all campaigning, officeholder caucuses, and undated, pre-signed resignations from office. They alienated independent reformers by their intense partisanship, especially their opposition to non-partisan election laws. Their increasing electoral strength between 1898 and 1910 had been leveraged by the local three party system. Fusion by Democrats and Republicans defeated the Socialists in the Spring of 1912, however, and a non-partisan election law ensured a two-way runoff beginning in 1914. While the Socialists professed to welcome this clearcut choice between Socialist and anti-Socialist and speedily accommodated themselves to the new system, their leverage was gone.[8]

On the other hand the Socialists were consistent supporters of municipal home rule. Like their opposition to non-partisan elections, their stand could be interpreted as self-interest, but in this case it agreed with the dominant reform view. To the degree that the Socialists could gain local power only, it was to their advantage to maximize the control Milwaukee had over its own affairs, especially as they aimed at changes in the existing order. After failing to approve home rule in 1914, the state waited a decade before acting favorably, only to circumscribe the new freedom by legislation in 1929. During the three decades of their hegemony in Milwaukee, the Socialists were generally unsuccessful in enlarging the capacity of the city for control over its own affairs. Through their own members in the legislature, through their informal relations with Progressive Republicans during the administrations of Governors McGovern, Blaine, and Phil LaFollette, through unremitting lobbying in Madison in conjunction with labor and the Milwaukee legislative delegation, especially in the Hoan era, the Socialists kept Milwaukee's case before the legislature and state administrative agencies, but with spotty success. At times the legislature responded to a contrary pressure to reduce the authority of offices occupied by Socialists, as in 1911, when Mayor Seidel was stripped of direct control over the police chief. Shortly after assuming office, Mayor Hoan complained of the inadequacy of the city executive's power, but he never achieved any improvement here, either. One may conclude that Hoan not only reconciled himself in time to the nominal weakness of the office, but even came to understand the uses of power not spelled out in charter and law.[9] For all their desire to bring about

[8] Erich C. Stern, "The Non-Partisan Election Law: Reform or Anti-Socialism?", *Historical Messenger*, September 1960, pp. 8-11.

[9] Daniel W. Hoan, "The Powers of a Mayor," *Marquette Law Review*, December

changes in the economic and social order and their understanding of the importance of political structure, the Socialists left almost no mark on the framework of government.

While the Socialists, whether from self-interest or principle, differed from contemporary Progressives on the need for structural reform in government, they agreed with them on the need for professional public servants, for the application of modern methods of public administration, for efficiency and economy in government services, and for intervention by government when private enterprise was inadequate to the task. Underpinning their attitude was the faith and the hope that proper management of public business at present levels would convince voters that the Socialists could be trusted with development of an all-embracing socialist state.

Between 1910 and 1940 Socialist officials compiled a superior record in handling appointments to departmental posts and to bureaus, boards, and commissions. Despite opposition charges of packing the City Hall with card-carrying Socialists, the Seidel and Hoan regimes actually defended civil service, sought competent appointees outside party ranks, and resisted rank-and-file expectations of patronage to a surprising degree. Under Seidel, Professor John R. Commons of the University of Wisconsin was called to set up a Bureau of Economy and Efficiency. Its primary responsibility was a thorough study of the functioning of city government. Its most useful achievements seem commonplace now—inventory of city property, cost accounting on city functions, regular audits, scientific budgeting. Then as well as later the Socialists were remarkably receptive to the use of experts and to the application of the latest findings of researchers.

More suggestive of the future was the survey, also undertaken under the direction of Commons and his Bureau, to determine the social and economic health of the city and of its people. The Socialist premise, of course, was that man is inherently good but the system under which he lives and labors is evil. Therefore the Socialists were deeply impressed by revelations of slum conditions and sought to remedy them by fundamental steps. They sought slum clearance, public housing, enforcement of building codes, expansion and improvement of free Health Department services, special attention to child welfare, public employment offices, and, from their puritanical streak, eradication of the red light district in the shadow of the City Hall.[10]

1918, pp. 40-42, and *City Government: The Record of the Milwaukee Experiment,* (New York, 1936).

[10] John R. Commons, *Myself* (New York, 1934), pp 151-53, and *Eighteen Months's Work* (Milwaukee Bureau of Economy and Efficiency, Bulletin No. 19, Milwaukee, 1912).

Uninhibited by doctrinaire notions of the limit of municipal action, the Socialists also encouraged public programs to lift the spirits of the people—the social centers in the lighted schoolhouse, free or cheap public band and orchestra concerts and dances, and park programs. During the 1920's and 1930's such efforts were strengthened by legislative support and sound administration. Perhaps the most unusual enterprise, to combat the high cost of living after the first World War, came when Hoan personally undertook to market consumer items to create a price yardstick.

Yet such objectives seemed remedial and ameliorative. What really distinguished the Milwaukee Socialists was their positive vision of what a city could be physically. They had no ideological objection to planning but rather encouraged it through their own programs and by creating instruments for carrying on planning. The Socialists did nothing more significant for the future of Milwaukee than to provide opportunity for Charles B. Whitnall. Under Whitnall's urging, city and county planning agencies were created, zoning and land use planning grew, park proposals took shape. The concept of a city beautiful spawned such long range projects, yet unrealized, as a Milwaukee River drive reaching to the northern edge of the county and a Civic Center. Soon after the first World War, Hoan also brought into being the Garden Homes housing development, experimental in its financing and in its community layout.

No such range of public enterprises could fail to threaten the tax rate of any city. Milwaukee between 1910 and 1940 was not faced with the revenue crisis that haunts every large city today, but it was required to live within the taxing authority and debt limits imposed by law, and to face the challenge of tax delinquency during the great depression. The Socialists were neither profligate spenders—an impossibility in a community noted for frugality—nor inveterate opponents of higher government expenditures. They favored sound budget and tax policies, but additionally embraced in the early 1920's a pay-as-you-go program. While they did not originate this scheme for a debt amortization fund which ultimately wiped out the city's bonded indebtedness, they embraced it warmly, for it coincided with their opposition to the payment of interest and to dealings with investment bankers. The effect of this policy, however, was to preclude adoption of many expensive public programs, however desirable, because of their tax or debt implications, and even to postpone or eliminate necessary public works.

To sum up the urban program of the Milwaukee Socialists: They were realistic enough not to expect to bring about revolution or the Socialist state. They were skeptical of most tinkering with governmental machinery, and viewed some of it from the standpoint of sheer self-interest. But they favored municipal ownership of public utilities and welcomed opportunities to expand government activities. They sought to manage public affairs competently in order to demonstrate that socialist proposals could be carried out. They believed in applying the new insights of the expert and the scholar and the technician to the business of the city, and they believed planning was essential. To some degree they shrank from the financial implications of carrying out their programs. When the Socialists ceased to wield influence and power in Milwaukee, about twenty years ago, their program was incomplete, indeed some of their objectives and some of their visions seemed as remote as ever. Urban problems were as intractable to the reformer then as now.

Perhaps we should close with a story told by Carl Sandburg. He had come to Milwaukee from the Illinois prairie shortly before 1910 and soon became a poetic evangelist for the Socialist movement. The reward for his street corner campaigning for Seidel was appointment as the mayor's confidential secretary at the munificent salary of $900 per year. Following the mayor's inauguration, he returned to his office with stars in his eyes as he pictured himself about to embark on a crusade to establish the brotherhood of man in Milwaukee. His first duty, unfortunately, was to comply with a telephone request to remove a dead dog from the street.[11] Like their comrade Sandburg, Milwaukee's idealistic Socialists often found themselves engaged in the more prosaic tasks of removing dead dogs from the streets.

[11] Karl Detzer, *Carl Sandburg: A Study in Personality and Background* (New York, 1941), pp. 81-84.

RECENT CHANGES IN WISCONSIN URBANISM, 1950-1960

John W. Alexander

The objective of this paper is to investigate three questions about urban population in Wisconsin: (1) How much change in total urban population occurred between the last two censuses of population, 1950 and 1960? (2) What areas within Wisconsin were distinguished in terms of urban change? (3) To what other phenomena might these spatial variations in urban population change be related?

I. How much *change in total number of urban people occurred* between 1950 and 1960?

In 1950, Wisconsin had a total population of 3, 434, 000. The urban component was 1, 987, 000 — 58% of the total.

During the next ten years all three of these measurements increased (Table 1). The total population expanded to 3, 951, 000. The urban population increased to 2, 522, 000, which raised the urban percentage from 58% to 64%. Obviously, then, Wisconsin's urban population is growing vigorously, and it is growing faster than the state's total population.

TABLE 1
Wisconsin: Population 1950 and 1960

			Change 1950 to 1960	
	1950	1960	Absolute	Relative
Urban Population	1, 987, 000	2,522, 000	+535, 000	+ 26%
Total Population	3, 434, 000	3, 951, 000	+517, 000	+ 15%
Percentage of Urban to Total	58%	64%	+ 6%	+ 10%

Source: United States Census of Population, 1960.

II. What *areas of urban change* are distinguishable? Where were urban increases located? Where were the decreases? To answer this question, a series of maps will be helpful.

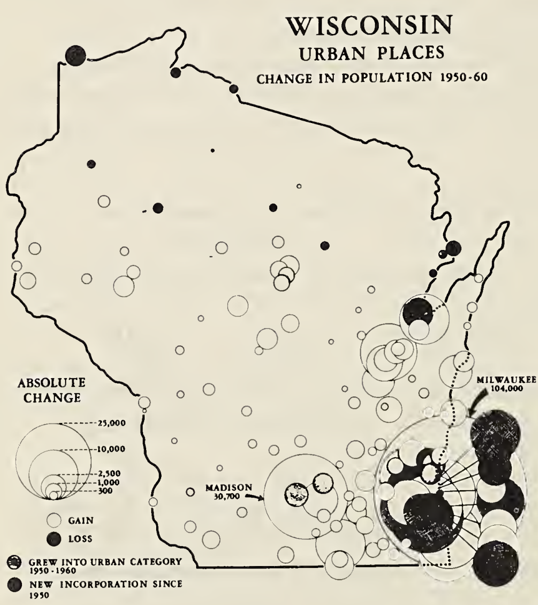
Figure 1 shows the location of population agglomerations (all incorporated settlements plus all unincorporated places having at least 1,000 inhabitants). Places which grew between 1950 and 1960 are shown by black dots; those which lost population are shown by white dots. Several areas stand out on this map. The "southeastern triangle" (bounded by Lake Michigan, the Illinois border, and an imaginary line from Green Bay to the southwest corner of the state) is clearly a region of growing settlements. Almost every dot in this area is black; conversely, most of the black dots on the map are in this area. A second area of growing settlements is the "west-central" and can be delimited by an imaginary border running from St. Croix Falls on the Mississippi River eastward to Wausau, south to Stevens Point, thence southwestward to La Crosse on the Mississippi. Within this area most of the dots are black. A third region is one of loss and may be termed the "southwestern area." Located between the southeastern triangle and the west-central area, it contains most of the white dots on the map; conversely, most of the area's dots are white. A fourth and final region is "northern" Wisconsin, north of a border from St. Croix Falls on the west to Green Bay. In this part of the state, the dots are sparser but most of them are white, making this the second major area of shrinking settlements.

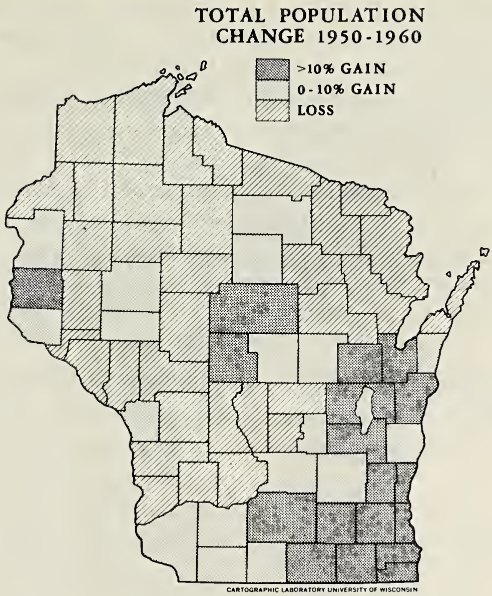
Figure 2 shows the locational pattern of change in those settlements which the census classifies as *urban*—places with a population of 2500 or more. Notice that this is a map of *change* (between 1950-1960), not a map of number of inhabitants. Change is expressed in terms of either absolute increments or absolute decrements. For example, the municipality of Milwaukee grew from 637,000 to 741,000—an increment of 104,000. (Note that this is the growth of, not the Milwaukee metropolitan area, *but the central city!)* Accordingly, on this map Milwaukee is represented by a large circle whose area is proportional to the value of 104,000. This figure exceeds the total population of the entire city of Madison in 1950. In other words, if we could have taken Milwaukee as of 1950 and Madison of 1950 and added the two together, we still would have had a city smaller than the actual Milwaukee of 1960.

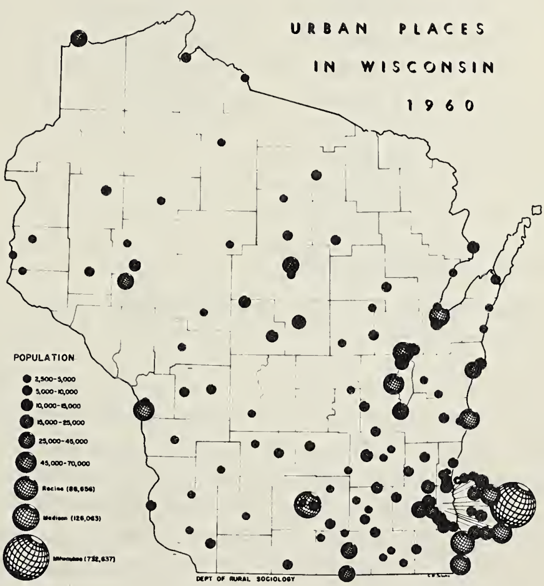
On this map, the black indicates *loss*. For example, the city of Superior had 35,000 inhabitants in 1950; by 1960 the number had shrunk almost to 33,000, a loss of 2,000.

The light gray color indicates a settlement which in 1950 was incorporated but too small to qualify as urban. By 1960 it had qualified. There are 13 light gray circles on this map, largest of which is Menomonee Falls.


WISCONSIN POPULATION
CHANGE, 1950-1960
INCORPORATED AND UNINCORPORATED PLACES OF 1000 OR MORE
GAINED
LOST


WISCONSIN
URBAN PLACES
CHANGE IN POPULATION 1950-60
MILWAUKEE
104,000
MADISON
30,700
ABSOLUTE
CHANGE
25,000
10,000
2,500
1,000
300
GAIN
LOSS
GREW INTO URBAN CATEGORY 1950-1960
NEW INCORPORATION SINCE 1950


TOTAL POPULATION
CHANGE 1950-1960
>10% GAIN
0-10% GAIN
LOSS
CARTOGRAPHIC LABORATORY UNIVERSITY OF WISCONSIN


URBAN PLACES
IN WISCONSIN
1960
POPULATION
2,500-5,000
5,000-10,000
10,000-15,000
15,000-25,000
25,000-45,000
45,000-70,000
DEPT OF RURAL SOCIOLOGY

The dark gray color indicates a settlement which was not incorporated in 1950 but now is an urban place. There are thirteen such circles on this map, largest of which is Brookfield.

The uncolored circles indicate settlements which were urban in both 1950 and 1960, and also grew.

TABLE 2
Wisconsin: Urban Places Ranked by Increment or Decrement 1950-1960

GAINERS (of at least 10,000) By Amount of Gain		LOSERS By Amount of Loss	
1. Milwaukee	104,000*	1. Superior	- 1,862
2. Madison	30,000	2. Marinette	- 849
3. West Allis	25,000*	3. Ashland	- 508
4. Wauwatosa	24,000*	4. W. Milwaukee	- 386
5. Brookfield	19,000*	5. Ladysmith	- 340
6. Racine	18,000	6. Hurley	- 271
7. Greenfield	17,000*	7. Oconto	- 250
8. Menomonee Falls	16,000*	8. Antigo	- 211
9. New Berlin	15,700*	9. Shorewood	- 209
10. Appleton	14,000	10. Spooner	- 199
11. Kenosha	13,500	11. Tomahawk	- 186
12. Brown Deer	11,280*	12. Park Falls	- 5
13. Janesville	10,300		
14. Green Bay	10,100		
15. St. Francis	10,065*		
16. Franklin	10,000*		

*In Milwaukee Urbanized Area

Source: United States Census of Population, 1960

Table 2 lists Wisconsin cities in terms of amount of change in population 1950-1960. There are many other methods by which urban changes could be portrayed, but since space is limited, the answers to the second basic question can be summarized as follows:

(a) Most of the increment in urban population was in the southeast triangle: 90% of the urban growth was here. And every single one of the large circles on Figure 2 is in the southeast triangle.

(b) The greater Milwaukee area is prominent; 66% of Wisconsin's urban increment was in the Milwaukee-Racine-Kenosha urbanized areas.

(c) Other areas of conspicuous urban growth are the Rock River Valley (from Beaver Dam to Madison, Janesville, and Beloit); the Fox River Valley (from Fond du Lac to Green Bay); and the west-central area within which the upper Wisconsin River Valley and the Chippewa Valley are prominent. There was comparatively little increment in the southwest. Indeed, La Crosse had so little growth (only forty people) that it hardly shows on the map. The larger circle in this vicinity is not La Crosse but Onalaska.

(d) Only twelve urban communities lost population, and almost all of them are in the north. Similarly, the northern part of the state has comparatively few cities—but almost all of them lost—from Superior in the west to Marinette in the east.

III. *To what other phenomena are these locational patterns related?* Four have been selected for consideration: (A) change in total population, (B) size of urban settlement, (C) migration, and (D) commuter labor.

(A) *Total population*

Figure 3. This map shows the location of *change in total population* on a county basis. In broad generalization, one can say that half of Wisconsin lost population and half gained. The gaining counties are located in five general regions. The largest is the southeastern triangle. Every county in this triangle was a gainer. A second area of gain is the upper Wisconsin River Valley. A third and still smaller area of gain is the Chippewa River Valley. A fourth area is in the westernmost part of the state (particularly St. Croix County). Outside of this quartet of areas, there was only one county of gain: La Crosse. All other counties lost population between 1950-1960. If we compare this map of change in total population with the map previously observed, of change in urban population, we notice a marked similarity. Generally speaking, the growing counties are the ones containing dynamic cities. The shrinking counties generally have either no cities at all or else contain shrinking cities.

(B) The second relationship, that between *size of urban place* and amount of urban increment, can be observed by comparing Figure 2 with Figure 4, a map showing Wisconsin cities in terms of their present size (as of 1960).

The symbols are spheres, the size of which is proportional—not to change—but to 1960 total population. (Table 3 lists the twenty largest cities in terms of size.) The most prominent area is the southeastern portion again, particularly the greater Milwaukee-Racine-Kenosha cluster. The Rock River Valley stands out, as does the Fox Valley; and there is at least a brief hint of the upper Wisconsin Valley and the Chippewa Valley. The glaring anomaly is La Crosse—a sizeable sphere on this map (indeed, it is the state's ninth largest city) which scarcely shows on Figure 2.

TABLE 3
Wisconsin: Twenty Largest Cities, 1960

	Population		Population
1. Milwaukee	741, 000	11. Oshkosh	45, 000
2. Madison	126, 000	12. Eau Claire	37, 000
3. Racine	89, 000	13. Janesville	35, 000
4. West Allis	68, 000	14. Superior	33, 000
5. Kenosha	67, 000	15. Beloit	32, 846
6. Green Bay	62, 000	16. Fond du Lac	32, 719
7. Wauwatosa	56, 000	17. Manitowoc	32, 275
8. Appleton	48, 000	18. Wausau	31, 000
9. La Crosse	47, 000	19. Waukesha	30, 000
10. Sheboygan	45, 000	20. South Milwaukee	20, 000

Source: United States Census of Population, 1960

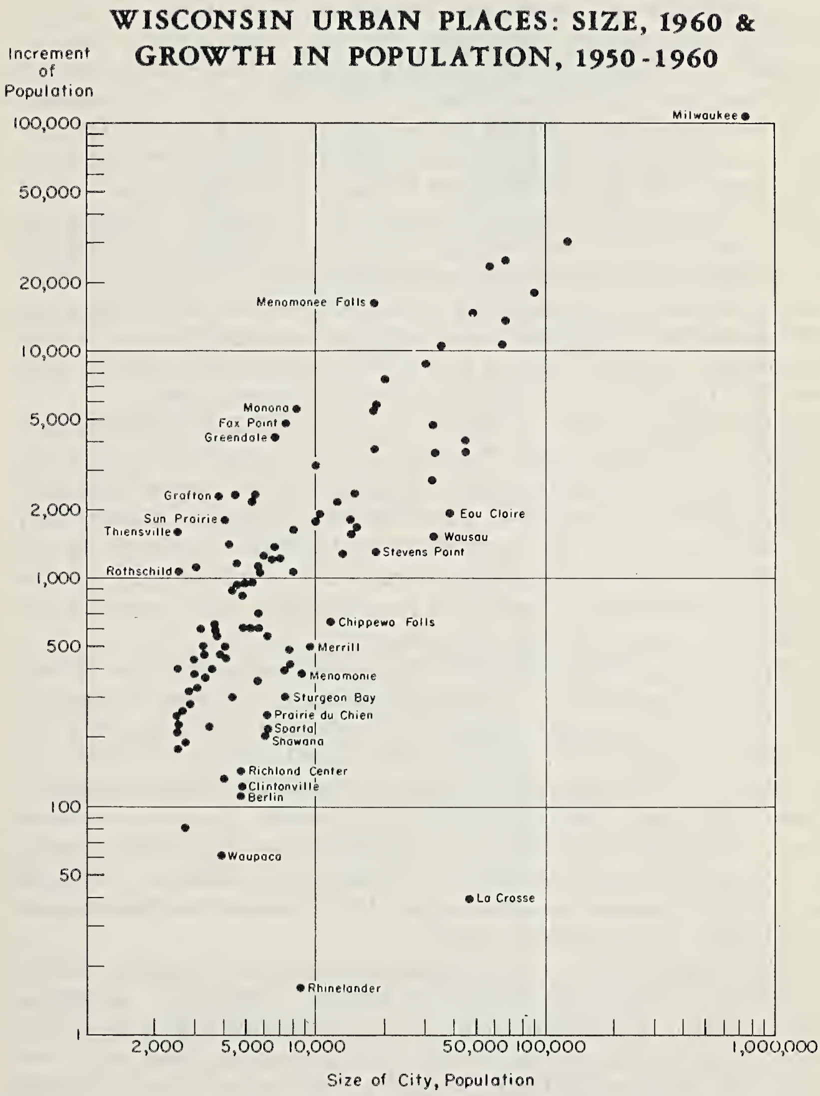
In general, however, the overall similarity between the patterns on Figures 2 and 4 suggests support for the hypothesis that the larger the city, the larger the growth.

However, there is another device for checking this relationship—a scatter diagram (Figure 5). On this scatter diagram the horizontal axis has been calibrated in terms of size of urban place. Notice that a logarithmic scale has been used. The vertical axis is calibrated in terms of change in urban population. Again a logarithmic scale has been used.

The dots tend to align with an upward slope from left to right, indicating a positive correlation. Clearly, there is a strong tendency for larger urban increments to be located in the larger urban places.

But there are two kinds of exceptions to this rule. One consists of large places which had comparatively little growth. These are represented by dots on the lower portion of the slope on the scatter diagram (e.g. La Crosse, Rhinelander, Waupaca, etc.). Most such places are located in the northern and western portions of the state.

The second type of exception is the smaller city which experienced an unusually large increment. These are represented by dots on the upper portion of the slope on the scatter diagram (e.g Menomonee Falls, Monona, Fox Point, Greendale, etc.). These are mainly satellite cities; in a sense they are being carried along on the coattails of a dynamic larger city, such as Milwaukee or Madison, on whose periphery they are located.


WISCONSIN URBAN PLACES: SIZE, 1960 & GROWTH IN POPULATION, 1950-1960
Increment of Population
100,000
50,000
20,000
10,000
5,000
2,000
1,000
500
100
50
1
Milwaukee
Menomonee Falls
Monona
Fox Point
Greendale
Grafton
Sun Prairie
Thiensville
Rothschild
Eau Claire
Wausau
Stevens Point
Chippewa Falls
Merrill
Menomonie
Sturgeon Bay
Prairie du Chien
Sparta
Shawano
Richland Center
Clintonville
Berlin
Waupaca
La Crosse
Rhinelander
2,000
5,000
10,000
50,000
100,000
1,000,000
Size of City, Population

Still another view of the relationship between change and size is portrayed by Table 4. This table summarizes the number of settlements (Column A), the number of gaining settlements (Column B), and the number of losing experiments (Column C) in terms of size of settlements. To illustrate: there were fifty-two cities with a population between 2,500 and 5,000; of this number, forty-seven gained and only five lost population between 1950 and 1960. By contrast, there were 118 settlements listed in the census with a population between 250 and 500; of these, seventy gained while forty-eight lost. All told, there were 563 settlements listed in the Census and 164 of them (29% of the total) lost population in this decade. In some respects, Column D is the most significant column in Table 4 for it indicates clearly an important relationship between (a) size of settlement and (b) change in population for the 1950-60 decade in Wisconsin: the smaller the settlement, the greater the probability that it would lose population. Indeed, 75% of the smaller settlements (those with less than 250 inhabitants) listed in the census were losers.

Notice that all the urban losers are in northern Wisconsin except for West Allis and Shorewood. The former is an industrial suburb (of Milwaukee) where tax policies favor industry which is expanding into residential areas. Shorewood is a residential suburb (of Milwaukee) of middle and high income groups almost exclusively developed in the 1920's. The decline in population here is the result of aging of the population, children having grown and moved away. The second wave of families with young children has not yet moved in.

(c) The third relationship to be considered regards urban growth and *migration of population*. I am indebted to colleagues in the department of rural sociology for data upon which these comments are based. Data on migration between 1950 and 1960 are arrived at by starting with the 1950 population figure, adding the number of births in the next ten years, then subtracting the number of deaths in those ten years. Suppose the resulting total exceeds the actual 1960 population: this means there has been a net migration outward. Suppose the resulting total is less than the actual 1960 population: this means there has been a net migration inward.

In 1950, Wisconsin has a total population of 3, 434, 575. Births exceed deaths in the next decade by 565, 477 (Table 5). In 1960, therefore, the state should have had a population exceeding 4,000,000—if there had been no migration. But the 1960 population was less than this figure, the differential being 48, 275—which means that the number of people departing Wisconsin exceeded the number coming in by over 48, 000.

When this system is applied to individual counties, the result is astonishing. There were seventy-one counties in the state between

TABLE 4
Wisconsin: Incorporated Settlements and Unincorporated Settlements Exceeding a Population of 1000

Number of Settlements by Size Category and by Population Change, 1950-1960

Population 1960	A Number of Settle-ments	B Number of Gainers	C Number of Losers	D Losers as % of Col. A	Identity of Losers
	7	7	0	0	
50,000	36	33	3	8%	Ashland Marinette Shorewood
10,000	37	35	2	5%	Antigo West Allis
5,000	52	47	5	10%	Hurley Ladysmith Tomahawk Oconto Park Falls
2,500	130	108	22	17%	
1,000	127	85	42	33%	
500	118	70	48	41%	
250	56	14	42	75%	
Total	563	399	164	29%	

1950 and 1960; of these, fifty-nine experienced a net loss from out-migration, and only twelve counties experienced a net gain from in-migration (Table 5-B).

At this point the question arises: where are these twelve counties located, the twelve which succeeded in keeping their natural increase (that is—excess of births over deaths) and also in attracting more in-migration than they lost in out-migration? More specifically, is there

Wisconsin: Population, Natural Increase, and Migration
1950-1960

A. State Totals

Total Population 1950	3, 434, 575
Excess of births over deaths between 1950 and 1960	565, 477
Tentative 1960 population had there been no migration	4, 000, 052
Actual 1960 population	3, 951, 777
Net out-migration	48, 275

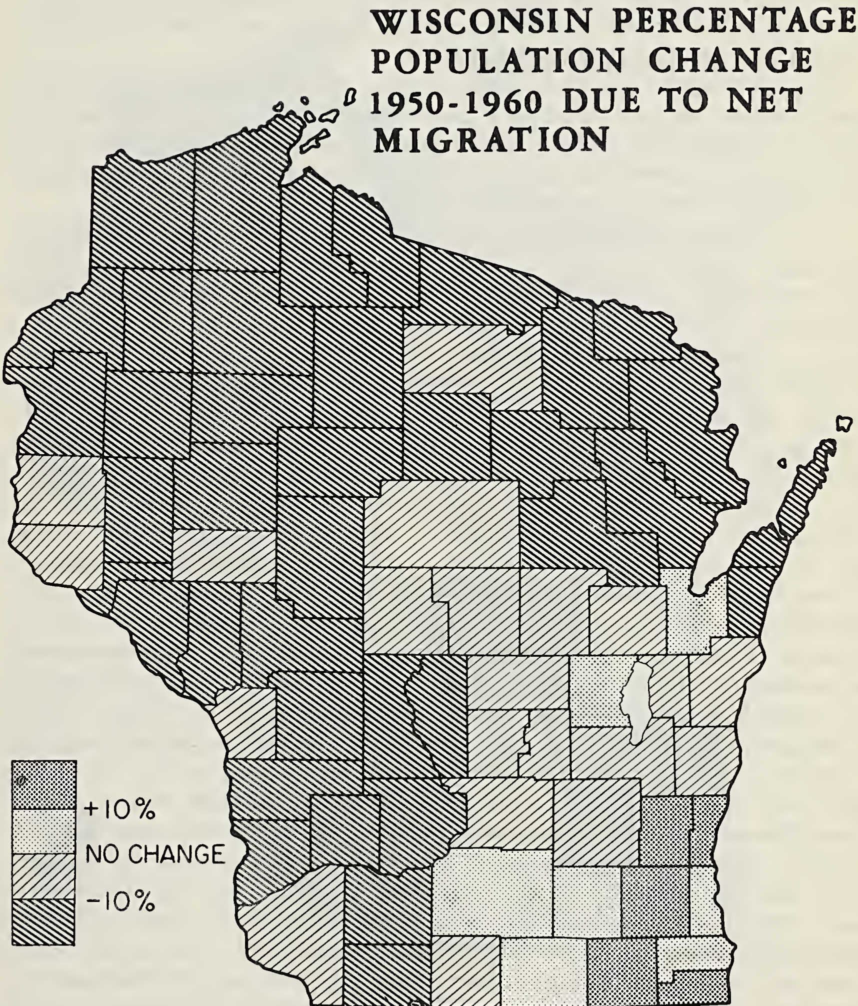
B. Leading Counties in terms of:

1.	Waukesha	+52, 706	1.	Sauk	-7, 323
2.	Milwaukee	+15, 221	2.	Douglas	-6, 395
3.	Dane	+14, 428	3.	Marathon	-6, 197
4.	Kenosha	+11, 517	4.	LaCrosse	-6, 086
5.	Racine	+10, 832	5.	Shawano	-5, 489
6.	Ozaukee	+ 9, 175	6.	Vernon	-5, 340
7.	Walworth	+ 5, 028	7.	Langlade	-5, 249
8.	Washington	+ 4, 721	8.	Barron	-5, 223
9.	Rock	+ 4, 277	9.	Clark	-5, 168
10.	Brown	+ 3, 130	10.	Marinette	-5, 168
11.	Jefferson	+ 2, 137	11.	Sheboygan	-5, 038
12.	Winnebago	+ 1, 190	12.	Monroe	-4, 855

Source: 1960 U.S. Census of Population and Wisconsin Board of Health as tabulated in James S. Bang, et. al. *Population Change and Migrations 1950-1960,* Population Series No. 1, p. 33-35.

any relationship between the location of these dozen counties and the location of urban growth.

Figure 6 gives a partial answer. Each county is shaded in terms of percentage of net migration relative to the 1950 total population. The fifty-nine which failed "to hold their own" are shown by lined symbols. The severest rates of out-migration blanket the northern


WISCONSIN PERCENTAGE POPULATION CHANGE 1950-1960 DUE TO NET MIGRATION
+10%
NO CHANGE
-10%
CARTOGRAPHIC LABORATORY UNIVERSITY OF WISCONSIN

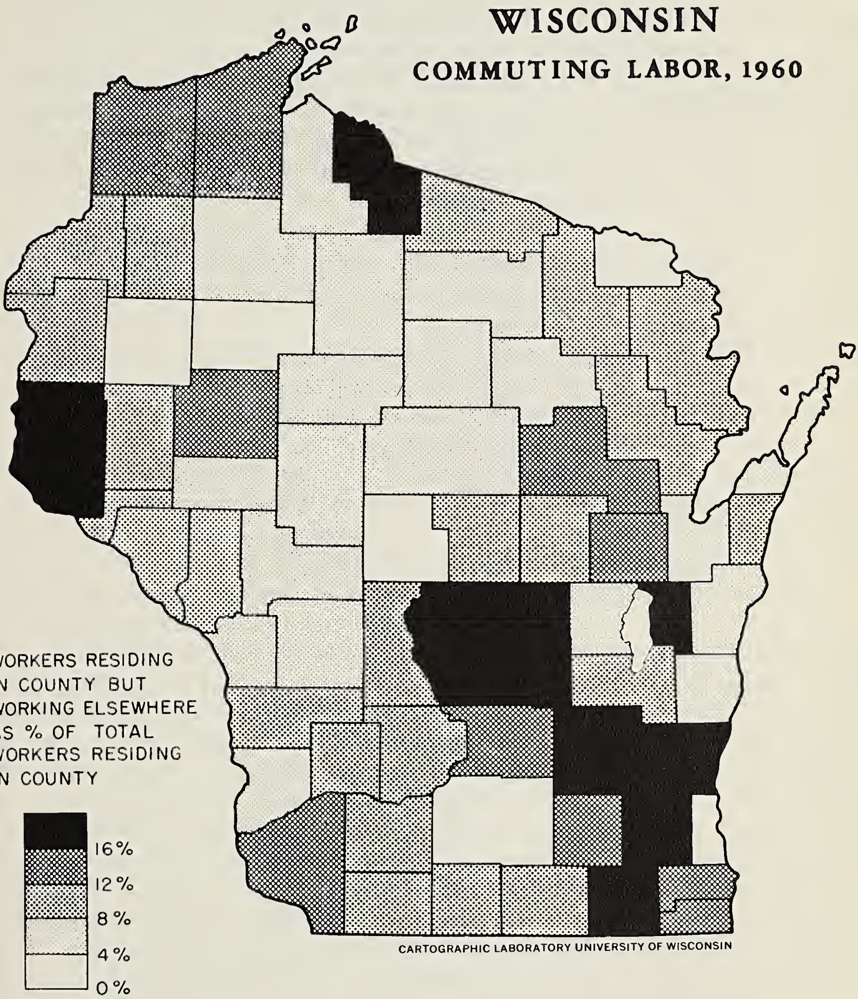
and the western portions of the state. The twelve counties which succeeded in "holding their own" and attracting more people from elsewhere are shown with dotted symbols. All twelve are in the southeast triangle. A trio of areas stands out: the greater Milwaukee-Racine-Kenosha zone, the Rock River Valley, and the Fox Valley. This pattern resembles that of Figure 2.

The conclusion on this point is that the presence of vigorously dynamic cities tends to pull in a positive net migration; and that the presence of mildly dynamic cities tends to ameliorate the severity of outward migrations—as for example the upper Wisconsin River Valley, the Chippewa Valley, and St. Croix County.

(D) The fourth relationship to be considered is that between urban change and *commuting labor*. The 1960 census for the first time contains information on location of where people work relative to where they reside. On this basis, Figure 7 has been constructed.

Each county is shown in terms of a percentage or ratio in which the denominator is the total number of workers who reside in the county; the numerator is the number of those resident workers who travel to another county to work. The two lowest counties are Milwaukee, with 2.0%, and Dane, with 3.3%. Both contain dynamic cities which import commuting labor. Notice that both are surrounded by counties with very high percentages. The highest percentage in the state is 44% for Waukesha County. Thus the highest percentage in the state and the lowest percentage in the state are adjacent. This suggests the following hypothesis; a large, growing city tends to act as a powerful magnet upon commuting labor causing its own county to have an abnormally low percentage on this map while causing contiguous counties to have unusually high percentages. The result might be compared to a doughnut with low values in the center surrounded by high values which in turn are surrounded by lower values. Further support for this theory can be observed in the Fox Valley where Green Bay and Neenah-Menasha repose in lower value counties surrounded by higher ones. Also, Sheboygan, Manitowoc, and Wisconsin Rapids are of this type. This theory might well explain the high values in Grant County (commuters from here work in Dubuque) and St. Croix County (commuters from here work in Minneapolis-St. Paul). Florence County in the extreme northeast has a low percentage, not because of a dynamic city but because the few people there are located too far from other-county employment opportunities to warrant much commuting.

At the moment the question is open to speculation as to why Barron and Rusk Counties should have such low values and why Iron, Bayfield and Douglas Counties such high values on Figure 7.


WISCONSIN
COMMUTING LABOR, 1960
WORKERS RESIDING IN COUNTY BUT WORKING ELSEWHERE AS % OF TOTAL WORKERS RESIDING IN COUNTY
16%
12%
8%
4%
0%
CARTOGRAPHIC LABORATORY UNIVERSITY OF WISCONSIN

Summary. At the outset three basic questions were raised: How much urban change occurred in Wisconsin between 1950-60? Where was that change located? It was mostly in the southeastern triangle, with the southeastern lake shore, the Rock Valley and the Fox Valley being most pronounced. To what other phenomena was this change related? Four relationships were observed: That urban change was positively associated with total population growth. It was positively associated with size of city. The greatest urban growth correlated with counties which, like vacuum cleaners, were attracting in-migration at a rapid rate. Growing cities appear to be associated with a considerable flow of commuter labor.

THE LANDSCAPES OF RURAL RETREAT IN MILWAUKEE COUNTY

Loyal Durand, Jr.

This paper deals with the landscapes of the present rapid rural retreat in Milwaukee County. The hedgehopped subdivision, whose advent during the late 1930's and whose rapid post-World War II expansion has been a major factor in the inclusion of rural forms of the landscape in urbanizing districts, has introduced a new dimension in city expansion; no longer does a city expand by continuous accretions along its borders nor by growth along star points alone. These last methods, although continuing at present of course, formerly steamrollered the adjacent rural territory into urban settings. Now the farmer, even some distance from the city, is pressured by adjacent subdivisions, rising taxes, demands for schools, sewers, parks and other necessities and amenities engendered by the presence of the rural nonfarm population of the subdivisions—a population with in general a city background and an urban psychology.

Urban expansion of Milwaukee in the past eliminated farm land, of course. If a few personal reminiscences may be forgiven, some random examples of this during the writer's youth may be cited. The famous celery area, oriented to the New York hotel market, and located on muck lands on the present far southwest side succumbed to the expansion of Milwaukee and West Allis. The large farm territory that separated Milwaukee and Wauwatosa, including the one-time famous brewery-owned farm where heavy draft horses were reared for the beer wagons, became urbanized. Five blocks north of where we now are, the farm owned by the resident of a large home on the lakeside side of Lake Drive, and cultivated by a Mr. Livingston, lay between Downer Avenue and Lake Drive from west to east, and present East Keefe Avenue (then Edgewood) and Capitol Drive from south to north. Just northwest of us, farms stretched northward from the present corner of Oakland Avenue and Capitol Drive. The Country Day School in Whitefish Bay was truly in the country, with farm land to its west, south, and north. The writer helped in an oats harvest on a farm stretching along Lake Michigan; the farm house and barn was at the corner of Lake Drive and Silver Spring Road, a couple of blocks from the present high class stores of the suburb. Blue Mound Road, westward from the present Milwaukee County Stadium to the County Line, wound through farm land. But, during that period, the farmer could see the inexorable advance of the urban roller toward him. Today, with hedgehopping, he may awaken, even though ten, twenty, or more miles from the urban fringe, to a rabbit-warren subdivision of 600 houses rising across the line fence or on a neighbor's back forty.

Milwaukee County has declined agriculturally within thirty years from one of the 100 leading counties in the nation in certain items to its present negligible position, and from a position as the leading dairy county of the state when measured on the *basis* of *milk production per acre of crop land or of farm land* to the situation where the remaining farms of the county contribute less than one per cent of the city's milk supply, and where only twenty-five farmers still produce milk for the Milwaukee milkshed and but six still ship to Chicago. The decline in agricultural land has been rapid, from more than half of the county's area to less than a tenth, from more than 600 dairy farms alone, more than 300 market gardens, to only some thirty to thirty-five dairy farms and three dozen vegetable growers. Farms on the Milwaukee milkshed dropped in numbers from more than 400 at the close of World War II to the present few. Within the two years shown on the slide the drop was from 111 to forty-one. Note that the broad subdivision zone of the early 1960's is in effect the milkshed of the 1920's. Even by the time of the Census of Agriculture of 1959 just about half of the $7,000,000 valuation of the county's agricultural production was contained in the output of 119 enterprises producing greenhouse products, field-grown flowers, nursery stock, shrubs and trees; in considerable part, no doubt, the market for the nurseryman is the homeowner in the subdivision—the owner is faced with the landscaping of his bare surroundings and the attempt to grow a lawn on the subsoil left by the bulldozer of the subdivider.

The landscape of the zone of rural retreat around American cities reflects the setting of the particular city—the geographical scene into which the expanding city and its present vanguard of hedgehopped subdivisions and other visible aspects of urbanism is moving. Thus, in part of the Los Angeles region, relict citrus orchards and walnut groves remain between and among subdivisions; near many eastern centers, such as the Connecticut suburbs of New York City, the second or third growth forest has been invaded by urban forms; in the Middle West the general relict forms are those of agricultural use of the land. In Milwaukee County, and in the suburbanized portions of adjacent counties, the most striking relict feature of rural retreat is the large, basement dairy barn. However, isolated fields, cash-cropped farms, and unused land awaiting "development" remain between and among the urban landscapes.

The intermixture of new urban landscape forms and of relict forms left from past agricultural use of the land, characterizes the zone of rural retreat. The intermixture is essentially the result of the present hedgehopping in the expansion of the city. The slides to follow illustrate types of this scene, one common today, unusual thirty or more years ago.

The shifting land uses that result from the urban sprawl are several. One of the most common, if the farm is still in use as a relict among other landscapes, is cash-cropping of grain. Animals are eliminated. In part, the cessation of dairying and the shift to cash grain was coupled with the change of the Milwaukee milk distributors from the collection of milk in cans to its collection in bulk tanks installed on the farm. The costs of installation, from $3, 000 to $5, 000 or more, depending on the size of the herd, the incurrence of a debt for the amortization of this capital equipment (even with some financial help from the dairy companies), and the uncertainty of the length of time it could be used, helped cause a rapid decline in dairying. Also, cash-grain farming is a response of many farmers to the competition of the nearby city and suburban factories for the labor necessary for an animal enterprise, and to the variety of pressures upon their farm land. Furthermore, the operator can devote part of his time to farming and part to off-farm work, something not too feasible in an intensive dairy economy. On a 120 acre farm not far north of here, one acre has been sold for a house, the father has taken a fulltime job elsewhere, the son lives on the farm, works in the city, but cash crops the entire acreage. Today more than half of the cultivated acreage of the county is devoted to corn, soybeans, and small grains (including flaxseed) and nearly all of the wheat, more than half of the corn, and a third of the oats are sold from the farm. The sales were of such magnitude on some two dozen commercial farms to result in their classification by the last census as cash-grain farms.

Other farmers, even close to the city, and with farms among urban features persist in their full time farming. It is the writer's opinion from field experiences that farmer resistance, or perhaps more properly, persistence in the continuance of his enterprise has been more determined in Milwaukee County to the inexorable forces facing him than in the usual urban county in most of the country where the rural population has been and is now more speculative on the whole. The interpretation of this persistence for as long as possible, I believe, lies in the cultural background of many of the third, fourth, or fifth

FIGURE 1
An unused relict dairy barn. The former barnyard is now deep in weeds and grasses.

FIGURE 2
An unused relict dairy barn on a farm now devoted to crops alone. Cultivation extends right to the foundation, and the former barnyard has been added to the field.

FIGURE 3
Relict dairy barn remaining in a subdivision.

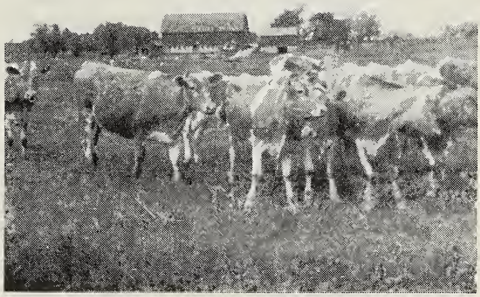


FIGURE 4
One of the 25 operating farms on the Milwaukee milkshed. Subdivisions and other urban forms of the landscape lie in all directions.

generation farmers of German descent, farmers whose antecedants settled the land in the late 1830's, the 1840's, and early 1850's durint the migration of the so-called "48ers" from the German states of the time—Prussia, Bavaria, Baden, and others. Love of the soil, extreme pride in herds and barns, and a tradition among many that a son take over the home farm or else be established upon one by his father, have been operative. Many of the German settlers brought with them, or developed, an emotional tie to the land as a permanent home to be handed down in the family; some of the remaining farm operators are fourth or fifth generation on the same farm. In contrast, many of the early American and Irish settlers looked upon the land as a temporary location, to be developed, sold at a profit—then to repeat the process on a new frontier.

The writer has collected a list from various sources of farms cultivated by the same family for a century or more, the longest on the list now having been in the family for more than 125 years. The list, far from complete, has been compiled from plat books, field work, correspondence, interviews, historical records where available, and from the century-certificates granted from time to time by the Wisconsin State Fair. At least eight of the "State Fair" farms are now within the city or subdivided. All on the writer's list are operating farms, some surrounded by subdivisions, and thus in effect relict landscape features themselves.

Of the some thirty-two century farms to my knowledge, twenty-five are farms of families of German origin; they date from 1837 to 1856. Three are Irish names, four of English origin. The preponderance of German names is expectable, considering the fact that most of the remaining farm land is in districts settled by these people, just as most early American settlement was near the village of Milwaukee. The Irish farms and one or two of the eastern American are or were residual islands in the areas of Germanic settlement; plat books and other records show that the vast majority of Irish settlers and many Americans sold to Germans quite early.

There apparently are islands or districts of persistence. One such in the southern part of Milwaukee County contains thirteen century farms within a two and one-half mile radius, through which subdivisions, major highways, night clubs, restaurants, and other features penetrate.

Two sample operating century farms will illustrate. One, in northern Milwaukee County, has been in the family since the first settler arrived from Bavaria in 1848. It is now operated by a member of the fourth generation—in his thirties. Nearby are all the cultural features of urban sprawl, ranging from single box-like, nonfarm homes to a subdivision of more than 650 generally similar houses. A small estate is in the same section, and nearly half of the section is owned for speculation. Seventy dairy cows, about half milking herd and half young stock, are maintained on eighty acres, a good example of the carrying capacity of Milwaukee County land. Most feed is home-grown and all pasturage is on the farm. Income is derived from the sale of registered calves as well as from milk.

A farm on 127 acres in the southern part of the county is virtually surrounded by all the features of urbanism—subdivisions to its south, southeast, and west; solid city three miles north; gasoline stations, outdoor movies, drive-ins, taverns, and other commercial property lie across the highway; street lights burn all night. Factories and their associated parking lots are located less than a mile from the back corner of the farm. The brothers who operate the farm, descendants of an Alsatian who settled it in 1844, have no intention of selling. In fact they have invested several thousand dollars in bulk milk tanks, modernization of barns for the dairy herd of fifty cows, and in other equipment. Offers of options at $3,700 an acre have been refused; only one small lot has been sold for $3, 000. This is their home and life; they intend to farm on the family homestead.

Elsewhere, if time permitted, the enlargement of family-operated farms through the setting up of sons in the activity through the years could be illustrated. The descendants of a Prussian immigrant who obtained eighty acres in 1839 now operate contiguous farms totalling 368 acres near an urban sprawl zone. Four members of another nearby family, dating from 1853, now operate non-contiguous farms totalling 278 acres.

The dairy farmers offered the major resistance through the middle 1950's, until faced with the investments connected with bulk tanks. They were able to persist, no doubt, as compared to the market gardeners, because of their peripheral location and economic situation of a regular monthly milk check—and they did not face the competition of frozen vegetables. Furthermore, if pressed financially, small areas of their farms could be sold for dispersed rural nonfarm homes; the market gardens were too small for this. Dairy farms persist on some of the busiest main highways of the county; the owner can lease frontage for filling stations, commercial establishments, billboards, experiments with exposure of painted boards to the elements, and other uses, can operate stands and sell some produce at retail prices, and still retain considerable acreage for his principal activity.

The future? No doubt much if not all of Milwaukee County will become urban in its landscapes. But it is impossible to forecast with any certainty. The county is now entirely in incorporated villages and cities. Every farmer is a city resident. Hedgehopping has jumped into all adjacent counties, in part because of lower taxes and auto-

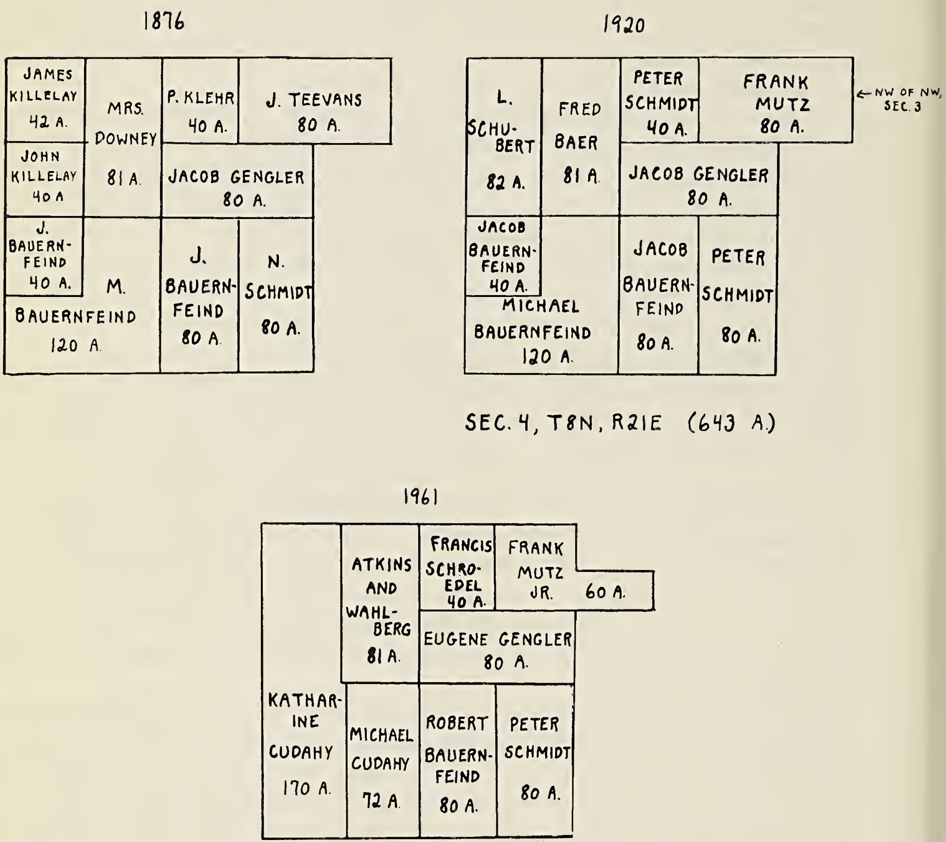


FIGURE 5

An example of a section (square mile) wherein farms have remained in the same family for a century or more, and are operated by descendants of the original settler. Note that the "Irish-owned" farms of the 1870's were sold to Germans. The Cudahy landholding of 1961 is a country estate.

mobile insurance rates. It is entirely possible, under our present patterns in the United States that relict farm land will remain for a considerable period of time. So far as the county itself is concerned, however, it is too late to do what has been done in southern California—incorporate cities to keep people out, cows and crops in.

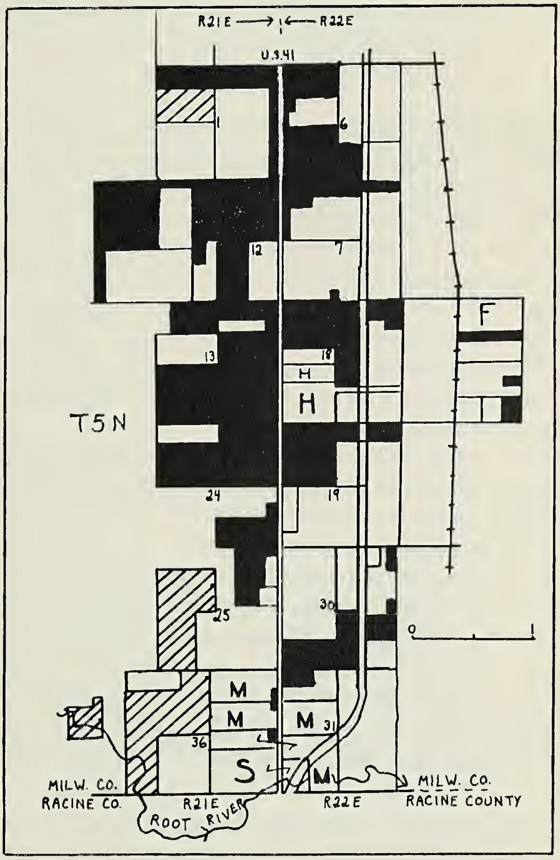


FIGURE 6
Urban land uses and century farms near the Milwaukee city limits. Black = subdivisions; lined = County Park land; F = factory; H, M, S = century farms. The numbers refer to sections on either side of U.S. Highway 41, the wide double line is the projected route of a new Interstate Highway.

THE NEW CLIMATE FOR THE ARTS IN THE AMERICAN CITY THE GROWTH OF CULTURAL CENTERS

Adolph A. Suppan

That indefatigable observer of the culture of cities, Lewis Mumford, has written that in the history of civilization, one of the chief functions of the city was to enlarge and transmit the cultural heritage.[1]

If this thesis about the metropolis is correct, then in our society there is taking place a transformation in regard to the arts which will ultimately make many of our cities the stimulating cultural centers which so many of the great cities of the past have been. For, in the last decade, there has taken place in the towns and on the campuses of our nation what has been described as a cultural explosion. It is the purpose of my talk here today to describe briefly and explore tentatively that phenomenon.

First, let us look into statistics concerning these far ranging manifestations in the arts in our cities, remembering that one authority recently stated that only ten years ago "art was one of the unmentionables" among many people in our society.[2]

According to the Stanford Research Institute,[3] consumer spending in the arts in the last seven years has risen well over 100%, or considerably more than twice as fast as spending on all recreation, and better than six times as fast as outlays for spectator sports or admission to movies. One hundred million Americans attend cultural events each year; twice as many attend concerts and recitals as see major league ball games. Fifty million Americans actively participate

[1] Lewis Mumford, *The City in History* (New York, 1961), pp. 432-433 (description of Plate 56, "University City").

[2] Mark Schubart, "Music: We Appreciate It — Do We Like It?," *The New York Times Magazine*, September 23, 1962, p. 17

[3] Arnold Mitchell, "Marketing the Arts" (Stanford Research Institute, n.d.), p. 6. (Unpublished lecture).

in amateur art activities; some seventy-five local cultural centers of varying kinds are built or are in the planning stage in twenty-nine cities.

In the field of music the explosion has taken on volcanic qualities. Sales of instruments, sheet music and supplies increased from $230 million in 1950 to almost $600 million in 1960. Some thirty million Americans now play musical instruments; there are more piano players in the United States today than licensed fishermen. Total record sales jumped from $172 million in 1950 to $492 million in 1960. There are 1,252 symphony orchestras in the United States, and classical record sales in ten years have gone from fourteen and one-half million to over ninety million.

To turn to the drama: there are 5, 000 community theatres and upwards of 100,000 play-producing groups of all sizes.[4] (U. S. theatre-goers outnumber boaters, skiers, golfers and skindivers combined.) Even the so-called "art movie houses" have risen in number, from twelve to over 500 in the last decade.

In the art market there has been an incredible upward trend. A Jackson Pollock painting in 1956 brought $3, 000—it is currently on the market at $100,000. Twenty years ago, New York had twenty galleries—a recent estimate is 325. Macy's, Gimbel Brothers, and supermarkets stock original paintings; Sears has introduced the "Vincent Price Collection of Fine Arts" in some of its retail stores.[5] Everyone remembers the record-breaking auction of Rembrandt's "Aristotle Contemplating the Bust of Homer" which went to the Metropolitan Museum of Art for $2,300,000 in the fall of 1961. Surprisingly enough, though there was grumbling by some New York taxpayers, the Metropolitan's new acquisition seemed to have overwhelming approval. Here in Milwaukee, attendance at the new Saarinen-designed art center last year was nearly four times the combined attendance at the old Layton gallery and Milwaukee Art Institute in 1954-55.[6]

According to one writer,[7] the forces responsible for this new look at the value of art are an increased recognition of the significance of art in our schools; our having homes, offices, and furniture contemporary in design which need the company of new painting and sculpture; a higher quality of artistic design and photography in our advertisements; and increased leisure time for many Americans in this era.

[4] "Fact Sheet," National Cultural Center, Washington, D.C., p. 1.

[5] Homer Page, "Art As Investment," *Think*, February, 1963, p. 15.

[6] Gerald Kloss, "Culture Boom Here? A Decade of Activity," *The Milwaukee Journal*. (Part 2), April 7, 1963, p. 1.

[7] Page, p. 16.

Another possible reason for this new interest in painting and sculpture is the snob appeal element which is relating itself to art in our society. Arnold Mitchell prophesies "a major swing to conspicuous aesthetics"[8] and points out that great corporations are even altering their corporate image in the eyes of the public through the associations evoked by simple contemporary design. We can surely assume that the arts have had an historical association with status in Western civilization and that a new set of status symbols is coming into our society. As will be evident from the data I will give later in regard to the construction of cultural centers, local pride also plays a part today in the advance of culture. Citizens boast about their symphony orchestras as well as their baseball teams and a *Saturday Review* article recently revealed that Louisville, Kentucky, insulted some years ago by a national magazine's describing it as a cultural desert, has undergone tremendous cultural rehabilitation through the efforts of civic groups and committees.[9]

Additional evidence of a cultural explosion in our nation is seen in the emergence of state arts councils. The most conspicuous and well-heeled of these organizations is the New York Council on the Arts, which received $450, 000 in 1961 with which it subsidized performing arts groups in major cities to tour through the smaller rural communities which otherwise could not afford them. Other state arts councils have been formed in Wisconsin, Washington, Virginia and the Carolinas, and Minnesota. There are also civic councils or their equivalent in Cincinnati, Louisville, New Orleans, St. Paul, Winston-Salem, and Milwaukee.

Ralph Burgard[10] points out that some of the councils are more than just vocal promoters of the arts. In one year, the Cincinnati and New Orleans councils each raised $400,000 for the arts in those two cities: St. Paul raised $160, 000; Louisville $150, 000; and Winston-Salem $60, 000. The advantage of such councils is that they can become valuable coordinating agents for numerous civic arts groups. These groups, by themselves and apart, could not possibly have the influence in regard to public attention and financial resources which they gain through the councils.

Not all social commentators and critics have climbed on the bandwagon of optimism in their interpretation of this boom in the arts in America. Some estimate that the boom has affected only thirty-six

[8] Mitchell, p. 19.

[9] John Tebbel, "Newspapers and the Cultural Beat," *Saturday Review,* April 13, 1963, p. 77.

[10] Ralph Burgard, "Arts Council—A New Approach to Cultural Leadership," *Arts in Society,* II, No. 2 (1962), 125.

million people, or 20% of the population.[11] *The Milwaukee Journal* recently pointed out that nearly 200 American singers have maintained their professional lives abroad because they could not find work in their own country; that, though 6,000 members of the Actors' Equity Union are looking for work on the Broadway stage, only 750 of them find such work and that, if the play for which the actors were hired was unsuccessful, their tenure was soon ended.[12] The world-famous dancer and choreographer, Agnes de Mille, writes: "We have demonstrated, we American dancers, remarkable creativity, diversity and vitality. And equally remarkable and enduring poverty." She goes on to point out that there are between four and five million dance students, and adds, "And yet, and yet we starve."[13] Miss de Mille also says that ours is the only nation without national sponsorship of the performing arts and the only country, great or small, which does not have a folk-dance group—"an organization dedicated to the maintaining of our heritage." Other skeptics raise the question as to whether, though we tend to support the arts out of intellectual conviction, we are not far behind other countries in developing a real feeling of love for art.[14]

One might also, at this point, raise the question as to what is being done in a meaningful way about our young people who show promise and genius in the arts and who might be the Rembrandts and Mozarts and Shakespeares of the future. As everyone knows, we have an overwhelming supply of scholarships, fellowships and general financial assistance for students showing ability in the sciences; how long will it take for us to get similar, massive support for equally worthy students in the arts?

We come now to the physical phenomena which relate themselves to this new climate in the arts of our society—the great cultural centers, often massive and strikingly contemporary in design, which are rising in our cities and on our campuses. One authority estimates that 1,000 theaters and multi-purpose art buildings will be constructed in the United States and Canada during the coming decade, at a cost of at least four billion dollars.[15] Truly, the creative and performing arts are being brought to main street. W. McNeil Lowry states that so

[11] Harry Ferguson, "Artists in Doldrums Though Arts Thrive," *The Milwaukee Journal* (Part 1), April 4, 1963, p. 20.

[12] Harry Ferguson, "Arts in America Are Enjoying a Boom," *The Milwaukee Journal* (Part 1), April 3, 1963, p. 25.

[13] Agnes de Mille, "Dance: 'We Deserve A Fair Showing'," *The New York Times Magazine*, September 23, 1962, p. 19.

[14] Schubart, p. 43.

[15] Mitchell, p. 4.

many cultural centers are on the drawing boards in many U.S. communities that "our country's businessmen or municipal and state officials appear to think that art begins with real estate."[16] Skeptics have also made salty comments about these new centers. One complains that the National Cultural Center in Washington will be "virtually wrapped in a spaghetti of highways."[17] Winthrop Sargeant, the music critic of the *New Yorker* magazine, had fears that Lincoln Center might "turn out to be a sort of Alcatraz of the performing arts."[18] Others have worried about the same center becoming a "cultural supermarket" and an "island of pomp" that forgot the creative arts while focusing upon the performing arts.[19]

Nevertheless, critics aside, cultural centers are sprouting up all over our nation—from St. Petersburg, Florida, to Seattle and from New York and New Jersey to Los Angeles, California. Some of the most notable (and expensive) are—first—The Lincoln Center of the Performing Arts which, when completed, will cost $142 million. The opening of Lincoln Center's Philharmonic Hall on September 23, 1962, focused the attention of the world on the arts and their importance to the American people. Capacity audiences almost daily through the center's first months enjoyed performances by the center's constituent, the New York Philharmonic, and by visiting orchestras and individual artists.

The National Cultural Center in Washington, D.C., will cost $30 million; the Los Angeles Center, $25 million; others are being planned or are in operation at Pittsburgh, Syracuse, St. Paul, Milwaukee, Seattle, and Trenton. Most of these large centers will include facilities for concerts, opera, ballet, theater, and art exhibitions. Some of them include museums and meeting rooms. A few, like the famous Aspen, Colorado, center, are more interested in spending their money on the performers than the buildings. Aspen, for instance, uses a rather elaborate tent for concerts, and spends $300, 000 a year (though its boxoffice income only amounts to around $40,000) in getting notable performing units and artists. The balance of the money is raised by fund drives involving institutions and individuals.

Similar cultural centers are being built on the campuses of the nation's universities and colleges. Some of these are planned (or

[16] W. McNeil Lowry, "The University and the Creative Arts," *Educational Theater Journal*, XIV (May 1962), 103.

[17] Wolf Von Eckardt, "A Center for Drive-In Culture," *The New Republic*, December 22, 1962, p. 28.

[18] Winthrop Sargeant, "Musical Events: Culture, Inc.," *New Yorker*, October 6, 1962, p. 94.

[19] "Cultural Centers Across the Land," *Newsweek*, September 24, 1962, p. 54.

already in existence) at Dartmouth, Oberlin, Lawrence, Knox and Maryville colleges, and at Indiana, Wisconsin, and Boston universities. These generally include the same facilities housed in the civic cultural centers mentioned above, as well as classrooms, workshops and studios.[20] One of the most notable campus cultural centers, which combines its architectural beauty with a practical philosophy in regard to its students, is the Hopkins Center at Dartmouth. This is so situated in the center of the college campus that students, whether they are in the arts or not, find it almost necessary to walk around or through the center in going to and from their classes. Dartmouth officials describe their center as a "cross-roads site to bring creative art into the daily lives of every student on campus." I am sure you know that the proposed Elvehjem Art Center in Madison will also house many of the arts; and you, yourselves, are listening to me in a new Fine Arts building on the UW-M campus, which is the first of a series of buildings ultimately constituting a fine arts complex, housing music, theater, art and the dance.

These centers, whether in the town or on the campus, will certainly bring fresh new experiences in the performing and creative arts to all our people. As Leonard Bernstein points out, what is really exciting about these structures is that they will bring *young people* closer to the arts.[21]

In heralding this new climate for the arts in the United States, and in telling the almost unbelievable story of how these cultural centers are being built and enjoyed by millions, we must not forget the fact that all art begins with the creative genius—the painter, the playwright, and the composer—who creates the work of art to be presented. Without him, there obviously would be no art; and these contemporary cathedrals for the arts would be hollow and empty shells without life or motion or sound within them. It would be tragic if, at the same time we are spending billions of dollars in the next decade (on these buildings), we would not be doing everything in our power to create a more healthy climate for the artists themselves—a climate in which, for instance, the finest oboist in a great metropolitan city would not have to work in a machine shop during the day to supplement his meager income as an orchestra player. It is unfortunate that we are not providing many more scholarships and fellowships in the arts for the nation's talented young students. Why should Agnes de Mille have to say about her brilliant young dancers, "And yet, and yet we starve."?

I have, in this brief general survey, discussed America's amazing

[20] Burgard, p. 124.

[21] "Cultural Centers Across the Land," *Newsweek*, September 24, 1962, p. 55.

cultural explosion, the factors which seem to have motivated it, the new climate in the arts in our society, some skeptical comments about it, and the great new cultural centers rising in our land. I have also raised a question for you to consider: as encouraging as the signs are for the arts in our time, are we likely to forget that the artists need assistance too?

TELEVISION AND THE URBAN COMMUNITY

Sprague Vanier

Some of what I will say is hyperbole.

Some of what I will say is statistical fact.

Some is considered opinion and some is prediction, or an attempt at prediction.

It is all designed, however, to bring into focus, with the ring of dramatic as well as literal truth, the magnitude of the communications revolution—and, thus, the cultural, social, economic, psychological and political revolution—which has come to pass almost casually in less than a decade.

Arthur Schlesinger Jr., writing in an introduction to a recently published paperback edition of a McGuffey reader, observes that that venerable handbook of frontier learning had the virtue, in its time, of providing a common frame of cultural reference to people in scattered, isolated communities and of vastly divergent cultural backgrounds. Regardless of the merits of its contents or its value as a tool in teaching, it did help unify a nation by giving the nation's people a handy set of common literary references, perhaps even a common set of popular values.

The point is interesting and difficult to dispute.

Is it possible that much of the same thing is happening to this nation as a consequence of television? but on a much more universal scale? Is it possible that we—as a people—are drawing strong impressions of what our rights before the law may be by watching "The Defenders?" Or that we are drawing conclusions as to what we expect of our medical men as the results of impressions gathered by watching "Ben Casey" and "Doctor Kildare?" Perhaps even the least sophisticated, the most underprivileged, even those kept in ignorance for generations are drawing more than entertainment from the television tube—perhaps they are even drawing some conclusions.

Just as surely as the McGuffey reader once represented the common cultural background of the literate American, television today represents the common cultural background of the American with electricity in his home—and that's nearly everyone.

Just as surely as the people of India once drew their impressions of America from watching silent Westerns and Charlie Chaplin movies, the American today draws his impression of the world beyond his doorstep from what he sees on the television screen.

How vast and how complete is this process of homogenizing the popular attitudes, impressions and standards of our nation? Ninety-three per cent of all the homes wired for electricity in the United States have television sets. There are fifty million homes with television sets in the nation today. It has never before, in all of human history, been possible to get so many people together on one thing, except perhaps the need to breathe.

The mere fact that a vast number of people have in common a physical possession could be of no significance in drawing conclusions about our society. Nearly everyone has in common some sort of shelter. Nearly everyone wears some sort of clothing.

American television, however, is projecting upon the public a point of view, an outlook, an attitude and a set of standards that is very near to being of uniform and consistent character.

This point of view may be characterized as "the standard, northern United States, urbanized outlook." For easy handling, call it the "urban outlook."

The "urban outlook" may be summarized as a series of popular attitudes which comprise the general orientation of most northern city dwellers. Hospitals are well equipped. Society is prepared and able to come to the rescue in time of desperate individual crisis. Fair play is important. Judges are sober. Policemen should be even-handed, calm and incorruptible, strong, brave and understanding. Everyone is entitled to speak his mind. Lawyers are smart. Everyone is entitled to the best education he can handle, at least through high school. The able and diligent will, with a little luck, do well in the world. Alcoholism is a disease. People should be kind to animals and children. Everyone is created equal.

Now, the northern, urban citizen may not always behave as if these were his standards and he may find out that many of his fellow citizens don't either; but, if he were asked to check each of those statements as "true" or "false," he would regard nearly all of them as true.

The hugely successful television programs which may reach more than one-third of all the television sets in the nation in a single night—sometimes 20 million homes—all reflect some aspect of this "urban outlook." Take a look at the following.

The Beverly Hillbillies: Money talks. Much of what passes for culture is shallow snobbery practiced by pretentious phonies.

The Naked City: Senior police officers are wise and patient; young ones may be hot-headed, but they learn.

Car 54: Policemen are dumb but good-hearted.

The Doctors Kildare and *Casey:* Doctors are dedicated. All the forces of modern medicine will be unleashed to relieve a human in agony, regardless of cost.

The Defenders: Justice will be served.

Sing Along with Mitch: We are essentially a happy, optimistic people.

Jack Paar: Americans can go anywhere. Publicity is good.

This list, obviously, could go on for many pages, but the above examples serve to illustrate the point. And the point is that these attitudes are being projected effectively, repeatedly and with great dramatic force into corners of our society which have never been touched by them. Moreover, urban dwellers themselves are acquiring, through the television habit, a common source for and uniformity in these attitudes.

Couple this information with the observed phenomenon that life tends to imitate literature and we have the makings of social revolution.

Saying it another way, constant exposure to "standard urban values" is very likely to lead some 160-million tube-watching Americans to *expect* reality to take on the attributes of the television fiction they have come to love so well.

Contemplating the above premise may lead one to picture a nation bemused by dreams born of television; such a picture may not be entirely distorted.

The acquisition of some or even many of these "standard urban values" may well be of benefit both to the individual and to his society. Certainly a nation whose people believe that men *should* expect equal justice and *should* have the right of self-expression is equipping itself to survive as a democracy, even though the lesson may have been learned through the emotional experience of identifying with characters in television dramas.

When the television viewer confronts a reality which is at sharp odds with his standardized, popular viewpoint, however, his reaction may be hostile and even violent; especially if he has absorbed his set of values over a long period of time starting in early childhood.

A danger asserts itself, therefore, when education to reality and education to the skills implied in equality and self-expression, fail to keep pace with the aspirations of men, however acquired.

Television offers a unique opportunity to communicate directly and simultaneously with nearly the entire population, in a way that not even radio did with its many outlets and, consequently, fractionalized audiences. Television communication, contrary to commonly held opinion, is not directed to a "mass of people"—but is directed, instead, to one or two or a handful of people at a time, each group receiving the message simultaneously with the others but isolated and remote from the others.

Thus there is an opportunity to influence tens of millions of people in an instant without any interaction between them and without an opportunity on their part to counter-react to the originator of the influence.

Why does this matter? It matters, I believe, because television causes us to short-circuit one vital step in the classic and traditional process of forming public opinion. Classically, public opinion has been formed by (1) an event stimulating (2) individual reactions and opinions, which are (3) discussed with and checked against the reactions of others. Cross-checking and discussion leads to (4) the recasting and modification of individually held opinions and, finally, to (5) the jelling of a discernible "public opinion."

It is step number 3 and its outgrowth, step number 4, which may be by-bassed in the age of television, unless careful education imbues the viewer with emotional and intellectual prudence.

Instant, direct and powerful communication may cause opinions to jell long before the opportunity for public discussion arises. Nor is television the only force in our age which tends to replace true public opinion by mass passion. It should be pointed out, also, that opportunities for public discussion were disappearing rapidly in our society long before television became a major factor on the American scene; but television has reduced the time lag between action and reaction so greatly that spontaneous over-reaction by the public seems to be an ever-present possibility.

As an example, during the Cuban crisis, one had the feeling that great masses of the public might, at any moment, bolt from the cities without any clear plan or destination had the news not been handled with the utmost care. The instantaneous, simultaneous character of such a reaction—arrived at independently by each family group—could be appalling. A foretaste of such hysteria was implicit in Orson Welles' famous "War of the Worlds" panic, triggered by radio.

This is not to say that mass hysteria never existed before man learned mass communication, but it is to say that the speed with which hysteria could strike in the age of electronics stuns the imagination. Intelligently used, of course, mass communications may also be employed to forestall and stem mass hysteria.

It is, perhaps, our society's instinct of self preservation that accounts for the popularity of discussion programs on television, especially those discussions which follow major events and major addresses by public figures. These programs provide some measure of discussion by proxy and compensate for general public discussion.

We are fortunate, however, as a nation, that no skilled television demagogue has seized the affections of the viewers during this period when education lags behind communications technology. (On a primitive scale, Castro typifies this corruption of mass communications.)

Those politicians and public figures who have been successful on television thus far—and how very successful they have been!—are crude practitioners alongside the monsters of seductivity who may be easily envisioned by the professional communications man. The really dangerous montebank of the future will be confidential in his manner. He will not address his viewers as if he were addressing a crowd nor will he reflect the coldness of official in power.

He will seem to be the private, personal partisan and confidant of each viewer. He will fill, through careful design, the private image of the leader as woven into the mind of each viewer as a part of "the standard urban outlook." He will feed back to the viewing public their own dreams.

It is this dreadful danger—a hazard inherent in the power of *total* communications—against which both the educator and the communicator must guard.

The communicator must guard against it by preventing the use of television to control, rather than liberate, men's minds. And it is my conviction that the communicator is actively aware of this responsibility.

The educator must guard against it by immunizing the public against easy beguilement. The vaccine to be used is the development of critical judgment and heightened awareness of reality on the part of more and more people in our population.

In this the broadcaster can and will help.

No social phenomenon, however, is isolated, we may see—side-by-side with the reinforcement in TV fiction of what I have called the "standard urban outlook"—an increased exposure of the public, through television, to reality itself.

All through the nation, television stations are expanding their local news programs and, in so doing, reaching out into the community to find stories and to show their viewers what is happening.

The national networks, through their great journalists and documentarians such as Fred Friendly, Dave Brinkley, Eric Severeid and Chet Huntley, are reaching into reality to engage and inform great masses of people.

Real lawyers talk about the law. Real doctors debate medical problems. Real policemen may defend their actions before the eyes of the public they serve.

With each opportunity the public enjoys to confront *objective* reality through television, the viewer perhaps checks this reality against his acquired "urban outlook" and asks himself whether he might not shape the world closer to his heart's desire.

This, then, is the great contribution that television can and will make to the "urban community" (and I might say that it is my contention that our entire society, through television, is becoming urbanized in outlook): Television can feed back to the immense audiences it serves the reality of the environment in which they live. It can and does bring them face to face with the people in power, so that they judge for themselves what the world is like. It can and will show them what is going on in the world—as it did in the documentaries, "The Battle of Newburgh," "Harvest of Shame," and "The Alabama Sit-Ins."

Because all television stations—both commercial and educational—depend for their survival entirely upon an audience commitment to them, they must be constantly at the work of soliciting that public commitment. This means that they must reflect the community they serve in order to gain audience loyalties.

Increasingly, in my opinion, local television stations will seek out the articulate elements of their own communities and use these elements to involve and interest audiences not only with fiction but with the real problems of our times.

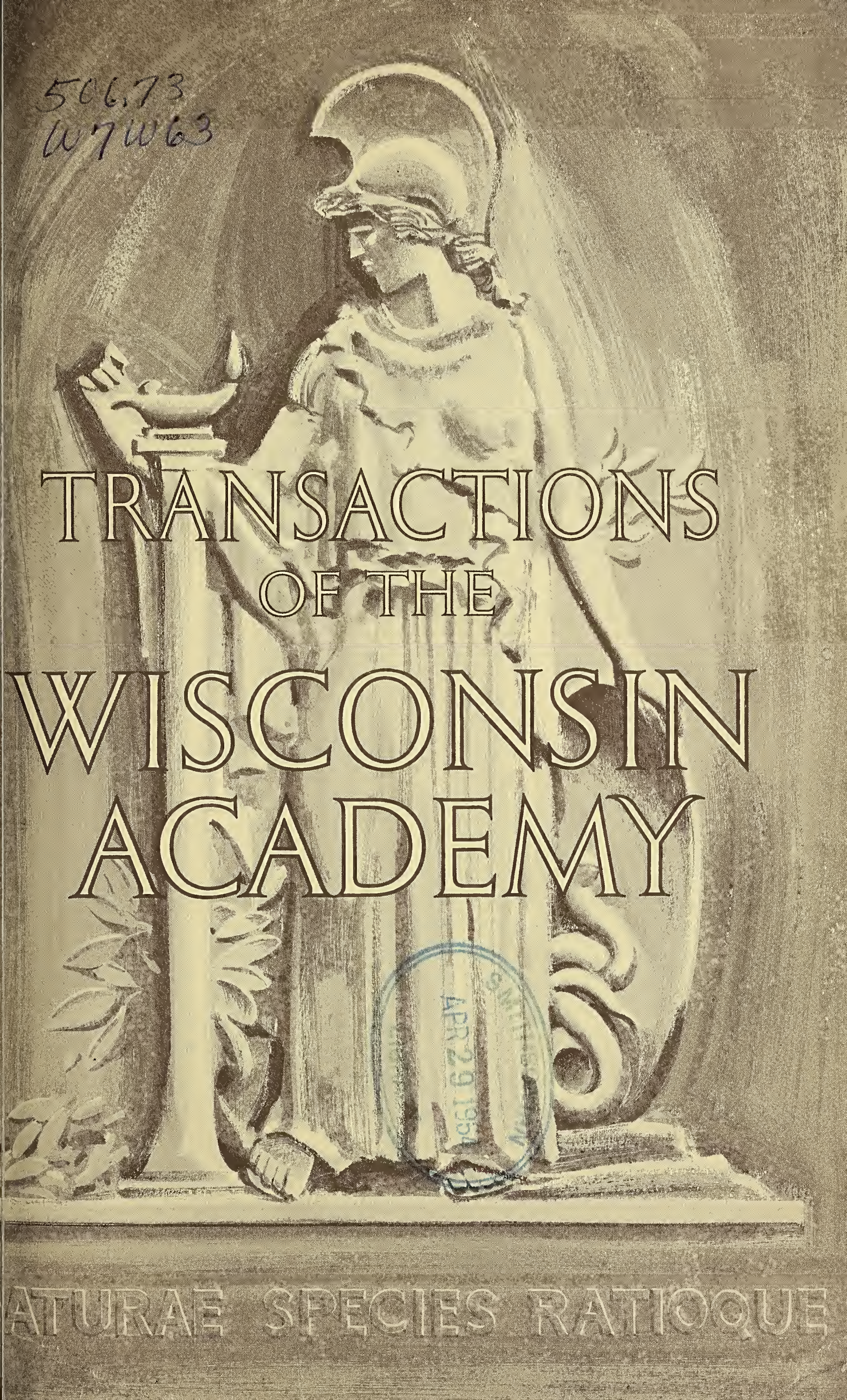
The solutions which most people will find satisfying for real problems may depend largely upon the content of the "standard urban outlook" which is being shaped so widely and so rapidly by television fiction.

Whether those "standard urban attitudes" are adequate to the task is a massive subject in and of itself. That question, however, may very reasonably be turned back to the educator in the terms that Gilbert Seldes—prominent educator and television critic—sagely advances:

> I don't give a hoot for the few intellectuals that criticize television. I want five million *active* critics. I would sacrifice reading and writing of a report on *Ivanhoe* if every student would write a report on *Have Gun, Will Travel.* If we had a GI Bill that the one course you must take is "Mass Media," we would now already have those five million families who view with a critical eye.

Mr. Seldes, it seems, would change the "standard urban outlook." If he is successful, he will also change television in the process.

TRANSACTIONS OF THE WISCONSIN ACADEMY



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HENRY JAMES AND SCIENCE: *THE WINGS OF THE DOVE*

Harry Hayden Clark

"The critic's first duty in the presence of an author's collective works," Henry James says in discussing George Eliot, "is to seek some key to his method, some utterance of his literary conviction, some indication of his ruling theory."[1] There are dozens of such comments in James's work which declare his central interest in philosophical and ethical attitudes—an area which recent criticism of James has neglected in its concern with formal technique rather than content. But it seems only logical to turn more fully to content in order to learn more about that area of James, the writer, which he as a critic centered on in other writers— an ethical sense. For, as James wrote in *French Poets and Novelists*, "Be the morality false or true, the writer's deference to it greets us as a kind of essential perfume."[2] In view of the weight James placed on moral questions and motivation, then, let us consider *The Wings of the Dove*, 1902, the culmination of some thirty-six years of thoughtful fiction and criticism, in terms of its philosophical and ethical attitudes.

James was, as is well recognized, especially concerned in general with the distinction between surface appearance and inner or psychological reality. But, holding that the novel "should begin with a picture and end with an idea," he was just as concerned with ways in which he could flesh out his characters' distinctively psychological conflicts. In fact, the quest of such ways, such images, seemed to James the very "essence of poetry." Hence, the critical interpreter has the problem of finding what James himself called "the figure in the carpet" represented in the configurations of images in a given story, assisted by what he said in non-fictional work about his general ideas.

Such an approach to *The Wings of the Dove* suggests that here James is ultimately concerned with a struggle for existence which

* Grateful acknowledgement is made of the fact that I have been much aided in getting this study into its present form through several versions by Mr. Clinton Burhans and Mrs. Carol Scotton, Research Assistants generously provided by The Graduate School of the University of Wisconsin. They deserve much credit.

[1] *Views and Reviews* (Boston, 1908), p. 1.

[2] *French Poets and Novelists* (London, 1878), p. 114.

is economic at center, though it is a struggle in which Milly Theale excels because of superior moral force. Further, the terms in which James describes this struggle—his images—suggest that Social Darwinism influenced his conception of the novel.

That James had such a view of the world is apparent from his other writings. "James saw [the world] a place of torment," his personal secretary Theodora Bosanquet wrote, "where creatures of prey perpetually thrust their claws into the quivering flesh of the doomed, defenseless children of light . . . He . . . saw fineness sacrificed to grossness, beauty to avarice, truth to a bold front. . . . He hated the tyranny of persons over each other."[3] And in his nonfictional *English Hours* James makes clear he saw society in general as well as business in terms of "the steady rumble of that deep keynote of English manners, over-scored so often, and with such sweet beguilement, by finer harmonies, but never extinguished—the economic struggle for existence."[4] As James sees meaning in society beneath its smooth surface, we should look for significance in *The Wings of the Dove* beneath all its surface "sweet beguilement."

One related consideration is important, and that is the novel's reflection of Jame's lifelong concern as an expatriate writer with the theme of international contrasts. For the struggle for existence is embodied in terms of these contrasts in *The Wings of the Dove.* This theme of international contrasts is considered not only because of James' travels and his conscious attempt to play the observant "cosmopolite,"[5] but because of his interest in the theme of "the great and admirable Taine" (on whom he wrote five essays) that a given book is determined by a writer's time, place, and race or nationality.[6] Along this line, Professor Christoff Wegelin in *The Image of Europe in Henry James* argues that in *The Wings of the Dove* the two contrasting heroines, "Milly and Kate are representative of the civilizations which formed them."[7] And Mr. R. P. Blackmur says that Milly Theale, with Maggie Verver of *The Golden Bowl,* "although victimized by Europe, triumph over it, and convert the Europeans who victimized them, by the positive strength of character and perceptive ability which their experience of treachery only brings out . . . By these means, in the figure of the American girl, candor, innocence, and loyalty become char-

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[3] *Henry James at Work* (London, 1924), p. 32.

[4] *English Hours* (Boston, 1905), p. 71. (First edition, 1875.)

[5] *Portraits of Places* (New York, 1948), p. 115.

[6] I have elaborated on these matters in "The Influence of Science on American Literary Criticism, 1860–1910, Including the Vogue of Taine," in *Transactions of the Wisconsin Academy* (XXXIV, 1955), 109–164.

[7] Christoff Wegelin, *The Image of Europe in Henry James* (Dallas, 1958), p. 117.

acteristic through not exclusive American virtues which redress the deep damage done by a blackened Europe."[8]

As we explicate *The Wings of the Dove,* then, let us watch for reflections of the influence of the current scientific determinism (whose teachings in general James had access to in hundreds of contacts) and the influence of Taine's thesis of the author being a spokesman of his time and place. By approaching this book in the light of ideas associated with science—an approach hitherto unexplored in depth—I do not claim that James was directly influenced by Darwinism. My point is only that in *The Wings of the Dove* James sees his characters' psychological conflicts and the essential conflict of the novel in terms of images of destruction, counterpointed at the end by an ethical renunciation associated with what Emerson called "the internal check." These images reflect current scientific ideas which make plausible in 1902 his interpretation of the socialite life of that time.

There is in Milly Theale's situation in *The Wings of the Dove* more than a suggestion of the evolutionary concept of the survival of the fittest in a struggle for existence. James, characteristically, is not interested primarily in the struggle in a life and death sense; he is concerned chiefly with the struggle of Milly, the wealthy young American who is dying of an incurable disease, to achieve at all costs life's fullest potentialities. As such, her struggle and quest is a matter of sensitivity and realization, not of breath and blood; its arena is not the jungle of fang and muscle but rather of drawing-rooms and galleries, of intellectual conversations and social graces. And it is here that Milly encounters the forces—members of London society who view her in economic terms—forces which would inhibit her quest.

James turns to upper-middle class English society because it has the conditions he considers necessary for the realization of life's highest potentialities. And, though this arena has its beguiling social aspects, it is a psychological jungle and James is as concerned with the moral and ethical problems of its conflicts as are those who deal with more obvious and basic jungles.

The essentially savage nature of English society is revealed by Kate Croy in her description of it to Milly Theale. For Kate speaks in terms of a "monster," to which one must be introduced and enabled to "walk all round . . . whether for the consequent exaggerated ecstasy or for the still more . . . disproportionate shock."[9] Milly's immediate social success in London is discussed one evening in similar bestial terms at a dinner party from which she is absent.

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[8] R. P. Blackmur, in *Literary History of the U.S.,* ed. R. E. Spiller et al. (New York, 1949), pp. 1056–7.

[9] Henry James, *The Wings of the Dove* (New York, 1930), Modern Library Edition, I, 302. All subsequent references will be to this edition.

Milly's friend and companion, Mrs. Stringham, is pictured as observing the discussion "very much as some spectator in an old-time circus might have watched the oddity of a Christian maiden, in the arena, mildly, caressingly martyred. It was the nosing and fumbling not of lions and tigers but of domestic animals let loose as for the joke" (II, 46).[10] And for Merton Densher at the same party, Milly's success is best described with similar animal images. He sees the situation in terms of competition within nature: "The huddled herd had drifted to her blindly—it might as blindly have drifted away. There had been of course a signal, but the great reason was probably the absence at the moment of a larger lion. The bigger beast would come and the smaller would then incontinently vanish. It was at all events characteristic . . ." (II, 47). James thus describes English society as an arena in which a struggle for existence akin to that in primeval nature is constantly going on.

Nearly everyone of English society in the novel is engaged in this struggle; more important, almost all are selfishly and unscrupulously using their personal relationships to advance their material and social interests. Kate's despicable father is a prime example, for he hopes to gain wealth and position through Kate's relationship with her wealthy aunt, Mrs. Lowder. Kate is ready to give up Mrs. Lowder because her aunt has offered her a home only on the condition that Kate have nothing further to do with her father and sister. But her father, insensitive to the insult and very greedy for money, refuses such a plan: "One doesn't give up the use of a spoon because one's reduced to living on broth. And your spoon, that is your aunt, please consider is partly mine as well" (I, 17).

Mrs. Lowder also sees in Kate a means of achieving her goals —in this case, attracting guests to enable her to outdo other competitors for social prominence. She feels that her money combined with Kate's charm and beauty will produce a marriage with the highest social connections. In the most economic of terms, Mrs. Lowder explains to Merton Densher her "feeling" for Kate: "I've watched [Kate's presence] long; I've been saving it up and letting it, as you say of investments, appreciate, and you may judge whether, now it has begun to pay so, I'm likely to consent to treat for it with any but a high bidder. I can do the best with her, and I've my idea of the best" (I, 92).

Kate, whom we shall see has had her sordid family background to teach her the meaning of a struggle for existence, realizes she

[10] In a non-fictional essay on "London," 1888 James remarks, "A sudden horror of the whole place came over me, like a tiger-pounce of home-sickness . . . London was hideous, vicious, cruel, and above all over-whelming; whether or not she was 'careful of the type' (as in Tennyson's view of evolution), she was as indifferent as Nature herself to the single life." (James's *Art of Travel* (New York, 1958), pp. 176–77.) On p. 189 he envisages London as an "ogress devouring the poor."

has "been marked from far back" (I, 32) for Mrs. Lowder's predatory purposes. She goes to live with her aunt, but secludes herself in her room as much as possible where she thinks of herself as "a trembling kid, kept apart a day or two till her turn should come, but sure sooner or later to be introduced into the cage of [Mrs. Lowder] the lioness" (I, 32–33). While Kate ponders her fate, James makes his most telling comment on the savage character of the situation: "Yet what were the dangers, after all, but just the dangers of life and of London? Mrs. Lowder *was* London, *was* life —the roar of the siege and the thick of the fray" (I, 35).

Yet Kate, too, is involved in the struggle as selfishly and unscrupulously as the next. She is in love with Merton Densher, the penniless but cultivated and charming journalist; but she refuses to marry him until her Aunt is reconciled to the marriage, for she doesn't want to lose the material affluence which life with Mrs. Lowder means. In a conversation between Kate and Densher on this subject, James seems clearly to indicate the basic nature of the struggle for existence which characterizes the society he is describing:

> " 'I don't see,' [Kate remarks,] 'why you don't make out a little more that if we avoid stupidity we may do *all*. We may keep her.'
>
> He stared. 'Make her pension us?'
>
> 'Well, wait at least till we've seen.'
>
> He thought. 'Seen what can be got out of her?'
>
> Kate for a moment said nothing. 'After all I never asked her; never, when our troubles were at the worst, appealed to her nor went near her. She fixed upon me herself, settled on me with her wonderful gilded claws.'
>
> 'You speak,' Densher observed, 'as if she were a vulture.'
>
> 'Call it an eagle—with a gilded beak as well, and with wings for great flights.' " (I, 82–3)

It is into this unscrupulous social struggle for existence that the American Milly Theale steps upon her arrival in England. She is innocent, not as one who is unaware of the art of living, but as one who is uncorrupted. And, suffering from an incurable disease, she is herself engaged in a struggle for existence far more importunate than that which she enters. In his preface James indicates explicitly—as does finally the entire novel—that his concept of a social struggle for existence is not the simple one between life and death; the struggle is rather to live up to life's fullest potentialities. "The idea," writes James in the preface, "reduced to its essence, is that of a young person conscious of a great capacity for life, but early stricken and doomed . . . while also enamored with the world; aware moreover of the condemnation and passionately desiring to 'put in' before extinction as many of the finer vibrations as possible, and so achieve, however briefly and brokenly, the sense of having lived" (v).[11]

It is essentially in the struggle of life and not in the fact of death that James is interested. Of the artist and his characters James says, "It is still by the act of living that they appeal to him, and appeal the more as the conditions plot against them and prescribe the battle. The process of life gives way fighting, and often many so shine out on the lost ground as in no other connexion" (vii). James, then, meant his tale in no way to be "the record predominately of a collapse" (viii) but rather the portrayal, of an ethical triumph. Thus, in the novel "powers conspiring to a sinister end" are yet "in such straits really to *stifle* the sacred spark" that Milly as "a creature so animated, an adversary so subtle, couldn't but be felt worthy, under whatever weaknesses, of the foreground and the limelight" (viii-ix).

When Milly arrives in England, she immediately is seized upon as all things to all people—all in an economic context in the struggle for existence. In Milly, Mrs. Lowder, who was Mrs. Stringham's classmate in girlhood, sees the person who will marry Densher and thus eliminate him as a threat to her plans for Kate's marriage to a man of social prominence. When Kate learns that Milly is dying and that her physician, Sir Luke Strett, feels that only happiness can prolong her life, she tries to arrange a marriage between Milly and Densher. Such a marriage, Kate feels—though she is secretly engaged to Densher—will bring Milly happiness and bring Densher, after Milly's death, the wealth which will make them independent of Mrs. Lowder. Milly and Mrs. Stringham leave London for Venice and Milly rents an ancient palace which becomes the scene of action. They are joined there by Mrs. Lowder, Kate, and Densher. Densher has agreed to Kate's plans, if in deference to his conscience he is a passive rather than an active participant. But Lord Mark, a penniless aristocrat whom Mrs. Lowder wants Kate to marry and who had met Milly in London, comes to Venice to ask Milly to marry him. As much involved as anyone in the economic struggle for existence, Lord Mark too is after Milly's money. Milly refuses him and he realizes that she loves Densher. Lord Mark then returns to London to ask Kate to marry him, but she also refuses. Now he discovers the scheme which she and Densher have to obtain Milly's money and he returns to Venice (motivated by animal-like jealousy and frustrated greed) to tell Milly

[11] Leon Edel in *Henry James: The Untried Years* (Philadelphia, 1953), pp. 226–38 and 323–33, discusses James's youthful devotion to Mary Temple, and the extent to which she served as an inspiration to his creation of Milly and others. Mr. Edel's many studies of James and his editing have placed all who study James deeply in debt to his expert knowledge and rich insights.

of their secret engagement, and hence of Densher's duplicity. This is the greatest of blows for Milly and she turns "her face to the wall" (II, 294).

At this point Mrs. Stringham goes to Densher and describes Milly's struggle to live:

> " 'She's more than quiet, She's grim. It's what she has never been. So you see—all these days. I can't tell you—but it's better so. It would kill me if she *were* to tell me.'
>
> 'To tell you?' He was still at a loss.
>
> 'How she fells. How she clings. How she doesn't want' " to die (II, 299).

But Densher can't tell a direct lie by going to Milly and denying Lord Mark's accusation, as Mrs. Stringham asks. A few weeks later Milly dies. But her physician, Sir Luke, had convinced her that Densher meant well in trying to prolong her diseased life, and Milly had seen him before her death. She sends him home in order that he might not see her die.

Densher's relation to Milly has been a very subtle one; he has been a passive participant in Kate's plan, but he has become involved with Milly on their own terms to the exclusion of other considerations. And he finally realizes he is in love with her memory. He refuses to marry Kate ("I won't touch the money") unless she joins him in renouncing the money. She replies she will if he can deny he is in love with Milly's memory. But this he cannot do, and they both realize there is too much between them—Milly's wings, the wings of the dove—to permit their marriage.

Both in the English society he describes, then, and in the character of Milly Theale, James seems to reflect the influence of the evolutionary concept of the survival of the fittest in the struggle for existence.

The fact that James's characters are clearly products of hereditary and environmental factors also reflects the influence of evolutionary science in *The Wings of the Dove*. Kate Croy's family background is one in which personal attachments are weighed in terms of financial value. To her father and her destitute sister, Marian, as Kate so clearly recognizes, "My position's a value, a great value, for them both. It's *the* value—the only one they have" (I, 80). In the light of such conditioning, Kate's actions in this pattern toward Milly Theale are easily understood. And Kate heavily feels the burden of her heredity, her natural affinity for family and its unhapy consequences: "Her haunting harassing father, her meanacing aunt, her portionless little nephews and nieces," writes James, "were figures that caused the chord of natural piety superabundantly to vibrate. Her manner of putting it to herself—but more especially in respect to Marian—was that she saw what you might be brought to by the cultivation of consanguinity" (I, 36).

In his preface James leaves little doubt of his intention with Kate as the product of corrupted heredity and environment. He explains her thus: "The image of her so compromised and compromising father was all effectively to have pervaded her life, was in a certain particular way to have tampered with her spring . . ." (xviii). And in a conversation between Kate and Densher, James again indicates the fruits of heredity, for to Kate her father's dishonor has become a part of her, and she concludes, "How can such a thing as that not be the great thing in one's life?" (I, 77)[12] Kate '"sleeps" with Densher to encourage him to continue to make love to Milly!

Quite ironically, Milly Theale sees Kate as the "wondrous London girl" (I, 190), the particular product of the London environment of whom she had read. But as the two girls become close friends, Milly perceives more than Kate's turns of head and tones of voice; she sees the Kate who is straining in an earnest competition. Significantly, James describes this element in Kate in terms that reflect both his conception of a social struggle for existence and his concern with environmental determinism. "Wasn't it," he writes, "that the handsome girl was, with twenty other splendid qualities, the least bit brutal too, and didn't she suggest, as no one yet had ever done for her new friend, that there might be a wild beauty in that, and even a strange grace?" (I, 201). And, as James continues, Milly soon saw the reason for such a bold approach to life, for "There were more dangers clearly roundabout Lancaster Gate [Mrs. Lowder's ostentatious home] than one suspected in New York or could dream of in Boston" (I, 201).

In the case of Merton Densher, James depicts an individual in whom the qualities have yet to be shaped by his environment into a final character. And of course in the novel it is Kate's plan and Milly's splendid fortitude, coupled with his renunciation of Milly's money, that determine the final form of his character.

It is significant that the two characters in the novel who see the final circumstances of Milly's death as a sort of ethical triumph are those two who are not distinctly products of any one environ-

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[12] J. A. Ward (*The Imagination of Disaster* (Lincoln, Neb., 1961), p. 130) in his analysis of *The Wings of the Dove* scarcely mentions its reflections of evolutionism but he does call attention to "hereditary predestination." "Both Milly and Kate, we are told, are destined to suffer for the sins of their ancestors, Milly by dying early and Kate by committing a great sin. Milly's family has been plagued by a long history of early deaths and widespread disaster. Kate also partakes mysteriously in the failure and disaster that have visited all her relatives and ancestors. Early in the story, Kate thinks of her family: "Why should a set of people have been put in motion, on such a scale and with such an air of being equipped for a profitable journey, only to break down without an accident, to stretch themselves in the wayside dust without a reason?' " (N.Y. ed., XIX, 4).

ment, that is, Densher and Susan Stringham. These characters also are the ones who, with Milly, spiritually gain something from the total experience encompassed in the novel. Thus, Densher, who had lived abroad, is delineated as "but half a Briton" (I, 101). Mrs. Lowder notices his "want of the right marks, his foreign accidents, his queer antecedents," (I, 101), and Kate discovers "how many more foreign things were in Merton Densher than he had hitherto taken the trouble to catalogue . . ." (I, 103). Densher himself insists he had come back "to being a Briton," but James observes, indicating clearly his partial belief in environmental determinism, "Brave enough though his descent to English earth, he had passed, by the way, through zones of air that had left their ruffle on his wings . . . . Something had happened to him that could never be undone" (I, 104). Densher's final renunciation of Milly's money is also explained in part by the fact that his father was a clergyman whose idealism the son inherited.

Mrs. Lowder and Mrs. Stringham are as much products of their backgrounds as the other characters, but background has fixed the London society matron into a rigid pattern of behavior and has left the New Englander all the more flexible for her experience. In renewing her childhood friendship with Mrs. Lowder when they were classmates in Switzerland, Mrs. Stringham notes the differences between her London friend and herself. To the questing New England companion of Milly, Mrs. Lowder appears now as concerned only with the fundamental "business" of life. Mrs. Stringham sees it thus: "The joy, for her, was to know *why* she acted—the reason was half the business; whereas with Mrs. Lowder there might have been no reason: 'why' was the trivial seasoning-substance, the vanilla or the nutmeg, omittable from the nutritive pudding wihout spoiling it" (I, 187–8).

Mrs. Susan Stringham is the perfect companion for Milly, whom she worships as a princess, because her character's development is determined throughout the story by the demands of the new environment, as was noted of Densher's character. Like Densher, she had spent part of her life in foreign lands; her mother had given her daughters five years abroad which was "to stamp the younger in especial—Susan was the younger—with a character [which] . . . made all the difference" (I, 133). Coming equipped with the simplicity and directness of a New England background and the perspective of travel, Mrs. Stringham does develop—under the demands of a new environment—a character subtle enough to perceive by the end of the story the involved but untold relationships between Merton, Kate, and Milly. "She has seen for herself," Merton tells Kate, "I've told her nothing. She's a person who does see" (II, 358).

James makes it clear in his preface what he intends of heredity and environment for Milly. "She should be the last fine flower,—blooming alone, for the fullest attestation of her freedom—of an "old' New York stem . . ." (x). Going with this, James sees a peculiar American background, for he speaks of "a strong and special implication of liberty, liberty of action, of choice, of appreciation, of contact—proceeding from sources that provide better for large independence, I think, than any other conditions in the world" (x).

When Susan Stringham visits Milly in New York, it is Milly's New York background which impresses, a background which is an "imense, extravagent, unregulated cluster, with free-living ancestors, handsome dead cousins, lurid uncles, beautiful vanished aunts, persons all busts and curls, perserved, though so exposed, in the marble of famous French chisels . . ." (I, 124). Milly *is* upper class New York to Mrs. Stringham, is undeniably the product of her environment. And what Milly represents is "all on a scale and with a sweep that had required the greater stage; it was a New York legend of affecting, of romantic isolation . . ." (I, 118). But most of all, James stresses, Milly represents, "in respect to the mass of money so piled on the girl's back, a set of New York possibilities" (I, 118). This is what makes Milly "*the* thing you were" (I, 136) for with her vast wealth and complete personal freedom she is truly "the heir of all the ages" (xi), with an unparalleled opportunity to encompass in herself all of the past which remains worthwhile.

Aware that the opportunity is hers but that the time is limited, Milly feels the need to grasp quickly the influences of the European cultural heritage. It is ironic that it is this heritage which kills her, but which also completes her in leaving her with an acute awareness. of life, and which she triumphs over in her forgiving generosity to her false lover, because of the hereditary and environmental power of her ethical innocence and goodness.

It is Milly's awareness of what she is that makes her a truly tragic character. She is never blinded by the London she encounters (except in the case of Densher). For, noticing the difference at a dinner party in Lord Mark's attitude toward Kate Croy and herself, Milly reflects that it was Kate, "one of his own species," who made him uncertain. But toward Milly his attitude is confident, for "about a mere little American, a cheap exotic, imported almost wholesale, and whose habitat, with its conditions of climate, growth, and cultivation, its immense profusion but its few varieties and thin development, he was perfectly satisfied" (I, 184). As the product of such an environment, born with every conceivable advantage but without the vigilance which experience usually inspires, Milly can flourish only for a moment's brilliant intensity and then die, knowing that her deceitful lover had been mainly actuated by mercenary motives.

What is most interesting in James's portrayal of Milly Theale's physician, Sir Luke Strett, is that James makes him on the surface a sort of demi-god and quite as much a psychiatrist as he is a physician. Throughout the story Sir Luke acts as the prime dispenser of understanding, sympathy and commands to action. And he is interested on Milly's behalf "in other questions beside the question of what was the matter with her. She accepted such an interest as regular in the highest type of scientific mind—his *being* the even highest, magnificently . . ." (I. 263). In this role, as something of a psychiatrist in the era of Walter Pater, he urges Milly on in the "pursuit of happiness." He tells her, "You've a right to be happy . . . You must accept any form in which happiness may come" (I, 265). Thus, Sir Luke, whom we may take as representing James's ambivalent attitude towards science, plays a strange role: unwittingly, he paves the way for Millie's gullible acceptance of Densher's pretended love, but he also administers "therapy" which may have been a factor in Milly's partial foregiveness of Densher. James appears (judging by his scientist in *Confidence* and *Washington Square)* to have absorbed something of Hawthorne's general view that the scientist has an inadequate insight into the emotional needs of distinctively human beings (cf Beatrice Rappaccini). Thus, James shows that Sir Luke in his prescibed treatment fails to predict that Lord Mark's jealous nature will motivate his telling Milly of the plot of Kate and Densher, and to realize that Milly's being told of Densher's duplicity will kill her. He also does not realize that Kate will lose Densher because of the wings of the dove which have eventually caused Densher to refuse to marry Kate if she keeps Milly's money secured by such duplicity.[13]

The rapid contemporary development of the science of psychology (in which his brother William's pioneering early studies were synthesized in 1890 in his *Principles of Psychology*[14]) influenced James's writing of *The Wings of the Dove.* As we have noted, Henry James is most obviously concerned with the psychological factors of consciousness and motivation. He seldom deals with his

[13] In "Lady Barberina," in a contexture contrasting the idle life of the British aristocracy with that of his hero, an American physician, James says the latter's "repression of pain, the mitigation of misery, constitute surely the noblest profession in the world." But the brilliant *and* cold-hearted Dr. Sloper in *Washington Square* illustrates James's ambivalent attitude toward men of medicine.

[14] "All my life I have . . . unconsciously pragmatized," Henry James wrote William (*Letters,* II, 83). "You are immensely and universally right" in evaluating ideas and conduct in terms of practical consequences as contrasted with Platonic absolutes. Densher fears that his duplicity (eventually brutally revealed to Milly by Lord Mark in his jealousy) will kill Milly in her delicate condition. She should have been more vigilant and pragmatic.

subject directly in an omniscient way; rather, he treats it from different points of view in terms of the varying consciousness of the observers. Thus, when Mrs. Stringham and Milly are introduced, their "more or less associated consciousness . . . " deals "unequally with the next presented fact of the subject" (xxviii), James notes in the preface.

James is even more concerned with the factor of motivation, for he is constantly probing for the "motive still finer" beneath the apparent actions and passions of his characters. The development of Densher and his reasons for becoming involved in such deep duplicity is a masterful study in motivation. Beginning as the son of a chaplain, Densher agrees to Kate's plan. This depends on many subsequent factors including love for Kate, financial needs, and the idealistic belief that his pretending to love Millie will prolong her life.

The influence of science is reflected in much of James's literary theory and practice, for he frequently refers to the "laws" which underly his writing. In developing his plot, James proceeds much after the scientific fashion of a construction-engineer. He describes the "fun" of establishing successive centers so that the portion of the subject commanded by them and accordingly treated from them would constitute "sufficiently solid *blocks* of wrought material, squared to the sharp edge, as to have weight and mass and carrying power; to make for construction, that is, to conduce to effect and to provide for beauty" (xvi). For example, James conceives of Kate Croy as "such a block (xvi). Thus, it is in Kate's consciousness at Milly's party in Venice that the drama is brought to a head, for there Kate "takes the measure of her friend's festival evening, squares itself to the same synthetic firmness as the compact constructional block inserted by the scene at Lancaster Gate" (xxiii).

James feels this scientific method of plot development—of devising blocks of action—is the best: "I have never . . . embraced the logic of any superior process," he says in his preface (xxi). The writer "places," he states, "after an earnest survey, the piers of his bridge—he has at least sounded deep enough, heaven knows, for their brave position; yet the bridge spans the stream, after the fact, in apparently complete independence of these properties, the principal grace of the original design" (xvii). Thus he sees *The Wings of the Dove* as blocks, each governed by a new center, although he deplores his "regular failing to keep the appointed halves of my whole equal." (xxiv).

James's method of describing persons and events through the consciousness of his characters is equally scientific and geometrical. He manipulates their consciousness like high-powered searchlights, revealing with dimensional intensity the elements of his story when they are turned on the object. Thus in the suspenseful final sections, while the center "dwells mainly . . . in the depths of Milly Theale's 'case' " (xxviii), it is through the other characters that actual events are related. In discussing the functional purpose of Milly's party in her Venetian palace, James very clearly describes his scientific and mechanical method of reflecting persons and events. "My registers or 'reflectors,' " he writes, "as I so conveniently name them (burnished indeed as they generally are by the intelligence, the curiosity, the passion, the force of the moment, whatever it be directing them), work . . . in arranged alternation . . ." (xxii). So it is in Venice that Kate Croy is "turned on . . . where the appearances, rich and obscure and portentous . . . as they have by that time become and altogether exquisite as they remain, are treated almost wholly through her vision of them and Densher's" (xxii).

James, then, engineers his scenes around carefully selected centers of consciousness which, in turn, are the determined products of their heredity and environment and which color the scenes in these terms.

His concern with environmental determinism is also reflected in his use of environment as an organic and quite functional background for his story. Mrs. Lowder's home is more than a simple setting for her part in the novel; it *is* Mrs. Lowder, and it gives her a dimensional expression beyond the power of direct descriptions. When Densher visits her he is dismayed by the massive and ostentatious furnishings of her house. He takes in "the message of her massive florid furniture, the immense expression of her signs and symbols . . ." (I, 85). He feels the "language of the house itself" speak to him, "writing out . . . the ideals and possibilities of the mistress. Never, he flattered himself, had he seen anything so . . . ugly—operatively, ominously so cruel" (I, 87). In Venice, when Lord Mark tells Milly of Densher's duplicity and Milly "turns her face to the wall," the weather immediately reflects the psychological climate. The sunny days end and the city becomes " a Venice all of evil . . . . A Venice of cold lashing rain . . . of general arrest and interruption, with the people engaged in all the water-life huddled, stranded and wageless, bored and cynical, under archways and bridges" (II, 283). With the arrival of Sir Luke and with Milly's psychological improvement, the weather changes and comes "into its own again" with "a suffusion of bright sound that was one with the bright color . . ." (II, 320).

In summary, it seems apparent that James's interpretation of life in *The Wings of the Dove,* as imaged in the destructive aspects at least, is parallel in many ways to the ideas associated with the science of James's era. These ideas certainly mesh with his concept of the social struggle for existence which underlies his presentation of English society in Kate Croy, "the modern London girl," in contrast with the American Milly Theale. The same parallel to current science is also evident in James's concern with partially[15] explaining conduct in the light of heredity and environment, and in his ambivalent attitude toward Milly's physician-psychiatrist, Sir Luke Strett. Finally, James's concern with motivation, presented in all its complexity, and his psychological concern with "centers of consciousness" and other practices of literary artistry and formal proportioning[16] also parallel current ideas in science. A reading of the novel in these terms seems to make most potent the significance of the struggle for existence which James is depicting, for the unscrupulous world over which Milly must triumph is most terrifying in its determined animalistic aspects.

One must finally recognize, of course, that in *The Wings of the Dove* the struggle for existence in terms of money-getting and grasping for happiness in the face of disease which medical science cannot cure is counter-balanced by an anti-materialistic idealism. Thus, Milly's ultimate victory over Kate's predatory spirit is the more triumphant for its non-materialistic, ethical and moral basis. Several students of James have concluded that the common denominator of the climaxes in his major fictional works involves a free-willed renunciation of something of price for something priceless, especially for one's self-respect.

While James never joined any sectarian religious group, it has been said that he develops his favorite characters as if they were approaching a religious state of grace after an initiation which had warned them that they should have been more vigilant of the world's evils of a naturalistic kind. The very title phrase, "The Wings of the Dove," from Psalm 55 suggests that Milly, after learning how she had been betrayed, might have yearned for the "wings of the dove" in order to escape from the city of deceit and fly from those who pretended to be her friends.[17]

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[15] For a discriminating discussion of this question, see Arnold Goldsmith, "Henry James's Reconciliation of Free Will and Fatalism," *Nineteenth Century Fiction* XIII (Sept., 1958), 109–126, a discussion condensed from his doctoral dissertation written at the University of Wisconsin.

[16] In addition to James's regret that this novel, unlike *The Ambassadors,* is not limited to having all the action refracted through only one unifying "centre of consciousness," he deplores (in his *Letters,* 1920, I, 403) the fact that "The centre . . . isn't in the middle, or the middle, rather, isn't in the centre but ever so much too near the end, so that what was to come after it is truncated." For a discriminating analysis of such formal matters, see Joseph Warren Beach's *The Method of Henry James* (New Haven, 1918).

[17] See also the subtle study of Ernest Sandeen, *"The Wings of the Dove* and *The Portrait of a Lady", PMLA* LXIX (Dec., 1954), 1060–75.

Another strong influence on James was the semi-platonic Emerson, the spokesman of a spiritual self-reliance. Emerson distinguished sharply between the "law for man" and the "law for thing" (materialism). And James, who wrote three appreciative essays on him, concluded that Emerson, while prone to have a too "ripe unconsciousness of evil," was right in seeing that "the prize was within." Of course James's devotion to George Eliot (on whom he wrote five essays) and other Victorians such as Arnold would also have militated against the materialism of the English upper class. Such materialism struck him "in many ways very much the same rotten and collapsible one as that of the French aristocracy before the revolution—minus cleverness and conversation."[18]

Whatever the sources, the great renunciation scene at the end of *The Wings of the Dove* in which the chaplain's son "won't touch the money" and will not marry Kate unless she too gives it up, is beautifully moving evidence that, fully as James realized the parallels to Darwinism in the socialite life of his time, he also paid homage to the need for the protective and contagious power of ethical innocence and goodness.[19]

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[18] *Letters*, I, 124.

[19] In the latest book-length study of Henry James, *The Madness of Art* (Lincoln, Nebraska, 1962, p. 55–56) Walter F. Wright follows his predecessors in scarcely mentioning social Darwinism. But he does show insight in finding a recurrence "in novel after novel" of two conflicting commandments. "The one commandment was 'Live all you can!' The other was 'Renounce, renounce!' The symbol of the first was often Europe; of the second, America, and particularly puritan New England. We should hasten to say that we are speaking only of those instances in which the geographic terms were used as symbols."

HENRY JAMES: A SENTIMENTAL TOURIST AND RESTLESS ANALYST

Donald Emerson

Henry James wrote accounts of travel over nearly forty years. In the rage of anthologizing which has rescued from magazines even his earliest uncollected accounts, critical attention has dwelt heavily on James's report of what he saw. The more interesting subject, however, is James himself, for the travel literature powerfully confirms James's realization that he was exclusively, for whatever vivid or deficient reactions the fact might involve, a man of imagination. Thus the travel accounts add striking brush-strokes to the self-portrait which he sketched in his notebooks, letters, and criticism, as well as in more forthright self-revelations.

In the autobiography written in his last years, he recalled himself as a small boy always dawdling and gaping, and saw in that memory the very pattern of his always wanting "just to *be* somewhere . . . and somehow receive an impression." He remembered feeling that to stop looking would be to take a long step towards not living at all. When in his twenties he began writing travel sketches, he made picturesque contrasts, impressions, and sketchable details one of his constant subjects. His other chief subject is the reaction of his powerful imagination, which at first outran actual experience and later suffered correction.

For at first he yielded to a tendency to "make images in advance." As a youthful "sentimental tourist" he gave Saratoga in anticipation "a shape and figure . . . a certain complexion, a certain colour." When he found the place different from the construction of his imagination, he acknowledged that his unsophisticated visions gained by their transmutation into fact. "There is an essential indignity in indefiniteness," he acknowledged; "you cannot allow for accidents and details until you have seen them. They give more to the imagination than they receive from it."[1] The Saratoga of reality proved more satisfactory than the "all-too-primitive Elysium" he had constructed in advance. But three years later, in the Roman church of Santa Maria Maggiore, he reflected that his

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* Paper read at the 93rd annual meeting of the Wisconsin Academy of Sciences, Arts, and Letters.

[1] *Portraits of Places* (London, 1883), p. 324 f.

"perfect feast of fancy" was largely the product of his "capricious intellect."[2] Over the years, James found that in the realm of travel experience "the virtue of the business" rested more in what he brought by imagination than in what he took by observation.

The travel accounts express James's reaction to acts of possession. He had seen Europe in childhood and received part of his education there, but when he returned in 1869 he went to seize it. He wrote of his experience then and later, but even after forty-five years, in his final recollection of the experience, he expressed nothing so keenly as his avidity for impressions and the complexity of his imaginative response.

England and Italy held the greatest charm for him; and after them, France; the Low Countries, Switzerland, and Germany had lesser appeals. He never saw more of Spain than San Sebastian, and never attained his wish to visit Greece. He longed vaguely for the East, but he had scant interest in remote parts of the world. He wrote most interestingly of his own country after twenty years of absence had given him an eagerness to penetrate mysteries much like the receptiveness with which he had approached Europe in his youth.

The collected travel accounts are more or less connected series of essays arranged to give the impression of continuous tours. James generally attempts to compose his details into a pleasing pictorial account of the places he visited.[3] He evolved a casual, easy, and graceful style for his travel pieces, and cultivated a cosmopolitan urbanity of tone. This is the manner of the "sentimental tourist." The "restless analyst" who much later wrote *The American Scene* speaks with a different voice.

James seldom muses on scenery. Even as a small boy he was "positively conscious" that the social scene would say more to him than anything else, and it was the human note he wanted, even among impressions of nature. In Switzerland he found that there was "a limit to the satisfaction with which you can sit staring at a mountain," and he preferred "the more equal intercourse between man and man."[4] In the placid English countryside he found his chief delight in the human associations of a scene in which "every-

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[2] *Transatlantic Sketches* (Boston, 1875), p. 125 f.

[3] He criticized Stendhal for failing to do this, noting that Stendhal ". . . is never pictorial . . . he never by any chance makes an image . . . his want of appreciation of the picturesque—want of the sketcher's sense—causes him to miss half the charm of a landscape." *A Little Tour in France* (Boston, 1900), p. 220 f. Gautier, on the other hand, seemed to James "the prince of travellers" because he simply looked and enjoyed, and his fancy was always on the alert. Unsigned review of Theophile Gautier's *A Winter in Russia*, *Nation*, XIX (Nov. 12, 1874), p. 321.

[4] *Transatlantic Sketches*, p. 36

thing . . . has a history, has played a part, has a value to the imagination."[5]

His human associations with natural scenes were frequently drawn from history and literature. At Poitiers, for example, he could look out from the Promenade de Blossac, through uncertain whether he was regarding the actual battlefield, and lose himself in reflections and associations. In Warwickshire, he peopled the landscape with characters from Trollope, and regarded his doing so as an example of the way Americans must bring imagination into play in the presence of English life.[6] He complained that the American scene was deficient in the poetry of association, whether from history or literature,[7] and by contrast cited the way in which the Roman scene provided an unbroken continuity of impressions at once "historic, literary, and suggestive."[8]

What James termed his "historic imagination" is actually a sentimental attachment to a sense of the past. He was almost entirely deficient in the sense of history, so far as that involved understanding of the motives and values of other times. He cared little for accuracy; his having a subjective impression was quite enough. His reflections on the battlefield of Poitiers sufficiently indicate the type of reaction he repeatedly experienced.

> It is carrying the feeling of race to quite inscrutable lengths when a vague American permits himself an emotion because more than five centuries ago, on French soil, one rapacious Frenchman got the better of another. Edward was a Frenchman as well as John, and French were the cries that urged each of the hosts to the fight. French is the beautiful motto graven round the image of the Black Prince as he lies forever at rest in the choir of Canterbury: *a la morte ne pensai-je mye.* Nevertheless, the victory of Poitiers declines to lose itself in these considerations; the sense of it is part of our heritage, the joy of it a part of our imagination, and it filters down through the centuries and migrations till it titillates a New Yorker who forgets in his elation that he happens at that moment to be enjoying the hospitality of France. It was something done, I know not how justly, for England; and what was done in the fourteenth century for England was done also for New York.[9]

In like fashion, the Citadel at Quebec evoked for James an image of the English past, as the Chateau d'Amboise recalled the French wars of religion.

In the same way that literary reference added interest to natural scenery, it created at times the very appeal of a church or a city. In the Cathedral at Tours, James found that the "profane name of Balzac" added an interest to the venerable sanctuary, and he wrote

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[5] *Portraits of Places,* p. 271.
[6] *Ibid.,* p. 256.
[7] *Hawthorne* (New York, 1887), p. 12.
[8] *Transatlantic Sketches,* p. 153.
[9] *A Little Tour in France,* p. 164 f.

rather more of Balzac's novel, *The Cure of Tours,* than he did of the church. In the end he went in search of the house of one of Balzac's characters.[10] At Angoulême he found the chief interest of the town in the fact that Balzac's *Lost Illusions* had "placed" the characters of the fiction there for him. He even congratulated himself that those personages were more real than mere historic individuals, and successfully avoided the "vagueness of identity" that was the misfortune of historical characters.[11]

As for the suggestive—so far as it may be distinguished from what James regarded as the literary or the historic—it was an essence he frequently detected. He felt that "a general impression of the past" was the chief thing Siena had to offer a casual observer. In summing up his reactions to the Boboli Gardens of Florence, with the view of the Pitti Palace which recalled to him the generations of the Medici who had lived there, he defined at once what the past furnished him in Europe and what he missed in America. "What remains . . . now is a mere tone in the air, a vague expression in things, a hint to the questioning fancy. Call it much or little, this is the interest of old places."[12] It could even evoke the ghosts of the past. At Haddon Hall in the growing dusk James felt that if there had been a ghost on the premises he would have seen it, and decided afterwards that he had. "I did see it, as we see ghosts nowadays. I felt the incommunicable spirit of the scene with an almost painful intensity. The old life, the old manners, the old figures seemed present again."[13]

There were times when he felt a strong reaction in favor of the actual, but this mood was infrequent, and James habitually valued places and scenes in proportion as they carried a weight of association or suggestion, a value for the imagination. Calculated ceremony had little charm for him; he absented himself from London during the celebration of Victoria's jubilee. He preferred the leisurely, individual impression, and he gave advice on the best hours for avoiding crowds.

It is typical of James that his reactions to places should frequently depend on childhood impressions. Nothing in all the travel writing is more charming than his account of an excursion to Greenwich:

> It is doubtless owing to the habit of obtrusive and unprofitable reverie that the sentimental tourist thinks it very fine to see the Greenwich observatory lifting its two modest little brick towers. The sight of this useful edifice gave me an amount of pleasure which may at first seem un-

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[10] *Ibid.,* p. 16.
[11] *Ibid.,* p. 166.
[12] *Transatlantic Sketches,* p. 256.
[13] *Ibid.,* p. 26.

> reasonable. The reason was, simply, that I used to see it as a child, in woodcuts, in school-geographies, in the corners of large maps which had a glazed, sallow surface, and which were suspended in unexpected places, in dark halls and behind doors. The maps were hung so high that my eyes could reach only to the lower corners, and these corners usually contained a print of a strange looking house, standing among trees upon a grassy bank that swept down before it with the most engaging steepness. I used always to think that it must be an immense pleasure to hurl one's self down this curving precipice. Close at hand was usually something printed about something being at such and such a number of degrees 'east of Greenwich.' Why east of Greenwich? The vague wonder that the childish mind felt on this point gave the place a mysterious importance, and seemed to put it into relation with the difficult and fascinating parts of geography—the countries of unintentional outline and the lonely-looking pages of the atlas. Yet there it stood the other day, the precise point from which the great globe is measured; there was the plain little facade with the old-fashioned cupolas; there was the bank on which it would be so delightful not to be able to stop running. It made me feel terribly old to find that I was not even tempted to begin.[14]

To such experience as this more is brought than is ever taken; it is in fact memories and associations that make the experience itself.

The most sentimental tourist, however, cannot foverver continue at the active pitch. In one ancient city on a hill-top, James found that his imagination refused to project into the dark old town "that sympathetic glow which forms half the substance of . . . genial impressions."[15] He recognized, too, the fact that observation of foreign lands is at best extremely superficial. At times he questioned the value of travel at all, if it meant leaving home only to see new forms of human suffering. There were moods of reaction against "beautiful useless things," though James reflected that the healthier state of mind was to allow time for intelligence to "make . . . its connections."[16]

At the end of his first visit to Rome in the early 1870's he departed with the "insistent faith" that his gathered impressions would "emerge into vivid relief if life or art should demand them." His art demanded a good many of them, and they emerged with sufficient vividness when he had had time to "make connections"; but he never mistook them for insights into the real life of Italy. England was another matter; it was never "foreign" to him, like Italy and France. After he settled in England he discarded the manners of the tourist and the relaxed enjoyment of impressions, for in England he was accepted into society, and he took his effort of understanding seriously. And within England, London provided a "banquet of initiation" which prolonged itself for years, until

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[14] *Portraits of Places,* p. 221 f.

[15] *Transatlantic Sketches,* p. 290.

[16] *Ibid.,* p. 287.

James felt that it had fed his intelligence more than any other source.[17]

In all James's accounts of travel before the turn of the century his imaginative experience forms the substance of the essays. He does not report, guide-book fashion, what is to be seen, but presents the experience of his own visit, with all its personal, imaginative accompaniments. This is the method of the sentimental tourist, as he frequently styled himself. But his interest in travel accounts de-declined as the freshness of impression which prompted them gave way to accumulated impressions that nourished his fiction.

When James returned to America in 1904 after an absence of twenty years and reported his journey in *The American Scene* (1907), he considered himself now a "restless analyst," capable of criticism as he had not been in Europe. There is some irony to this delusion, for *The American Scene* differs from the earlier travel essays chiefly in the even greater quantity of what James "brings" and the richer and fuller notation of what he "takes." Like all the travel accounts, it is primarily a record of imaginative experience, now raised to a pitch which James exceeds only in his autobiography. But by an enrichment of irony, James actually does succeed in penetrating further into the American scene than the European by the very intensity of his entire reliance on impressions.

For one thing, expatriation had now made it possible for his imagination to respond to America as it could no more react to Europe. European complexity had become for him usual and calculable, while "with his relaxed curiosity reviving and his limp imagination once more on the stretch" James could now find "romance and mystery—in other words the *amusement* of interest," in America.[18] He had always valued the intensity of first impressions; he found now that they were accompanied by trains of association that receded to the dimness of his extreme youth. This struck him as a great advantage; besides the freshness of the inquiring stranger he had also, he felt, the acuteness of the initiated native; he was convinced he would vibrate with more curiosity than the most earnest of foreign visitors.

He was fully aware that he was incapable of providing information on "immensities of size and space, of trade and traffic, of organization, political, educational, economic." He would have nothing to do with statistics; his record would speak only of his personal adventure. "I would take my stand," he declared, "on my gathered impressions, since it was all for them, and for them only, that I returned; I would in fact go to the stake for them."[19] Direct

[17] *The Middle Years* (New York, 1917), p. 60.
[18] *The American Scene* (New York, 1907), p. 351.
[19] *Ibid.,* p. v.

perceptions, enriched by James's lifelong concern for the human subject and his "rage for connections," make up the substance of *The American Scene*. When repeatedly James discovered that his vivid impressions had emerged out of elements insufficient to account for them, he positively congratulated himself that he was not a journalist dependent on items.

Again and again he found his subject so thin as to require more of the imagination than it offered it. When he felt that the history he encountered was neither very stout nor the rarities of nature very rare, he confessed his need to be "shamelessly subjective" about both. This involved him in a problem of notation, for he found that a little of all his impressions was reflected in each of them. To detach or reject one was to mutilate or falsify the others, for the history of a given impression often resided in those which led up to it or accompanied it. This explains the density of James's notation, which for years was held to make *The American Scene* a curiosity of literature.

The American scene was for him primarily the American social scene. The "great lonely land" actually depressed him with its vastness. Nature in America seemed to him unfinished, as society was as yet unformed. During a twilight journey on Lake Worth, where palms silhouetted in the sunset made him think of the Nile, it seemed to him that the American lake was the greater antiquity—it was "*previous*" to everything.[20]

Even at best the historic impress on America appeared to James slight, and he repeatedly felt the necessity of "reading into" his American subjects before they could give out interest. He even created interest out of the blankness itself, as when he visited Richmond. That he felt justified in his method is evident from his definition of history, made at a moment when the triviality of his subject, though he made it the source of rich subjective experience, tempted him almost to apologize. He restrained the impulse, and drew courage from his reflection that "History is never, in any rich sense, the immediate crudity of what 'happens,' but the much finer complexity of what we read into it and think of in connection with it."[21]

This is precisely the "shameless subjectivism" of James's responses turned to aspects of the past, though prompted by the individual report of the immediate experience. Its interest lies in the observer, who must indeed be ready to go to the stake for his impressions, for he has almost nothing else. James felt, for ex-

[20] *The American Scene,* ed. W. H. Auden (New York, 1946), p. 465. This passage was omitted from the original American edition.

[21] *The American Scene* (New York, 1907), p. 177.

ample, that any report of Independence Hall which he might make could be "news" only so far as it was news of himself; in that character it could pretend to freshness, even brilliance. He found that "every fact was convertible into a fancy," and that trivial events could again and again renew his appreciation of "the mystery and marvel of experience" by which small externals prompted an enormous inner enrichment. He felt nothing was more wonderful than the quantity of significant character a well-guided imagination could recognize in the scantest group of features, objects, or persons.[22] There were subjects, however, to which it failed utterly to respond; mere promiscuous encounter never alone evoked interest for James where he felt none or where, as with Wall Street, he was simply baffled.

James's account of America has the weakness of its omissions, but also the coherence of its consistent subjectivism. This was all, James felt, that it could very well have, for even to the most restless of analysts conclusions were impossible. The "great inscrutable answer to questions" hung in the vast American sky, to his imagination, as "something fantastic and *abracadabrant*" which would become legible only with time.[23] Meanwhile he noted the absence of social forms, the terrible impermanence of things in the face of money-making possibilities, the rampant commercialism, and the childishness of a society confident of its safety in an absence alike of doubts or convictions.

Though he spoke for himself in declaring that the unsatisfied wants of the spirit must be met somehow, and revealed himself, in his shameless subjectivism, busily knocking together substitutes, he discovered at last that the country at large was also knocking together, somehow, substitutes for an appetite very like his own.

> . . . the human imagination absolutely declines everywhere to go to sleep without some apology at least for a supper. The collective consciousness, in however empty an air, gasps for a relation, as intimate as possible, to something superior, something as central as possible, from which it may more or less have proceeded and round which its life may revolve—and its dim desire is always, I think, to do it justice, that this object or presence shall have had as much as possible of an heroic or romantic association. But the difficulty is that in these later times . . . the heroic or romantic elements . . . have been all too tragically obscure . . . so that the central something . . . has had to be extemporized rather pitifully after the fact, and made to consist of the biggest hotel or the biggest common school, the biggest factory, the biggest newspaper office, or, for climax of desperation, the house of the biggest billionaire. These are the values resorted to in default of higher, for with *some* colored rag or other the general imagination, snatching its chance, must dress its doll.[24]

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[22] *Ibid.*, pp. 277, 65, 380.

[23] *Ibid.*, p. 118.

[24] *Ibid.*, p. 279.

Dressing its doll seemed to James also an explanation for the great American artistic activity of "faking." The prevalence of it confirmed his view of the childish explanation of American society, for the public which could respond to the arts of fakery seemed to him "quite incalculably young."[25]

The American Scene is James's most coherent attempt to give an account of a society. In becoming the restless analyst, the whilom sentimental tourist approached his subject with a mature preceptiveness more penetrating than his youthful enthusiasm. But really, he did nothing but what he had always done. He lived by his imagination and cultivated impressions. Sentimental or analytical, James the tourist was consistent; his sentiments and his analysis alike depended upon the responses of a powerful imagination which ever, in its experiences, brought more than it took. The travel essays thus complement James's account of himself as a man of imagination. They are even proof that he could be nothing else.

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[25] *Ibid.*, p. 440.

USE OF OTOLITHS TO DETERMINE LENGHTH AND WEIGHT OF ANCIENT FRESHWATER DRUM IN THE LAKE WINNEBAGO AREA

Gordon R. Priegel

The freshwater drum, *Aplodinotus grunniens* Rafinesque is an abundant, native fish species found in Lake Winnebago. Although much information is available concerning the current length-weight relationships of the drum, information is completely lacking on the size of the drum during aboriginal times.

This study was initiated to determine if there was any difference in drum length and weight during aboriginal times when the drum population was relatively unexploited and during present times when the drum population is exploited greatly by commercial fishing (Priegel, 1961).

Otoliths from drum have been found in the middens or cooking ruins of Indians who dwelled in the Winnebago area. Since there is a proportionate relationship between fish size and otolith size, as will be shown later, it was reasoned that aboriginal otoliths because of their non-deteriorated structure could be used to reconstruct a comparative size structure value for aboriginal drum. Witt (1960) demonstrated that there was a proportionate relationship between drum length and otolith length for drum collected from the Mississippi River.

In the fishes the otoliths are called sagitta in the sacculus, asteriscus in the lagena, and lapillus in the utriculus. In nearly all fishes the sagitta is the largest otolith and is the one used in this study. Otoliths have enameled surfaces etched with markings and peculiar grooves for passage of the fluids found in the inner ear. Because of distinctive shapes and markings, otoliths can be used to identify fish, and with their enamel surfaces, a skeletal structure is available that is usually well preserved and intact making it an ideal structure for comparison with similar structures of present-day fishes.

Methods and Material

During the summer of 1959, freshwater drum otoliths were collected from Lake Winnebago. Otoliths were obtained from 983 drum which ranged in total length from 0.5–29.5 inches. The otoliths were air dried for two months, weighed to the milligram, and their length measured to the tenth of an millimeter.

Aboriginal otoliths were obtained from three Indian Sites in Winnebago County, Wisconsin. The Oshkosh Public Museum and the Illinois State Museum were the source of 28 otoliths from the Bell Site which is located on the Bell farm along the south shore of Big Lake Butte des Morts (Horton, pers. comm.). This site was used between the early and mid-eighteenth century for approximately 50 years. At the Bell Site, 100 peculiar bell-shaped fire pits, 2 to 4 feet in diameter, were located. The otoliths from this site considering their age, are extremely well preserved.

Fifty-three otoliths from the McCauley Campsite were obtained at the Milwaukee Public Museum. The McCauley Site is located on the Jennie McCauley property, Lake Drive, in the city of Oshkosh, which is located on the west shore of Lake Winnebago (Kannenberg, 1932). These otoliths are associated with the upper Mississippi Culture and are estimated to date from 500–1750 A.D. The otoliths were well preserved.

The Oshkosh Public Museum was also the source of 160 additional otoliths from the Lesley Point Site which is located on the east shore of Lake Winneconne, one mile north of the Village of Winneconne. The site was used by the Winnebago aboriginals around 1600 A.D. and represents a large village (Bullock, 1940 and 1942). These otoliths were also extremely well preserved.

Results

The recent drum collection was arranged into one-half inch groups and corresponding average otolith lengths were determined for all otoliths (right and left) in each group (Table 1). After average body length in millimeters was determined for each group, a curve was fitted to these data (Figure 1) and the relationship between otolith length and body length of the drum can be described by the equation: $BL = -37.77 + 28.26\ OL$, where $BL =$ Body length in millimeters and $OL =$ otolith length in millimeters. This relationship can be used to estimate the length of aboriginal drum when otolith length is known.

Witt (1960) obtained a relationship between otolith length and body length of the drum from the Mississippi River and can be described by the equation: $BL = -70.3253 + 29.8974\ OL$.

Corresponding average otolith weights were determined for each half-inch group and an empirical curve showing the relationship between otolith weight and body length was plotted, but no relationship was calculated due to the wide variation in otolith weight of drum over 4 inches. This variation increased as body length increased. A wide variation existed if average weights were used for all otoliths in a given group or if only the average weights of the right or left otoliths in a given group were used. A lack of or excessive amounts of calcium deposits on the otoliths due to faster or slower growing individuals is probably responsible for the wide weight variation in the otoliths. Witt (1960) obtained a body length and otolith weight relationship for drum collected from the Mississippi River at Hannibal, Missouri, and is described: Log OW = —3.1286 + 2.3534 Log BL, where OW = otolith weight and BL = body length, but he also found wide variation in otolith weight for larger drum.

The body length-weight relationship (Figure 2) was calculated for the recent drum from a sample of 923 drum taken on October 27–28, 1959, while trawling with a 12-foot bait trawl in pelagic areas of Lake Winnebago, and is described as: Log W = —5.17129 + 3.10600 Log L, where Log W = weight in grams and Log L = total length in millimeters (Priegel, 1961).

With the above relationship established, lengths of otoliths from aboriginal drum can thus be substituted into the predetermined otolith length-body length equation and the calculated length of aboriginal drum can be obtained. This length can then be substituted into the length-weight equation and the weight of aboriginal drum can be estimated.

The size of recent and aboriginal drum was compared by the calculated lengths and weights of the aboriginal drum and actual lengths and weights of recent drum. Eroded aboriginal otoliths were not used since this would lead to under-estimates of body length and weight. Either the left or right otolith can be used in the otolith length-body length equation since the average difference in length for left and right side otoliths in each half-inch group did not vary more than one-tenth of a millimeter until the 23.5–23.9 inch-group where a difference of two-tenths of a millimeter existed (Table 1).

Discussion

Aboriginal otoliths collected from known campfire sites should only be used to determine length and weight of aboriginal drum common to the area. Otoliths used in this study were obtained from three different sites: Bell, McCauley, and Lasley Point Sites. The Bell Site was a fire pit area while the McCauley and Lesley Point Sites were village sites. Some of the otoliths from the Lasley Point Site were dark blue to black in color and this indicates a prolong stay in hot ashes which most likely means cooking fires. If aboriginal otoliths are obtained from sources other than known campfire sites, this may indicate that the drum otoliths were used for ornaments or money rather than only for their food value. Niehoff (1952) describes five aboriginal otoliths found in Wisconsin that were perforated at two points, indicating that they were strung, probably either for a necklace or a bracelet. Hubbs (in litt.) related the occurrence of aboriginal drum otoliths found in Utah in which region drum at the time were not native. These otoliths must certainly have been carried as some sort of trinket or wampum. If otoliths were sought only for ornaments or money, the tendency would probably be to acquire larger size otoliths which would be of more value, but would no doubt lead to an overestimate of aboriginal drum size when comparing them to present day drum.

The length frequency distribution of aboriginal otoliths from the three sites are very similar (Figure 3) and their calculated body length and weight ranges and means are very similar (Table 2). This would indicate that the drum were primarily taken for the same purpose (food), that similar selective fishing methods were employed, or that similar environmental conditions existed.

The mean length of 13.9 inches for present day drum from Lake Winnebago, is smaller than the mean lengths of drum from the aboriginal sites: Bell Site, 18.3 inches, McCauley Site, 18.6 inches; and Lasley Point Site, 18.1 inches. The drum length ranges indicate that the aboriginal Indians did not take many drum under 10 inches.

The fishing methods employed by the aboriginals during their use of the Bell, McCauley, and Lasley Point Sites would certainly allow the aboriginals to capture both large and small fish. Driver (1961) wrote that the aboriginals captured fish by every method known to modern commercial fishermen: weirs, traps, nets, spears, hooks, poison, arrows, snares, and rakes. Kuhm (1926) stated that much of the food supply of the early Wisconsin Indian consisted of fish so it seems likely that they would employ and develop numerous methods of capturing fish.

The smaller size of recent drum in Lake Winnebago is probably due to a combination of factors. Water pollution by industries and municipalities, and runoff over fertile soils as agriculture became important in the watershed, had much to do to increase the fertility of Lake Winnebago, thus making the lake a more favorable environment for the drum, but at the same time, creating a situation that led to a slow-growing population due to little or no exploitation until 1954, when an intensive removal program began. Hubbs and Lagler (1949) state that the drum occurs generally in large rivers and lakes, usually in silty waters. Lake Winnebago, because of its size (137,708 acres) and rectangular shape (28 miles long and 10.5 miles wide at its widest point) is continuously affected by wave action that prohibits aquatic plant growth and encourage turbid water. Profuse algal growth especially during the summer, keeps the water turbid, a situation preferred by the drum.

The sizes of fishes during aboriginal times are of value to ichthyologists and fishery biologists, but their sizes are poorly known. To estimate the size of fishes during aboriginal times, a skeletal structure must be well preserved and it must be possible to relate the size of this structure to the size of the same structure and to the size of present day fishes. The otolith in this study was well suited to estimate the size of aboriginal drum in the Lake Winnebago area.

Table 1. Average Lengths and Ranges in Millimeters of Otoliths From 983 Freshwater Drum Taken From Lake Winnebago, 1959

Length Interval of Drum	Number of Drum	Right Otolith		Left Otolith	
		Range (mm)	Average (mm)	Range (mm)	Average (mm)
0.5– 0.9	13	0.6– 1.2	0.9	0.6– 1.2	0.9
1.0– 1.4	23	1.2– 2.2	1.6	1.2– 2.0	1.5
1–5– 1.9	24	2.0– 2.7	2.4	2.0– 2.7	2.4
2.0– 2.4	23	2.6– 3.2	2.9	2.6– 3.1	2.9
2.5– 2.9	13	3.1– 3.7	3.4	3.1– 3.7	3.4
3.0– 3.4	23	3.6– 4.2	3.9	3.7– 4.4	4.0
3.5– 3.9	16	4.1– 4.8	4.5	4.2– 4.8	4.5
4.0– 4.4	22	4.9– 5.8	5.2	4.7– 5.8	5.1
4.5– 4.9	23	5.6– 6.2	5.9	4.6– 6.2	5.8
5.0– 5.4	20	5.8– 6.7	6.3	5.8– 7.0	6.3
5.5– 5.9	20	6.3– 6.9	6.5	6.3– 6.9	6.6
6.0– 6.4	23	6.4– 7.5	6.9	6.7– 7.5	7.0
6.5– 6.9	24	6.7– 7.9	7.3	6.8– 7.9	7.3
7.0– 7.4	23	7.6– 8.9	7.9	7.7– 8.8	7.9
7.5– 7.9	22	7.8– 8.8	8.2	7.9– 8.9	8.3
8.0– 8.4	24	7.9– 9.0	8.5	7.7– 9.2	8.6
8.5– 8.9	22	8.2– 9.6	8.9	8.2– 9.7	9.0
9.0– 9.4	25	8.6–10.5	9.5	9.0–10.2	9.5
9.5– 9.9	19	9.3–10.2	9.8	9.4–10.2	9.9
10.0–10.4	25	10.2–11.0	10.6	10.0–11.0	10.6
10.5–10.9	25	10.1–11.7	11.0	10.2–11.9	11.0
11.0–11.4	25	10.8–12.4	11.5	10.8–12.6	11.5
11.5–11.9	25	11.2–12.8	11.9	11.2–12.7	11.9
12.0–12.4	25	11.9–13.5	12.7	11.9–13.6	12.6
12.5–12.9	23	12.3–14.0	13.2	12.1–14.0	13.1
13.0–13.4	25	12.5–15.3	13.8	11.9–15.3	13.7
13.5–13.9	25	13.1–16.3	14.4	13.0–16.1	14.3
14.0–14.4	25	13.4–16.0	15.1	13.6–16.4	15.1
14.5–14.9	25	14.2–16.9	15.8	14.2–16.7	15.7
15.0–15.4	25	15.1–17.5	16.1	15.1–17.5	16.1
15.5–15.9	25	15.0–17.3	15.9	15.1–17.4	16.0
16.0–16.4	25	15.4–17.9	16.5	15.1–17.9	16.5
16.5–16.9	25	15.8–18.7	17.2	16.2–18.6	17.1
17.0–17.4	25	16.4–19.0	17.5	16.0–19.1	17.6
17.5–17.9	25	16.0–20.2	17.8	15.8–20.3	17.8
18.0–18.4	25	16.6–20.0	18.2	16.4–19.9	18.3
18.5–18.9	25	16.5–19.7	18.2	16.5–19.7	18.2
19.0–19.4	24	17.1–21.1	19.1	17.3–20.8	19.2
19.5–19.9	23	17.6–20.4	19.0	17.5–20.8	19.1
20.0–20.4	14	18.3–20.6	19.3	18.1–20.6	19.3
20.5–20.9	20	18.4–22.5	20.1	18.3–23.0	20.1
21.0–21.4	17	19.1–21.9	20.3	19.3–22.1	20.3
21.5–21.9	10	19.2–22.1	20.4	19.1–22.3	20.4
22.0–22.4	7	20.3–22.4	21.5	19.9–22.5	21.4
22.5–22.9	2	21.2–21.4	21.3	21.0–21.4	21.2
23.0–23.4	4	21.3–23.0	21.9	21.5–22.7	22.0
23.5–23.9	2	21.7–22.7	22.2	21.7–23.0	22.4
24.0–24.5	4	20.8–24.5	22.6	21.0–23.5	22.3
26.0–26.4	2	23.3–24.4	23.9	23.3–24.4	23.9
26.5–26.9	2	23.7–24.8	24.2	22.7–24.9	23.8
27.5–27.9	1		26.2		26.0
29.5–29.9	1		25.0		25.0

FIGURE 1. Relationship between otolith length and fish length. Broken line equals empirical variation of otolith length.

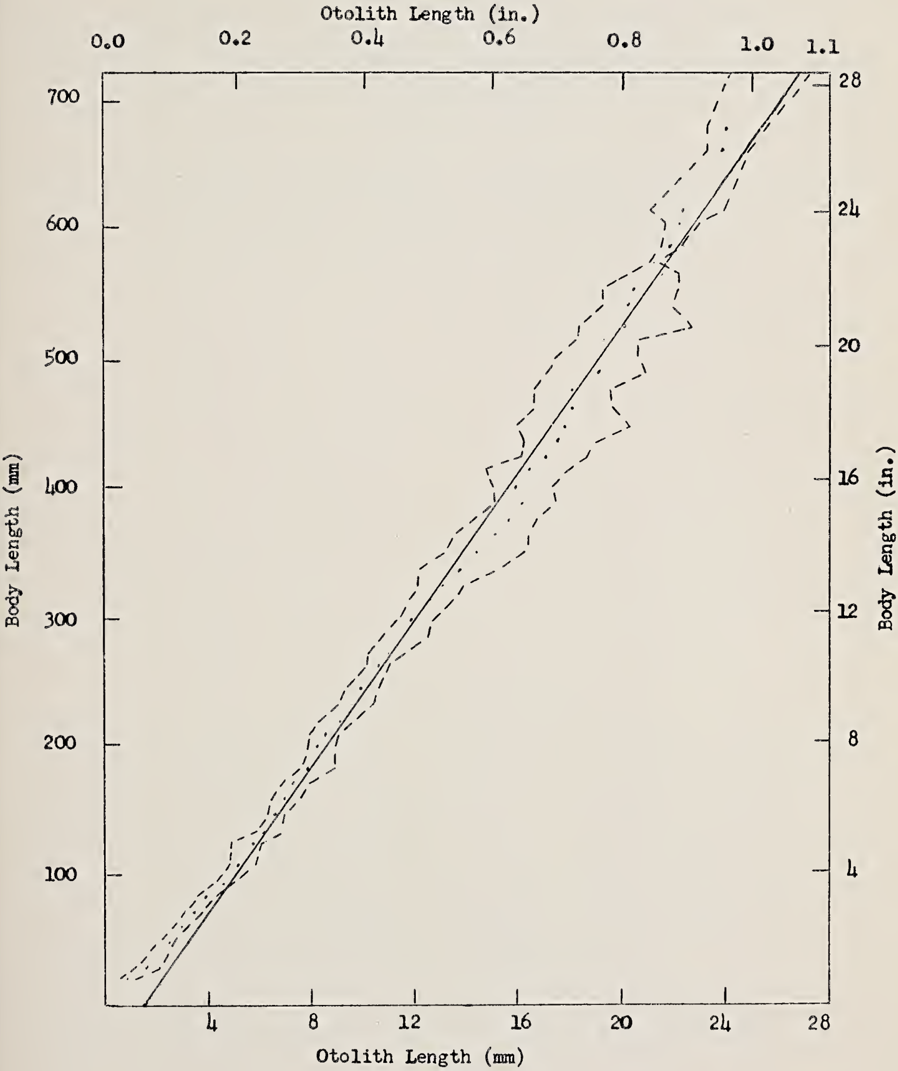

FIGURE 2. Length-weight relation of freshwater drum. The smooth curve represents the calculated weights and the dots represent the empirical weights.

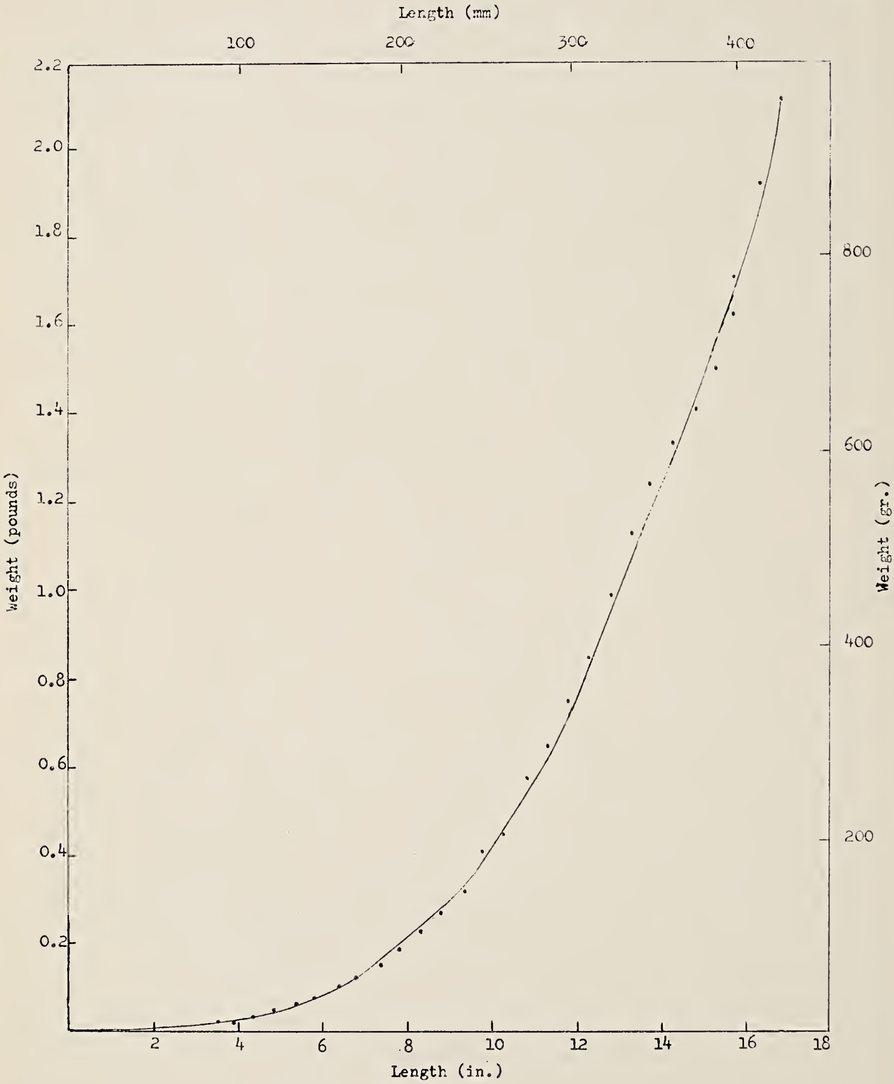

FIGURE 3. Length-frequency distribution of ancient otoliths from freshwater drum.

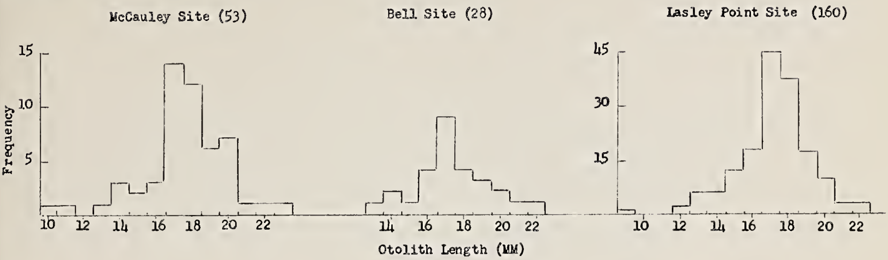

TABLE 2. CALCULATED TOTAL LENGTH IN MILLIMETERS (INCHES) AND WEIGHT IN GRAMS (POUNDS) OF ANCIENT FRESHWATER DRUM. ACTUAL LENGTHS AND WEIGHT FOR RECENT DRUM.

LOCATION	DATE	NO.	LENGTH		WEIGHT	
			Range	Mean	Range	Mean
McCauley Site Winnebago Co., Wis.	500–1750 A.D.	53	270–635 (10.6–25.0)	472 (18.6)	240–3420 (0.53–7.54)	1356 (2.99)
Lasley Point Site Winnebago Co., Wis.	1600 A.D.	160	276–609 (9.9–22.9)	460 (18.1)	257–3004 (0.57–6.62)	1318 (2.91)
Bell Site Winnebago Co., Wis.	1700–1750 A.D.	28	329–595 (12.9–23.4)	465 (18.3)	444–2795 (0.98–6.16)	1330 (2.93)
Lake Winnebago	1959	923	183–447 (7.2–17.6)	353 (13.9)	81–1220 (0.18–2.69)	526 (1.16)

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THE FISHES OF LAKE MENDOTA

Donald C. McNaught

Lake Mendota has a relatively rich fauna of fishes. Sixty-one species belonging to 20 families are now present or have been reported in the past. Of these, 57 species in 19 families are well documented, while the remainder are questionable.* This lake lies in the valleys of the pre-glacial Middleton and Yahara Rivers, which were dammed with glacial drift at least 9,000 years ago. Geographically, the lake is part of the Mississippi drainage, although the fish fauna exhibits affinities to both the Mississippi and Great Lakes drainages. Mendota, the "Upper Lake" in the Yahara chain, drains into the Mississippi by way of the Yahara and the lower lakes and thence to the Rock River, entering the Mississippi near Rock Island, Illinois, at least 195 river miles below the lake.

Of the 61 species of fishes reported for Lake Mendota, 60 are listed among the 173 species in 29 families (28 families if the Coregonids are included with the Salmonids) found in the Great Lakes drainage (Hubbs and Lagler, 1958). The shortnose gar, *Lepisosteus platostomus*, not recorded by Hubbs and Lagler (1958), has recently been shown to have made the transition into the Great Lakes drainage by Priegel (1963). For zoogeographic purposes, the affinities of the primary fishes of Mendota to those of the Mississippi and Great Lakes drainages are more meaningful than a comparison of the entire fauna; the primary fishes being those which, with few exceptions, have been restricted to fresh-water throughout their known history. Among the fishes of Mendota, we find 43 primary species in 8 families, or about 16% of the primary fauna of the Mississippi drainage (260 species in 13 families, Miller 1958). All 43 fishes are included among the primary species found in the Great Lakes (112 species in 12 families, Miller, *op. cit.)*. Thus while Mendota is a part of the Mississippi system, all of her fishes are now common to the Great Lakes.

The families Cyprinidae, with 15 species, and Centrarchidae, with a total of 9 species, contribute the largest number of species. The Percidae, with 6 species, and the Ictaluridae with 5 species, are also well represented.

* Taxonomy from Bailey *et al.* (1960).

The Pelagic Fishes

The yellow perch, *Perca flavescens,* and the white bass, *Roccus chrysops,* are numerically dominant among the larger pelagic fishes and provide for an important sport fishery. Both have been studied extensively, especially as concerns movement and feeding periodicity (Hasler and Bardach, 1949; Hasler and Villemonte, 1953; McNaught and Hasler, 1961), reproductive behavior (Horrall, 1961), and homing behavior as related to sun orientation (Hasler *et al.,* 1958). The perch population has been variously estimated at from 4 to 8 million (Bardach, 1949) to 15 million individuals (Pearse and Achtenberg, 1920), however, the fact that an estimated 1½ million perch were taken through the ice by anglers during the winter of 1956–57 makes the larger estimate more likely. The large population of white bass provides for a unique type of fishing. These fish feed actively at the surface at dawn and dusk, and may be taken in large numbers by stalking the schools by boat.

Table 1. Catches of Cisco, *Coregonus artedii,* in Lake Mendota, Wisconsin, Between 1867 and 1962

Year	Maximum Catch Per Man Night	Catch Per Man Season*	Fish Sighted Per Man Season*	Length of Season*	Gear	Authority
1867	300				Spear	Cited by
1875	437				Spear	Neuenschwander (1946)
1884	480				Dip-net	
1930		24		1–4 Dec	Dip-net	Records of
1931		441		2–12 Dec	Dip-net	C. J. Telford* from
1932		303		23 Nov– 2 Dec	Dip-net	Neuenschwander (1946)
1933		265		20 Nov– 3 Dec	Dip-net	and John (1954)
1935		147		22 Nov– 7 Dec	Dip-net	
1936		189		21 Nov–30 Nov	Dip-net	
1937		198		22 Nov– 4 Dec	Dip-net	
1938	214	457		26 Nov– 4 Dec	Dip-net	
1939		372		26 Nov– 1 Dec	Dip-net	
1940	100	194		25 Nov– 8 Dec	Dip-net	
1941		11		26 Nov– 1 Dec	Dip-net	
1942	no run, some beneath ice			8–9 Dec	Dip-net	
1943		21		17 Nov– 9 Dec	Dip-net	
1944	no run					
1945	no run					
1946		1			Dip-net	
1952		7	16		Dip-net	Records of
1953		13	100		Dip-net	C. J. Telford*
1954		100	200		Dip-net	(personal communi-
1955		0	1		Dip-net	cation)
1956		1	5		Dip-net	
1957		0	1		Dip-net	
1958		0	1		Dip-net	
1959		7	12		Dip-net	
1960		—	—		Dip-net	
1961		3	6		Dip-net	
1962		0	0		Dip-net	

*Mr. C. J. Telford, 221 Kendall Avenue, Madison, Wisconsin.

The cisco, *Coregonus artedii,* formerly an important component of the pelagic fishery, has undergone catastrophic die-offs in recent years and is now a rare species. John (1954) concluded that fishing with gillnets in 1949 was five times poorer than in 1931 and at least ten times poorer than it had been in 1892. Catch records provided by Mr. C. J. Telford of Madison document the ciscoes' recent demise. Whereas during the late 1800's a single man could dip-net 300 to 400 fish per night, by the early 1940's 100 to 200 fish per night constituted a good catch. Mr. Telford has taken as many as 7 fish per season only once in the last 8 years (Table 1).

The Minnows

A general lack of information concerning the species of *Notropis* present, as well as both their ecological role and ethology, represents one of the largest gaps in our knowledge of Mendota's fishes. In their recent catalogue of the fishes of the United States and Canada, Bailey *et al.,* (1960) list 97 species of *Notropis,* thus the 9 species reported from Mendota represent only about 9% of the species belonging to this diverse and interesting genus.

The spottail shiner, *Notropis hudsonius,* was first reported from Lake Mendota in 1944 (Black, 1945), although earlier surveys failed to list this easily recognized species. The spottail may have entered Mendota early through the Mississippi drainage or more recently from the Great Lakes via the Chicago Sanitary and Ship Canal, the Illinois River and the Mississippi. The behavior of this most interesting fish merits future attention. Adults have been observed schooling with yearling white bass (McNaught and Hasler, 1961). Large aggregations of the shiner have been observed on the spawning grounds of the white bass, although it is not known if the shiner is likewise spawning (Horrall, 1961). A study of possible relationships between the spottail and the white bass seems desirable. Other members of this and related genera have been demonstrated to have certain close relationships with larger species of Centrarchids. The northern redfin shiner, *Notropis umbratilis,* is a nesting associate of the green sunfish, *Lepomis cyanellus* (Hunter, 1962). Similarly, the golden shiner, *Notemigonus crysoleucas,* has been described as utilizing the nests of the largemouth bass, *Micropterus salmoides* (Kramer and Smith, 1960).

Introduced Fishes

Species introduced to Lake Mendota during early stocking programs are most important in any consideration of the extant fauna. Certain fishes have become a nuisance. Carp were supplied to individuals in the Madison area beginning in 1887, although a carp was taken from Mendota on 24 November 1877 (*Wisconsin State Journal,* 27 November 1877, cited by Neuenschwander, 1946). Less than 600 fish were distributed to Madison residents between 1887 and 1893, yet in 1962 approximately 13,000 pounds of carp were removed by the State Conservation Department in an effort to control the population (personal communication, N. Miller). A close relative, the goldfish, *Carassius auratus,* was stocked in 1885 by Gov. Farwell and likely many times since by one-time aquarists or fishermen. Large specimens are infrequently taken (Footnote #13), however, and the goldfish is certainly not a problem at the present.

The white bass, *Roccus chrysops,* was abundant in Mendota as early as 1867 (*Wisconsin Union,* 15 December 1867, cited by Neuenschwander, 1946). Any influence on the population from those fish stocked in Lake Monona in 1891 or in Mendota in 1940 and 1943 would be difficult to assess. Yet the transfer of a few yellow bass, *Roccus mississippiensis,* a close relative of the white bass, may eventually alter the over-all population structure in Lake Mendota. The yellow bass was stocked in Lake Wingra sometime in the 1930's, likely during a rescue transfer from the Mississippi (Noland, 1951; Helm, 1958), and has since spread to the upper lakes. Previous to 1960, only one specimen had been collected during yearly fyke-netting operations at Governor's Island and Maple Bluff. In 1960, Horrall (1961) captured well over 100 yellow bass. He speculated that the 1960 invasion of Mendota may have resulted from an extremely large hatch in Lake Monona in 1957. The yellow bass was possibly aided in the expansion of its range during the construction of a new dam and lock at Tenney Park.

Although large numbers of muskellunge fry as well as fingerlings were stocked between 1933 and 1941, this favorite game fish has rarely been reported in the catch. The one substantiated report was that verified by Prof. J. C. Neess in 1946 (Footnote #11), quite possibly a return from the efforts of the 1930's. Likewise, the hook-and-line success for brook, brown and rainbow trout is insignificant. The majority of trout are stocked in tributary streams, although a few may spend the colder months in the lake (Footnote #7).

Approximately 109 million walleye fry and fingerlings were stocked in the lake between 1883 and 1958, making this game fish the most heavily stocked (Footnote #38). Other species frequently added to the lake include the northern pike, bluegill, smallmouth bass, largemouth bass, crappie, yellow perch, bullhead, and the cisco (Footnotes #23–38).

Unusual Fishes

Public interest is easily aroused by publicized catches or sightings of unusually large or uncommon fishes, whether native or exotic. The lake sturgeon was likely native to the Madison lakes. A Mr. Harnden took a sturgeon from Lake Monona sometime prior to 1876 (*Wisconsin State Journal,* 11 August 1876, cited by Neuenschwander, 1946). Attempts were made by the Conservation Department in 1934 and 1936 to bolster the population by stocking a limited number of adults from the Wolf River (Footnote #23). The recent capture of an apparently healthy specimen (Footnote #6) was unusual in that it was the first sturgeon taken by a member of the Laboratory since intensive fyke-netting operations began 9 years ago. Its age of 29 to 31 years makes it unlikely that it was one of those stocked in either 1934 or 1936; whether or not it was the result of a successful spawning in one of the tributary streams is purely speculative.

Before the white man succeeded the Winnebago on Mendota's shore, the American eel had access to the lakes via the Mississippi and Rock Rivers. An article in the *Wisconsin Union* for 15 December 1867 indicated that eels had not ascended into Lake Monona. However, the *Wisconsin State Journal* for 20 August 1880 (cited by Neuenschwander, 1946) reported the capture of an eel 2 feet in length in Lake Monona, thought to be the third or fourth eel captured in the lakes since Madison was first settled. By 1935 eels were becoming rare in the upper Mississippi due to the construction of dams (Greene, 1935). Obviously they were to die if prevented from reaching their presumed spawning ground in the Sargasso Sea, a journey of approximately 2900 miles from Mendota. Many of the more recent records in other areas of the state and especially the Mississippi were the result of stocking (Greene, *op. cit.).*

The channel catfish may have been transferred into Lake Wingra during rescue operations from the Mississippi (Noland, 1951). Just over 100 years ago a 40 lb. catfish 3½ feet in length was caught in Mendota (*Wisconsin State Journal,* 15 July 1862, cited by Neuenschwander, 1946). Certainly this beautiful fish must then be considered native to Mendota. Although now a rarity, a few specimens are taken in the annual netting operations of the Laboratory at Maple Bluff and Governor's Island.

Fishes of Other Lakes of the Upper Yahara Basin

The larger fishes of Lake Wingra were listed by Noland (1951). Lake Wingra lies west of Lake Monona and connects to it by Murphy Creek, whose channel was first dredged in 1905. Of those fishes reported for Wingra, only the muskellunge x northern pike cross, *Esox masquinongy* x *E. lucius,* the spotted sucker, *Minytrema melanops,* and the satinfin shiner, *Notropis analostanus* (Helm, 1958), have not been observed in Lake Mendota. The spotted sucker, along with a redhorse, channel catfish, white crappie and yellow bass were likely introduced into Lake Wingra from the Mississippi (Noland, *op. cit.).* Recently (10 September 1963) the northern hog sucker, *Hypentelium nigricans* (LeSueur), was taken while seining in Lake Wingra by T. Wright of this Laboratory.

The redfin shiner, *Notropis umbratilis,* was introduced into one of the University of Wisconsin Arboretum Gardner Ponds in 1954 (Hunter and Wisby, 1961). Now well established, it has access to Lake Mendota, Monona and Wingra and the Lower Lakes via Murphy Creek when the Ponds overflow during times of high water.

The golden redhorse, *Moxostoma erythrurum,* has been collected in Lake Waubesa (Footnote #48); likewise, the quillback, *Carpiodes cyprinus,* has been reported from Lake Kegonsa (Footnote #40). Neither species has been observed in Lake Mendota, although both must have ready access.

List of Fishes

Despite the interest in Lake Mendota among biologists, a detailed study of the fish fauna does not exist. Students of the fishes at the Laboratory have often felt a need for a check-list of its fishes. An effort was made in this direction by Dr. Roger Davis in 1955. His list was based upon the work of Pearse (1918), with additional species confirmed through interview with Laboratory personnel. In addition, Davis included an unconfirmed group whose probability of occurrence he felt to be reasonable, based on reports of fishermen. As of this writing, only four species mentioned by Davis have not been confirmed; also, a number have been added.

The list presented here includes the species encountered by Pearse (1915, 1918) in his studies of the foods of local fishes; those listed, and in most cases examined by Greene (1935) from Lake Mendota; those captured by Horrall (1961) over a period of 9 years of fyke-netting in the area of Maple Bluff and Governor's Island; and those catalogued in the Museum of the Department of Zoology. Additional valuable information was gained through access to the stocking records of the Wisconsin Conservation Department.

The taxonomy used by the earlier workers has been revised according to Bailey *et al.* (1960). The various species are all within the range of distribution indicated for them by Trautman (1957).

List of Fishes

Scientific Name (Family, Genus and Species)	Common Name	Authority
Petromyzontidae—lampreys		
Lampetra lamottei (LeSueur)	American brook lamprey	4
Acipenseridae—sturgeons		
Acipenser fulvescens Rafinesque	Lake sturgeon	6, 23
Lepisosteidae—gars		
Lepisosteus osseus (Linnaeus)	Longnose gar	1, 2, 3, 10
Lepisosteus platostomus Rafinesque	Shortnose gar	2, 8
Amiidae—bowfins		
Amia calva Linnaeus	Bowfin	1, 2, 3
Salmonidae—trouts, whitefishes, and graylings		
Coregonus artedii LeSueur	Cisco or lake herring	2, 9, 10, 26
Salmo gairdneri Richardson	Rainbow trout	27
Salmo trutta Linnaeus	Brown trout	7, 28
Salvelinus fontinalis (Mitchill)	Brook trout	29
Umbridae—mudminnows		
Umbra limi (Kirtland)	Central mudminnow	1, 2
Esocidae—pikes		
Esox americanus vermiculatus LeSueur	Grass pickerel	39
Esox lucius Linnaeus	Northern pike	1, 2, 3, 10, 24
Esox masquinongy Mitchill	Muskellunge	11, 25
Cyprinidae—minnows and carps		
Carassius auratus (Linnaeus)	Goldfish	13
Cyprinus carpio Linnaeus	Carp	1, 2, 3, 30
Notemigonus crysoleucas (Mitchill)	Golden shiner	1, 2, 3, 41
Notropis anogenus Forbes	Pugnose shiner	2
Notropis atherinoides Rafinesque	Emerald shiner	2
Notropis blennius (Girard)	River shiner	2
Notropis cornutus (Mitchill)	Common shiner	2
Notropis heterodon (Cope)	Blackchin shiner	1, 2, 42
Notropis heterolepis Eigenmann and Eigenmann	Blacknose shiner	2, 43
Notropis hudsonius (Clinton)	Spottail shiner	3, 12, 44
Notropis spilopterus (Cope)	Spotfin shiner	5
Notropis umbratilis (Girard)	Redfin shiner	14
Pimephales notatus (Rafinesque)	Bluntnose minnow	1, 2
Pimephales promelas Rafinesque	Fathead minnow	1, 2
Semotilus atromaculatus (Mitchill)	Creek chub	5
Catostomidae—suckers		
Catostomus commersoni (Lacépède)	White sucker	1, 2, 3
Ictiobus cyprinellus (Valenciennes)	Bigmouth buffalo	3, 45
Moxostoma macrolepidotum (LeSueur) =*M. aureolum* (LeSueur)	Northern redhorse	5, 47
Ictaluridae—freshwater catfishes		
Ictalurus melas (Rafinesque)	Black bullhead	1, 2, 3, 31
Ictalurus natalis (LeSueur)	Yellow bullhead	2, 3, 31
Ictalurus nebulosus (LeSueur)	Brown bullhead	1, 2, 3, 10, 31
Ictalurus punctatus (Rafinesque)	Channel catfish	3, 15
Noturus gyrinus (Mitchill) =*Schilbeodes mollis* (Herman) or *S. gyrinus*	Tadpole madtom	1, 2, 50
Anguillidea—freshwater eels		
Anguilla rostrata (LeSueur) =*A. bostoniensis*)	American eel	16
Cyprinodontidae—killifishes		
Fundulus diaphanus (LeSueur)	Banded killifish	1, 2
Fundulus notatus (Rafinesque)	Blackstripe topminnow	2
Gadidae—codfishes and hakes		
Lota lota (Linnaeus)	Burbot	2, 17, 49
Gasterosteidae—sticklebacks		
Eucalia inconstans (Kirtland)	Brook stickleback	1, 2
Serranidae—sea basses		
Roccus chrysops (Rafinesque)	White bass	2, 3, 10, 32
Roccus mississippiensis (Jordan and Eigenmann)	Yellow bass	3

Scientific Name (Family, Genus and Species)	Common Name	Authority
Centrarchidae—sunfishes		
Ambloplites rupestris (Rafinesque)	Rock bass	1, 2, 3
Chaenobryttus gulosus (Cuvier)	Warmouth	21
Lepomis cyanellus Rafinesque	Green sunfish	3
Lepomis gibbosus (Linnaeus)	Pumpkinseed	1, 2, 3
Lepomis macrochirus Rafinesque	Bluegill	1, 2, 3, 33
Micropterus dolomieui Lacépède	Smallmouth bass	1, 2, 3, 10, 34
Micropterus salmoides (Lacépède)	Largemouth bass	1, 2, 3, 35
Pomoxis annularis Rafinesque	White crappie	3, 10, 36
Pomoxis nigromaculatus (LeSueur)	Black crappie	1, 2, 3, 10, 36
Percidae—perches		
Etheostoma exile (Girard)	Iowa darter	1, 2
Etheostoma flabellare Rafinesque	Fantail darter	1, 2
Etheostoma nigrum Rafinesque	Johnny darter	1, 2
Perca flavescens (Mitchill)	Yellow perch	1, 2, 3, 10, 37
Percina caprodes (Rafinesque)	Logperch	2, 18
Stizostedion vitreum vitreum (Mitchill)	Walleye	3, 38
Sciaenidae—drums		
Aplodinotus grunniens Rafinesque	Freshwater drum	3, 10
Cottidae—sculpins		
Cottus bairdi Girard	Mottled sculpin	1, 2
Atherinidae—silversides		
Labidesthes sicculus (Cope)	Brook silverside	1, 2

AUTHORITY

1. Pearse (1918).
2. Greene (1935).
3. Horrall (1961).
4. Davis (1955) considered the American brook lamprey, *Lampetra lamottei*, as unconfirmed but probable, based on reasonably reliable reports of fishermen.
5. Davis (1955) confirmed as present the spotfin shiner, *Notropis spilopterus*, the northern redhorse, *Moxostoma macrolepidotum*, and the creek chub, *Semotilus atromaculatus*, through discussion with members of the Laboratory, although they have not been mentioned in the literature.
6. A lake sturgeon, *Acipenser fulvescens*, was captured, tagged (UW #825) and released by H. F. Henderson from a fyke-net located off Governor's Island on 22 May 1963. (Length 156.6 cm or 61¾ inches, age of 29–31 years).
7. Brown trout, *Salmo trutta*, caputred in a fyke-net at Maple Bluff by H. F. Henderson on 28 May 1963. (Length 51.7 cm).
8. Shortnose gar, *Lepisosteus platostomus*, examined and verified by Prof. John C. Neess from a sample taken from carp-holding pens in the Catfish Bay–Yahara River area. Lake Mendota is close to the northern limit of the shortnose gar according to Trautman (1957).
9. John (1954).
10. Tibbles (1956).
11. Muskellunge, *Esox masquinongy*, caught and taken to a local butcher shop; identified there by Prof. Neess (personal diary, 1946).
12. Published accounts: Black (1945), McNaught and Hasler (1961), Horrall (1961).
13. Goldfish, *Carassius auratus*, stocked in 1855 by Gov. Farwell; captured in a gill-net by R. M. Horrall about 1960.
14. Redfin shiner, *Notropis umbratilis*, introduced into one of the University of Wisconsin Arboretum Ponds in 1954 (Hunter and Wisby 1961). Now established, with access to the Madison lakes via Murphy Creek.
15. Channel catfish, *Ictalurus punctatus*, captured in Mendota in 1862 (Neuenschwander 1946).
16. American eel, *Anguilla rostrata*, captured in Lake Monona in 1880 (Neuenschwander, 1946); Greene (1935) noted presence in the Mississippi River, Crawford Co., Wis.
17. Burbot, *Lota lota*, examined from Lake Mendota, as indicated by map on pg. 217, by Greene (1935); this was possibly the specimen collected by Wagner (Footnote #49).
18. Log perch, *Percina caprodes*, observed in what was possibly a spawning aggregation of approximately 500 individuals below the Sherman Ave. Bridge at the Yahara River outlet to Lake Mendota, during the first week of May 1963, by C. W. Voigtlander.
19. Bluntnose minnow, *Pimephales notatus*, collected along the shore at Maple Bluff with cast-net by G. Hergenrader, 22 May 1963.
20. The banded killifish, *Fundulus diaphanus*, is especially abundant in the area of Spring Harbor.
21. The warmouth, *Chaenobryttus gulosus*, is infrequently taken by fishermen (Warden A. Koppenhaver, May 1963).
22. Black (1945) noticed that many perch taken during winter ice-fishing regurgitated one or more emerald shiners, *Notropis atherinoides*, although suggesting that the species was not usually considered common in Mendota.

These additional notes (23–38) have been compiled from stocking records on file with the Wisconsin Conservation Department (*indicates stage of development uncertain, flg. = fingerling, ad. = adult).

23. Lake sturgeon, *Acipenser fulvescens*, 20 individuals from the Wolf River were stocked in Lake Mendota during Sept.–Oct., 1934; an additional 51 adults were planted in 1936.

24. Northern pike, *Esox lucius,*

1922	340,000 fry*		
1929			300* (from Mississippi)
1935		3,750 fgl.*	
1936		2,500 fgl.*	
1937–39		19,250 fgl.	
1940–44	65,000 fry	5,942 fgl.	
1948–49	30,000 fry		35 ylg.
1958			32 ad.
1961			334 ad.*
1962			36 ad.*

25. Muskellunge, *Esox masquinongy,*

1933		80 fgl.
1935	40,000 fry	
1936	52,250 fry	
1937	181,750 fry	
1938	62,500 fry	95 fgl.
1939	60,000 fry	50 fgl.
1940	60,000 fry	
1941		300 fgl.

26. Cisco, *Coregonus artedii,*

1852–55	(Stocked by Gov. Farwell)
1880	75,000 fry
1886	180,000 fry
1946	6,282,086 fry*

27. Rainbow trout, *Salmo gairdneri,* first stocked in Door Creek tributary to Monona in 1889, and in Token Creek tributary to Mendota in 1908.

28. Brown trout, *Salmo trutta,* stocked in Token Creek beginning in 1927 and later in the Pheasant Branch.

29. Brook trout, *Salvelinus fontinalis,* stocked in Six Mile and Token Creeks beginning in 1877 and frequently thereafter.

30. Carp, *Cyprinus carpio,* first supplied to individuals in the Madison area in 1887 and continued until at least 1893.

31. Bullheads (species not indicated),

1939		25,000 ylg.	
1942	25,000 fgl.		500 ad.
1943		1,800 ylg.	200 ad.

32. White bass, *Roccus chrysops,*

1891	2,000,000 fry* (Lake Monona)		
1940		15,000 fgl.	
1943			12,500 fgl.

33. Bluegill, *Lepomis macrochirus,*

1937	10,000 fgl.	3,000 ylg.	
1941–44	18,500 fgl.	12,000 ylg.	1,200 ad.

34. Smallmouth bass, *Micropterus dolomieui,*

1940–48	100,000 fgl.

35. Largemouth bass, *Micropterus salmoides,*

1906–09	65,100 fgl.* } Likely largemouth, but shown only as black bass.		
1910–19	68,500 fgl.* }		
1920–29	none		
1930–34	28,102 fgl.*		
1937–39	27,207 fgl.	500 ylg.	192 ad.
1940–49	107,692 fgl.	725 ylg.	20 ad.
1950–58	10,052 fgl.		

36. Crappie (species not indicated),

1937	5,000 fgl.	
1941		150 ad.

37. Yellow perch, *Perca flavescens,*

1936	352,000 fgl.*
1940	15,000 fgl.
1943	12,904,400 eggs

38. Walleye, *Stizostedion vitreum vitreum,*

1883–89	10,850,000	(Mendota, Madison Lakes and Six Mile Cr.)
1890–99	3,400,000 fry*	
1900–09	16,310,000 fry*	
1910–19	26,445,000 fry*	
1920–29	8,025,000 fry*	
1935–36	5,476,000 fry*	
1937–39	10,938,000 fry*	
1940–49	27,375,000 fry	42,045 fgl.
1958		1,500 fgl.

The following notes (39–50) have been compiled from records in the fish collection in the Museum of the Department of Zoology, The University of Wisconsin.

39. Grass pickerel, *Esox americanus vermiculatus,*

Lake Mendota	K. Ackley	Dec. 1961	#15628

40. Quillback, *Carpiodes cyprinus,*

L. Kegonsa	J. D. Black	2 May 1944	#382

41. Golden shiner, *Notemigonus crysoleucas,*

L. Mendota	A. S. Pearse	13 April 1915	#364

42. Blackchin shiner, *Notropis heterodon*,			
L. Mendota	G. Wagner	4 Sept. 1905	#1214
L. Mendota	G. Wagner	3 Aug. 1914	#373
L. Mendota	G. Wagner	1 Sept. 1914	#1216
L. Mendota	A. S. Pearse	13 April 1915	#1198
43. Blacknose shiner, *Notropis heterolepis*,			
L. Mendota	G. Wagner	4 Sept. 1905	#1007
L. Mendota	G. Wagner	3 Aug. 1914	#359, 369
L. Mendota	A. S. Pearse	13 April 1915	#372
44. Spottail shiner, *Notropis hudsonius*,			
L. Mendota	Black & Marshall	3 April 1944	#13
L. Mendota	Marshall	28 Jan. 1945	#165
45. Bigmouth buffalo, *Ictiobus cyprinellus*,			
L. Monona	J. D. Black	16 Oct. 1944	#389
46. Spotted sucker, *Minytrema melanops*,			
L. Wingra	J. D. Black	26 Oct. 1944	
47. Northern redhorse, *Moxostoma macrolepidotum*,			
L. Waubesa	J. D. Black	12 May 1945	
L. Wingra	J. D. Black	17 June 1945	
L. Kegonsa	J. D. Black	18 June 1945	
48. Golden redhorse, *Moxostoma erythrurum*,			
L. Waubesa	J. D. Black	12 May 1945	#814
49. Burbot, *Lota lota*,			
L. Mendota	G. Wagner	no date	#118
50. Tadpole madtom, *Noturus gyrinus*,			
L. Mendota	G. Wagner	6 Aug. 1914	#907

Acknowledgment

Acknowledgment is made to Prof. Arthur D. Hasler, Director of the Laboratory of Limnology. His support of this project, comments concerning the fishes of the Madison area, and his critical reading of this manuscript are especially appreciated. Mr. H. E. Neuenschwander, a former student of Prof. Hasler, spent many hours searching through newspaper files in order to document the history of the cisco and other fishes in Lake Mendota.

Permission for the use of the original drawings by Mr. Douglas Tibbitts is gratefully acknowledged. The originals, made directly from specimens taken from Mendota, are on permanent display at the Laboratory of Limnology. These drawings were made possible by a grant from the Research Committee of the Graduate School.

The stocking records of the Wisconsin Conservation Department for 1877 through 1937 are located at the Nevin Fish Hatchery, and were made available through the cooperation of Mr. Thomas Wirth. Those for the period 1937 to the present are located at the Pennsylvania Avenue office of the Department and were examined with the permission of Mr. Harold H. Kernan.

Mr. C. J. Telford of Madison, through many years of fishing the cisco on Lake Mendota, has accumulated a valuable reservoir of knowledge on this species. His long-term records document the decline of the cisco better than a short-term scientific study could possibly do.

This work was supported by a research grant from the Wisconsin Conservation Department as well as through funds of the Wisconsin Alumni Research Foundation administered by the Research Committee of the Graduate School.

FIGURE 1. Northern Pike, *Esox lucius* Linnaeus. From an original drawing by Douglas Tibbitts.

FIGURE 2. Golden shiner, *Notemigonus crysoleucas* (Mitchill). From an original drawing by Douglas Tibbits.

FIGURE 3. Common Shiner, *Notropis cornutus* (Mitchill). From an original drawing by Douglas Tibbitts.

FIGURE 4. Spottail shiner, *Notropis hudsonius* (Clinton). From an original drawing by Douglas Tibbitts.

FIGURE 5. Bluntnose minnow, *Pimephales notatus* (Rafinesque). From an original drawing by Douglas Tibbitts.

FIGURE 6. Brown bullhead, *Ictalurus nebulosus* (LeSueur). From an original drawing by Douglas Tibbitts.

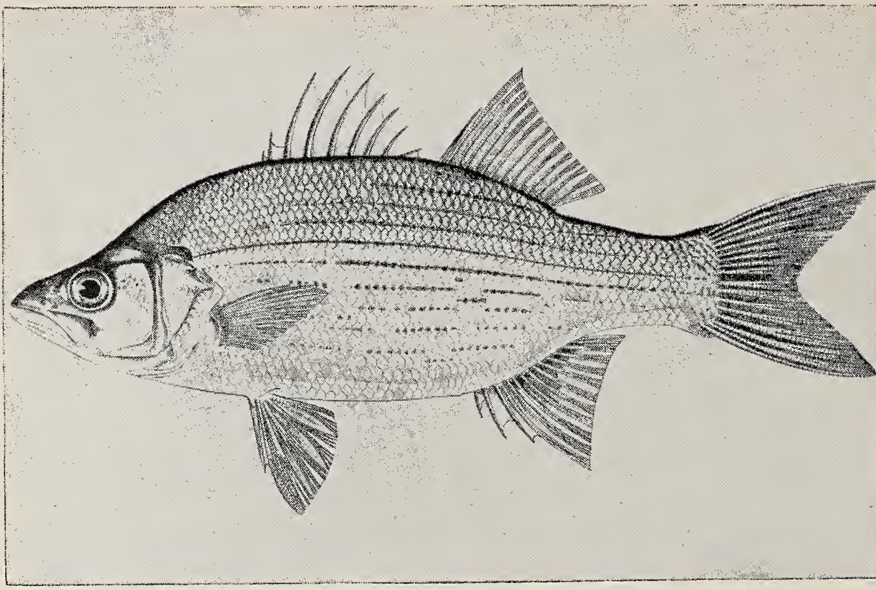

FIGURE 7. White bass, *Roccus chrysops* (Rafinesque). From an original drawing by Douglas Tibbitts.

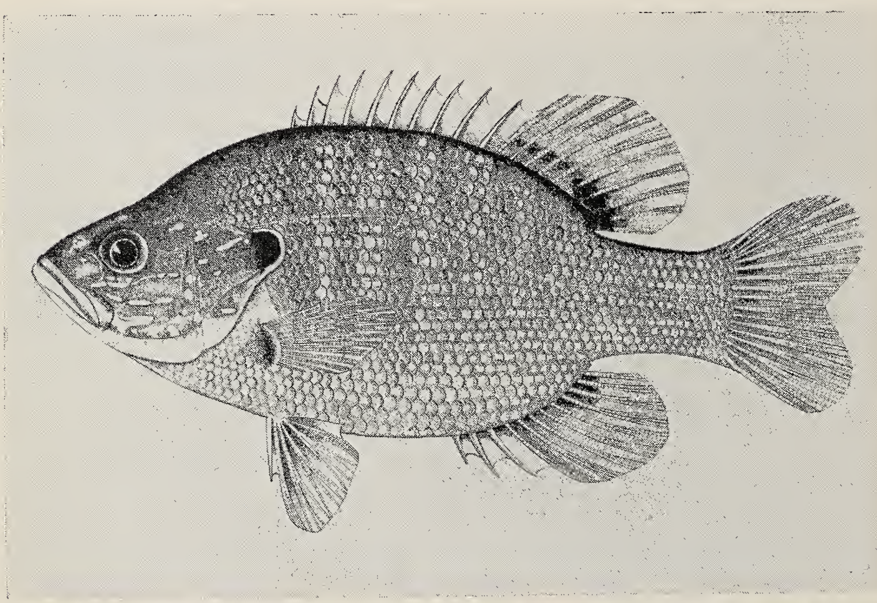

FIGURE 8. Green sunfish, *Lepomis cyanellus* Rafinesque. From an original drawing by Douglas Tibbitts.

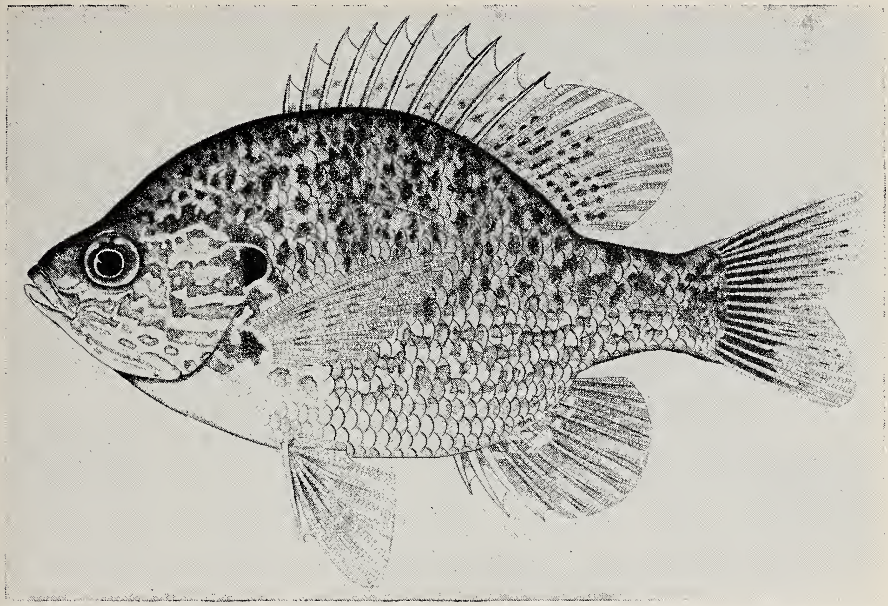

FIGURE 9. Pumpkinseed, *Lepomis gibbosus* (Linnaeus). From an original drawing by Douglas Tibbitts.

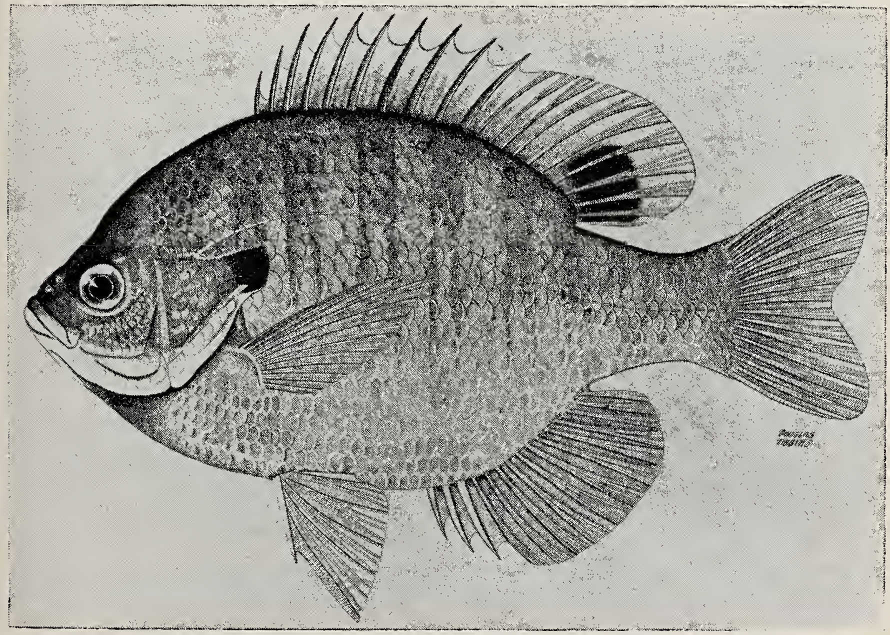

FIGURE 10. Bluegill, *Lepomis macrochirus* Rafinesque. From an original drawing by Douglas Tibbitts.

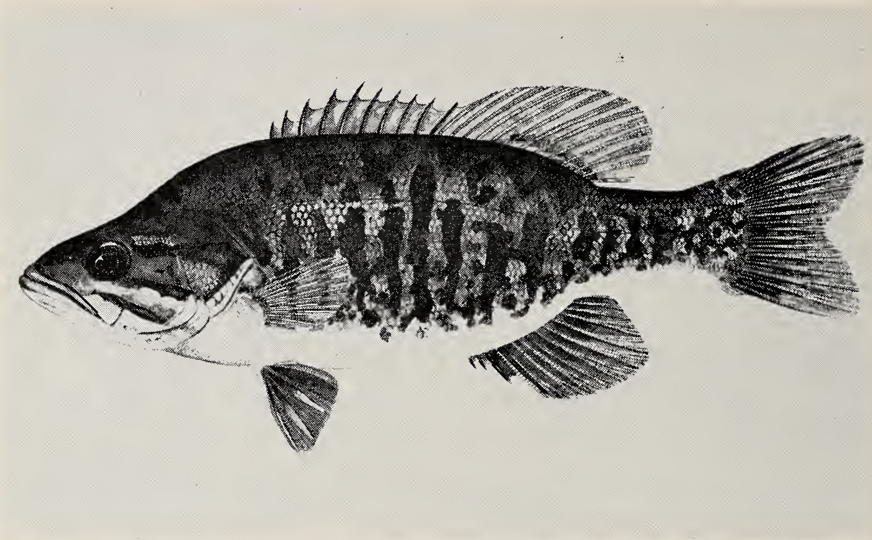

FIGURE 11. Smallmouth bass, *Micropterus dolomieui* Lacépède. From an original drawing by Douglas Tibbitts.

FIGURE 12. Largemouth bass, *Micropterus salmoides* (Lacépède). From an original drawing by Douglas Tibbitts.

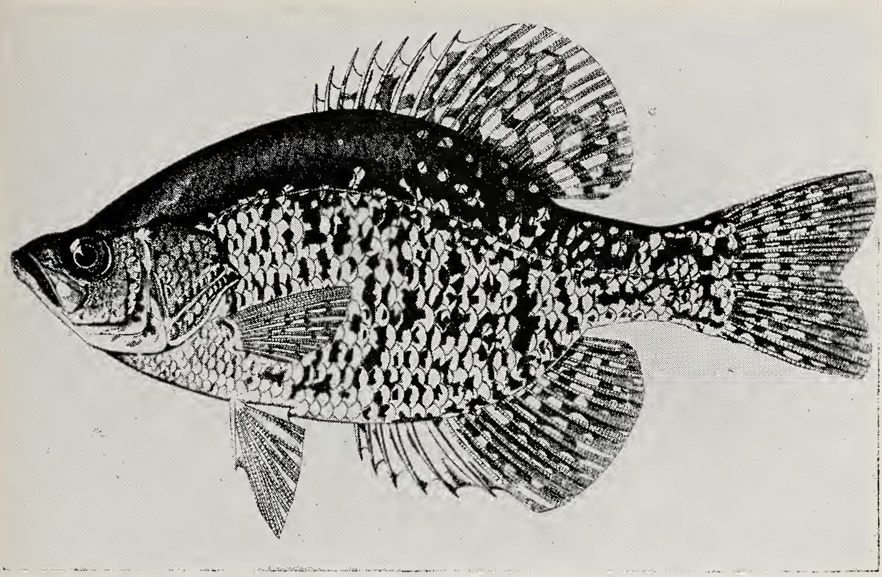

FIGURE 13. Black crappie, *Pomoxis nigromaculatus* (LeSueur). From an original drawing by Douglas Tibbitts.

FIGURE 14. Yellow perch, *Perca flavescens* (Mitchill). From an original drawing by Douglas Tibbitts.

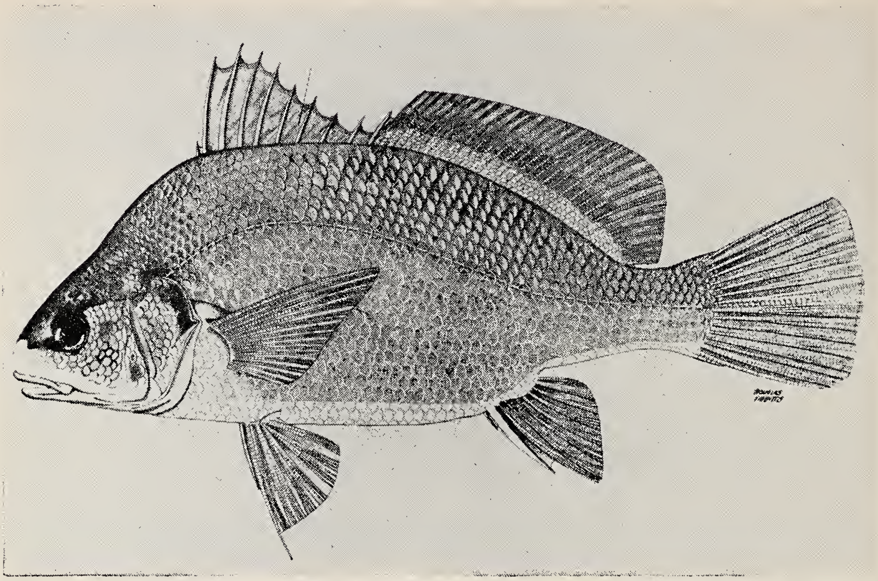

FIGURE 15. Freshwater drum, *Aplodinotus grunniens* Rafinesque. From an original drawing by Douglas Tibbitts.

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THE GEOGRAPHY OF WISCONSIN'S TROUT STREAMS

C. W. Threinen and Ronald Poff

Trout of the brook, brown and rainbow species are a highly valued and relatively scarce fish resource largely restricted to cold-water streams. The location of those cold-water streams capable of supporting trout, therefore, becomes a matter of interest for management of the fish and habitat protection purposes, because of the tenuous character of these limited habitat conditions. In order to show locations, all known trout streams are noted on a hydrographic map of the state. The circumstances leading to their origin are then interpreted.

Certain environmental requirements which become limited to trout formed the basis for this interpretation. Cool water in summer is the primary requirement. Trout of all three species (brook, brown, and rainbow) have thermal tolerances which can be exceeded by summer temperatures. This temperature is generally recognized to be 77.5° F. for brook trout under prolonged exposure (Brett, 1956) and somewhat higher for the other species (Needham, 1938). Brett (1956) noted the optimum temperature for growth and feeding for brook trout was 19° C (66.2° F).

Since brook and brown trout spawn during fall and rainbow trout spawn during fall or spring, water conditions have to be suitable for spawning and development of eggs and young. Trout usually spawn in October and November at which time the females seek out water of suitable temperatures and conditions, dig redds in gravel riffles and, following fertilization, bury their eggs. As a reflection of these conditions, concentrations of spawning trout (especially brook trout) occur near springs. The eggs are dependent upon steady percolation of water through the gravel for aeration, and development of the egg proceeds most rapidly and successfully with steady and moderate water temperatures. Mortalities of eggs are known to be high where the water temperatures are low (near freezing).[1] Ground water springs are, therefore, essential to produce these conditions.

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[1] Unpublished research of the Wisconsin Conservation Department.

FIGURE 1. State hydographic map with trout streams darkened.

Another possible limiting factor cited by other workers in the mountain states is the formation of anchor ice (Maciolek and Needham, 1952). Under very cold conditions in the northern part of the state, anchor ice can form over the rocks and riffles and result in the movement or displacement of the stony bottom materials and destruction of redds and food resources. Obviously warm waters would not allow the formation of anchor ice. A usual characteristic of good trout waters is that they are seldom covered by ice because of the warmer temperatures of the ground water springs feeding trout streams with temperatures between 48° and

50° F. These are streams fed by significant amounts of ground water. Benson (1953) called streams free of ice on cold days "good" trout streams and those ice covered "poor".

Climate Conditions and the Hydrological Cycle

Rain falling on the ground either soaks in to become part of the ground water, becomes absorbed by the surface soils or runs off on the surface. If it percolates into the ground to become part of the ground water, it will flow downhill later to reach surface drainage. The capability for percolation into the ground and movement underground will obviously be best when soils are light and where sufficient hydraulic gradient prevails, and it will be poorest with heavy soils and poor gradient. With trout streams heavily dependent upon cool water, the ground water flow, circumstances providing slope and surface infiltration will be the conditions most productive of trout streams. All streams are dependent upon ground water for their base flow but to have importance for trout during critical periods, a high portion of the base flow must be recently expressed ground water which has not yet warmed or cooled to surrounding temperatures.

Water absorbed by surface soils is of no immediate value to trout streams. It either evaporates or is transpired by plants. The heavy soils will hold more water and infiltrate less than light soils and therefore make a lesser contribution to ground water and make more available to evaporation and transpiration. Similarly surface runoff is of limited value to trout streams because it closely reflects surrounding temperatures, and it lacks permanence because of the intermittency of rainfall.

Wisconsin has a northern climate typical of the continental land mass. It is characterized by hot summers (July average, 66°–72° F) and cold winters (January average, 10°–22 F). Daytime summer temperatures are hot enough to warm surface waters above the maximum tolerated by trout. Winter temperatures are sufficiently cold to freeze surface waters and to cause moisture storage in the form of snow from December through March. Although there are intermittent thaws which make contributions to the surface water, this weather cycle causes some of the lowest runoff of the year to occur in the winter. Streams or portions of streams without strong ground water sources, therefore, tend to fluctuate in both volume and temperatures more than those with and, therefore, provide a less stable habitat for fish. Another low period in stream discharge usually occurs in the summer when vegetation is actively transpiring water and evaporation rates are high. Drescher (1956) described rapid rises in ground water levels in the spring, and discharge exceeding recharge during the growing season.

Rainfall averages about 30 inches a year in Wisconsin divided as follows: 17.2 per cent falls in the winter months of December, January, February, and March; 22.5 per cent falls during the nongrowing season of April, October and November; and 60.3 per

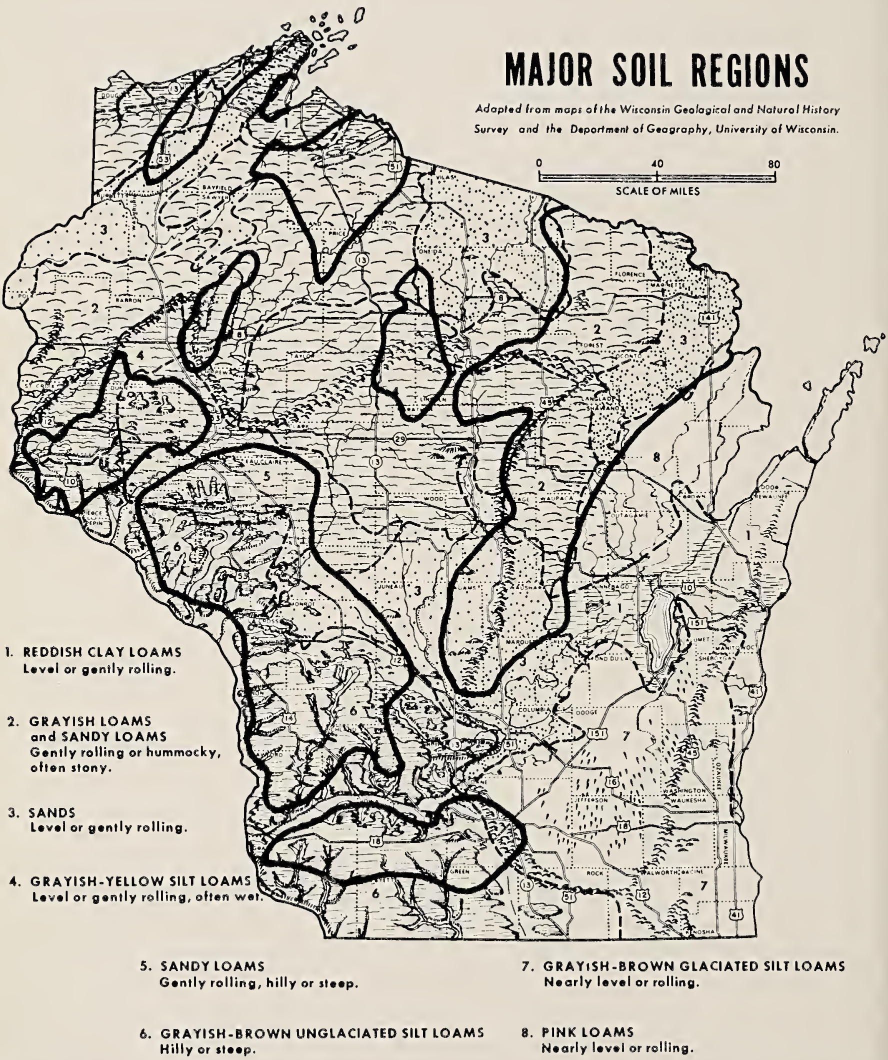

FIGURE 2. Trout stream complexes superimposed on a soils and topographic map of Wisconsin.

cent falls during the growing season (USDA, 1941). The humid climate of Wisconsin has ground water within 100 feet of the surface except beneath high, steep-sided hills (Drescher, 1956).

Wojta's (1949) summary reported 6 per cent runoff on the surface, 15 per cent went to subsurface runnoff, 70 per cent went to evaporation and transpiration and 9 per cent went to ground water. It must be recognized, however, that great variation can occur. Ground water levels closely correspond to precipitation, so changes in spring flow can be expected to result from changes in precipitation (Drescher, 1956). The term "spring" as used in this report is defined as surface expression of ground water.

Distribution and Character of Trout Streams

Designation of streams as "trout streams" is the product of many years of surveys and creel observations gathered by the field personnel of the Wisconsin Conservation Department. This designation means that a stream has shown consistent ability to support trout without excessive natural mortalities. It is recognized that stream habitat conditions change and could affect this designation. This is particularly true where impoundments have been constructed. Such structures frequently change a cold-water environment to a warm-water environment.

Although there are individual and partial losses of trout water which have been reported, these have not been great enough to alter seriously the general geography of Wisconsin's trout streams. In our opinion, most of the alterations have occurred within the present complexes of trout streams. Perhaps the greatest change has occurred in the cranberry and duck mash areas of central Wisconsin in the bed of glacial Lake Wisconsin.

We have several complexes of trout streams plus some scattered streams. The largest and most important complex occupies an arc beginning in Adams and Marquette Counties and extending north and northeast into Florence and Marinette Counties. Within this belt are some of the best-known trout streams in the state and almost without exception there is substantial natural reproduction of trout in them. The complex second in size and trout concentration lies in the northern tier of counties most of whose drainage flows into Lake Superior. This includes some of the more spectacular streams with high gradients such as the Brule. The third major complex occupies the unglaciated southwestern part of the state. There are minor complexes centered in Lincoln County and portions of adjoining counties, and in Rusk, Barron, Dunn, Pierce, and St. Croix Counties.

Regions conspicuously lacking trout streams or lightly represented are the lake regions of the north, the heavy soil regions of Marathon, Taylor, Clark and Wood Counties, much of the bed of old glacial Lake Wisconsin, and most of southeastern Wisconsin. Further inspection of the hydrography will show that the trout streams are not unique to particular drainages, but that they do have regional distribution. The largest complex has streams flowing into both the Lake Michigan drainage and the Wisconsin River.

The gradient characteristics of trout streams vary greatly. They include everything from white water to spring ponds, and from ditches and tiny feeders to rivers. Some examples of the extremes follow: The Little Brule in Florence County has much white water; the Nine Mile in Langlade County is a slow, meandered stream flowing through a swamp; Trout Springs is a spring pond in Vilas County; Ten Mile Creek is a ditch through a former marsh in Portage County; the Wolf River in Langlade County is a substantial river at least 50 feet in width. In many cases only a part of the stream will be trout water, with summer water too warm both above and below, an example of which is Rocky Run Creek, Columbia County. Most have this in common: They are generally the headwaters of river systems, and the big river trout stream is the exception rather than the rule.

Relationship to Topography

The major complexes of trout streams have been superimposed on a combination soils and relief map adapted from Whiteson, (1927) and Martin (1932) (Fig. 2). In the absence of an elaborate topographic map with contours, the topography of the state is evident in the hydrographic map (Fig. 1) by noting the drainage divides. State elevations begin at 1,650 feet in the northern highlands and drop to 595 feet in the Mississippi, 581 feet in Lake Michigan and 602 feet in Lake Superior. Wisconsin is fundamentally a sculptured plain which slopes gradually from the northern highlands to the south, east, and west and more abruptly to the north. Major water courses originate in the highlands and flow in these directions. The hills of the terminal moraines generally are some of the highest features on the landscape, and they often form the drainage divides. In the southwest, erosion has cut through the level plain of the upland with elevations of 1000-1200 feet to form deep valleys or coulees leading to the major water courses with elevations approximately 600–700 feet.

Almost all the trout stream complexes are associated with some hilly topography but not all hilly topography has trout streams.

FIGURE 3. Trout stream complexes superimposed on a glacial deposit map of Wisconsin.

The largest complex has as its center the terminal moraines of the Green Bay lobe of the last Wisconsin glacial period and streams flow in both directions. Although many of the trout streams are associated with hilly moraine areas, this feature is not always productive of trout streams as will be noted by the scarcity of trout streams in the extensive Kettle Moraine hills. Surface topography is important in this regard: The ground water moves from recharge areas, which are usually divides and hills, toward discharge points of lower elevation, and springs occur where the ground water table coincides with the surface. Thus, the hills provide hydraulic gradient toward points of discharge. Also, where the stream cutting exposes an aquifer endowed with water, or the ground water itself, a spring can originate. Surface cutting and erosion has not been great in the younger surface of the glaciated regions, but it has been extremely important in the unglaciated portion of southwestern Wisconsin. Sharply cut and deeply eroded valleys which have carved the plateau are characteristic of this region.

Another factor can be the stream gradient. A sluggish stream does not have the water exchange of a stream with large gradient, and thus is less likely to retain the cool summer and warm winter temperatures required of a trout stream. As noted, however, some trout streams are sluggish. The typical drainage sytem in the unglaciated portions of Wisconsin has small feeder streams of high gradient and a sluggish main stream of lower gradient.

Aside from the unglaciated region, we note that the hilly topography of the Lake Superior drainage and the Barron Hills has a high incidence of trout streams, but the hilly western portion of Marathon County, eastern Clark County and southern Taylor County has relatively few trout streams. It is a well-known fact that streams in this region have seasonal flows comprised mainly of surface runoff. There are relatively few springs feeding these streams and they may become intermittent. Although having sufficient gradient, ground water storage is limited because of the thin ground water reservoir.

Evidently sharp topography is not always necessary for the presence of trout streams. There is a group of them that flows through part of the extremely flat bed of old glacial Lake Wisconsin and in the sand and gravel deposits in the central sand plain in Adams and western Portage Counties. One group consists of the drainage ditches that drained the old Buena Vista Marsh, a very flat piece of landscape. These streams owe their existence to exceptionally favorable ground water conditions. On the other hand the bed of old glacial Lake Oshkosh has not a single trout stream in it. This area is generally the lower part of the major drainages and is impregnated with numerous shallow lakes and marshes. Few springs occur in this region.

Glacial Geology

The glaciers had a profound influence on all the Wisconsin landscape except parts of the driftless area. For an evaluation of the contribution of glacial geology, the trout stream complexes have been superimposed on the glacial map of Thwaites (1956) (Fig. 3).

Basically the repeated glaciers filled the valleys with sediments, leveling the landscape, giving much of Wisconsin a gently rolling character alternately consisting of low hills and lowlands of the ground moraine with its poor drainage, produced outwash plains of sandy soils, some pitted, some not and gave rise to steep hilly topography in the terminal moraines. Pitted outwash plains of the glaciers gave rise to most of the lake regions (Thwaites, 1959). Unpitted outwash consists of the well-drained sandy till which has such excellent water-bearing and transmission qualities. Such streams as the Chippewa, Black, Wisconsin, and Mississippi Rivers were major drainages to the south, which carried the load of melt water.

The gently rolling hills and lowland of southeastern Wisconsin, with drainage to the south, has few trout streams except on its western edges. The western-most streams have cut through the higher elevation of the plateau of the driftless area and terminal moraine to join the lower main stream. The streams of southeastern Wisconsin aside from these are geologically young with less elevation and have not eroded down into deep valleys as compared with those of southwestern Wisconsin. Almost nowhere is bedrock exposed by their erosive action and the clay till of southeastern Wisconsin has poor waterbearing characteristics. Almost all the streams in southeastern Wisconsin have low gradients (except when they originate in the hills of a moraine) and low runoff (Table 1). Here and there among the gravel hills of the Kettle Moraine, there are large deposits of sand and gravel furnishing a good ground water reservoir. The local steep gradient of the ground water table produces springs of sufficient magnitude to permit the existence of a trout stream. Trout streams are, however, conspicuously absent all along the shore of Lake Michigan where there is usually quite a fall. Almost all the smaller streams up and down the Michigan shore are intermittent also because of the poor water-bearing qualities of the soil, although subterranean drainage is naturally toward the lake as is the surface drainage. Artesian conditions prevail along much of the shore because of impermeable rock and soil conditions along the shore.

TABLE 1. COMPARISON OF YEARLY RUNOFF OF 5 TROUT STREAMS AND 5 NONTROUT STREAMS[1]

Stream	Years of Record	Range in Runoff (In.)	Median Runoff (In.)
Trout Streams			
Wolf River (Keshena)	40	9.00–17.14	12.76–12.80
Embarrass River (Embarrass)	31	5.11–16.46	10.03
Brule River (Brule)	7	15.97–23.00	18.04
Pike River (Amberg)	35	7.59–19.25	12.36
Prairie River (Merrill)	27	8.90–22.89	15.74
Nontrout Streams[2]			
West Branch Fond du Lac River (Fond du Lac)	10	1.74– 8.43	3.53– 3.54
Cedar Creek (Cedarburg)	19	2.12–13.08	6.55
Duncan Creek (Bloomer)	6	5.07–10.91	8.12– 8.18
Crawfish River (Milford)	18	2.10–11.62	6.02– 6.24
Turtle Creek (Clinton)	10	6.44– 8.49	7.14– 7.52

[1]Source: USGS water supply papers 1307 and 1308.
[2]Only streams not having any trout streams as tributaries were utilized.

The flat bed of old glacial Lake Oshkosh in the Green Bay lobe has no trout streams in it. It is significant that much of this basin is covered with reddish clay loam, a soil not well adapted to water infiltration or lateral movement. Marshes and shallow lakes are characteristic of this region and in many places artesian water conditions prevail.

Moraines appear to have a high incidence of trout streams, especially the moraine that marks the edge of the Green Bay lobe of the glacier. A high incidence also occurs in the moraine of glacial Lake Duluth. This is, however, not always the picture. Trout streams are relatively scarce in most of the Kettle Moraine and scarce in the moraine stretching across Taylor County. As a whole trout streams are notably scarce in the unsorted glacial till but well represented in the alluvium, with some exceptions. These exceptions are the important lake districts such as the highlands of Vilas and Oneida Counties; the northwest lake district of Polk, Burnett, Washburn, Sawyer and southern Bayfield and Douglas Counties; and the small, concentrated lake district occupying northern Chippewa County and southern Rusk County. The lakes act as impoundments and cause the water to become too warm for trout in the summer time. Only a few short streams occur in this region. Elsewhere lakes are not so concentrated that they influence the location of trout streams.

The coarse, well-sorted sandy alluvium such as found in central and northwestern Wisconsin makes an excellent infiltration bed for

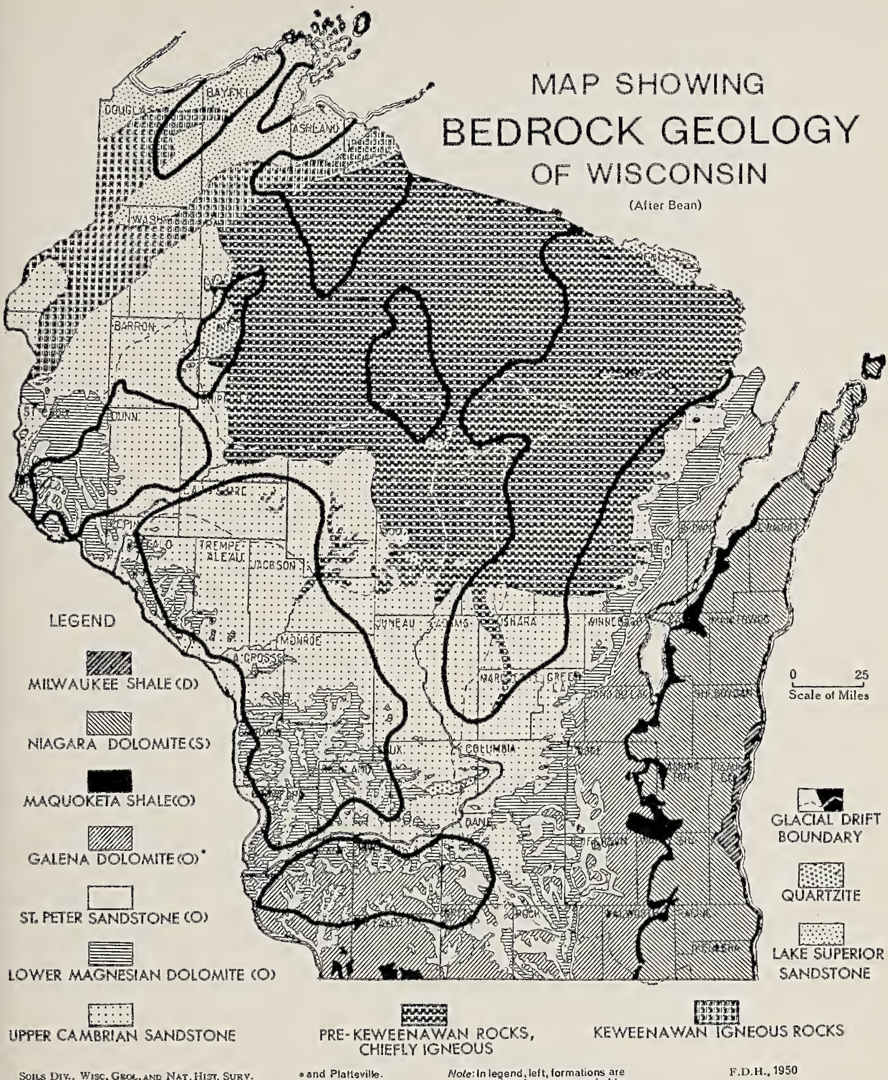

FIGURE 4. Trout stream complexes superimposed on a map of bedrock geology.

the recharge of ground water, the source of springs. Comparatively less water will be held by the sands in these surface layers and remain available for evapotranspiration. The unsorted till, on the other hand, contains the poorly sorted soil mixtures and pockets strong on the silts and clays which inhibit free percolation and lateral movement of ground water and yet hold a great deal of it.

The fractions of the soil particles of various sizes are reproduced from Weidman and Schultz (1915) to illustrate this point (Table 2).

Soil Types

The location of trout streams in relation to soil types is presented by imposing the trout stream complexes upon a soils map of the state. The conventional soils map of Whitson (1927) was adapted for this purpose (Fig. 2).

This map is indicative of the infiltration capabilities of the various soils. There is a good correlation between trout stream location and certain soil types, with some exceptions which of course are what would be expected from our review of the glacial geology. In most areas, the trout streams do not occur in the clay and glaciated clay loams and silt loams which include the red clay region of glacial Lake Oshkosh, the grayish-brown glaciated silt loams of the southeast, and the grayish-yellow silt loams of the north central region. Some local exceptions occur. Many of the streams flowing into Lake Superior pass through the red clay belt along the shore. Most, however, originate in the lighter sandy soils to the south.

Streams in the southwest originate from lands covered with soils originating from sandstones and dolomite. In recognition of the greater presence of springs in the southwest than the southeast, it must be concluded that unglaciated silt loam is capable of contributing to ground water through percolation and porous rock formations capable of taking it up. Thus, other conditions being favorable, it will give rise to springs and trout streams. Evidently, the gradient or topography and bedrock formations determine whether or not a soil region gives rise to springs. In the southwest there is a soil mantle of variable thickness which in many places is eroded right down to or into the bedrock. Erosion of the surface soils and rock has nowhere proceeded to this extent in the southeast.

Bedrock Geology

The circumstances which produce springs most commonly are: (1) a ground water table which reaches the surface or, in other words is exposed by the surface elevations, and (2) less permeable stratum that restricts the downward movement of water and allows it to move laterally to discharge as a spring. We have seen how this would readily occur in the southwestern part of the state with its eroded stream courses which cut deeply into the soil and rock mantle (Fig. 7). The question is, how does the bedrock geology affect spring development elsewhere? The trout stream complexes have been superimposed on the geologic map of the state (Bean, 1947) for an illustration (Fig. 4).

The greatest concentration of trout streams is located over the impervious Canadian Shield or near its edge with some notable gaps. One of these gaps occurs in the silt loams of north central Wisconsin—a heavy soil region where poor percolation, poor lateral subsurface movement and little storage would be expected. Of special interest is the fact that the line of streams coinciding with the Green Bay lateral moraine also lies right on the edge of the Canadian Shield. The topography overlying the Shield has its highest point in the northeastern highlands of Vilas County and slopes off toward the various water courses. It is the edge of this slope with a high gradient where subsurface water movement is readily intersected by the surface drainage. A cross-sectional diagram of this scheme adapted from Weidman and Schultz (1915) appears in Fig. 5.

The ground water level of the sandy soils of this region is maintained by the impervious rock substrate. The existence of this slope and movement of ground water can be illustrated by the Wolf River. Most of its feeders known to be trout water are on the west side. This does not, however, explain the southern extension of this group of streams, which occur in Waushara, Marquette and Adams Counties, all underlain by Upper Cambrian sandstone. In this general area there is still a hydraulic gradient arising from the moraine hills and adequately recharged through the sandy soils. It is perhaps significant that the Pre-Cambrian granite comes to the surface in some localities in Marquette County and may contribute to this slope.

Many streams flowing over trap rock or the Lake Superior sandstones have rich spring sources from overlying alluvium. A high

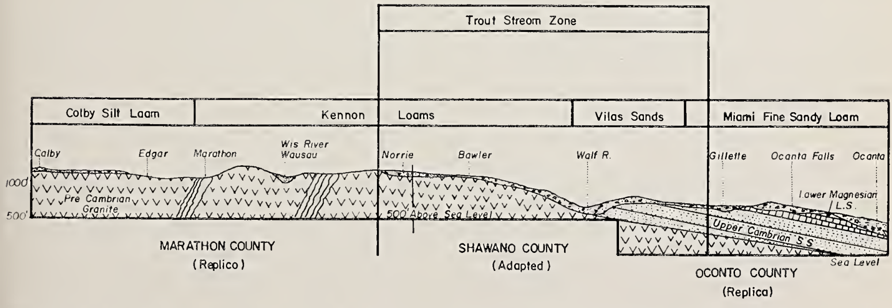

FIGURE 5. Geology, soils and trout stream distribution across an east-west section of Wisconsin at the latitude of Wausau. Adapted from Wiedman and Schultz (1915) and Whitson (1926).

ground water level is maintained by the impervious cemented sandstone of the trap rock, and the high elevation of this region gives the ground water ample hydraulic gradient to flow downhill through the sandy till to emerge as springs. Most of the springs supplying the Brule and other south shore streams have their origin above the lacustrine clay belt that marks the bottom of glacial Lake Duluth and their infiltration bed is the Brule sand barrens. Bean (1944) diagrammed this picture in detail.

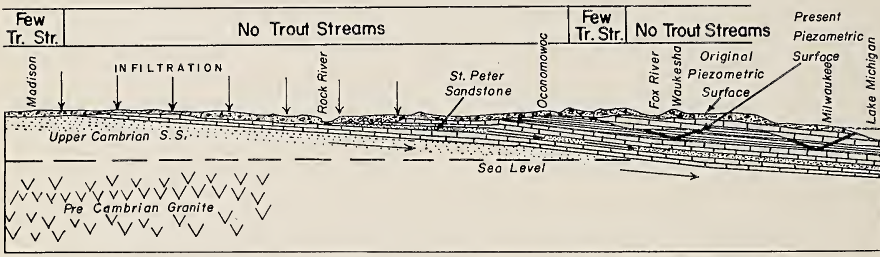

FIGURE 6. An east-west geologic section from Madison to Milwaukee with areas of trout stream occurrence noted. Recopied from Thomas (1952) who adapted work of Wiedman and Schultz (1918).

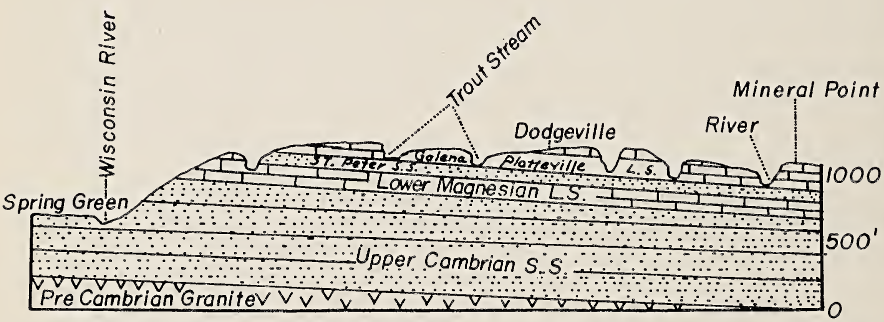

FIGURE 7. A north-south geological cross-section of the terrain that creates spring sources and trout streams in southwestern Wisconsin (Wiedman and Schultz, 1915).

The southeastern part of the state does not have many large springs nor much gradient to its streams. The deep layer of poorly sorted drift over porous bedrock in many places is not conducive to development of numerous and consistent spring sources. The clay loams have poor recharge properties and, should water reach the rock aquifers, it would flow toward areas of discharge (streams, lakes, wells, etc.) to the east or south. Rock aquifers include the porous St. Peter sandstone, Cambrian sandstone, the less porous Prairie du Chien dolomite, and the Galena dolomite. Cities digging wells in this region usually seek either the St. Peter sandstone or the Cambrian sandstone. Even the Niagara limestone which underlies all the lake shore counties is reasonably permeable due to the numerous fractures and joints. A simplified diagram of the system has been reproduced from the report of Thomas (1952) (Fig. 6).

There is much to be gained by observing the runoff of important streams which lie within these regions. It is low for the streams in the southeast and much higher for the streams which originate on the Canadian Shield and streams that originate in the Southwest. This is further evidence that precipitation enters the ground to be expressed at distant points and does not become an immediate part of surface discharge; is retained by the clayey soils to enter the evapotranspiration cycle; or is impounded in marshes or lakes. The streams with good spring sources on the other hand have a high base flow with little fluctuation which is well distributed through the year (Table 1).

Discussion

Wisconsin has abundant rainfall amounting to 27–34 inches per year—enough to make contributions to the ground water, surface runoff, evaporation and vegetation growth. The fraction that enters the ground and becomes expressed as springs and seeps in what interests us the most because of the trout's dependence on the cool ground water. This amounts to 5.0 inches per year for southern Wisconsin according to Wojta's (1949) review and much higher in sandy regions, reaching 80–90 per cent (Drescher, 1955). Most of this recharge takes place during the periods when vegetation is not actively transpiring water, and it is very much greater in porous materials than in semi- or nonporous materials. With sufficient water for recharge, we can assume the potential for trout stream development always exists provided other physical conditions occur. An additional requirement is springs of sufficient number and size to sustain desired water temperatures. The size of streams inhabited by trout is suggestive of temperature requirements. Large streams do not make good trout water except seasonally. They have too much of their water volume derived from distant sources, which would have been subject to the tempering influence of weather conditions and excessively warmed or cooled, to have other than very local or seasonal value to trout. It will, therefore, be only the small- and medium-sized waters which can be sufficiently cooled or warmed by ground water springs—the head-

TABLE 2. MECHANICAL ANALYSIS OF TYPICAL SOILS OF WISCONSIN*

		Per Cent of Soil Fraction						
		Fine Gravel 2 to 1 mm.	Coarse Sand 1.0–0.5 mm.	Medium Sand 0.5–0.25 mm.	Fine Sand 0.25–0.1 mm.	Very Fine Sand 0.1–0.05 mm.	Silt 0.05–0.005 mm.	Clay 0.005–0 mm.
Plainfield sand	Outwash	0.5	17.8	30.9	33.9	5.8	6.5	4.5
Plainfield sandy	Outwash	0.1	25.5	23.6	16.5	2.0	22.6	9.1
Boone fine sandy loam	Outwash	0.2	5.9	13.5	54.9	5.8	14.7	5.1
Chelsea (Coloma) loam	Outwash	0.1	5.7	4.0	4.0	19.4	53.6	12.8
Colby silt loam	Ground moraine	0.1	3.2	4.0	3.6	12.6	61.9	13.6
Knox silt loam	Unglaciated—loess	0.1	0.6	.5	1.2	5.3	80.8	11.6
Miami fine sandy loam	Ground moraine	0.9	5.9	9.4	24.6	18.5	33.1	7.4
Miami clay loam	Ground moraine	0.8	4.0	4.0	11.5	12.4	43.2	23.2
Superior clay	Lake bed	0.2	1.1	1.5	5.4	5.3	28.6	58.2

*Reproduced in part from Weidman and Schultz (1915).

waters for most streams. Usually the trout water will extend down about a mile below the significant spring sources.

The circumstances which have produced significant springs are multiple. First and most important, it takes a good porous soil to make contributions to the ground water through infiltration. This requirement has been well met by the glacial alluvium with its sandy soils. Trout streams are abundantly represented in this surface type or in conjunction with it. The second requirement is ground water with sufficient hydraulic gradient to cause the ground water to reach the surface such that interception by drainage is possible. The slopes of the Canadian Shield, moraine hills and coulees provide this requirement.

Thirdly, there must be free lateral underground movement of the ground water so that it can reach the surface drainage systems which have cut down into the surface deposits. Free movement is permitted in the sorted alluvium with its predominantly sands and gravels in the overlay, but it is not permitted in the unsorted till or original lake clays with their higher fraction of clays or frequent pockets of clay and silt. Free movement of water is permitted in some of the sandstones which are exposed in the central and the western parts of the state.

It is perhaps fortunate that sandy soils and hilly regions are most productive of trout streams. Intensive agriculture will not be so demanding of these waters for irrigation nor will there be complete tillage of the soil with attendant erosion. The one crop that thrives on the sandy silt loams of outwash flats is potatoes. Since this crop gives the best yields when irrigated, competition for surface water from spring sources in such areas can be expected. The sandy soils and hillsides are more intensively dedicated to forest enterprises, a land use that indirectly contributes to rainfall infiltration, delayed runoff and utimate expression as ground water springs.

The geography besides heavy soil types which is unproductive of trout streams contains many lakes. Also, it is a well-known fact that an impoundment will mark the lower limits of trout water. Impounded waters whether in lakes of glacial or man-made origin usually have surface outflow and become warmed beyond the tolerances of trout. These circumstances suggest that if protection of trout streams is to be achieved, impounding of trout waters should be avoided. The trend toward construction of small impoundments for farm pounds, private fish hatcheries and other recreational and business enterprises is regarded as a serious threat to the future of trout streams.

Summary

Trout streams in Wisconsin have been located on a hydrographic map of the state. In this manner the geography leading to the existence of the streams can be seen. Since the trout require cold waters in summer and warm waters in winter, they are dependent upon ground water for these conditions. Trout streams occur abundantly in regions with good slope that provide a hydraulic gradient for ground water, in regions that have permeable sandy soils which permit ready infiltration and lateral movement of ground water. Trout streams are lacking in regions of little slope and clay soil types, and in regions containing abundant lakes. Impoundment of trout streams is regarded as the greatest threat to the maintenance of trout waters.

Acknowledgements

Presentation of these data would have been impossible without the extensive surveys of field men in the Wisconsin Conservation Department. The critical review of these data by Mr. Lee Holt, Dr. John Ockerman and editing by Dr. Ruth Hine is gratefully acknowledged.

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THE MILWAUKEE FORMATION ALONG LAKE MICHIGAN'S SHORE

Katherine G. Nelson and Jeanette Roberts

The presence of Devonian rocks in southeastern Wisconsin was recognized more than 100 years ago by Increase A. Lapham, who reported their discovery in 1860 to the Milwaukee Geological Club, and later to the St. Louis Academy of Sciences and in the American Journal of Science.[1] He made his correlation on the basis of fish fossils. While relatively rare, where present these fossils are very conspicuous and leave little doubt that they are representatives of the "Age of Fishes", as the Devonian is commonly called. About this same time, James Hall was commissioned to make a geological survey of Wisconsin, and in his report of 1862, he describes the rock and correlates it with the Hamilton beds of New York. As State Geologist of New York, he was the outstanding authority of his time on the Devonian.

The name "Milwaukee Formation" was not applied formally until 1906, when W. C. Alden's *Milwaukee Special Folio* was published by the United States Geological Survey. The term "Milwaukee Cement Rock", however, had appeared in print as early as 1883 in T. C. Chamberlin's *Geology of Wisconsin,* Volume I,[2] and had probably been in use considerably earlier. It was Lapham who had pointed out the possibility of using the shaly dolomite to make cement in 1874, and two years later the Milwaukee Cement Company began operations in the vicinity of the type locality along the Milwaukee River at Berthelet, north of what is now Capitol Drive.

The cement industry became a booming one, not only at the Milwaukee site, but at others where the hydraulic limestone could be located. Outcrops were few, for two reasons: as the topmost of the Paleozoic formations exposed in Wisconsin, most of it had been removed by erosion during the Mesozoic and Cenozoic Eras; and most of what is left is buried under glacial drift. Since the Paleozoic rocks in general dip away from north central Wisconsin,

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[1] Cleland, H. F., *The Fossils and Stratigraphy of the Middle Devonic of Wisconsin,* Wisconsin Geological Survey, Bull. 21 (sc. s. 6), 1911. pp. 21–22.

[2] Chamberlin, T. C., *The Geology of Wisconsin,* Vol. I, p. 201, Wis. G. S., 1883.

the rocks along the eastern border of the state have a general regional dip to the southeast. Thus, the area underlain by the Devonian—the youngest of the sequence of dipping beds—is confined to a narrow strip, nowhere extending more than 3 to 4 miles west of Lake Michigan, and stretching less than 50 miles in a north–south direction. The gentle regional dip toward the lake is generally obscured in the outcrop areas by local warping. The warping, itself, is in part responsible for some of the outcrops, causing them to arch toward the surface through the glacial drift. Whether the strata are continuous under the drift is doubtful—it is likely that pre-glacial erosion has cut through the Devonian to the underlying Silurian beds in many places.

The two most prominent exposures of the Devonian are the type area along the Milwaukee River, and the region along the shore of Lake Michigan east of Lake Church, about 30 miles north of the former. Both of these areas and their fossil content were described in some detail by Cleland in 1911.

One of the more obscure outcrops is located on the lake shore in Fox Point, just north of Whitefish Bay, and this is the area with which the present study is most concerned. Cleland gives only six lines to this location:

> "The Hamilton formation outcrops about two miles north of Whitefish Bay station on the lake shore. It was here that Whitfield obtained some of his specimens for Volume IV of the Geology of Wisconsin. The rock here was formerly mined by tunneling by the Consolidated Cement Company, but in 1907 no work was being done, and the rock was inaccessible except on the shore of the lake."[3]

Alden, in 1906, stated that the Consolidated Cement company did not begin production until 1900[4] Why was this enterprise so short-lived? Why was it located there in the first place? Apparently, for about six years, the company had an extensive layout there, evidence of which can still be seen in concrete abutments and rusting steel tracks along the shore. Probably the cessation of operations was influenced by the same factor that has made it difficult to locate this outcrop in recent years—the level of Lake Michigan. Alden stated that the exposure was at the foot of the bluff on the shore of "Whitefish Bay, a few feet *above* the water's edge".[5] The cement company's operation was a mine, reached by a shaft from the top of the bluff, which extended 22 feet *below* the level of the beach. Several times during the 1940's and early 1950's the senior author and others attempted to locate the outcrop along

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[3] Cleland, op. cit., p. 10.

[4] Alden, W. C., *Description of the Milwaukee Quadrangle, Wisconsin,* U.S.G.S. Atlas, Milwaukee Special Folio (No. 140), p. 10, 1906.

[5] Ibid., p. 3 (The italics *(above)* are the present authors'.)

the shore in this vicinity, to no avail, and the conclusion was reached that the slight area where bedrock had once been visible had been buried either by beach sand or by creep of the glacial till at the base of the bluff. During the summer of 1956, when the lake was lower than it had been for several years, the authors looked for it again, on a hot summer day, and discovered it under the water, a bit east of the edge of the beach. It was accessible only by wading, but obviously the slabs of rock were in place, and represented several beds of the long-sought Milwaukee Formation. In the fall of 1962, the junior author found that the lake level was even lower, and that there was a good exposure of the Devonian rocks visible for a distance of several hundred feet along the beach. Enough of it was out of the water so that specimens could be collected.

When winter and the formation of massive ridges of ice along the beach put a temporary stop to field studies, the junior author delved into the records of what is now the city of Glendale to see if she could learn more about the operations of the Consolidated Cement Company that is described in the Milwaukee Folio. Alden stated that the company had opened a shaft in the bluff several years earlier, to supply its mill above, but that production did not begin until 1900.[6] This is the year when the name of the Consolidated Cement Company first appears in the Personal Property Assessment Roll, with a listing of "Wagons, Carriages and Sleighs—1, Value $10" and "Personal Property, $18,000". By 1901, the company had 4 wagons, with a value of $100, and the same entry appears for 1902. The 1903 records list only the personal property valuation of $18,000, but in 1904, two houses, with a value of $100 are listed, and the location of the plant in School District #5 (now Green Tree District) is cited. This year must mark the end of successful operation of the company, for on page 231, Volume 6 of the Town Clerk's Record, we find the following notations:

> "July 13, 1904—Mr. Griese of the Consolidated Cement Company who has an $18,000 assessment on the personal property against the company said the assessment was 50% too high. He stated that the identical plant newly installed would cost but $12,000. His case was taken under advisement."

> "July 14, 1904—Messrs. Griese and Kiewert appeared again on behalf of the Consolidated Cement Company and the board determined to place the assessment on their personal property of $18,000 at $13,000, a reduction of $5,000. They were satisfied with this reduction."

The next year's assessment record shows the value of personal property further reduced to $10,000, and in 1906 and thereafter, the Consolidated Cement Company is no longer listed on the tax rolls.

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[6] Ibid., p. 10.

While harbor expediters and ships' captains have worried about the low level of Lake Michigan in 1963, it must be stated that this spring's near-record low level of the Great Lakes has been most helpful to the authors in their research. With the level of Lake Michigan 1.6′ lower than the ten year average, and a foot lower than it was just a year earlier, the Milwaukee Formation along the shore of Whitefish Bay in Fox Point is better exposed that it has been for many years. It is no longer necessary to wade to reach it. Army engineers forecast a further drop of nearly a foot by July and August. Although many shake their heads in dismay at this prospect, there are at least two geologists who are looking forward to walking out farther on the bedrock that is now submerged, in the hope of finding fossils of interest[7].

The character of the rock and its fossil content have been the primary concern of the writers. Cephalopods characteristic of Zone B of the Milwaukee Formation are present. These include several specimens of *Ovoceras,* and several that appear to be *Gyroceras.* It will take considerable study before an accurate and complete listing can be made, because the fossils that are found in place are almost all in the form of casts and molds, and rapid identification is not often possible. Several typical brachiopods have been recognized, however—among them *Stropheodonta, Atrypa, Cyrtina, Spirifer,* and *Mucrospirifer.* Pelecypods of the genera *Palaeoneilo* and *Nuculites* have also been recognized, as well as an unidentified coral, bryozoan molds, and gastropods. All of these have been found in place in the rock at the water's edge. Besides this brownish, rather hard dolomite with some weak, shaly layers, there are numerous fragments on the beach of a greyer, more fossiliferous rock. Most of these are probably derived from the material thrown out of the shaft, as noted in Alden's description. This fine-grained, hydraulic limestone, he noted, was characterized by abundant pyritized fossils, pyrite crystals and calcite, and traces of bitumen. Today grey fragments of limestone with an abundance of crinoid stem fragments, *Tentaculites,* an occasional trilobite *(Phacops rana),* spirifers and other brachiopods, and bryozoans can be picked up on the beach. Sometimes they contain pyrite and calcite crystals, and vugs lined with asphaltic material. Some of this bitumen has also been found in the rocks cropping out at the water's edge, by the authors,

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[7] In mid-July, 1963, the authors have found new exposures extending a little to the south, but the shifting character of the beach sands and gravels has brought about burial of some of the beds studied in March and April.

and this leads to speculation as to whether there might some day be a strike of off-shore oil for Wisconsin to turn over to the Federal government. Or how far out would the state's rights extend?

We wonder whether this ticklish problem will ever be put to the test.

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PARASITES OF EASTERN WISCONSIN FISHES

James D. Anthony

Abstract

In a survey of fish parasites undertaken during the summer of 1960 from 17 lakes and pounds, 324 fishes representing 25 different species were examined. Those infected with at least one species of parasite totaled 300 and represented 93% of the total autopsied. The number of fish infected with each parasite is presented. The most common parasites found were monogenetic trematodes, of the Order Gyrodactyloidea, on the gills, scales and fins of 15 species of fish and *Neascus* spp. in 11 species of fish.

Introduction

This is the first of what is hoped to be a series of papers surveying the parasitic fauna of Wisconsin fishes. It is expected that future papers will attempt to show a correlation between th parasitic burden of lake and stream fishes with the chemical composition of the waters.

Surveys of fish parasites in northern Wisconsin by Fischthal (1947, 1950, 1952), and Bangham (1946) indicate that approximately 93% of the fishes collected were parasitized. This is, in general, higher than studies made in other parts of the United States but compares favorably with the results of the present study.

Collections were made with hook and line and with an electric shocker. The fish were examined as soon as possible after they were caught. Since the electric shocking was usually done at night the parasite examinations were conducted the next day after the fish had been on ice over night. The acanthocephalans and tapeworms were allowed to relax in the refrigerator and were then placed, along with the trematodes and other parasites, in Bouin's or formalin-alcohol-acetic acid fixative. Staining was done with borax carmine or haematoxylin. Mountaing was in piccolyte.

Special appreciation is due Mr. Vernon Hacker of the Wisconsin Conservation Department, the various district fish managers and

[1] Supported in part by the Research Committee of the Graduate School from funds supplied by the Wisconsin Alumni Research Foundation.

the crew of the boat containing the shocker, without whom it would have been impossible to conduct this survey. The identifications of the fish were aided by the above persons. Thanks are also due Dr. Ludwig Pauly for furnishing fish from Lake Beulah and Mr. Robert Calentine for confirming the diagnosis of *Khawia iowensis*. The fish names used are those in Hubbs and Lagler (1958).

LAKES AND PONDS SURVEYED

Name	County	Location	Acreage	Date
1. Lake Bernice	Fond du Lac	Southeast	30	1 July 1960
2. Weyer's Lake	Manitowoc	East Central	10	6 July 1960
3. Beechwood Lake	Sheboygan	Southwest	14	12 July 1960
4. Jetzer's Lake	Sheboygan	North	12	13 July 1960
5. Black Otter Lake	Outagamie	Southwest	62	15 July 1960
6. Lake Beulah	Walworth	Northeast	570	17 July 1960
7. Westfield Pond	Marquette	Northwest	....	20 July 1960
8. East Alaska Lake	Kewaunee	East	60	28 July 1960
9. Europe Lake	Door	North	220	2 Aug. 1960
10. McDill Pond	Portage	Central	140	2 Aug. 1960
11. Fish Lake	Waushara	West	177	17 Aug. 1960
12. Lake Nagawicka	Waukesha	Northwest	918	22 Aug. 1960
13. Iola Pond	Waupaca	West	150	31 Aug. 1960
14. Alderly Pond	Dodge	Southeast	....	13 Sept. 1960
15. Random Lake	Sheboygan	South	210	27 Sept. 1960
16. Little Green Lake	Green Lake	Central	467	5 Oct. 1960
17. Green Lake	Green Lake	Central	7325	29 Nov. 1960

LIST OF FISH

Amia calva Linnaeus—Bowfin

Coregonus artedii birgei (Wagner)—Green Lake Cisco

Catostomus commersonnii commersonnii (Lacépède)—Common White Sucker

Erimyzon sucetta kennerlii (Girard)—Western Lake Chubsucker

Cyprinus carpio Linnaeus—Carp

Semotilus atromaculatus atromaculatus (Mitchill)—Northern Creek Chub

Notemigonus crysoleucas auratus (Rafinesque)—Western Golden Shiner

Notropis cornutus frontalis (Agassiz)—Northern Common Shiner

Pimephales notatus (Rafinesque)—Bluntnose Minnow

Ictalurus melas melas (Rafinesque)—Northern Black Bullhead

Ictalurus nebulosus nebulosus (LeSueur)—Northern Brown Bullhead
Ictalurus natalis natalis (LeSueur)—Northern Yellow Bullhead
Schilbeodes gyrinus (Mitchill)—Tadpole Madtom
Umbra limi (Kirtland)—Central Mudminnow
Esox lucius Linnaeus—Northern Pike
Perca flavescens (Mitchill)—Yellow Perch
Stizostedion vitreum vitreum (Mitchill)—Yellow Walleye
Percina caprodes (Rafinesque)—Logperch
Micropterus dolomieui dolomieui Lacépède—Northern Smallmouth Bass
Micropterus salmoides salmoides (Lacépède)—Northern Largemouth Bass
Lepomis cyanellus Rafinesque—Green Sunfish
Lepomis gibbosus (Linnaeus)—Pumpkinseed
Green Sunfish X Pumpkinseed
Lepomis macrochirus macrochirus Rafinesque—Common Bluegill
Ambloplites rupestris rupestris (Rafinesque)—Northern Rock Bass
Pomoxis nigromaculatus (LeSueur)—Black Crappie

Amia calva Linn.—Bowfin 5/5

Three fish from Lake Bernice and two fish from Lake Beulah were examined and all were infected. Those from Lake Bernice had *Azygia augusticauda* in two; *Contracaecum* sp. in three; *Proteocephalus* sp. in two; *Macroderoides parvus* in three; *Neoechinorhynchus cylindratus* in two; *Spiroxys* sp. in one and *Haplobothrium golbuliforme* in one. The two fish from Lake Beulah had *A. augusticauda* in two; *Contracaecum* sp. in two; *Proteocephalus* sp in two; *Macroderoides typicum* in two; *N. cylindratus* in one and *H. globuliforme* in one.

Coregonus artedii birgei (Wagner)—Green Lake Cisco 6/8

The five cisco from Little Green Lake and one of the three from Green Lake were heavily infected with *Cystidicola stigmatura* in the swim bladder. Two of the fish had over two hundred of these large nematodes and the others averaged approximately seventy-five per fish.

Catostomus commersonii commersonii (Table 1) 58/59

The suckers from Europe Lake were all heavily infected. All of them had *Diplostomulum* sp. in the lens of the eye and in most cases several hundred were present making the lens almost opaque. There was undoubtedly some loss of vision. Many of these fish also carried *Octomacrum lanceatum* on the gills; *Clinostomum marginatum* embedded in the flesh and *Neoechinorhynchus crassus* in the intestine.

Erimyzon sucetta kennerlii (Girard)—Western Lake Chubsucker 1/2

One of the two chubsuckers from Iola Pond was infected with one immature *Camallanus oxycephalus* and an immature Carophyllaeidae which appears to be *Glaridacris catostomi* but which cannot be positively identified.

Cyprinus carpio (Table 2) 38/45

Fourteen of the twenty carp from Alderly Pond were infected with *Khawia iowensis* as were two of the fish from Lake Bernice. This species was described by Calentine and Ulmer (1961) and the identification has been confirmed by these authors. The other caryophyllaeids were too immature to identify.

Semotilus atromaculatus atromaculatus (Mitchill)—Northern Creek Chub 8/8

The eight specimens from Lake Nagawicka were all parasitized. Gyrodactyloidea were found in seven; *Contracaecum* sp. in five; *Neascus* sp. in four; *Posthodiplostomum minimum* in two; *Proteocephalus* sp. in two and *Allocreadium lobatum* in two.

Notemigonus crysoleucas auratus (Rafinesque)—Western Golden Shiner 16/20

Four of the six fish from Lake Bernice had Gyrodactyloidea on the gills and three had *Neascus* sp. Nine of the eleven fish from Beechwood Lake had Gyrodactyloidea; five were infected with *Neascus* sp and *Plagiocirrus primus* occurred on three. The three fish from Random Lake all had Gyrodactyloidea. Two of the fish from Lake Bernice and two from Beechwood Lake were negative.

Notropis cornutus frontalis (Agassiz)—Northern Common Shiner 8/9

All of the common shiners were secured from Lake Bernice. Gyrodactyloidea and *Rhabdochona cascadilla* were found in four; *Allocreadium lobatum* was found in three and *Neascus* sp. in two.

Pimephales notatus (Rafinesque)—Bluntnose minnow 1/1

The one bluntnose minnow from Europe Lake had ten *Neascus* sp. metacercaria on the scales, immature *Contracaecum* sp. encysted in the liver and larval *Diplostomulum* sp. in the lens of the eye.

Ictalurus melas melas (Table 3) 19/19

Most of the black bullheads carried a heavy infection of *Aloglossidium corti* and *Corallobothrium fimbriatum* in the intestines as well as numerous Gyrodoctyloidea on the gills.

Ictalurus nebulosis nebulosis (Table 4) 30/30

Many of the brown bullheads had *Proteocephalus* sp. which was not found in the black bullheads and a lighter load of *Alloglossidium* sp. The infection of *Corallobothrium fimbriatum* and Gyrodactyloidea was about the same.

Ictalurus natalis natalis (LeSueur)—Northern Yellow Bullhead 3/4

Three of the four yellow bullheads from Iola Pond had Gyrodactyloidea; one had *Contracaecum* sp. and one had both *Dichelyne robusta* and *Phyllodistomum staffordi.*

Schilbeodes gyrinus (Mitchill)—Tadpole Madtom 1/1

This fish from McDill Pond was kept alive and autopsied a week after capture. It was found to have a heavy infection of Gyrodactyloidea and five *Trichodina* sp. on the gills. There were also eight *Spiroxys* sp. encysted on the mesenteries.

Umbra limi (Kirtland)—Central Mudminnow 5/7

Two of the three mudminnows from Jetzer's Lake had *Spiroxys* sp. and one had a single *Bunoderina eucaliae.* Three of the four from Iola Pond had *B. eucaliae* and three were single infections of *Proteocephalus* sp., *Clinostomum marginatum* and *Leptorhynchoides thecatus.*

Esox lucius Linn.—Northern Pike 3/3

The one pike from Jetzer's Lake contained twenty-six *Proteocephalus pinguis;* the one from Iola Pond had *Neascus* sp. and six *Leptorhynchoides thecatus;* the one from Random Lake had several hundred *Neascus* sp., three *Protocephalus pinguis* and four *Crepidostomum cooperi.* The low number of these fish secured indicates their ability to escape capture with an electric shocker.

Perca flavescens (Table 5) 16/16

The yellow perch in Lake Bernice and Europe Lake had relatively large numbers of *Bunodera sacculata.* The fish from Lake Bernice and Iola Pond had many Gyrodactyloidea on the gills.

Stizostedion vitreum vitreum (Mitchill)—Yellow Walleye 1/3

One of the three walleyes from Little Green Lake had an immature *Proteocephalus* sp. These were all young fish which had been planted after the lake had been poisoned. This perhaps is one method of controlling heavily parasitized lakes.

Percina caprodes (Rafinesque)—Logperch 1/1

The one logperch from Lake Bernice had three *Illinobdella* sp., one immature *Proteocephalus* sp. and one *Phyllodistomum etheostomae.*

Micropterus dolomieui dolomieui Lacepede—Northern Smallmouth Bass 3/3

The three fish from Europe Lake were all infected with *Neascus* sp., two of them had *Proteocephalus ambloplitis,* one had a light infection of *Diplostomulum* sp. and *Contracaecum* sp. occurred in two.

Micropterus salmoides salmoides (Table 6) 29/30

The largemouth bass were not heavily infected with any one parasite but had more of a variety of parasites than the other fish. Since these came from more different localities there seems to be a correlation between the number of different parasites and the variety of the habitats.

Lepomis cyanellus Rafinesque—Green Sunfish 5/5

The three fish from Weyer's Lake had an average of eighteen Gvrodactyloidea on the gills. The two fish from Random Lake had large numbers of *Diplostomulum* sp. in the lens of the eyes; one was infected with two immature *Proteocephalus* sp. and the same fish had one *Spinitectus* sp.

Lepomis gibbosus (Table 7) 7/8

The pumpkinseeds carried light infections with the exception of the Gyrodactyloidea on the gills, fins and scales.

Green Sunfish X Pumpkinseed 2/2

One of the two hybrids from Little Green Lake had one immature *Proteocephalus* sp. while each of the two fish contained two *Crepidostomum cooperi.*

Lepomis macrochirus macrochirus (Table 8) 26/26

The bluegills had almost the same parasitic infections as the pumpkinseeds except that *Bothriocephalus cuspidatus* was found in the former. Since these were from different lakes the occurrence is probably not significant. *Neascus* sp. was not found in the bluegills in Random Lake but was found in the pumpkinseeds.

Ambloplites rupestris rupestris (Rafinesque)—Northern Rock Bass 4/4

The rock bass were all collected from Europe Lake. All were infected with *Neascus* sp., *Capillaria catenata, Camallanus oxycephalus, Proteocephalus ambloplites* and Gyrodactyloidea. Three also had *Crepidostomum cooperi* and *Neoechinorhynchus cylindratus. Clinostomum marginatum* and *Spinitectus* sp. were found in two. One had a moderate infection of *Diplostomulum scheuringi.*

Pomoxis nigromaculatus (LeSueur)—Black Crappie 4/5

Two of the three crappies from Jetzer's Lake were parasitized with immature *Proteocephalus* sp. Both of the fish from Random

Lake had heavy infections of *Neascus* sp. in the fins and scales. Both also had light infections of *Proteocephalus pearsei*, *Crepidostomum cornutum* and *Spinitectus* sp. in the intestines.

Check List of Parasites

TREMATODA

Allocreadium lobatum Wallin, 1909
Allogossidium corti (Lamont, 1921)
Alloglossidium geminus (Mueller, 1930)
Azygia augusticauda (Stafford, 1904)
Bunodera sacculata Van Cleave and Mueller, 1932
Bunoderina eucaliae Miller, 1938
Clinostomum marginatum (Rudolphi, 1819)
Crepidostomum cooperi Hopkins, 1931
Crepidostomum cornutum Osborn, 1903
Diplostomulum scheuringi Hughes, 1929
Diplostomulum spp.
Gyrodactyloidea
Macroderoides parvus (Hunter, 1932)
Neascus spp.
Octomacrum lanceatum Mueller, 1934
Phyllodistomum etheostomae Fischthal, 1942
Phyllodistomum staffordi Pearse, 1924
Posthodiplostomum minimum (MacCallum, 1921)
Triganodistomum attenuatum Mueller and Van Cleave, 1932

CESTODA

Bothriocephalus cuspidatus Cooper, 1917
Caryophyllaeidae
Corallobothrium fimbriatum Essex, 1927
Glaridacris catostomi Cooper, 1920
Haplobothrium globuliforme Cooper, 1914
Khawia iowensis Calentine and Ulmer, 1961
Proteocephalus ambloplitis (Leidy, 1887)
Proteocephalus pearsei La Rue, 1919
Proteocephalus pinguis La Rue, 1911
Proteocephalus spp.

NEMATODA

Camallanus oxycephalus Ward and Magath, 1917
Capillaria catenata Van Cleave and Mueller, 1932
Contracaecum spp.
Cystidicola stigmatura (Leidy, 1886)
Dichelyne robusta (Van Cleave and Mueller, 1932)
Rhabdochona cascadilla Wigdor, 1918

Spinitectus gracilis Ward and Magath, 1917
Spinitectus spp.
Spiroxys sp.

ACANTHOCEPHALA

Leptorhynchoides thecatus (Linton, 1891)
Neoechinorhynchus crassus Van Cleave, 1919
Neoechinorhynchus cylindratus (Van Cleave, 1913)
Octospinifer macilentus Van Cleave, 1919
Pomphorhynchus bulbocolli Linkins, 1919

PROTOZOA

Trichodina sp.

COPEPODA

Achtheres micropteri Wright, 1882
Argulus catostomi Dana and Herrick, 1837
Ergasilus caeruleus Wilson, 1911

HIRUDINEA

Illinobdella sp.

TABLE 1. *Catostomus commersonii commersonii* (LACÉPÈDE)—COMMON WHITE SUCKER

	Lake Bernice	Jetzer's Lake	Westfield Pond	East Alaska Lake	Europe Lake	Alderly Pond
Examined 59	3	14	11	3	17	11
Infected 58	3	14	10	3	17	11
Argulus catostomi	0	0	1	0	0	0
Clinostomum marginatum	0	0	0	0	6	0
Diplostomulum sp.	0	0	0	0	17	0
Glaridacris catostomi	2	0	10	0	3	4
Gyrodactyloidea	2	4	6	1	3	9
Neoechinorhynchus crassus	1	6	0	1	8	0
Octomacrum lanceatum	0	0	0	0	12	0
Octospinifer macilentus	0	2	0	1	0	2
Pomphorhynchus bulbocolli	0	4	0	2	2	0
Proteocephalus sp.	0	0	0	0	0	3
Triganodistomum attenuatum	1	3	5	0	0	5

TABLE 2. *Cyprinus carpio* LINNAEUS—CARP

	LAKE BERNICE	JETZER'S LAKE	WEST-FIELD POND	ALDERLY POND	RANDOM LAKE
Examined 45	5	3	14	20	3
Infected 38	3	2	11	19	3
Caryophyllaeidae	1	0	0	5	0
Gyrodactyloidae	3	2	8	15	1
Khawia iowensis	2	0	0	14	0
Pomphorhynchus bulbocolli	0	0	0	0	3
Proteocephalus sp.	0	2	0	0	0
Spinitectus sp.	0	0	5	3	0

TABLE 3. *Ictalurus melas melas* (RAFINESQUE)—NORTHERN BLACK BULLHEAD

	LAKE BERNICE	BEECH-WOOD LAKE	BLACK OTTER LAKE	RANDOM LAKE
Examined 19	5	4	7	3
Infected 19	5	4	7	3
Alloglossidium corti	4	3	5	3
Azygia augusticauda	1	0	2	0
Corallobothrium fimbriatum	3	4	3	1
Dichelyne robusta	1	2	2	2
Gyrodactyloidea	4	4	6	3
Leptorhynchoides thecatus	0	0	1	0
Pomphorhynchus bulbocolli	0	1	0	0
Spinitectus gracilis	2	0	0	0

TABLE 4. *Ictalurus nebulosus nebulosus* (LESUEUR)—NORTHERN BROWN BULLHEAD

	East Alaska Lake	Lake Beulah	Fish Lake	Iola Pond
Examined 30	15	5	6	4
Infected 30	15	5	6	4
Alloglossidium corti	0	2	0	1
Allogoloosidium geminus	2	0	1	0
Clinostomum marginatum	0	0	1	0
Corallobothrium fimbiratum	11	4	6	2
Dichelyne robusta	3	0	1	0
Diplostomulum sp.	2	1	0	0
Gyrodactyloidea	13	5	3	3
Leptorhynchoides thecatus	2	0	1	0
Proteocephalus sp.	6	3	3	1
Spinitectus sp.	1	0	0	0

TABLE 5. *Perca flavescens* (MITCHILL)—YELLOW PERCH

	Lake Bernice	Europe Lake	Iola Pond	Random Lake
Examined 16	6	4	4	2
Infected 16	6	4	4	2
Bothriocephalus cuspidatus	0	0	2	0
Bunodera sacculata	4	3	0	0
Camallanus oxycephalus	0	1	0	1
Clinostomum marginatum	0	2	0	0
Diplostomulum sp.	0	1	0	0
Gyrodactyloidea	5	0	3	0
Neascus sp.	3	3	2	0
Neoechinorhynchus cylindratus	0	1	0	0
Proteocephalus sp.	1	1	0	0
Spinitectus sp.	2	0	1	2

TABLE 6. *Micropterus salmoides salmoides* (LACÈPÈDE)—NORTHERN LARGEMOUTH BASS

	LAKE BERNICE	BEECHWOOD LAKE	JETZER'S LAKE	EAST ALASKA LAKE	FISH LAKE	IOLA POND	RANDOM LAKE	LITTLE GREEN LAKE
Examined 30	4	5	3	3	5	4	3	3
Infected 29	4	5	3	3	5	4	3	2
Achtheres micropteri	1	0	0	0	1	0	0	0
Azygia augusticauda	2	0	0	0	0	0	0	0
Clinostomum marginatum	1	1	0	0	0	0	0	1
Contracaecum sp.	0	0	1	0	0	1	0	0
Crepidostomum cooperi	0	0	0	0	2	0	0	0
Diplostomulum sp.	0	0	0	2	0	0	1	0
Ergasilus caeruleus	0	0	0	1	0	0	0	0
Gyrodactyloidea	3	5	2	0	2	4	3	0
Leptorhynchoides thecatus	0	2	1	2	0	0	2	0
Neascus sp.	0	3	1	0	0	2	0	0
Neoechinorhynchus cylindratus	1	0	0	0	0	0	0	0
Proteocephalus ambloplitis	2	2	2	1	3	0	2	0
Proteocephalus sp.	0	2	0	0	0	1	2	1
Spinitectus sp.	1	0	0	0	0	0	2	0

TABLE 7. *Lepomis gibbosus* (LINNAEUS)—PUMPKINSEED

	LAKE BERNICE	IOLA POND	RANDOM LAKE
Examined 8	2	3	3
Infected 7	2	2	3
Camallanus oxycephalus	0	0	1
Clinostomum marginatum	1	0	0
Diplostomulum sp.	0	0	2
Gyrodactyloidea	2	2	3
Neascus sp.	0	1	3
Posthodiplostomum minimum	1	0	1
Spinitectus sp.	1	0	1

TABLE 8. *Lepomis macrochirus macrochirus* RAFINESQUE—COMMON BLUEGILL

	JETZER'S LAKE	LAKE BEULAH	FISH LAKE	ALDERLY POND	RANDOM LAKE
Examined 26	9	1	7	4	5
Infected 26	9	1	7	4	5
Bothriocephalus cuspidatus	2	1	5	0	0
Crepidostomum cooperi	3	0	6	3	2
Diplostomulum sp.	0	0	0	0	4
Ergasilus caeruleus	0	0	1	1	0
Gyrodactyloidea	5	1	3	4	4
Illinobdella sp.	1	0	0	0	0
Leptorhynchoides thecatus	1	0	1	1	3
Proteocephalus amboplitis	0	0	3	0	0
Spinitectus carolini	2	0	2	0	1

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ZUR KENNTNIS DER SCOLYTIDAE— UND PLATYPODIDAE— FAUNA AUS COSTA RICA

Marian Nunberg

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It is interesting to observe that entomologists from Wisconsin are working in Costa Rica, that the insects involved in this paper were named by an authority on bark beetles in Poland and that the article is written in German. This illustrates well the cooperation occurring among organizations and individuals in the scientific field.

Im J. 1962 erhielt ich vom Herrn Prof. R. D. Shenefelt, University of Wisconsin, U.S.A., eine Sendung von 497 Käfern aus oben erwähnten Familien zum Bearbeiten.

Alle Käfer stammen aus Costa Rica, Ortschaft LaLola; sie waren an das Licht gefangen. Aus diesem Grunde darf man annehmen, dass alle Käfer schon ausgefärbt, ja die pilzzüchtende Holzbrüter selbst im ausgereiften Zustande waren.

Für das Ermöglichen dieser Arbeit möchte ich an dieser Stelle Herrn Professor R. D. Shenefelt meinen besten Dank aussprechen.

FAMILIE: SCOLYTIDAE

Bekannte Arten

1. *Pagiocerus frontalis* (F.)
   26.VII.61–1 Ex. (Weibchen); 24.VIII.61–1 Ex. (Männchen).

2. *Neodryocoetes hymenaeae* Egg.
   10.VII.61–2 Ex.; 17.VII.61–2 Ex.; 28.VII.61–1 Ex.
   So weit nach Norden wurde diese Art noch nicht gefunden. Bis jetzt gemeldet aus Brasilien, Fr. Guayana und Hol. Guayana.

3. *Pityophthorus guadeloupensis* Nunb. (= *denticulatus* Egg.)
8.VIII.61–1 Ex.
Diese Art wurde bis jetzt nur aus der Insel Guadeloupe bekannt.

4. *Pterocyclon plaumanni* Schedl
12.VII.61–1 Ex.; 23.VIII.61–1 Ex.
Bis jetzt bekannt nur aus Brasilien.

5. *Xyleborus affinis* Eichh.
12.VII.61–1 Ex.; 17.VII.61–1 Ex.; 21.VII.61–1 Ex.; 25.VII.61–2 Ex.; 26.VII.61–2 Ex.; 30.VII.61–1 Ex.; 8.VIII.61–2 Ex.; 23. VIII.61–2 Ex.; 24.VIII.61–5 Ex.

6. *Xyleborus ferrugineus* (F.).
13.V.58–4 Ex.; 10.VII.61–3 Ex., in cacao plantation; 11.VII. 61–1 Ex.; 15.VIII.61–1 Ex.; 23.VIII.61–7 Ex.; 24.VIII.61–10 25.VII.62–1 Ex.; 26.VII.61–1 Ex.; 28.VII.61–4 Ex.; 29.VII. 61–1 Ex.; 30.VII.61–2 Ex.; 31.VII.61–2 Ex.; 4.VIII.61–12 Ex.; 8.VIII.61–6 Ex.; 10.VIII.61–1 Ex.; 11.VIII.61–1. Ex.; 13.VIII. 61–2 Ex.; 15.VIII.61–1 Ex.; 23.VII.61–7 Ex.; 24.VIII.61–10 Ex.; 26:VIII.61–1 Ex.

7. *Xyleborus macer* Bldf.
23.VIII.61–1 Ex.

8. *Xyleborus perforans* (Woll.).
13.V.58–1 Ex.; 17.VII.61–3 Ex.; 18.VII.61–2 Ex.; 19.VII.61–1 Ex.; 20.VII.61–2 Ex.; 21.VII.61–2 Ex.; 26.VII.61–1 Ex.; 28. VII.61–1 Ex.; 30.VII.61–1 Ex.; 4.VIII.61–1 Ex.; 8.VIII.61–1 Ex.; 10.VIII.61–1 Ex.; 11.VIII.61–1 Ex.; 13.VIII.61–2 Ex.; 15.VIII.61–2 Ex.; 23.VIII.61–7 Ex.; 24.VIII.61–4 Ex.; 26. VIII.61–2 Ex.

9. *Xyleborus spinulosus* Bldf.
23.VIII.61–1 Ex.
Weit verbreitet in Süd- und Mittelamerika (Antillen eingerechnet) aber in Costa Rica noch nicht gefunden.

10. *Xyleborus volvulus* (F.)
10.VII.61–1 Ex.; 12.VII.61–1 Ex.; 17.VII.61–3 Ex.; 18.VII. 61–5 Ex.; 19.VII.61–13 Ex.; 20.VII.61–10 Ex.; 21.VII.61–3 Ex.; 25.VII.61–9 Ex.; 26.VII.61–10 Ex.; 28.VII.61–4 Ex.; 29. VII.61–7 Ex.; 30.VII.61–5 Ex.; 31.VII.61–4 Ex.; 4.VIII.61–13 Ex.; 8.VIII.61–12 Ex.; 15.VIII.61–1 Ex.; 23.VIII.61–35 Ex.; 24.VIII.61–25 Ex.; 28.VIII.61–3 Ex.
Neue Arten

11. *Pityophthorus semiermis* sp. n.
Männchen (Taf. I.Fig. 1–4).
Länge: 1,7 mm.

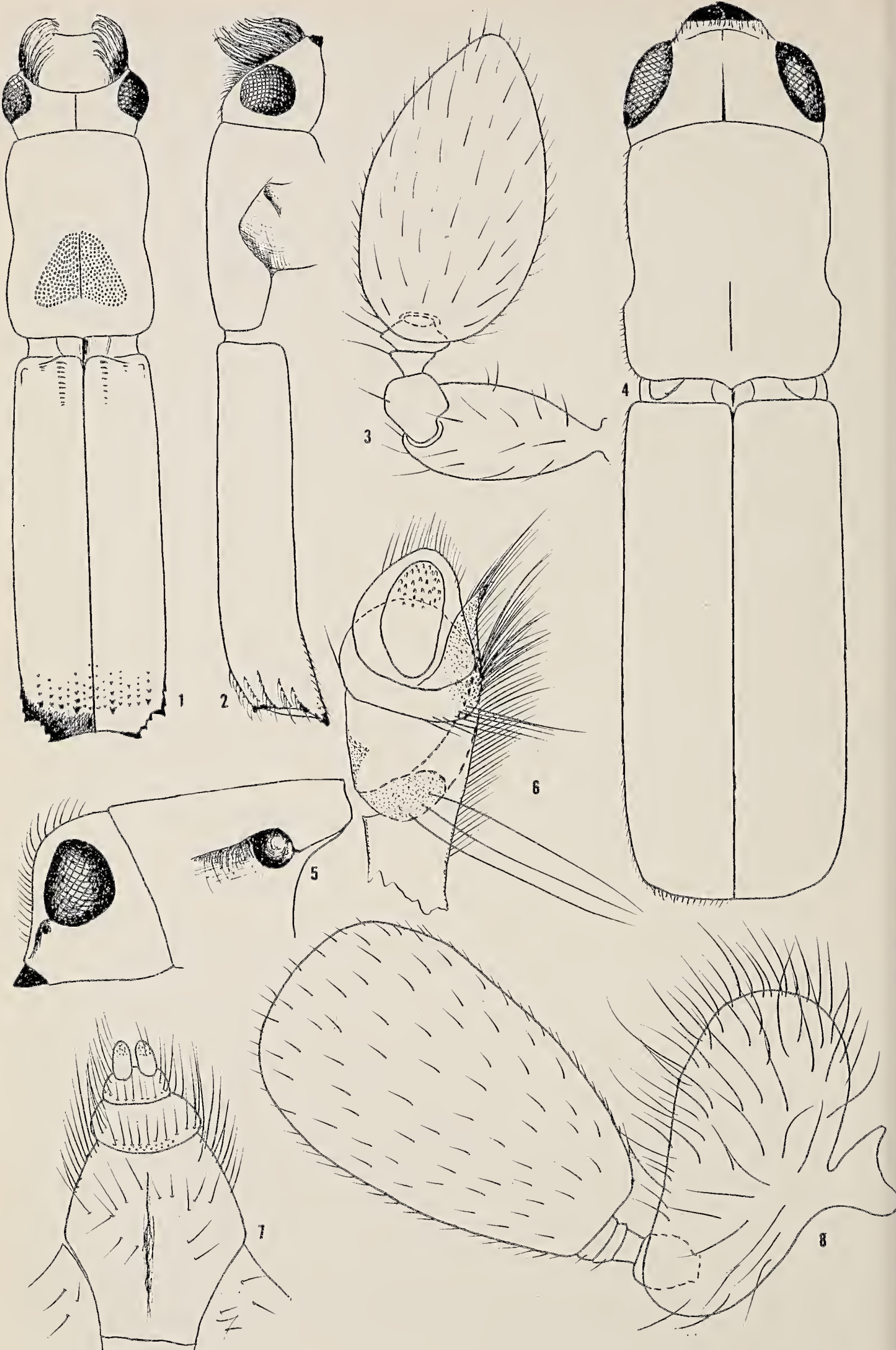
Hellbraun, auf dem Absturze und dem Halsschilde etwas dunskler. Behaarung spärlich; im unteren Teile der Stirn und auf der vorderen Hälfte des Halsschildes im Bereiche der Schuppenkörnchen ziemlich dicht aber kurz behaart; in der hinteren Hälfte der Flügeldecken sind einzelne aufrechte Haare zu bemerken.

Stirn im unteren Teile zwischen den Augen auf einer halbbkreisförmigen Fläche schwach eingedrückt und fein punktiert, am oberen Rande des Eindruckes mit einem undeutlichen Höckerchen. Augen sehr gross, vorne tief ausgerandet. Fühlerkeule eiförmig, mit zwei Einkerbungen im Umriss und zwei bogig gekrümmten und unvollkommen septierten Nähten; die dritte Naht nur durch Borsten angedeutet. Die Keule etwas länger als die Geissel und ebenso lang wie der Schaft.

Halsschild kaum länger als breit, an der Basis fast gerade, Seiten in der basalen Hälfte parallel dann schwach eingeengt, der Vorderrand ziemlich schmal gerundet, Seitenrand deutlich aber nicht scharf. Halsschild ohne deutlichen Buckel und gleich dahinter leicht eingedrückt. Die erste Höckerreihe läuft entlang des Vorderrandes und ist aus kleinen gleichgrossen Höckern gebildet; oberhalb der ersten liegt ein breiter glatter fein punktierter Streifen; die zwei weiteren Höckerreihen liegen in gleicher Entfernung voneinander und in der Mitte zeigen sie eine unregelmässige Anordnung der Höcker; gleich vor dem Summit sind keine Höcker mehr nur quere feine Runzeln. In der basalen Hälfte fein punktiert und eine ziemlich breite Mittellinie freilassend.

Schildchen breit dreieckig.

Flügeldecken 1, 6 mal so lang wie der Halsschild, an der Basis kaum schmäler als dieser, hinter der Schulterbeule schwach ausgebaucht, von da an allmählich convergierend und am Ende ziemlich schmal abgerundet. Oben in der Länge flach, im ersten Drittel schwach eingedrückt; Absturz beginnt im letzten Drittel und ist sanft abgewölbt. Flügeldecken in unregelmässigen Reihen punktiert, speziell an der Basis stehen die Punkte in grosser Unordnung. Zwischenräume fein quer gerunzelt und mit einzelnen feinen Pünktchen. Die Naht in nicht grosser Entfernung hinter dem Schildchen erhöht, stärker auf dem Absturze, hier glatt, ohne Körnchen; die Furche auf dem Absturze läuft im Bereiche des zweiten Zwischenraumes (Nahtzwischenraum eingerechnet), ziemlich tief; die Seitenwülste kaum höher als die Naht, mit drei kleinen spitzen, borstentragenden Körnchen.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FIGURENERKLÄUNG DER TAFELN I, II

Tafel I

Figure 1. *Pityophthorus semiermis* sp. nov., von oben.

Figure 2. *Pityophthorus semiermis* sp. nov., von der Seite.

Figure 3. *Pityophthorus semiermis* sp. nov., Kopf von vorne.

Figure 4. *Pityophthorus semiermis* sp. nov., Fühler, Vergr. 115 x.

Figure 5. *Sampsonius costaricensis* sp. nov., Fühler, Vergr. 115 x.

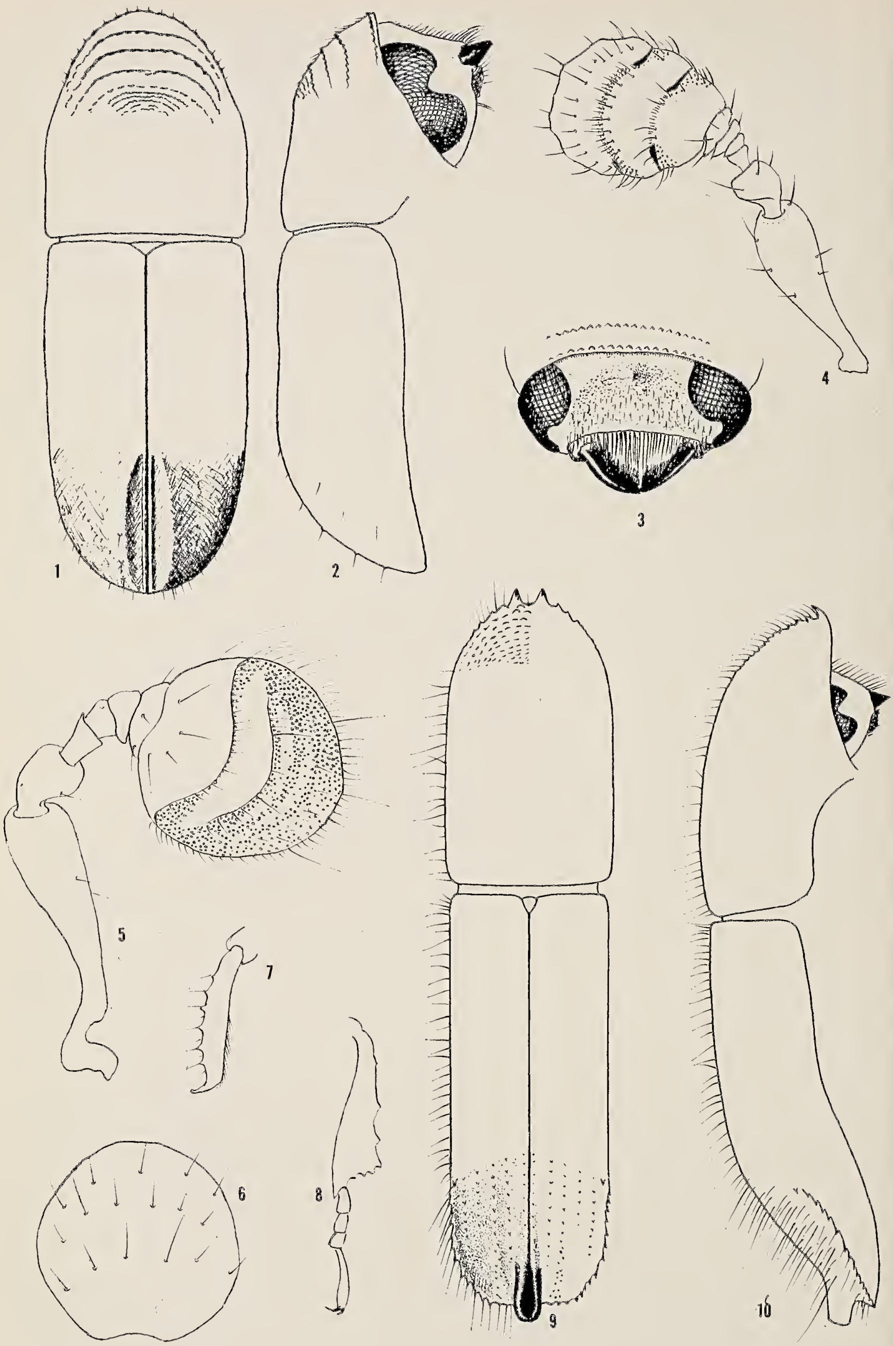
Figure 6. *Sampsonius costaricensis* sp nov., Fühlerkeule, die Rüskseite, Vergr. 115 x.

Figure 7. *Sampsonius costaricensis* sp. nov., Vordertibie.

Figure 8. *Sampsonius costaricensis* sp. nov., Hintertibie und Tarsus.

Figure 9. *Sampsonius costaricensis* sp. nov. Weibchen, von oben.

Figure 10. *Sampsonius costaricensis* sp. nov., Weibchen, von der Seite.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TAFEL II

FIGURE 1. *Cenocephalus lalolaensis* sp. nov., Weibchen, von oben.
FIGURE 2. *Cenocephalus lalolaensis* sp nov., Weibchen, von der Seite.
FIGURE 3. *Cenocephalus lalolaensis* sp. nov., Fühler, Vergr. 115 x.
FIGURE 4. *Costaroplotus shenefelti* sp. nov., Weibchen, von oben.
FIGURE 5. *Costaroplatus shenefelti* sp. nov., Kopf und Halsschild, von der Seite.
FIGURE 6. *Costaroplatus shenefelti* sp. nov., Maxille, Vergr. 115 x.
FIGURE 7. *Costaroplatus shenefelti* sp. nov., Unterlippe, Vergr. 115 x.
FIGURE 8. *Costaroplatus shenefelti* sp nov., Fühler, Vergr. 42 x.

Unterseite heller as die Oberseite. Die Vorder -und Mitteltibien aussen mit drei Zähnchen; neben den Vorderhüften, etwas seitlich, befindet sich ein ovaler Schlitz (?). Die Vorderhüften stossen zusammen, die beiden anderen Paare sind getrennt. Die Mittelfurche an der Hinterbrust sehr fein, zieht sich nach vorne bis zu ⅔ der Brustlänge. Die Bauchringe an den Seiten breiter, die zwei ersten schwach bogig, andere stärker; Pygidium von unten sichtbar als halb kreisförmige Platte.

Type in Sammlung der Universität Wisconsin.

Nach dem Bau des Kopfes und Halsschildes dem *P. elegans* Schedl ähnlich, aber die Höker auf dem Halschilde stehen bei der letztger nannten Art mehr locker; auf dem Absturze des *P. elegans* befinden sich auf der Naht feine Körnchen, während bei *semiermis* die Naht glatt ist.

Die Fühler sind sehr ähnlich denselben bei vielen Arten z. B. *Pit. regularis* Blkm. Nach dem Absturze erinnert die neue Art an *Pit. sambuci* Blkm. bei welchem aber auf dem breit abgerundetem Absturze die Punktstreifen 1. und 2. gut sichtbar sind.

12. *Sampsonius costaricensis* sp. n.

Weibchen (anatomisch festgestellt) (Taf. I. Fig. 5–10).

Länge: 3,4 mm.

Dem *Sampsonius dampfi* Schedl sehr ähnlich und am nächsten verwandt, aber verschieden durch andere Proportionen der Körperabschnitte, die Körnelung des Absturzes und Ausbildung des Fortsatzes auf dem Absturze.

Beim *S. dampfi* ist der Käfer 3,7 mal so lang wie breit, beim *costaricensis* m. 4,4 mal; die Ursache liegt in der Länge des Halsschildes, welcher beim *dampfi* Schedl 1,25 länger als breit ist, bei der neuen Art aber 1,66 mal. Die Flügeldecken sind bei der neuen Art verhältnismässig kürzer: beim *dampfi* Schedl sie sind "nahezu doppelt so lang wie der Halsschild"—beim *costaricensis* nur 1,5 mal.

Beim *dampfi* Schedl stehen auf dem Absturze die Körnchen nur auf den Zwischenräumen 3,4 und 5 und sind einreihig geordnet. Bei *costaricensis* m. sind die Körnchen auf den Zwischenräumen 1–5; die Körnchen des 1–n (Nahtzwischenraumes) und 2–n verschwinden auf der Höhe der Fortsatzbasis, auf dem dritten, welcher bis zum Apikalrande zieht, stehen sie in der oberen Absturzhälfte einreihig in der unteren mindestens zweireihig (kurz vor dem Apikalrande auch dreirehig) ; auf dem 4–n sind nur etwa 4–5 Körnchen, auf dem 5–n zieht sich die Körnchenreihe etwas weiter nach hinten, auf dem 6–n steht nur am oberen Absturzrande ein stärkeres Zähnchen; der 7–e bildet wie beim *dampfi* Schedl den Absturzseitenrand. Die Punktreihen sind auf dem Absturze zwischen den Körnchenreihen nicht "grob quergerun zelt"—sondern fein chagriniert, matt. Die Absturzfläche ist leicht gewölbt, der 2–3 Zwischenraum leicht vertieft, wodurch die Naht und der dritte Zwischenraum gehoben erscheinen; der letzte ist im apikalen Drittel etwas verbreitet. Die Zwischenräume 4–6 fallen gegen den Seitenrand allmählich ab. Beide Fortsätze an der Naht bilden beim *dampfi* Schedl "ein gemeinschaftliches stumpfes Horn". Beim *costaricensis* m. bilden sie (bei geschlossenen Flügeldecken) ein löffelartiges Gebilde, welches oben tief ausgehöhlt ist.

Die Fühlerkeule trägt auf der Aussenseite, kurz vor der Mitte, eine volkkommene Naht; die zweite mehr weniger parallele Naht verliert sich zwischen den dicht stehenden Punkten neben dem Rande; es sind noch Spuren von Weiteren zwei Nähte, welche nur durch mehrreihige Punktstreifen markiert sind. Das erste Keulenglied trägt einige steife Borsten. Auf der Rückseite sind drei bogige Borstenreihen, welche fast auf derselben Höhe laufen, wie die Nähte der Vorderseite.

Die Tibien des ersten Beinpaares sind schmal, aussen nur schwach bogenförmig erweitert und hier auf ganzer Länge mit etwa 5–6 Zähnchen. Der Endhaken ist stark und nach aussen gekrümmt. Die Tibien des zweiten und dritten Beinpaares sind allmählich erweitert und im apikalen Viertel schräg abgeschnitten.

Drei Exemplare gefangen am 20.VII.61, 24.VIII.61 und 23.VIII.61. Eine Paratype befindet sich in meiner Sammlung.

BESTIMMUNGSTABELLE DER *SAMPSONIUS*-ARTEN

1(2). Seitenrand des Absturzes nicht ausgepraägt. Am Beginn des Absturzes auf dem dritten Zwischenraume steht senkrecht ein dicker konischer Zapfen, auf dem vierten in der Mitte und kurz vor dem Ende ebenfalls ein doppelt so langer nach innen und vorn gebogener stumpfer Zahn. Körperlänge 8 mm ______*Sampsonius sexdentatus* Eggers

2(1). Seitenrand ausgeprägt. Die Bezahnung der Absturzfläche ist andere.

3(8). Auf dem Absturze jeder Flügeldecke unmittelbar vor dem Apikalrande befindet sich nur auf dem Nahtzwischenraume ein Zahn.

4(5). Der Zahn ist spitz, nach hinten und aussen gerichtet. Körperlänge 5,3 mm _____________*Sampsonius buculus* Schedl

5(4). Der Zahn ist als plattenförmiger stumpfer Fortsatz ausgebildet.

6(7). Die Firtsätze der geschlossenen Flügeldecken bilden ein gemeinschaftliches stumpfes Horn. Kleine Körnchen befinden sich nur auf Zwischenräumen 3,4,5. Körperlänge 3,2 mm ________________________*Sampsonius dampfi* Schedl

7(6). Beide Fortsätze der geschlossenen Flügeldecken stossen nicht zusammen zum gemeinschaftlichen Horn, sondern oben tief klaffen. Kleine Körnchen auf dem Absturze befinden sich auf Zwischenräumen 1–5. Am Anfange des sechsten Zwischenraumes am Beginne des Absturzes ein spitzes kleines Zähnchen. Körperlänge 3,4 mm ________________________________*Sampsonius costaricensis* sp. nov.

8(3). Die Zähne auf dem Absturze befinden sich nur auf dem zweiten Zwischenraume, zwei bis drei an der Zahl.

9(10). Auf dem zweiten Zwischenraume stehen drei gleichgrosse, kegelförmige Zähne. Körperlänge 5,5 mm ______________________________________*Sampsonius conifer* (Hagedorn)

10(9). Auf dem zweiten Zwischenraume stehen zwei Zähne; der obere ist ein spitzer Kegelzahn, der untere ist stumpf. Körperlänge 5,3 mm. ______*Sampsonius quadrispinosis* Eggers

FAMILIE: PLATYPODIDAE

Bekannte Arten

13. *Platypus dejeani* Chap.
13.V.58–12 Ex (9 Männchen, 3 Weibchen); 2.VII.61–10 Ex. (6 M., 4 W.); 10.VII.61–10 Ex (8 M., 2 W.) in cocoa plantation; 10.VII.61–2 Ex. (1 M., 1 W.); 11.VII.61–10 Ex. (5 M., 5 W.); 12.VII.61–14 Ex. (5 M., 9 W.); 18.VII.61–7 Ex. (3 M., 4 W.); 20.VII.61–1 Ex. (1 M.); 21.VII.61–4 Ex. (3 M., 1 W.); 25.VII.61–1 Ex. (M.); 26.VII.61–7 Ex. (5 M., 2 W.); 28.VII. 61–5 Ex. (2 M., 3 W.); 29.VII.61–6 Ex. (4 M., 2 W.); 30.VII. 61–15 Ex. (7 M., 8 W.); 31. VII.61–11 Ex. (9 M., 2 W.); 4. VIII.61–19 Ex. (13 M., 6 W.); 8.VIII.61–1 Ex. (W.); 10.VIII. 61–4 Ex. (M.); 11.VIII. 61–2 Ex. (M.); 13.VIII.61–2 Ex. (1 M., 1 W.); 15.VIII.61–5 Ex. (3 M., 2 W.); 23.VIII.61–1 Ex. (M.); 24.VIII.61–4 Ex. (2 M., 2 W.); 26.VIII. 61–3 Ex. (1 M., 2 W.); 28.VIII.61–3 Ex. (M.).

14. *Platypus discicollis* Dej.
24.VIII.61–1 Ex. (W.).
Gemeldet aus Brasilien, Columbien, Bolivien, Guatemala und Fr. Guayana.

Das Exemplar hat Flügeldecken fein gleichmässig chargriniert und dadurch seidenglänzend. Die Borsten auf dem Halsschilde zwischen der Mittelfurche und dem Seitenrande stehen mehr weniger an der Grenzlinie der braunen und blassgelben Farbe.

15. *Platypus obtusus* Chap.
10.VII.61–1 Männchen. in cocoa plantation.
LaLola ist der nördlichste Fundort. Bis jetzt gemeldet aus Brasilien, Fr. Guayana und Columbien.

16. *Platypus perpusillus* Chap.
2.VII.61–2 Ex. (M.) ; 10.VII.61–1 Ex. (M.) ; in cocoa plantation.
Bekannt aus Brasilien, Venezuela und Fr. Guayana.

17. *Platypus pulchellus* Chap.
10.VII.61–1 Weibchen, in cocoa plantation; 12.VII.61–2 Weibchen; 17.VII.61–3 Ex. (1 M., 2 W.) ; 18.VII.61–1 M.; 20.VII. 61–1 M.; 29.VII.61–2 Ex. (1 M., 1 W.) ; 30.VII.61–1 M.; 31. VII.61–3 W.; 4. VIII.61–2 Ex. (1 M., 1 W.) ; 8.VIII.61–1 W.; 13.VIII.61–1 W.; 15.VIII.61–1 M.; 24.VIII.61–1 M.; 28.VIII. 61–1 W.

18. *Platypus rudifrons* Chap.
2.VII.61–1 Weibchen.
Bis jetzt bekannt aus Mexico und Argentinien.

19. *Platypus subitarius* Schedl
10.VII.61–1 Weibchen, in cocoa plantation; 24.VIII.61–1 Männchen.
Bekannt nur aus Brasilien.

20. *Tesserocerus dewalquei* Chap.
2.VII.61–1 Weibchen.
Bis jetzt bekannt nur aus Südamerika (Brasilien, Argentinien, Fr. Guayana, Bolivien und Peru).
Neue Arten und Gattungen

21. *Cenocephalus lalolaensis* sp. nov.
Weibchen (Taf. II. Fig. 1–3).
Länge 3,3 mm.
Langzylindrisch, Flügeldecken nach hinten kaum divergierend; rostbraun, auf dem Absturze angedunkelt; nur am Kopfe und auf dem Absturze deutlich behaart.

Kopf mit ziemlich stark eingedrückter Stirn, die Fläche des Eindruckes glänzend, nicht punktiert; beide Seiten des Eindruckes bis zur halben Augenhöhe mit dichter Haarfranse, die Haare am Ende leicht nach innen gebogen. Übriger Seitenrand kürzer behaart, ähnlich wie der zerstreut aber ziemlich stark punktierte Scheitel. Übergang von der Stirn zum Scheitel nicht stark hervortretend. Die dunkle Scheitellinie zieht sich nach unten bis zur Mitte des Stirneindruckes. Augen unregelmässig rundlich. Fühler mit dreigliederigen Geissel (nicht viergliederig!) und langeiförmigen Keule.

Halsschild viel länger als breit, glänzend, in der Länge flach gewölbt, Seiten (von oben betrachtet) in der Mitte deutlich eingebuchtet, die basale Hälfte kaum breiter als die vordere, Basalrand angerundet, zweibuchtig. Die Pleuren mit doppelter Grube zur Aufnahme der Schenkel und Schienen; der Rand der Grube bogig ausgeschweift, ohne eckige Vorsprünge. Auf der Scheibe, beiderseits der Mittellinie ein grosser mehr weniger dreieckiger Fleck aus ziemlich grossen Punkten, die Ecken des Fleckes abgerundet, die Basis eingebuchtet. Restliche Fläche fein punktuliert und ausserdem ziemlich zerstreut grob punktiert: die Punkte an der Halsschildbasis und an den Seiten stärker.

Flügeldecken (von der Seite gesehen) oben flach, der Absturz beginnt im letzten Viertel, die Fläche des Absturzes oben sanft abgewölbt, unten fast senkrecht. Basalrand im Bereiche der Zwischenräume 1–5 gekantet. Der dritte an der Basis stärker gewölbt und hier mit etwa 5 Querrunzeln welche weiter nach hinten in Körnchen übergehen; der fünfte mit 1–2 undeutlichen Querrunzeln. Die drei ersten Puntreihen schwach streifig vertieft, den Seiten zu werden die Punkte der Streifen immer schwächer, nur der neunte ist wiederum streifig vertieft. Zwischenräume der Scheibe schwach gewölbt, die seitlichen flach, alle hie und da mit einzelnen sehr feinen Pünktchen. Alle Zwischenräume kurz vor dem Absturze deutlich gekielt und weiter hinten gekörnt, auf den ungeraden Zwischenräumen gehen die Körnchen in Zähnchen über, auf dem dritten, siebenten und neunten sind sie am stärksten entwickelt: nach hinten nehmen die Zähnchen an Stärke zu. Auf dem steilen Abschnitte des Absturzes ist die Fläche glänzend, zertreut punktiert und gekörnt, im unteren Teile, beiderseits der Naht flach eingedrückt; der mittlere Teil des Hinterrandes glatt. In der Verlängerung des dritten Zwischenraumes zieht sich ein schwach gewölbter Streifen in der Richtung des grössten Zahnes am Hinterrande. Die Zähnchen und Körnchen auf dem Absturze tragen kurze, gekrümmte Haare.

Die Vorderschieben tragen auf der Aussenseite drei quere Leisten, die mittleren zwei und die hinteren nur eine Leiste.

Zwei Exemplare gefangen am 4.VIII.61. Die Paratype befindet sich in meiner Sammlung.

BESTIMMUNGSTABELLE DER *CENOCEPHALUS*-WEIBCHEN

1(4). Auf der Scheibe des Halsschildes beiderseits der Mittelfurche befindet sich ein Fleck aus zahlreichen Punkten gebildet.

2(3). Der Fleck ist rundlich. Körperlänge 5,3 mm Brasilien ---- ------------------------------*Cenocephalus thoracicus* Chap.

3(2). Der Fleck ist dreieckig. Körperlänge 3,3 mm. Costa Rica -- -------------------------*Cenocephalus lalolaensis* sp. nov.

4(1). Auf der Scheibe des Halsschildes, beiderseits der Mittelfurche, befindet sich kein Fleck aus zahlreichen Punkten.

5(6). In der Mitte der concaven Stirnfläche befindet sich eine quere kurze Leiste. Körperlänge 4,4 mm. Fr. Guayana -------- -------------------------------*Cenocephalus pusillus Schedl*

6(5). Die concave Stirnfläche ist glatt. Körperlänge 4 mm. Guayana ------------------*Cenocephalus pulchellus* Schedl

Costaroplatus gen. nov.

Eine Gattung, welche wegen des Baues der Unterlippe und der Fühler schwer in das System einzureihen ist. Vielleicht nach dem Finden des anderen Geschlechtes (Männchens) wird es erst möglich sein. Die Gattung wird auf Grund des einzigen weiblichen Exemplares gegründet.

Kopf ohne Bruch zwischen Stirn und Scheitel, dem Kopfe des *Tesserocerus*-Weibchens ähnlich; Augen unregelmässig rundlich. Fühler mit grossem Schafte, welcher sehr stark abgeplattet und schwach löffelartig ausgehöhlt ist; auf der Vorderseite und an den Rändern ist er ziemlich lang behaart. Beide Schäfte bedecken die Stirn bis zur Hälfte der Augenhöhe, ähnlich wie bei *Tesserocranulus* Schedl, aber im kleineren Masse (die erwähnte Gattung hat lange, unten genäherte Augen!). Geissel viergliederig, Glied 1 kurz kegelförmig, das 2. verkehrt kegelförmig, um die Hälfte kürzer als Glied 1., das dritte und vierte kurz, etwas breiter. Die Keule solid, unregelmässig länglich oval, nicht viel grösser als der Schaft.
Maxillen mit gesonderten Laden, die Tasterglieder stark abgeplattet, membranenartig. In der Unterlippe sind sowohl die Tasterträger wie auch die beiden ersten Glieder verwachsen, weshalb separat nur die letzten Glieder ausgebildet sind. Eine faltenartige Zunge ist auch zu bemerken. Durch diesem Bau wohl am meisten der *Crossotarsus*-Gattung genähert, bei welcher aber nur die Tasterträger zusammengewachsen sind, fehlt aber das zweite Stück, welches durch Zusammenwachseb der beiden ersten Glieder entstanden ist.

Halsschild Platypodiden-artig, ohne Poren oder Punktfleck, mit feiner Furche. Der Rand der Schenkelgruben nur hinten eckig, und hier mit einer fast halbkugeligen, tiefen Eindellung (ähnlich aber stärker als bei manchen *Crossotarsus*-Weibchen, z.B. *Cross nipponicus* Bldf.). Flügeldecken wie beim *Platypus*-Weibchen.

Die Vordertibien mit 6 Querleisten, die mittleren mit drei, die Hintertibien ohne derselben. Tarsen wie beim *Platypus.*

22. Genus-Type: *Costaroplatus shenefelti* sp. nov.
Weibchen (Taf. II. Fig. 4–8).
Länge: 4,4 mm.

Hell graubraun, Scheibe der Flügeldecken und die Unterseite etwas heller. Wegen sehr feinen Grundchagrinierung seidenglänzend. Behaarung kaum nennenswert, spärlich, kurz.

Stirn über dem schwarzen Clypeus beiderseits der Mitte länglich schwach eingedrückt, auf der Höhe der Augen in der Mitte stärker gewölbt und hier mit einem feinen, schwarzem Strich, welcher etwas über die Hälfte der Augenhöhe zieht. Die Scheitellinie sehr schmal. Stirn in der oberen Hälfte fein eingestochen punktiert, stärkere Punkte sind in beiden länglichen Vertiefungen über dem Clypeus.

Halsschild um ¼ länger als breit, in der basalen Hälfte etwas breiter als vorne, mit gut von oben sichtbaren Einbuchtungen der Schenkelgruben. Die Furche zart. Punktierung auf der Scheibe sehr spärlich und fein, stärker gegen die Seiten und Basis.

Flügeldecken fast zweimal so lang wie der Halsschild, hinter der Mitte kaum breiter als an der Basis, hinten fast quer breit abgerundet. Punktstreifen sehr fein, Punkte klein; der Nahtstreifen etwas eingedrückt. Die Basis des dritten Zwischenraumes erweitert und mit einigen Querrunzeln und Körnchen. Absturzfläche zweimal so breit wie hoch, kurz behaart mit Ausnahme eines schmalen Streifens unterhalb der Bruchlinie des Absturzes.

Holotype in der Sammlung der Universität Wisconsin.

CHANGING REGIONALIZATION OF SHEEP HUSBANDRY IN WISCONSIN

Stephen L. Stover

The Wisconsin dairy cow has gained such prominence that the state's other farm animals are often overlooked. This is understandable, for dairy cattle in 1960 accounted for about 63% of the income from livestock and livestock products in the state. In this paper, however, the focus turns from dairying to sheep-raising, at the present time not high in statistical importance. In 1960 it accounted for 3½ million dollars, about .35% of farm income from livestock.[1]

The procedure in this study in historical geography is to examine the sheep-raising industry at selected intervals in time and thus to develop a series of cross-sections centering on distribution maps based on county units. Emphasis is on evolving patterns as a means of understanding the place of sheep husbandry in the total picture.

The first sheep in Wisconsin apparently were the seven head purchased at Mackinac and shipped to Green Bay in a barge about 1790. In the southeastern part of the territory, sheep were brought in—to Walworth County—around 1840, "after the wolves were mostly exterminated."[2]

Wisconsin's 3500 sheep in 1840 were concentrated in the southeast. Almost ¾ (73%) of them were in the six counties bordering Illinois. Milwaukee County, then including the area to become Waukesha County, reported the most, 798; no county averaged more than about 1 per square mile.[3] There was little emphasis on stock raising. Wheat was and continued to be the main source of income until about 1875 although in 1850 there were already reports of poor winter wheat crops with blame being placed on continuous cropping to wheat. The answer to the need for a change in emphasis was seen in more animal husbandry. Interest in swine-raising was growing, and a report from Jefferson county asserted: "The

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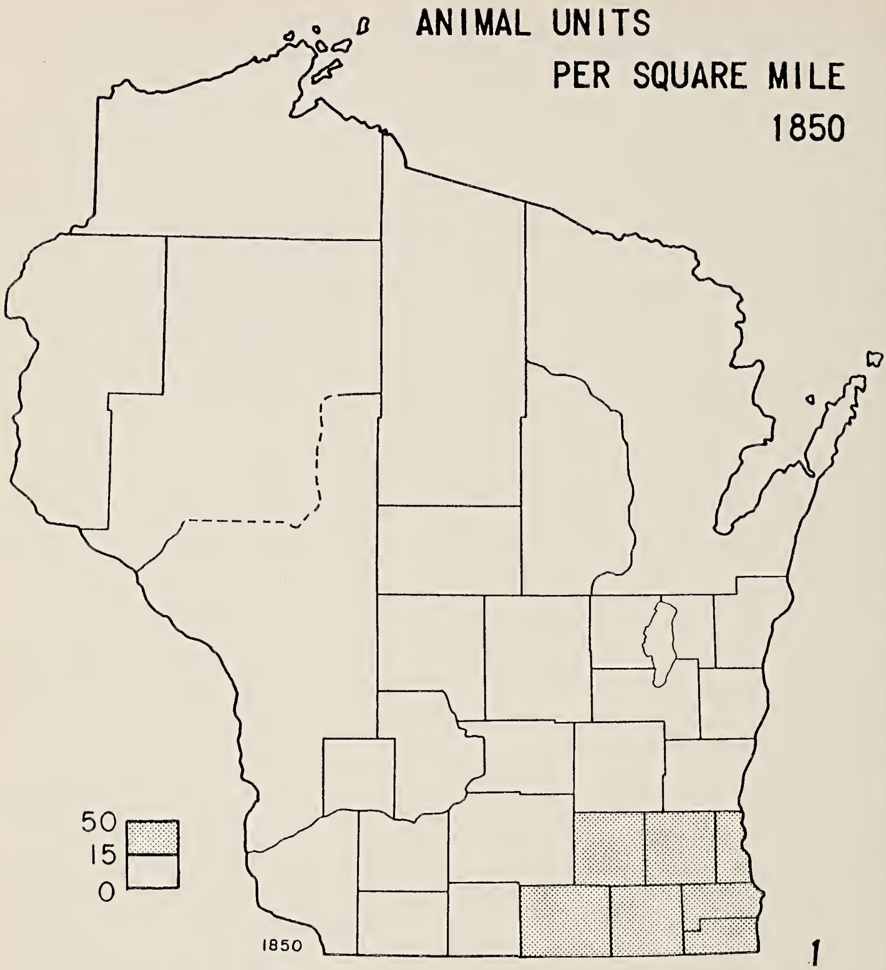
[1] In 1960 the rest of Wisconsin farm income from livestock and livestock products was derived approximately as follows: cattle and calves 17%; hogs 12%; chickens and eggs 7%; turkeys 2%. Calculated from: Wisconsin State Department of Agriculture (WSDA), *Wisconsin Livestock, Dairy, and Poultry,* Special Bulletin 78 (Madison: 1961).

[2] An exception to the generalization that sheep could not endure frontier conditions was the wether reported to have strayed from Prairie du Chien in 1837 and to have survived two winters on its own before being discovered, killed, and eaten in the spring of 1839. Wisconsin State Agricultural Society (WSAS), *Transactions* (I: 1851) 146.

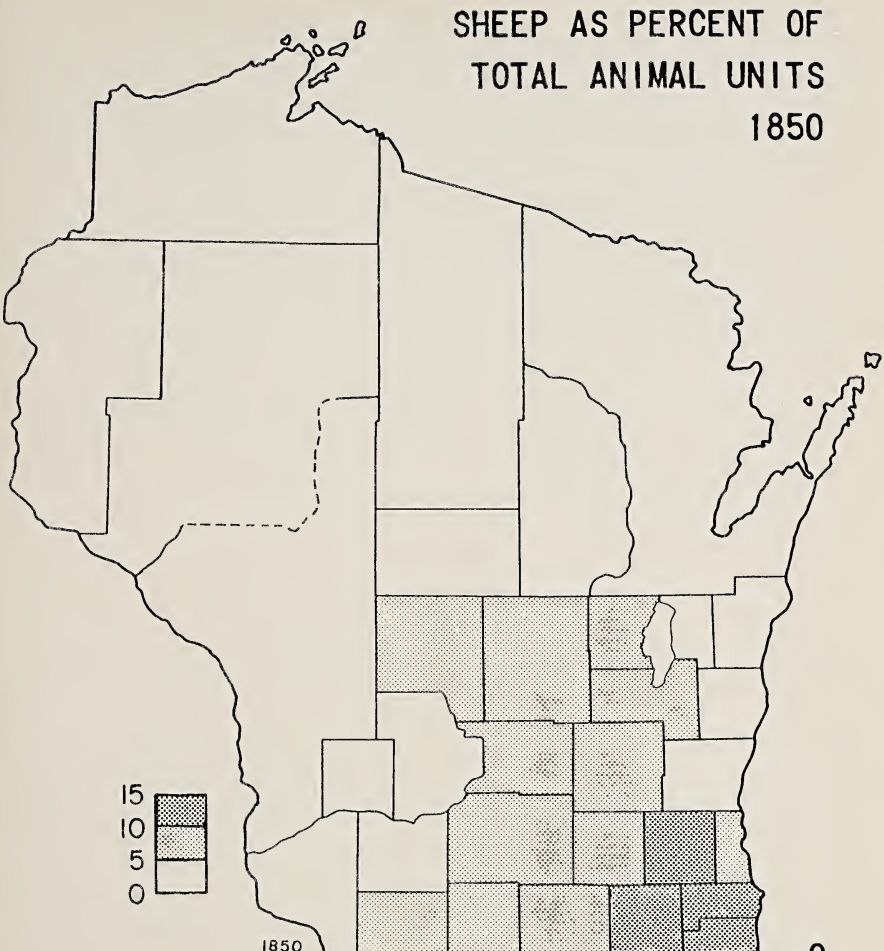
[3] United States Census (1840), 342 ff. For the state the average was about 11 sheep per hundred persons, the inhabitants numbering then about 31,000.



substitution of sheep husbandry for exclusive wheat-growing will doubtless be found profitable on our best grass lands, if not in every part of the county." From Kenosha another correspondent wrote, "The wool-growing business seems to be the special order of the day among our most enterprising farmers . . ."[4]

Wisconsin farm animals, considered as animal units, were distributed in 1850 as shown in figure 1, a pattern confirming the con-

[4] WSAS, *Transactions*, I, 177. He reported further that there were "some very respectable dairies in this county," that their output was steadily increasing, and that he could see "no reason why Wisconsin should not become a cheese-exporting instead of a cheese-importing State. . ." One of the reported drawbacks to expansion of livestock raising and especially of dairying was the lack of cultivated grasses suitable for hay for fall and winter feeding. The answer, appearing in 1850, was clover and timothy. See *Ibid.*, 213, 225.



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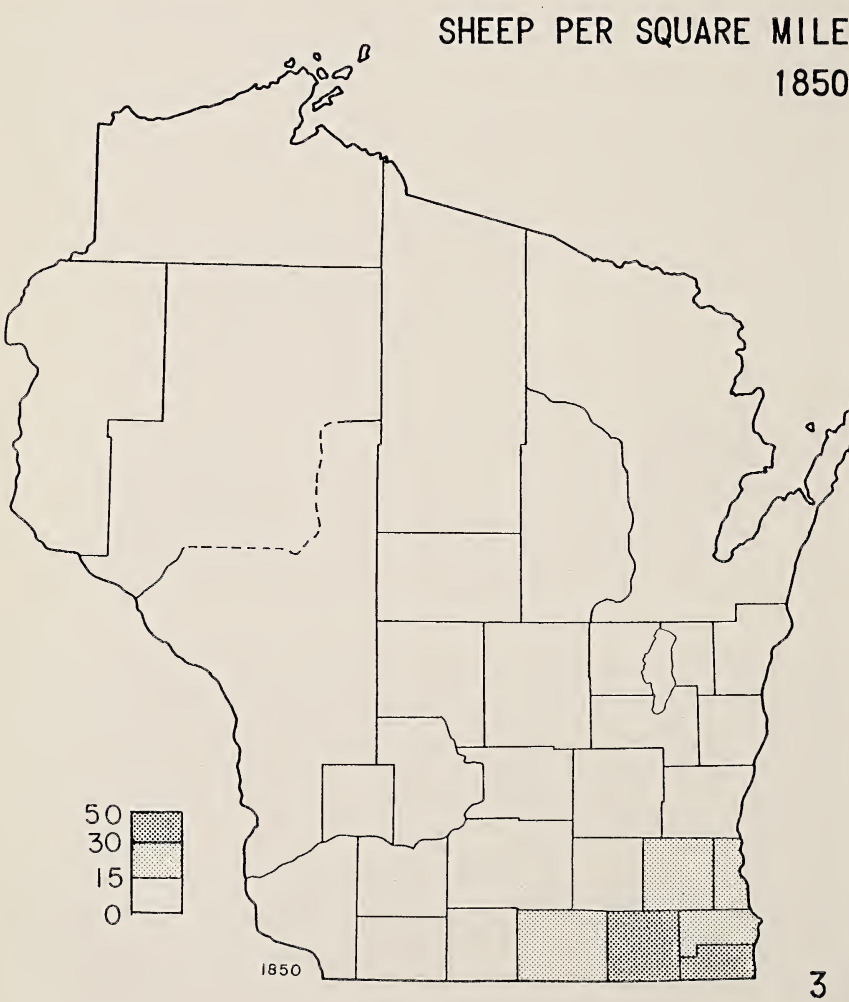
centration of agricultural settlement in the southeast.[5] Sheep, numerically a poor third to cattle and swine, were relatively most important in four southeastern counties, but even in these they comprised less than 15% of the animal units (figure 2). Highest in this regard was Walworth with 14½%, but 5–10% was more

[5] The term, "animal units," is used to equate different kinds of farm livestock on the basis of their feed requirements. In this study one mature cow is considered as the standard or one animal unit, and other livestock are equated to this standard as follows: one horse, five swine, seven sheep, seven goats. The general ratios employed in this study are those cited by Wellington D. Jones, "Ratios and Isopleth Maps in Regional Investigation of Agricultural Land Occupance," *Annals of the Association of American Geographers,* XX (December, 1930), 177–195.

typical elsewhere south of the Fox-Wisconsin line. In 1850 sheep were recorded on farms in 24 of the state's 30 counties, but in general they were still few and far between (figure 3). Only in the extreme southeast did they appear in significant numbers on a county level, Kenosha averaging 47 per square mile, followed by adjacent Walworth with 41.

Wool provided the primary incentive for keeping sheep since tastes then as now ran to beef and pork, and many people preferred wild game to mutton as a supplement. Wool, however, filled a real need for fibers, and as a cash crop it could easily be stored and shipped. Spinning at home was the early practice, but by 1850



woolen factories had made their appearance.[6] Merinos usually were preferred though coarser-wooled breeds were also grown.[7] By 1850 some farmers could boast of flocks improved by imports of pure breds from Vermont, New York, or Ohio, even a few direct from Europe.[8] Improved stock meant heavier fleeces, but judged from the average yield per animal shorn (2.03# as compared to 8.3# in 1959), improved breeding had just begun in 1850.[9]

Turning from the state pattern to the county having the highest sheep density, we may direct our attention to Kenosha. Sheep there were most numerous in Pike (later re-named Somers) township, where the average was about 88 per square mile. Even here, however, farmers with sheep were the exception—61 of the town's 85 farms reported none at all. Half the flocks were small, containing fewer than 20 animals each, and the bulk of the town's 3165 sheep were kept in a few large flocks, of which there were seven over 200, the largest reporting 700. Kenosha's lowest average density was reported by the lakeshore town of Southport, where the 49 sheep were kept on three of the town's 28 farms.[10]

1870

During the next twenty years numbers of sheep along with other livestock reflected the state's growing population, which by

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[6] WSAS, *Wisconsin: Its Natural Resources and Industrial Progress* (Madison 1862), 45. See *Wisconsin and Iowa Farmer and Northwest Cultivator,* IV, No. 6 (1852). An advertisement describes a mill as "largest and best establishment in the State. Will make any kind of cloth desired for one half the product or at a charge of 25–38¢ per yard." The proprietor warranted his "heavy, well-twisted cloths to do twice the service of those bought in the Eastern market." See also John G. Gregory, editor, *Southeast Wisconsin: A History of Old Milwaukee County,* II (Chicago, 1932), 656 ff.

[7] Reuel Bryan Frost, *The Geography of the Distribution of Sheep in Wisconsin* (unpublished thesis, M. Ph.: Madison, 1928), 10. Frost describes southeast Wisconsin as a Merino stronghold as of 1855. Further indication of the preference for fine-wooled sheep is given by the entries in the State Agricultural Society's First Annual Cattle Show and Fair in 1851. There were 7 long-wools, 3 medium-wools, and 71 fine-wools. WSAS, *Transactions,* I, 54. Introduction of Merino sheep hastened the decline in the use of linen in Wisconsin although of more importance was the rapid growth of cotton culture and manufacturing. Methods were also devised to mix wool and cotton in a variety of fabrics. Fred L. Holmes, *Wisconsin: Stability, Progress, and Beauty,* (Chicago:1946), I, 484.

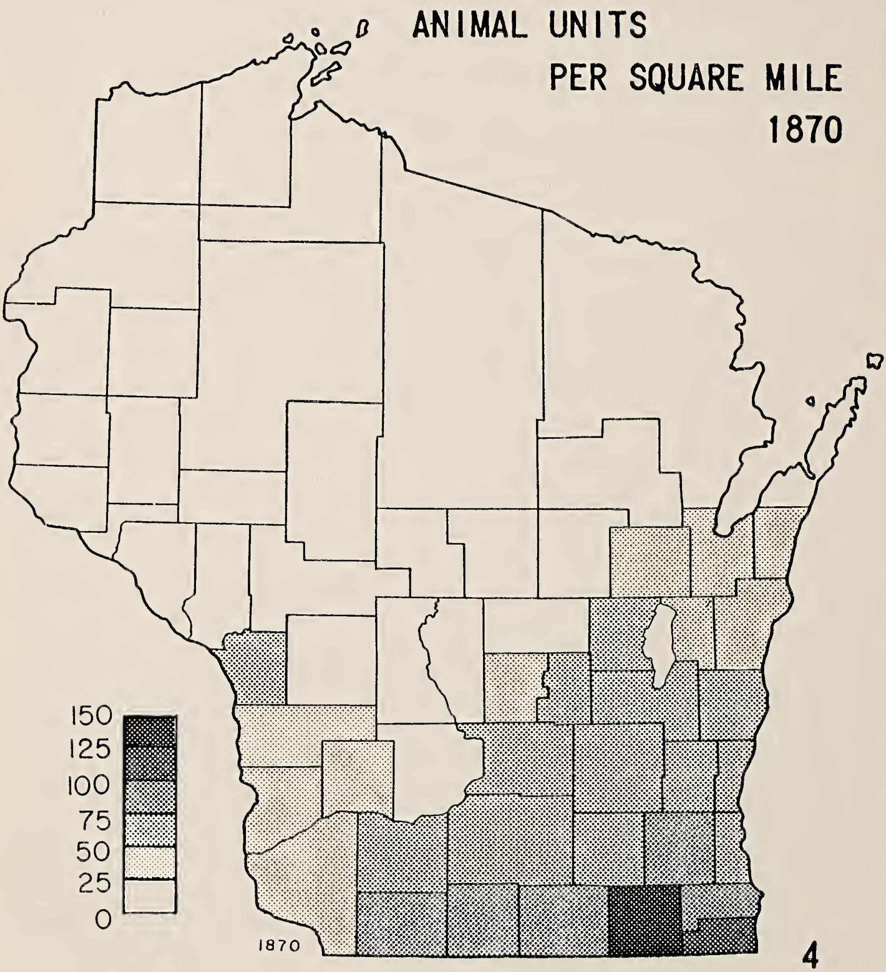
[8] N. B. Clapp, a prominent livestock farmer of Kenosha, raised several varieties of purebred sheep. He had bought Spanish Merino ewes in Vermont, and the original stock for his flock of 500 Saxony Merinos had come from Dutchess County, New York in 1844. WSAS, *Transactions,* I, 54. Joseph Schafer suggests that among Wisconsin farmers, sheep held the highest place among improved livestock at that time. Joseph Schafer, *A History of Agriculture in Wisconsin* (State Historical Society of Wisconsin: 1922), 115.

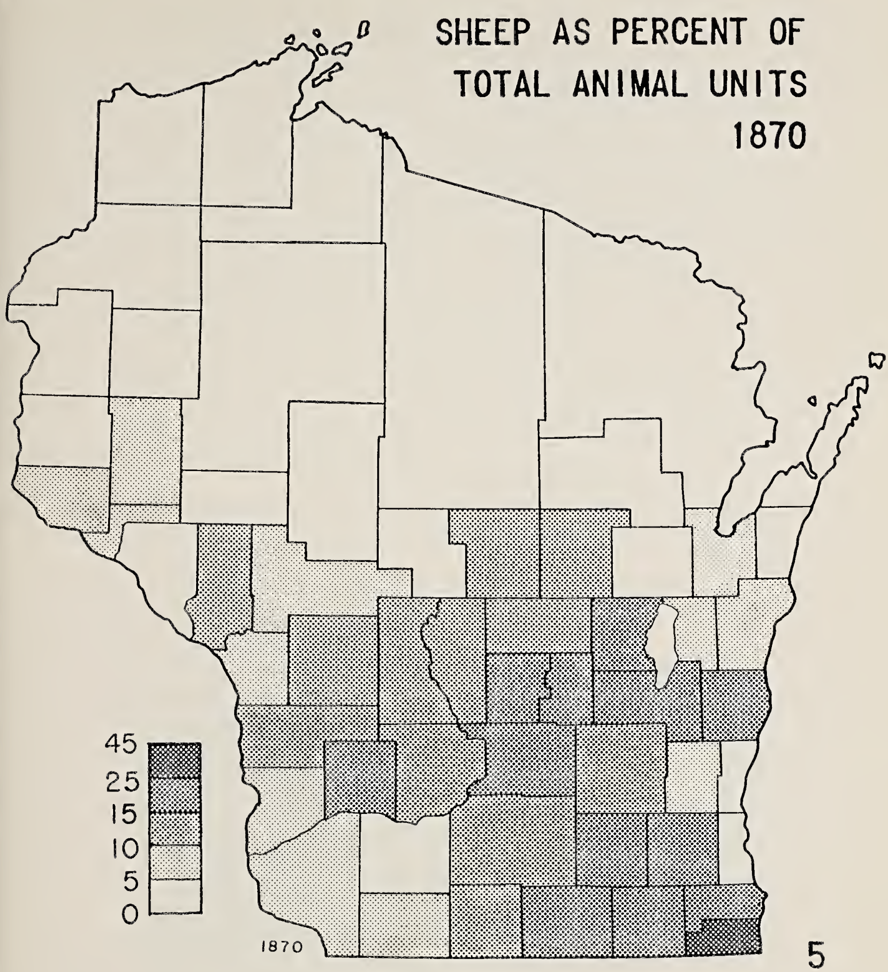
[9] Western Historical Association, *History of Walworth County, Wisconsin* (Chicago: 1882), 158.

[10] United States Census, 1850: Schedule 4 Mss. The farm with the flock of 700 was composed of approximately 1200 acres of which about 50% were unimproved. Its production in 1850 was: wheat, 3000 bushels; oats, 1500 bushels; corn, 250 bushels, Among farm livestock sheep were far and away the most important, but there were also 30 hogs, 16 milch cows, 8 working oxen, and eleven horses. When not otherwise specified, data on livestock numbers cited in following pages are from U.S. Census, appropriate year.

1870 reached 1.1 million. At that time there were 1.2 million animal units (figure 4), an increase of some 60% over 1850; whereas six counties were supporting 25 or more animal units per square mile in 1850, 21 counties had reached that average twenty years later. The pattern of distribution was basically unchanged although the southeast-northwest gradient was much more marked.

When the proportion of sheep among total animal units is considered, the change in distribution is more complex (figure 5). In 1870 the state had twelve counties with more than 15% of their animal units in sheep and one (Kenosha) with 26%. Though farm livestock were sparse beyond the Fox-Wisconsin line, a half-dozen counties in 1870 were reporting enough sheep to comprise 10% or

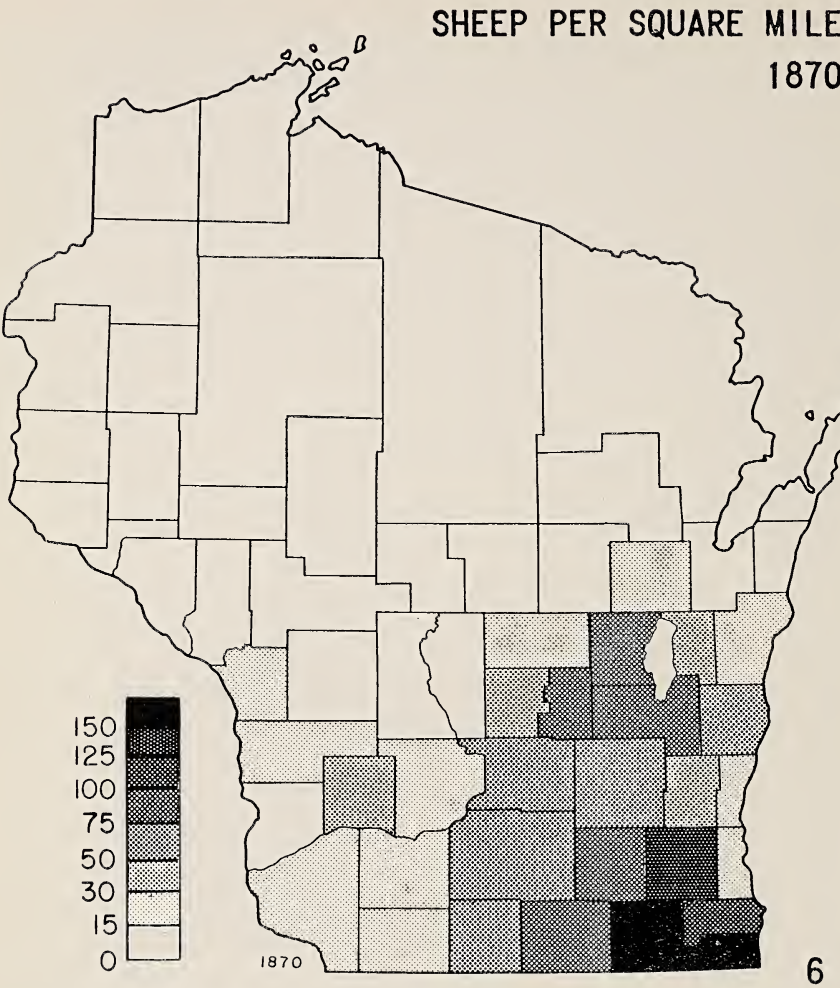




more of their animal units. Sheep numbers had reached their peak at about 2 million in 1868.[11] The war-bolstered wool market had weakened as southern cotton fields again became productive, and the price of wool between 1864 and 1867 fell from $1.05 to .29 per pound.[12] Discouraged sheep farmers—especially those specializing in fine wool—reduced their flocks, often by selling for shipment to western ranges. Mutton breeds (long and medium wools) were substituted for the fine wools by some farmers, while others

[11] Frost, 10. Wisconsin Crop and Livestock Reporting Service, *A Century of Wisconsin Agriculture, 1848–1948* (Madison, 1948) estimates almost 1,600,000 head in 1867, implies it was a peak year. 61.

[12] Milwaukee Chamber of Commerce (now Milwaukee Grain and Stock Exchange), *Report, 1867* (Milwaukee, 1868), 39.



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turned from both wool and mutton to take up the more dependable business of dairying.[13]

Figure 6 indicates the larger total sheep population in the state as compared to 1850, and the continued prominence of the southeast, where the leading county now averaged 181 sheep per square mile as opposed to 47 two decades before. In general, the average density, as expected, still fell away toward the northwest, but the appearance of a secondary center south and west of Lake Winne-

[13] Schafer, 126. During the war years cattle breeding had received less stimulus than had wool-growing and crop-raising. In fact the number of cattle in the state in 1866 had been approximatly 413,000, in the neighborhood of 25% as compared to 1860. WSAS, *Transactions*, VII (Madison, 1868), 41. See also Commissioner of Agriculture, *Report . . . for the Year 1869* (Washington, 1870), 537 ff.

bago had complicated the pattern somewhat. Significant numbers of sheep were beginning to appear north and west of the Wisconsin River, growing in importance somewhat faster than farm livestock as a group. At this time in Wisconsin quality of breeding stock was considerably above the level of 1850. With reference to Wisconsin the United States Commissioner of Agriculture reported in 1869: "Farmers hope to rival Vermont and Michigan in breeding fine horses and sheep, Kentucky in cattle, and perhaps New York in the dairy business . . . Cattle breeding has not received its proper share of attention, owing partly to the great interest concentrated in wool-growing."[14]

As was true in 1850 the distribution pattern for the state in 1870 emphasizes the southeastern counties with Kenosha again heading the list (181 sheep per square mile). The town (Pike) with the highest average density in 1850 had fallen to last place in the county while Bristol, one of the two lowest towns in 1850, reported an average of almost 300 sheep for each of its 36 square miles. The western and southwestern towns were prominent in both years.

Within Bristol Town ¾ (74%) of the farmers were now keeping sheep; only a small proportion belonged to large flocks. Thus the absolute rise in sheep numbers is associated with a higher proportion of farms keeping sheep and also with a rise in the number of medium-sized flocks. The most common flock size had now become 50–100 as opposed to 1–20 in 1850. For the state as a whole the impressive rise in sheep numbers as compared with 1850 was the result of a widespread shift into sheep-raising rather than merely an expansion of flocks on those farms where sheep-raising had been a specialty.

1900

The next cross section is that of 1900. At that time the number of stock sheep (1.1 million) was about the same as it had been thirty years before although the long-range downward trend was already taking shape. There had been a temporary upturn in the mid-1880's and another in the mid-90's, but each crest was somewhat lower than the one before, in spite of the efforts of those who insisted that sheep-raising was more profitable (both wool and mutton being for sale), less confining, and more conducive to soil fertility and weed destruction than was true for other types of farm production.[15]

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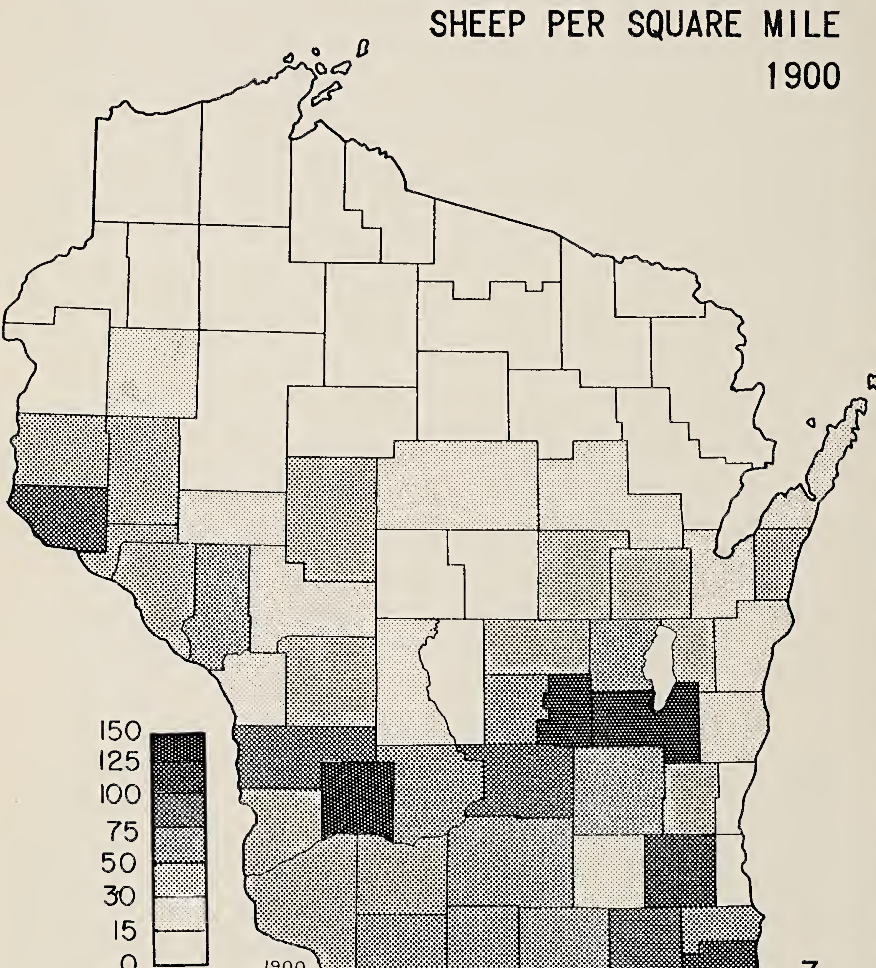
[14] Commissioner of Agriculture, *Report*, 537.

[15] United States Department of Agriculture (USDA), *Origins and Growth of Sheep Husbandry in the United States* (Washington: 1880), 10. It was suggested by William F. Renk, among others, that dairymen might do well to raise small flocks of sheep upon their farms. Wisconsin Live Stock Breeders Association, *Directory* (Madison: 1912), 58.

The pattern in 1900 shows a pronounced shift to the westward with the far southeast now overshadowed by two other areas—one farther north centering on Fond du Lac and Green Lake counties, and one north of the Wisconsin River in Richland county (figure 7). The center of gravity remained in south-central Wisconsin, but



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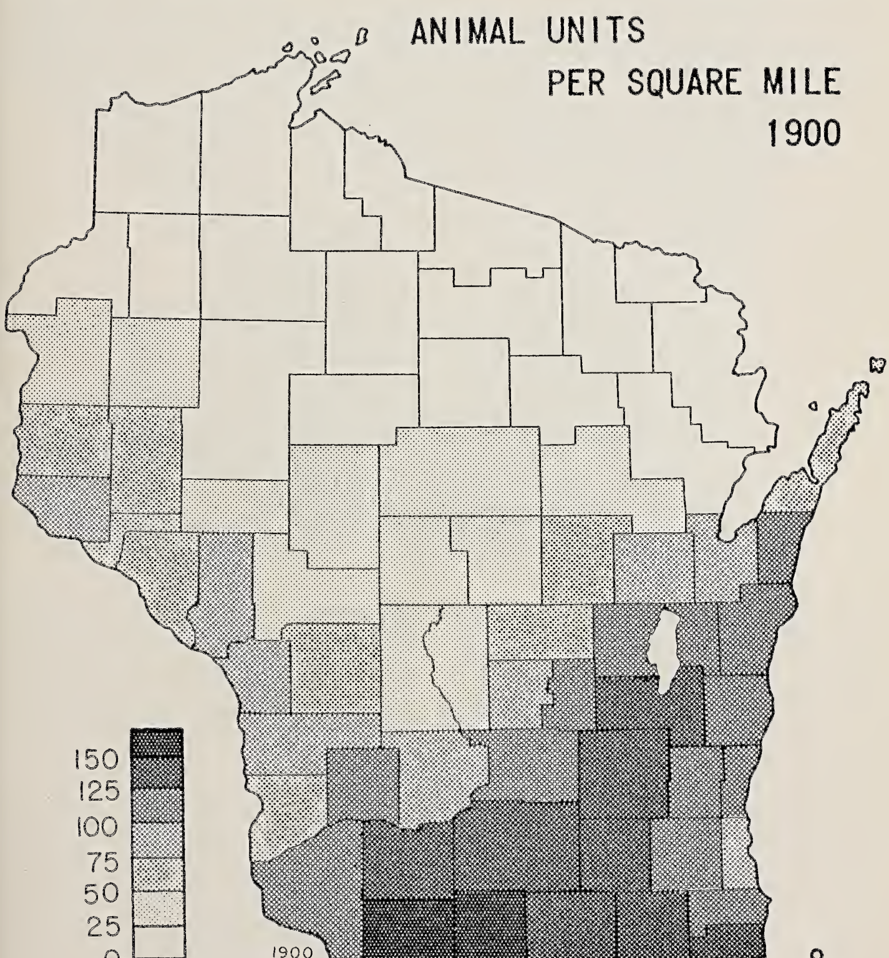
an extension of sheep-raising toward Green Bay and the Door the Mississippi. The northern part of the state together with the central counties of Adams, Wood, and Portage retained character-Peninsula was more than balanced by growth of the industry along istic low density, but the area with a density below 15 was not noticeably smaller than it had been in 1870. Thus, although the number of sheep in 1900 was about the same as it had been three decades before, they were now more widespread with leading counties not only farther northwest but also less densely populated with sheep. This section was not heavily populated by other types of farm livestock, as well, as figure 8 shows. The distribution pattern of animal units emphasizes the concentration of farm livestock in southern Wisconsin with an extension of high density counties to the northeast and a less impressive one to the northwest.

Comparison of figures 7 and 9 points up the fact that those counties with highest average densities of sheep and those where sheep rank highest in comparison to other livestock are not necessarily one and the same. Fond du Lac, for example, stands out in absolute



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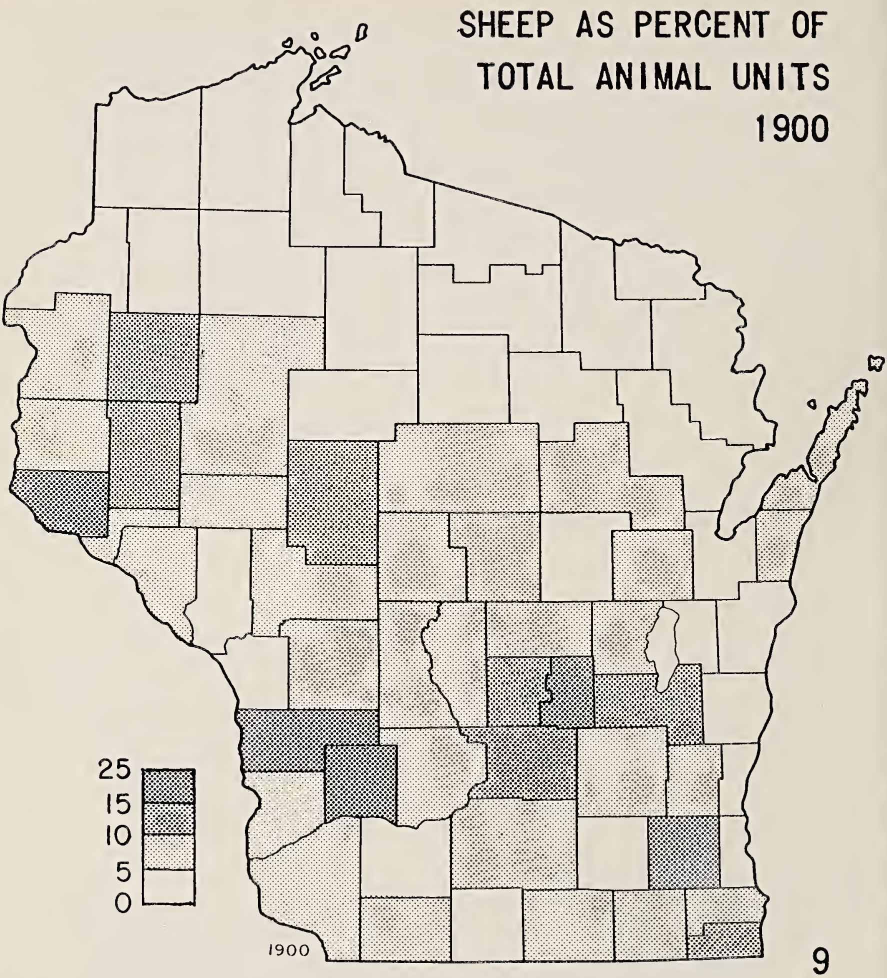
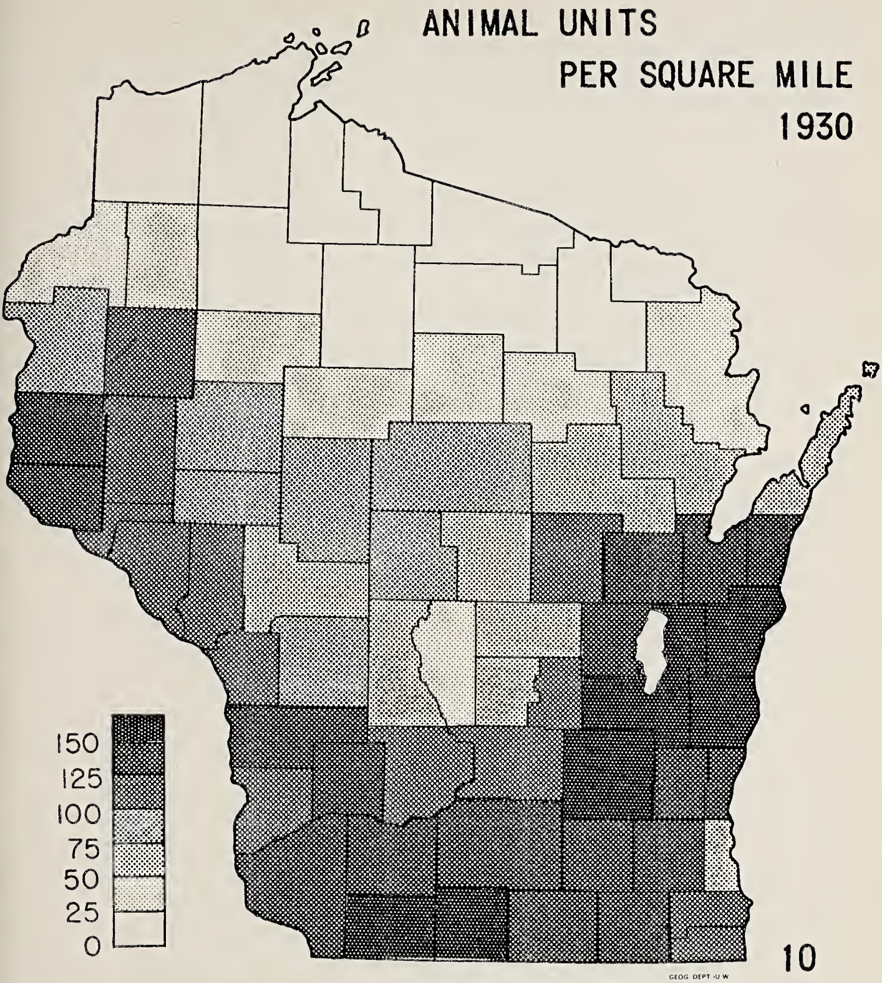


numbers of sheep, but it is not outstanding with reference to the proportion of sheep among its total farm livestock. In general, however, figure 9 reinforces the interpretation made from figure 7 and perhaps makes more noticeable the greater relative importance of western counties in 1900 as compared to 1870 as well as the continued low density in the north.[16]

[16] This low density in northern counties persisted despite efforts to interest potential settlers in moving into that part of the state. They were assured of cheap land, a drained soil, medium natural pasture, and a liberal supply of water with no wolves and no dogs to plague their flocks. They were further told that disease would be no problem since "Snuffles, internal worms, scab or foot rot are altogether unkown to the sheep; a condition that is highly indicative of the adaptation of the climate and soil for sheep life." John A. Craig, "Dairy and Sheep Farming at Superior," Wisconsin Agricultural Experiment Station (WAES) Bulletin 43, *Agricultural Horticultural and Livestock Features of a Portion of Wisconsin Tributary to Superior,* (1895), 47.



In 1900 there was increasing preference for dual purpose animals as opposed to fine wools. Arguments supporting this change in emphasis were: the growing population, the high cost of beef, the inferiority of pork, the demand for good mutton, and the increase in price of worsted wools as compared to fine wools.[17]

[17] USDA, *Origins,* 9. As the relative importance of Merinos went down, so too did interest in the Wisconsin Sheep Breeders and Wool Growers' Association, started in Whitewater, 1877; its last meeting was held in 1900. Western Historical Association, *Cyclopedia of Wisconsin* (Madison, 1906), 346. This was "the first breed association to be active in the state. It was a successor to the Wool Growers' Association which was organized at Oshkosh in 1866. In 1889 the Southeast Wisconsin Sheep and Wool Growers' Association was organized. Milo Milton Quaife, *Wisconsin, Its History and Its People.* (Chicago), 56. In 1904 the Wisconsin Sheep Breeders Association appeared. Its membership was largely breeders of Shropshires, a dual purpose breed popular with Wisconsin farmers.

The county leading in sheep density in 1900 was Richland with 146 per square mile. There the range was from 11 in Buena Vista township in the southeastern part of the county to 174 in Marshall in the northwest.

1930

In 1930 the total number of livestock units had reached 4½ million, up about 28% from 1900. Their distribution in terms of county averages per square mile (figure 10) was fairly similar to what they were shown to be in the preceding geographical cross section (figure 8). A northward extension of stock-raising was evident, but it was not simply a later edition of the 1900 pattern, for Adams county had now become the center of a low-density area bounded on the north by a statistical ridge some two counties wide. There were also changes farther to the south. Dodge county and four contiguous ones to the northeast had joined Lafayette and Green as the most outstanding in the state so that the "center of growth" appears noticeably northeastward. At the same time in the west and northwest increases were apparent also, especially in Pierce and St. Croix counties.

In this general rise in the livestock population between 1900 and 1930, sheep were not keeping pace. In 1900 they had been sufficiently important to comprise 5% or more of the animal units in 43 counties, but in 1930 no county could qualify. The nearest was Green Lake with 4.6%. It is not surprising then that the pattern is rather a faint one (figure 11).[18]

The leading county was again Richland, now one of five scattered counties with a density of thirty or more. The map in general suggests a shift to the westward as eastern and southeastern counties dropped below the threshhold for this study—i.e. below 15 head per square mile. Richland's 24,000 sheep in 1930 were less than ⅓ the number in 1900 though distributed in a pattern roughly similar.

Medium-wool sheep had long since supplanted almost all of the pure Merinos in Wisconsin. Nevertheless, the wool clip remained consequential, and it was at this time that the Wisconsin Co-operative Wool Growers Association came into being.[19]

The practice of fattening lambs in feed lots was not new, but it had assumed a greater importance than in 1900, especially in those parts of southern Wisconsin where surpluses of corn and pea vines

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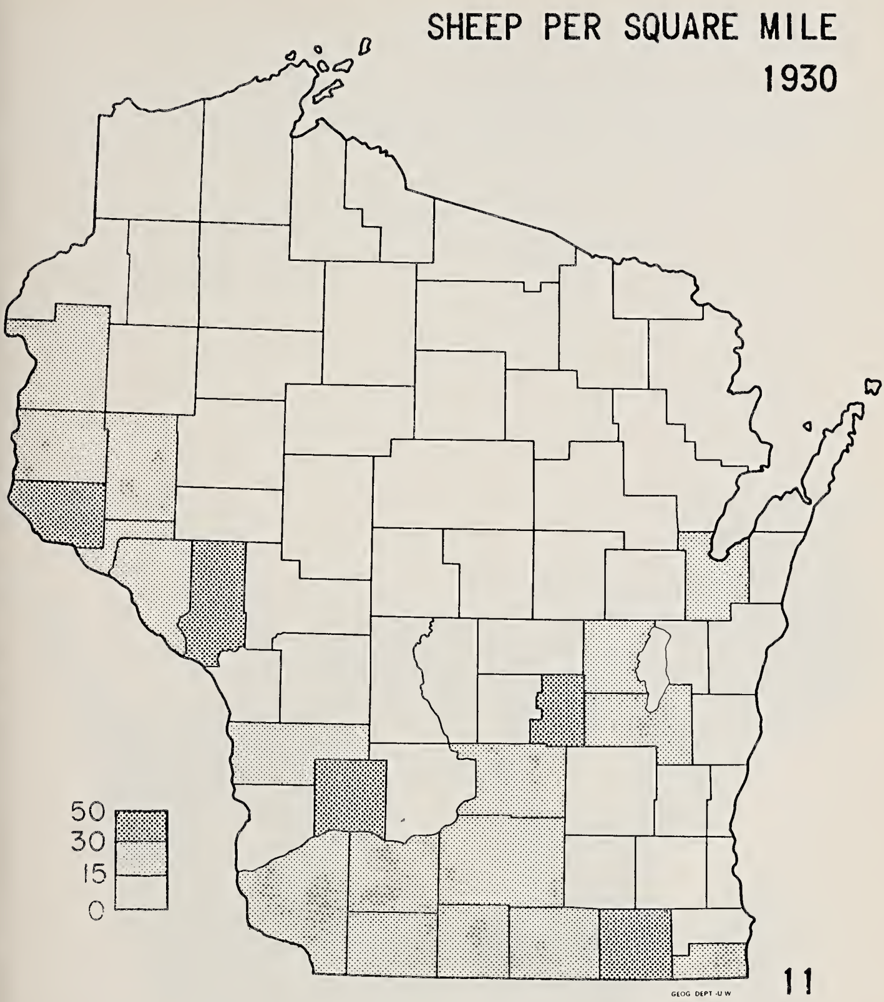
[18] On these maps northern Wisconsin still does not show much evidence of the efforts directed toward stocking its vast acreage of cut-over land with sheep. During World War I the College of Agriculture had been active in aiding in the introduction of small flocks of breeding ewes into that part of the state. R. B. Pixley, *Wisconsin in the World War* (Milwaukee, 1919), 359–360. See also WAES Bulletin 306, *The Soils of Northwest Wisconsin*, (second edition, April, 1922).

[19] Wisconsin State Department of Agriculture and Markets, *Biennial Report*, 1929–30, 13.

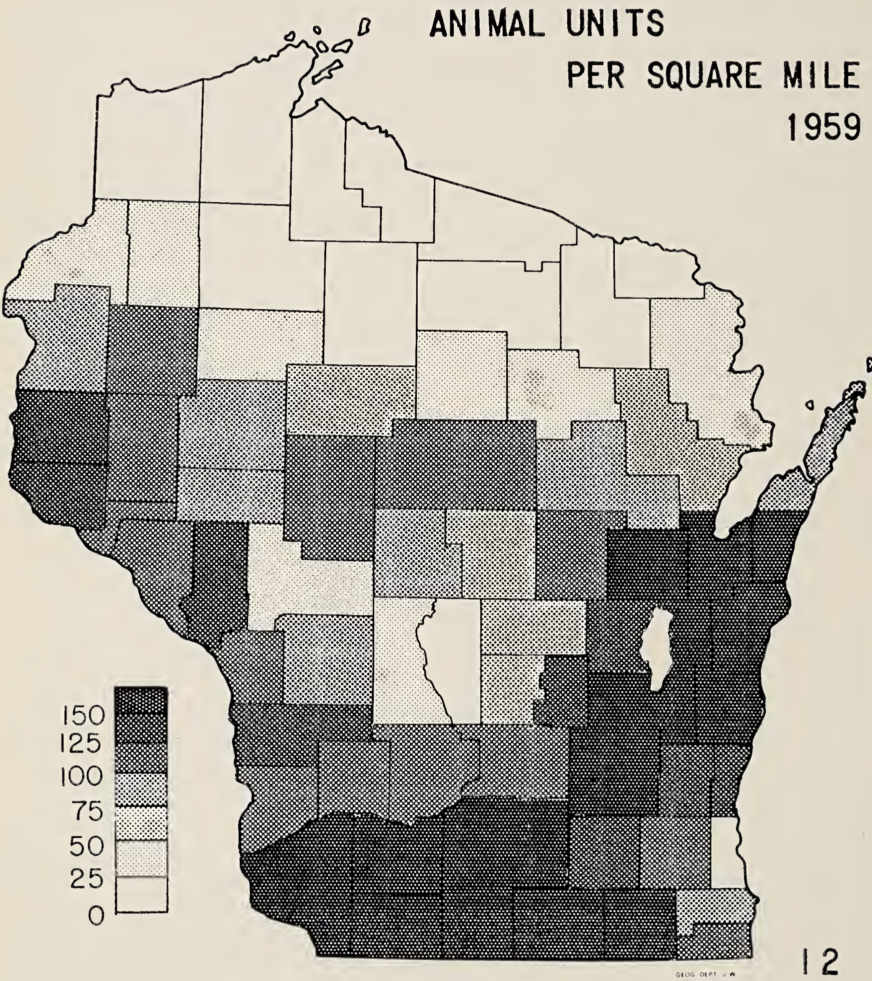


facilitated the practice. On feed in 1930 were approximately 500,000 lambs, about 30% of them shipped in from the western range. Few lambs on feed are included in the figures on which these maps were based because of the late enumeration date (April 1), but generally Wisconsin's western hills were prominent in the feeder lamb picture. This suggests a utilization of pasture on slopes difficult to crop while the more tillable surfaces were producing the winter feed.[20]

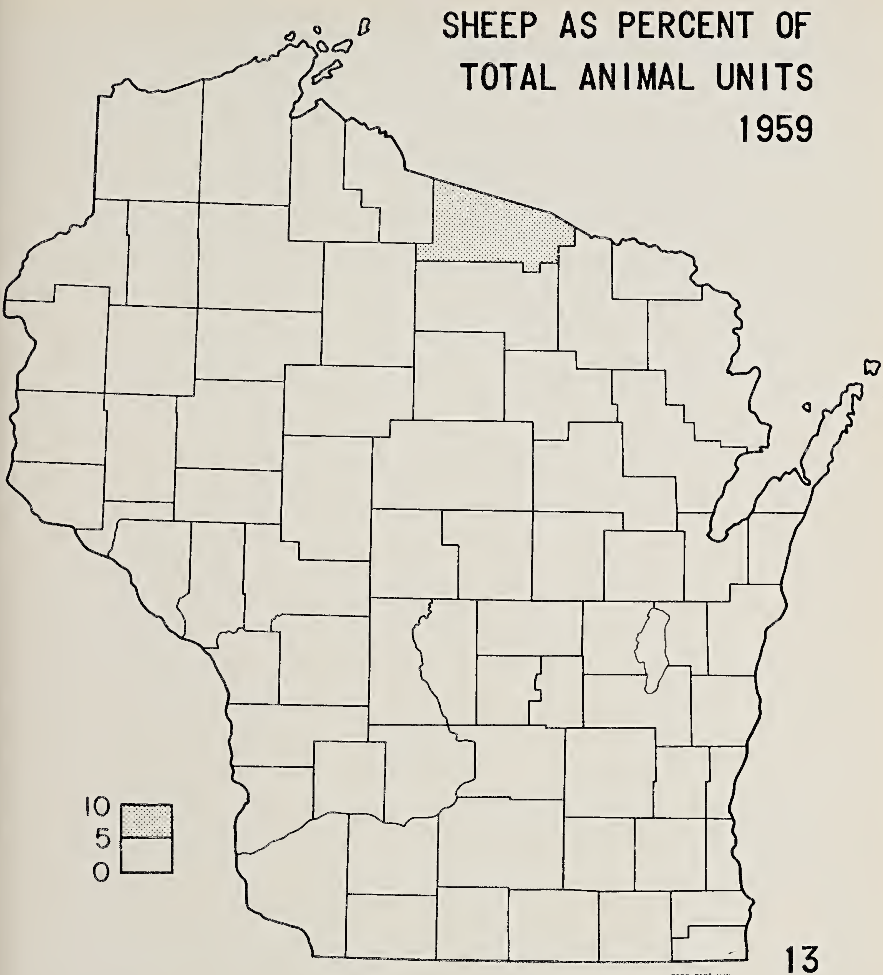
[20] See Frank Kleinheintz, "The Sheep Industry in Wisconsin," *Directory of the Wisconsin Livestock Breeders Association, 1924–25* (Madison: 1925), 25; and WAES, Bulletin 306, 28.

1959

In 1959 animal units numbered 4.7 million, an increase of about 4½% over the figure for 1930. The distribution of these farm animals (figure 12) was very little different from what it had been in



1930 (figure 10), but their concentration south and east of the Fox-Wisconsin line was somewhat more noticeable. The low-density area of northern counties was unchanged, but the paucity of livestock in the central sand plain and in Milwaukee county was even more pronounced.



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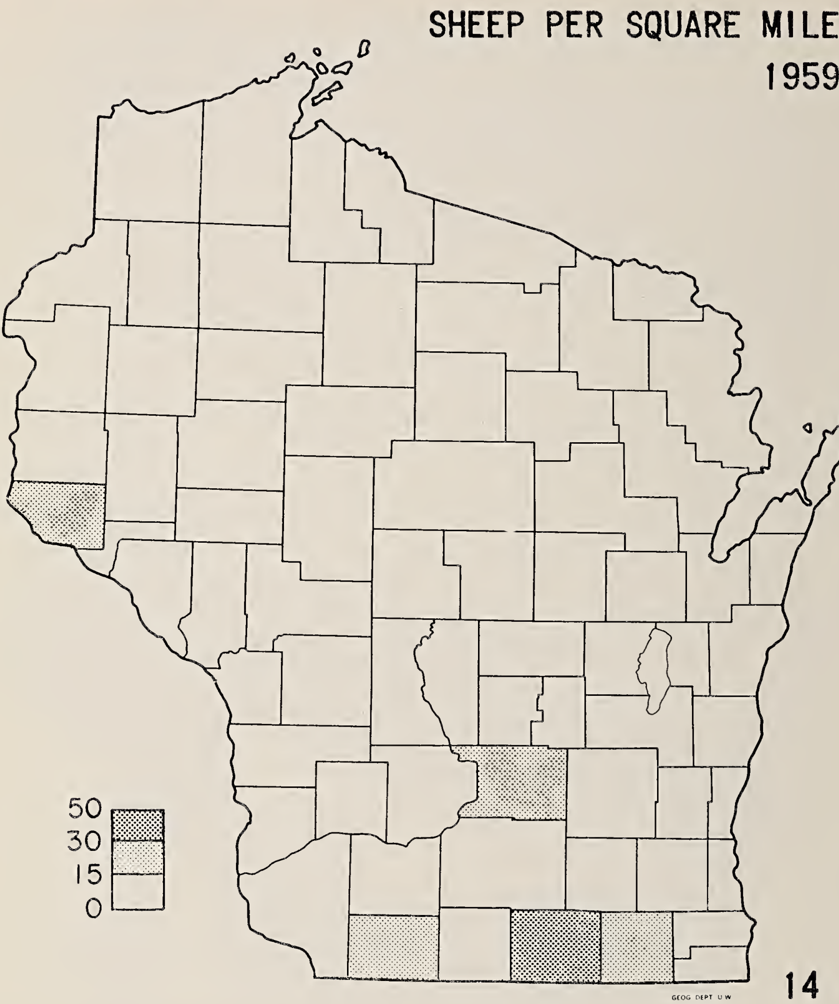
The place occupied by sheep in this farm livestock picture had become minimal (figure 13). For the state as a whole it averaged about .9% and in only one county, Vilas, did it exceed 5%. Figure 14 shows three of the five leading counties to be in the south, one in the west, and one in the south-central part of the state. Rock county was the only one to exceed a density of 30. In 1930 it may be recalled, five counties had reached this level of density, Rock, however, not having been one of them.

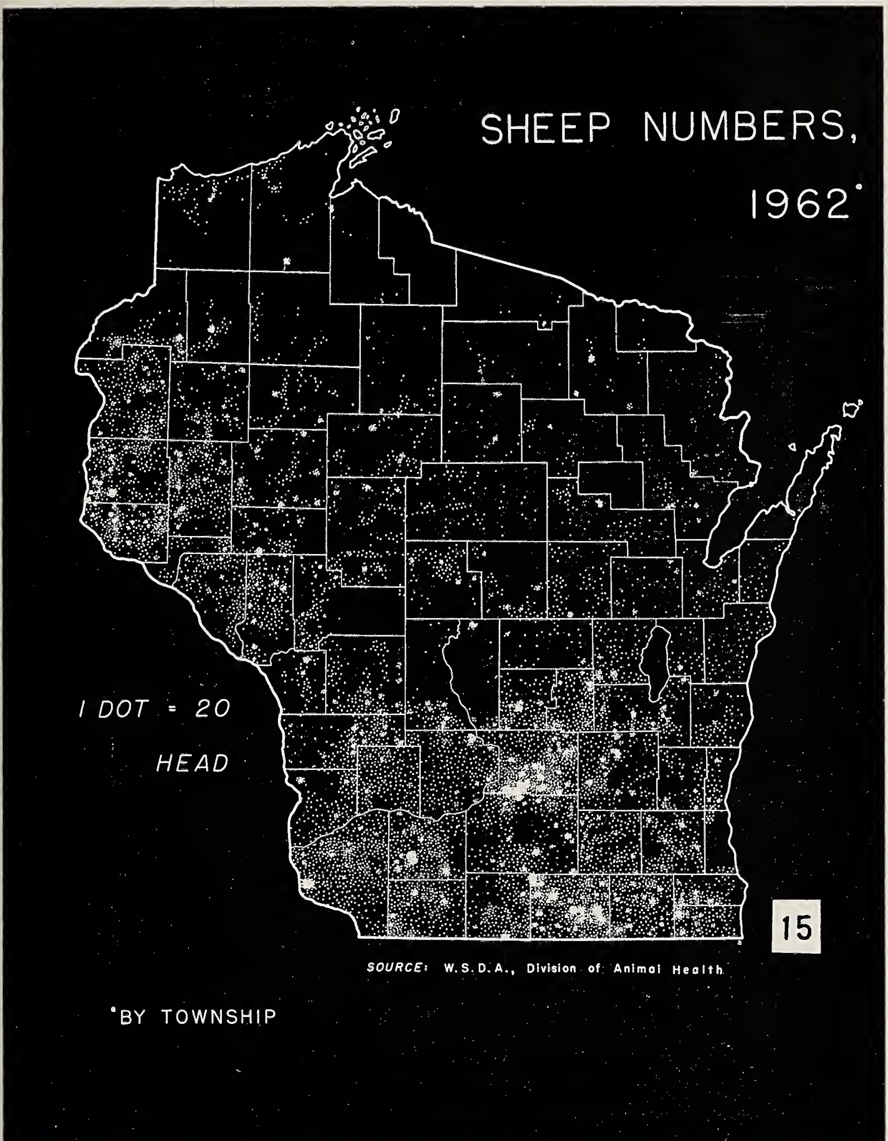
This paper has concerned itself primarily with changing patterns of distribution of stock sheep in the state. The story of feeder sheep is a separate one, mentioned only incidentally here, but in



connection with the present scene, it should be pointed out that last year (1962) about 19,000 feeders were brought into Wisconsin, most of them from Montana, South Dakota, Minnesota, and Illinois. This has been about average for at least the past three years. Inshipments now account for about 37% of the total on feed.[21]

Figure 15 differs from the others in this article not only in cartographic technique but also in the animals included. It is made from data collected in eary 1962 by the State Division of Animal Health

[21] Wisconsin Crop Reporting Service, *Sheep and Lambs on Feed, January 1, 1963*, January 16, 1963.



to determine the health status of all sheep in Wisconsin. The map shows their distribution by town and suggests again the concentration in the south, where feed gains are most likely to be available.

Summary

Wisconsin's sheep husbandry began early and reached its peak numerically and relative to other livestock during the Civil War era. Since then, it has declined in both these respects. Its changing distribution patterns since 1850 show first a concentration in the southeast, followed by a spread northward and westward before retrenchment left the highest density counties once more in the south. Although these broad changes are a reflection of market conditions, a more full explanation would depend upon a detailed evaluation of a myriad human considerations along with terrain, climate, soils, and vegetation. During the period from which these cross-sections were taken, emphasis has changed from wool to fat-lamb production; continued careful management has brought higher quality of both meat and wool as well as greater yield per animal. Sheep husbandry is minor but still a going concern in Wisconsin agriculture.

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THE DOMESTIC TURKEY IN MEXICO AND CENTRAL AMERICA IN THE SIXTEENTH CENTURY

A. A. Schorger

The Spaniards used a number of names for the turkey *(Meleagris gallopavo)* and there is uncertain identification in some cases. We have *pavo, guanajo, gallina, gallina de la tierra, gallina de papada, gallo, gallipavo,* and *gallo de Indias.* Only *gallina de papada* is sufficiently descriptive of the turkey. The display of the turkey was so like that of the peafowl that the use of *pavo* was logical. Mexico and Central America contained several species of large gallinaceous birds sometimes called *pavos.* Oviedo[1] definitely included the curassow *(Crax)* among the *pavos.*

It is not certain when the turkey was first seen. Mártir[2] states that when Vincent Yañez Pinzón was at the Gulf of Paria, Venezuela, in 1500, the Indians gave him some fowls of the country *(pavos)* which differed from the peafowl in color. There were females to be taken to Spain for propagation and males to be eaten at the time. If the birds could be raised in quantity it is probable that they were turkeys. Eden assumes that they were turkeys for he has the marginal note: "Peacockes which we caule Turkye Cockes."[3] It is entirely possible that Columbus received turkeys in Honduras in 1502 during his fourth voyage. There being nothing of importance on a group of islands which he called the Gunajas, he landed at Point Caxinas (Cabo de Honduras) on August 14. Here the natives brought him native fowls, *gallinas de la tierra,* which were more savory than those of Spain.[4] It is believed that the Cuban name for the turkey, *guanajo,* was derived from the birds received by Columbus near the Guanajas. When Cortés arrived at Trujillo, Point Caxinas, in 1525, the natives gave him fish and turkeys, according to Diaz,[5] who is consistent in using *gallinas* for these fowls.

There is no doubt that the birds found by Cordoba, when he discovered Yucatan in 1517, were turkeys. Las Casas[6] came to Cuba in 1511 and lived in the New World for thirty-six years. He states that when members of the Córdoba expedition landed near Cape Catoche, the natives gave them two roasted turkeys *(gallinas)* as large as peafowls. At Campeche they received many fowls with a dewlap, or throat wattle *(gallinas de papada),* just as large and perhaps better than peafowls.

The handsome ocellated turkey *(Agriocharis ocellata)* of the Yucatan Peninsula does not appear to have received a distinguishing name by the early Spaniards. Landa[7] came to Yucatan in 1549. He states that the Mayas called Yucatan the land of the turkey and the deer *(Umil cu[t]z yetel ceh)*. The meaning is the same in Espinoza's[5] orthography, Yetelzeh y Vnunuýz. According to Seler[9] the Maya name of the ocellated turkey was *cutz*. Some modern names for this bird are *pavo de monte*, and *kuts*,[10] *guajalote de Yucatán, guajalote brilliante*, and *cūt*.[11] The ocellated turkey is represented frequently in the Mayan codices, the common turkey, rarely. All of the numerous "turkey" bones found at archeological sites in Yucatan have been referred to the ocellated turkey.[12] Pollock and Ray[13] found 1268 bones of the ocellated turkey, none of the common turkey, at the ruins of Mayapan, dating for the most part from the 13th to the 15th century A.D. This suggests that the Mayas did not have the domestic turkey until shortly before the Conquest. Supporting evidence is to be found in the relatively small numbers of turkeys reported by the discoverers. The ocellated turkey was not domesticated by the Mayas.

The expeditions of Cortés revealed that the domestic turkey was widely distributed. On July 10, 1519, he[14] wrote that many *gallinas*, like those of Tierra Firme and as large as peafowls, were raised by the coastal people from Cozumel to Veracruz. Turkeys were reported at nearly every town on his march to the city of Mexico. The Anonymous Conqueror[15] wrote that many turkeys were raised by the Mexicans; and Diaz refers frequently to the birds.

Some of the numbers of turkeys exacted as tribute are a strain on credulity. Ixtlilxochitl[16] states that about 1430, Netzahualcoyotzin, Lord of Texcoco, required 100 turkeys *(cocqs)* daily, or 36,500 yearly. Torquemada[17] reduces the number to 6,000 to 8,000 annually. According to Cook[18] every inhabitant, *"chicos y grandes,"* of Mizquiahuala had to contribute a turkey every twenty days. He estimated the population of the town to have been 7500 in 1519, so that the annual contribution would have been 137,000 turkeys. If we assume that only adults actually paid tribute and that they formed two-fifths of the population the annual conrtibution would still be 56,800 birds. It is difficult to believe that even this number could have been supplied. According to Torquemada,[17] 1400 to 1600 turkeys were consumed daily during the fiesta for the Tlaxcalan god, Camaxtli. The raptors and carnivores in Montezuma's menageries required daily large numbers of turkeys. Salazar[19] and Clavigero[20] state that 500 turkeys were required daily just to feed the raptors. Gomara[21] gives the same number and adds that 300 men were required to attend the aviary. Some turkeys were also fed to the carnivores.[14] If we, in addition, allow for the turkeys consumed by Montezuma's large entourage, the daily consumption may have been 1000 birds. In fulfilling the request of Cortés[14] for an estate, Montezuma provided 1500 turkeys. Mártir[2] was informed that the number was 1500, some of the birds being for propagation, others for the table.

The domestic animals of the Aztecs were limited to dogs, turkeys, ducks, and a few other birds. Turkeys formed the largest source of meat. The markets of the city of Mexico have been described by several writers. Cortés in his letter of 1520 states: "There is a street for game in which are sold all kinds of native birds such as turkeys, partridges, quails, wild ducks, . . ." Diaz[5] mentions hen and cock turkeys, rabbits, hares, deer, and other game. Eggs of turkeys, geese, and many other birds were also for sale in large amounts.[22] All transactions in the markets were by barter. The closest approach to money was the cocoa bean. Gomara[21] states that a turkey was exchanged for a bundle *(haz)* of maize. I have been unable to find a quantitative definition of *haz*. Motolinía[23] wrote that a turkey was worth three or four Spanish chickens. In 1628 a turkey or a Spanish chicken sold for a real in Yucatan.[8] According to Oviedo[1] a *pavo,* in this case a curassow, was worth a ducat, and sometimes a castellano or gold peso, worth a real in purchasing power in Spain. If he refers to the old gold Castilian castellano, which weighed 4.6 grams, a curassow was worth $5.65 in present United States dollars.

Little is known about the methods used in raising turkeys. Sahagun[24] states that the young were given maize in the form of mash, cooked pigweed *(bledo),* and other plants. The mother fed the poults worms and other things that she found. He has four plates showing the "domestic life" of the birds. The breeding female appears to have had a small coop provided for her.

The domestic turkey descended from the wild turkey of Mexico. At the time of the Conquest the domestic bird was only about one-half the size of the wild one. The degeneration may have been due to improper feeding, or to failure to select the best birds for breeding. About 1580 it was stated that the wild turkeys in the state of Puebla were much larger than the domestic ones.[25] This was not true of the turkeys kept in confinement by the Pueblos of New Mexico. They resembled closely the wild bird in size and color. One of the members of Coronado's Expedition was impressed by their size for he wrote that they were larger than those of New Spain.[26] Many species of wild birds undergo changes in color of the plumage by domestication. Sahagun[24] mentions that the Mexican turkeys were of various colors, white, black, red, and brown. Salazar[19] states: "This bird is white and blackish and has no other color." A

Franciscan friar wrote about 1538–39 on the customs of the people of Michoacan, and mentions that the Chichimecas made banners of white turkey feathers.[27]

The Aztec name for the turkey was *huexolotl,* or *mexolotl.* Molina[28] gives *quetzaltototl* as a synonym for *pavo,* but it is more properly applied to one of the trogons. Salazar[19] called the turkey *cuzcacahtl.* According to Sahagun,[24] the female, or the turkey in general, was called *totollin,* the male, *huexolotl.* The latter was subsequently corrupted to *guajalote,* or *guajolote,* by which name the turkey is commonly known in Mexico today.

Some of the Indian names for the turkey follow:

Cáhita or Yaqui, *cúvis.*[29]
Cocopa, *urút.*[30]
Maya of Yucatan, *tux, itux,* female; *ulum,* male.[9]
Opata, *chique.*[31]
Papago, *tóva.*[30]
Tarahumara, *tshīví,*[32] *siwí.*[33]
Zapotec, *pète hualache, pète zaa,* female; *pète nigola,* male.[9]
Mexicans of Durango, *cocino.*[32]
Central America, *guanajo, chumpìpe, huehuecho.*[34]

Isthmus of Tehuántepec:[35]

Zapotec, *toú.*
Nahuat, *totóli.*
Chontal, *lapump, tulú.*
Popoluca, *tu? nuk*
Mixe, *tutk*
Zoque, *túnuk*
Huave, *tu:l.*

When the turkey was domesticated in the area under consideration is unknown. There are good archeological data on the turkey in New Mexico. Here the bird was confined, if not domesticated, shortly after the birth of Christ. Two bones of the turkey were found at the ruins of Zaculeu, near Huehuetenango, Guatemala, in the earlist phase, Atzan, *c.* 700 A.D.[36] They were identified by Dr. Alexander Wetmore as those of the common turkey *(M. gallopavo).* Since this bird is not native to Guatemala, it must have been brought in from the north where it was probably domesticated at a considerably earlier time.

Food was of prime concern to the early Spanish explorers and travelers so that domestic turkeys are mentioned frequently. The cultivation of maize and the raising of turkeys went hand in hand. Many of the settlements where these birds were found can not be located due either to disappearance, change of name, or variation in spelling. No early reliable information on the occurrence of domestic turkeys in Mexico north of latitude 25° was found. The gap between this latitude and the United States boundary indicates that domestication took place independently in Mexico and the Southwest. The places where turkeys were raised are shown in Fig. 1. The latitudes and longitudes of existing towns have been

FIGURE 1. Localities where turkeys were raised in Mexico and Central America in the sixteenth century.

taken from the Gazetteers of the United States Board on Geographic Names. A very useful map of the early pueblos of southern Mexico is that of Barlow.[37] The position of many old places in central Mexico are given by Borah and Cook,[38] and the work of Lopez-Portillo[39] was helpful in locating pueblos in westcentral Mexico. The *Suma de Visitas*[40] is rich in references to turkeys paid as tribute in the middle of the sixteenth century. The distance in leagues, often only approximate, of a small pueblo from a main town is frequently given. The Spanish league was 2.63 miles.

Campeche. When the Spaniards landed at the pueblo of Campeche in 1517, the cacique entertained them at a feast in his palace where turkeys and other birds were served.[2, 41] At the same time many turkeys were seen at a farm at Champoton.[6] Dampier,[42] who was in Campeche in 1676, informs us that among the fowls of the country are "Quams (guans), Corresoes (curassows), Turkies." The turkeys at which he shot unsuccessfully were the ocellated.

Chiapas. During the Cortés expedition to Honduras the natives of a village near Chiapa brought turkeys and cherries. The caciques at the town of Gueyacala (Acala, twenty-three miles southeast of Tuxtla) sent twenty loads of Maize and some turkeys.[5] About 1625 turkeys were abundant at Chiapa.

Colima. In 1530, during the conquest of New Galicia, the cacique of Contlán appeared at Chiametla with many mantles and turkeys.[44] Ystlahuacán (Ixtlahuacán) contributed to the Spaniards 8 turkeys every month; Coatlán, 5 leagues from Colima, and Escayamoça, each contributed 24 turkeys annually; Malacatlán, 4 annually; Quiçilapa (Quezalapa) and Tequepa, each 36 annually; Tepacuneca (Petlazoneca), 12 annually; Teçitlan (Tecuicitlán), 48 annually; Tlacoloastla, 24 annually; Tecolapa, 30 annually; and Xocotlán, 24 annually.

Costa Rica. Significant evidence for the raising of turkeys in Costa Rica in pre-Columbian times is a turkey effigy jar shown by Lothrop.[45] The long frontal caruncle is clearly that of the common turkey. The jar was found at Bolson and is considered to be of local manufacture. There was a Mexican colony at the isthmus of Nicoya. The Mexicans had an extensive trade along the Pacific coast as far south as Panama where there was also a small colony. It is probable that the Mexican colonists brought turkeys with them but Lothrop[46] does not believe that these birds were raised south of the Nicoya peninsula.

Durango. Many turkeys were being raised at Nombre de Dios in 1608.[47]

Guanajuato. The middle of the 16th century, the inhabitants of Acanbaro (Acambaro) had turkeys, chickens, and quails.[48] Hardy[49] noted that turkeys were raised in abundance at San Francisco [del Rinçon] in 1825. He purchased a fine one for fifty cents.

Guatemala. Four turkeys were supplied to the Cortés expedition (1524–26) at Tayasal, located on an island in Lago Petén. At the pueblo of Tayca, 30 turkeys were found in four houses, and the following day the Spaniards came to a farm where there were turkeys. Sailing up the Rio Dulce, they came to Lago de Izabel where the inhabitants had many turkeys.[5] These birds were plentiful about 1636 at the pueblos of Guatemala, Mixco, and Rabinall (Rabinal).[43] For the campaign of 1694, Totonicapa (Totonicapán) and Gueguetenango (Huehuetenango) were each to contribute 800 turkeys. The Indians at Dolores killed turkeys and offered the blood to their idols. There were many turkeys at Lacandón, near present San Luis.[50]

Guerrero. Ayutla and neighboring towns contributed to Montezuma one turkey daily.[37] Under the Spanish regime Ayutla also provided one turkey daily; Acamistlauca (Acamixtlavaca), 2 daily and 15 in addition each month; Nochtepeque, 20 leagues from Mexico and 3 from Tasco (Taxco), one turkey daily; and Tetela [del Rio], one every 80 days.[40]

In 1579 chickens and turkeys were raised in abundance at Tzicaputzalco (Ixcapuzalco). The domestic animals at Alaustlan (Alauiztlan, Alahuixtlan) were small dogs, chickens, and turkeys. Ostuma (Oztoman) had an abundance of these fowls. Quatepeque (Coatépec de Guerrero, Cuatepeque, Cuautepec), Tlacotepeque (Tlacotépec de Guerrero), Utatlan (Utlatlan), Tetela, Cuetzala (Quezala), and Teloloapa (Teloloápan) raised chickens and turkeys in large numbers. The domestic birds at Tasco were Castilian chickens, turkeys, and doves.[51] There were both wild and tame turkeys at Asuchitlan (Ajuchitlan).[52]

Hidalgo. The contribution of turkeys to Montezuma by the pueblo of Mizquiahuala (Mizquiyauallan) has been mentioned.[18] The price of a turkey at Mizquiahuala in 1571 was two reals (1 peso = 8 reals).[53] Epaçoyucan (10 miles southeast of Paucha) also contributed turkeys to Montezuma.[37] Acatlan contributed to the Spaniards 4 turkeys and 4 quails *(quatro gallinas y quatro codornizes)* every 5 days; Tlacachique, 12 turkeys every 40 days; Tututepeque, one on every meat day; and Vauagasco, 30 chickens and turkeys every three months.[40]

In 1579 there were tame turkeys and chickens at Zimapán; turkeys, chickens, doves, and white geese at Axocupan (Axacuba); chickens, turkeys, quails, and hawks at Yetecomac; doves, turkeys, Castilian chickens, and quails at Tornacustla (Tulnacuchtla); turkeys and chickens at Tezcatepec (Texcatepec) and Tecpatepec. The inhabitants of Uexutla de Hidalgo (Huejutla, Huexotla, Huexutla) had no other birds than *gallinas,* which grow wild; and they raise turkeys *(gallinas de tierra)* which are like peafowls. At Atitalaquia, they ate the male turkeys which in Spain were called *gallopavos*. The females were kept for propagation as it was considered poor management to eat them.[51]

Honduras. When Cortés arrived at Trujillo in 1525, the inhabitants of the neighboring islands brought presents of fish and turkeys. While at this town some natives of Olancho (Guayapa) came to him complaining that the soldiers were stealing their turkeys.[5]

Jalisco. The province in 1530, according to Guzman,[54] was well supplied with turkeys. He states further that turkeys were abundant at the pueblo of Nuyano and at Chapala.[55] Tello[44] informs us that during the conquest of Nuevo Galicia, the cacique of Chola appeared at Chiametla with mantles and turkeys; that the latter were plentiful at Tonolán (Tonolá); and that in 1536 the natives of Purificación were raising turkeys and other birds in quantity. Lopez-Portillo[39] cites the statement of Gonzalo López that the valley at Cuitzeo was supplied with an abundance of provisions such as turkeys, deer, hares, and some fruit. The inhabitants of Cuynan has turkeys. The same statement is made by Samáno[56] for a valley near Chapala. An unknown writer informs us: "At the end of two days of travel we arrived at the province of Tonalá and when we came in sight there appeared certain peaceful Indians with turkeys in hand saying that the lady *(señora)* of this province was peaceful and in her house."[57]

Acatitlán contributed to the Spaniards 3 turkeys annually; Cuyseo (Cuitzeo) and Poçintlán (Poncitlán) together, 20 turkeys every two months; Cuistlán, one every 5 days; Yztlan (Ixtlán), 5 annually; Mechinango, 20 annually; Cuyutan (Coyutlán), Miztlan (Mixtlán), and Acatitlán, some turkeys; Mizquiticacan (Mexticacán), 2 per week; Nuchistlán, 2 every two months; Ocotlán, one every Sunday; Ocotique (Ocotic), one every week; Tetitlán, 5 every 4 months, Tequeçistlán (Tesixtan), one every 5 days; Tlacotlán (Tlacotán), 2 every 5 days; and Tlaxomulco (Tlajomulco), one every week.[40]

Mexico. According to Alvarado Tezozomoc,[58] the Aztec nobleman, 600 turkeys were provided for the people from Huejotzingo, Cholula, and Tlaxcala who came to Mexico to attend the funeral rites of King Axayacatl, the middle of the 15th century. When messengers came from King Ahuitzotl regarding a victory over Cuextlan and other pueblos, the people of Chalco, Xochimilco, Tabuca, and Aculhuacan (Culuican), to celebrate the success, brought especially birds, *huexolome,* i.e. turkeys *(gallipavos)* and *cihuatototolin* or peahens *(pavas),* wild turkeys *(gallinas del monte),* and doves. It is difficult to determine if the names of the birds have suffered from translation from the Aztec. Apparently the people brought male and female domestic turkeys, and wild ones.

Each Indian at Atenco contributed to Montezuma one turkey every 20 days.[37] According to Gamio,[59] prior to the conquest, Teotihuacán contributed 62 turkeys annually, and 14 in addition from time to time. In 1543 Domingo Hernández, a resident of Xochimilco and judge for the Viceroy, fixed the tribute at turkeys daily.

Due to a protest in 1552, Fray Diego Rengifo reduced the number to 7 every 80 days.

In 1950, when Cortés neared Tecoco, the houses were found to be filled with turkeys and dogs which the Tlaxcalans carried off[5] The Humboldt fragments record a sale of turkeys at Chalco in 1564. Plate XX of Seler[53] shows the heads of 61 turkeys paid as tribute at some unknown locality. Tomson, [60] in 1555, found "Guiny-cockes" cheap in the city of Mexico. When Hawks[61] was in the city in 1572, he noted that there were "Guiny cocks and hennes," old English names for turkeys. A turkey cost \$0.75 to \$1.00 in 1822.[62]

Tepechpa (Tepexpan) and Tecama each contributed to the Spaniards 4 turkeys daily; Tequecistlan (Tequisistlan), one daily; Taxcaltitlan (Texcaltitlán), 2 daily. Tepepulco raised turkeys in quantity; and Cuauhquilpan, 3 leagues from Pachuca and about 10 from the city of Mexico, raised both chickens and turkeys. In 1580 turkeys were eaten in Tamazcaltepec.[40, 51]

Michoacan. Guzman[54] wrote on July 8, 1530, that the inhabitants of the province had an abundance of maize and turkeys *(aves de tierra)*. The unnamed Franciscan friar,[27] writing of the customs in Michoacan, mentions turkeys frequently. He states that the Tarascans did not eat turkeys but raised them for their feathers to decorate their gods. One of the caciques had 80 royal eagles and smaller ones in cages which were sometimes fed turkeys. Before the arrival of the Spaniards, one of the priests dreamed that people came bringing horses. They slept in the temples and the many turkeys that they brought made the buildings dirty. At a place called Quangaceo, near Metalcingo, Cristoval de Olí requested and received presents of rich mantles, turkeys, and eggs. The Spaniards were in the town for six months during which time they were provided with bread, turkeys, eggs, and fish. On account of fear of the Spaniards, the inhabitants of Hiripan and Tangaxoan abandoned their towns leaving the dogs, parrots, and turkeys. The cacique of Yzipamuca ordered his people to kill and eat all the dogs, parrots, and turkeys since they were to remain there only five days.

In the latter part of the 16th century, Aquila contributed 48 turkeys annually; Estopila (Estapilla), Teçuatlan, and Yluistlan ((Yhuitlán), each, 24 annually. The latitudes and longitudes given by Borah and Cook[38] would place Estopila and Yluistlan in the Pacific Ocean. Apapapalán contributed 36 turkeys annually; Comanja, 2 daily; Necotlán, 10 every 20 days; Pomaro, 28 annually.[40] Tarequato raised well turkeys and chickens, while Yurirapundaro had chickens and a few turkeys. Chilchota, and Oran, subject to Chilchota, raised chickens and turkeys in quantity. Tasaguararo also raised turkeys. Chocandiran had both wild and domestic turkeys.[48]

Morelos. In 1579, Teputztlan, 12 leagues from the city of Mexico had wild and domestic turkeys. The inhabitants of Ocopetlayuca ate turkeys.[51]

Nayarit. When Guzman passed through Jalisco, he found the people on the side of a mountain. Eventually they came down and gave him turkeys and other foods.[63] The province of Aztatlan had an abundance of provisions, turkeys, and a multitude of all kinds of fishes. The Spaniards often took the name of a pueblo for a province. While Guzman was at Azatlan (Aztatlan) there came lords of the province of Chiametla (Chametla), 20 leagues distant, bringing many turkeys, chili, and fish.[57] This would place Aztatlan on or near the Acaponeta River. The map in Lopez-Portillo[39] locates Aztatlan close to this stream. The Antonio Garcia y Cubas map (1863) has Etzatlan south of Acaponeta on a branch of the Acaponeta River. Regarding the Rio Hastatlan (Aztatlan, now Acaponeta river) it was said: "Here they found so great a supply of food, turkeys *(gallinas de Mexico)*, maize, ducks, and other birds that it was a strange thing to see."

Five leagues from Chametla was a province called Cazala where turkeys and maize were found.[65] The inhabitants of Tepic had turkeys in 1531. Tzenticpac (Teimoac) provided much maize and turkeys. Honey and turkeys were also furnished by Tzapotzinco (Izapotzinco).[44] The latter part of the 16th century Apetatuca contributed 16 turkeys every Easter; Cuyacán, 3 every four months; Tepique (Tepic), 6 every 3 months; Camotlán, 5 every week; Xalxocotlan (Jalcocotlan), 10 yearly; and Xala (Jala), one every week.[40]

Nicaragua. Pedrarías Dávila arrived at Darien in 1514 and organized Tierra Firme, consisting of most of Panama, Costa Rica, and part of Nicaragua. Andagoya[66] states that there was no game in the provinces except birds, consisting of two kinds of *pavas*, pheasants (chachalacas), and doves. If his *pavas* were game birds, they must have been curassows and not turkeys. Córdoba conquered the Rivas area in 1524 and founded the towns of Leon and Grenada. The inhabitants, according to Andagoya, had an abundance of maize, grapes, turkeys *(gallinas de aquella tierra)*, and small dogs which they ate.

Gil González Dávila explored northward along the Pacific Coast in 1522 and arrived in the Department of Rivas, between Lake Nicaragua and the coast. The cacique Diriajen came to his camp with 500 men each carrying one or two male or female turkeys *(pavo o' pava)*. No other bird than the domestic turkey could have been supplied so abundantly. Here was a Mexican (Nahuatl) colony and it is to be expected that it would have turkeys. Oviedo[67] adds that in settling a marriage contract, the Indians killed large turkeys *(gallinas),* which are like peafowls *(pavos),* but better than those of Spain. The supplying of turkeys by the cacique "Dirigen" was first mentioned by Mártir.[2]

Benzoni[68] was in Central America from 1541–1556. He reported that in Nicaragua there was to be found a kind of peacock that had been brought to Europe and called Indian fowl. In the New World it was to be found elsewhere only in Guatemala, Cape Fonduri, Mexico, and on the shores of New Spain. The Mexican language was the most important one in Nicaragua, and in this tongue, he adds, fowls were *totoli,* the Mexican word for the turkey hen being *totolin.* About 1635 Gage[35] found turkeys to be ordinary meat in Nicaragua.

Oaxaca. There is little information on the turkey prior to the middle of the 16th century when it was being raised in quantity. Coquitlan contributed 3 turkeys weekly; Chiomesuchitl, 17 every 20 days; Camotlán, 12 yearly; Çimatlan (Zimatlán) and Cuyutepeque (Coyotepec), one daily; Gueytepeque (Huitepec), 10 every 80 days; La Chichina, 20 annually; Necotepeque, 10 every 80 days; Totolapa (Totolapan), 12 every 80 days and 2 every 10 days; Xaltepeque (Tlazoltepec), 40 every 100 days; Ticatepeque (Ticatepec), 40 yearly; Tlaquaçintepeque (Tlacuatzintepec), 20 every 80 days; and Vepanapa (Huapanapa), 120 yearly.[40]

Iztepexi contributed turkeys to Montezuma and later raised both chickens and turkeys. At Texupa (Tejupan), the chiefs ate turkeys at their fiestas. Turkeys and chickens were raised at Chinantla, and the people of Macuilsúchil (Macuilxóchitl) and Treutitlan (Teotilán) de Valle raised these fowls in their homes. The inhabitants of Teticpac formerly paid tribute to Montezuma with turkeys, hares, rabbits, deer, and honey, and subsequently raised turkeys and chickens for commerce. Coatlán sacrificed dogs, turkeys, and quails, and Tlacolula, dogs, turkeys, and Indians. Turkeys and chickens were raised in quantity by Mitla and Taliztaca (Tlaliztaca, Tlalixtac). Guaxilotitlan (Huajolotitlan, Huitzo) raised Castilian chickens, turkeys, and pigs in large numbers. At Puerto de Guatulco, there were bred many native birds called chachalacas which are like Castilian chickens. One statement reads: "ay muchas palomas torcazas y codornizes y 'chachalacas,' que son como gallinas de Castilla, y gallos e gallinas de la tierra; codos estos generos son aues monteses, y demas desto crian entrellos muchas aues de castilla e de la tierra domesticas." Elsewhere are mentioned "chachalacas y gallos y gallinas que son de la generaçion de las domesticas de la tierra."[69] Since chachalacas are mentioned specifically, "gallos y gallinas" can refer only to turkeys, or possibly to the curassow or crested guan; however neither of the latter species would have been raised in numbers.

Puebla. During the conquest the caciques of Cholula sent turkeys and bread. The pueblos of Tepeaca, Quacholae, and Tecamachalco (Tepemaxalco) had plenty of turkeys and little dogs. When Guatomac was made king of Mexico, he sent his armies to raid the pueblos of Guacachula (Huaquechula) and Ozucar where they robbed the people of turkeys and other possessions.[5]

About 1580, the inhabitants of Guachinango (Huachinango) contributed a turkey or its equivalent every five days.[40] Xonotla (Jonatla), as did Tetela, had a great quantity of domestic turkeys.[25]

Quintana Roo. During the Cordóba expedition of 1517, the Spaniards while near Cape Catoche, were given two turkeys.[6] Two years later, on the island of Cozumel, turkeys were found in the houses abandoned by the natives, and Pedro de Alvarado ordered that 40 of the birds be taken.[5]

Sinaloa. At Chametla, a pueblo and province on the Baluarte River, the Spaniards during the Guzman expedition, found many provisions and many turkeys which did not exist farther on. Nevertheless it was subsequently stated that the provinces of Huxitipa and Panuco abounded in fruits, deer and other animals, and that there were many turkeys.[64] Lopez-Portillo[39] shows the pueblo of Chiametla on the Acoponeta River on one map, and on another map on the Baluarte River, on which stream lies modern Chametla. According to Obregón,[70] the province of Chiametla had an abundance of provisions consisting of maize, beans and turkeys, and many cattle which had multiplied from those left by Coronado. The inhabitants presented many turkeys to Diego de Ibarra.

Regarding the pueblo of Actlan, province of Chiametla, it is stated: "And gave a great quantity of turkeys and some fish, and leaving in peace said province he returned bringing with him the son of the lord with about 150 men all laden with turkeys from which the [Spanish] people took no little consolation because there had been many sick ones."[65]

The pueblo of Piastla (Piaxtha), according to Guzman,[55] was well supplied with all kinds of provisions except turkeys of which were found only three or four males. Quinota, a short distance northeast of modern Quila, had abundant provisions, but only a few turkeys were found. Near Pascua there were many large turkeys but nothing else. Regarding a pueblo near the mouth of the Rio Culucan, he wrote: "There were not many turkeys there because they ate them, knowing that we were coming, since there was a pueblo where I found four turkeys dead and plucked."

Some turkeys, many parrots, and some falcons in cages were found at Pochotla, a pueblo above Piaxtla on the Piaxtla River. There was much to eat in Culiacan, one item consisting of "a turkey as large and tough as a he-goat."[65] In 1534 the inhabitants of Culiacan, according to Tello,[44] had many turkeys and Castilian chickens. Another writer states that the province of Culiacan had only a few turkeys, but there was "no lack of mosquitos."[57]

Sonora. No early account of the keeping of turkeys in Sonora was found. An unknown Jesuit, writing in 1763, stated that in some places in Sonora there were domesticated turkeys.[31] Sonora was defined as the area north of the Yaqui River, west of the Sierra Madre Mountains, and south of the Gila River in Arizona.

Tabasco. At the mouth of the Grijalva River in 1518 and 1519, according to Diaz,[5] the Indians brought to the Spaniards cooked fish and turkeys. He mentions several pueblos where turkeys were obtained during the expedition of Cortés to Honduras. I have relied for the location of the towns on the map in Maudslay's[71] translation of Diaz. Turkeys were obtained at an unknown pueblo on the Rio Usumacinta at approximately 17°40′N, 91°30′W. Cortés built a bridge across the Rio San Pedro at approximately 17°20′N, 91°10′W. Here Diaz arrived with maize and 80 turkeys that the soldiers appropriated. The following evening he went out and returned with 20 turkeys for Cortés. Evidently the source of supply was not more than six miles from the bridge. The Indians at Gueyacala, a pueblo up stream, brought maize and some turkeys. In some of the houses they found many cooked cock and hen turkeys *(gallos de papada y gallinas)*.

The natives of the Rio Tabasco (Grijalva) brought to Cortés, during his expedition of 1519, eight dark turkeys neither smaller nor less tasty than peafowls.[2] Cortés,[14] writing in the same year, says that some Indians in a canoe brought certain *gallinas* and a little maize. At the port of San Antonio, near the mouth of the Rio Grijalva, Grijalva[72] informs us that in 1518 the Indians brought cotton mantles and turkeys. These birds, according to Dampier, were raised in 1676 in the towns along the Tabasco River. Of one of them he wrote: "They feed abundance of Turkies, Ducks, and Dunghill Fowls, of which the Padre has an exact account; and is very strict in gathering his Tithe :and they dare not kill any except they have his Leave for it."[42] Turkeys were also raised along the Chiltepec and Dos Bocas Rivers.

Tlaxcala. According to Mártir[2] the city of Tlaxcala contained a great number of fat birds lke peafowls, which were raised in place of Spanish chickens. Cortés[14] wrote that in 1520 the place was well supplied with bread, turkeys, game, and fish.

Veracruz. The people of Cempoala (30 miles north of Veracruz) gave turkeys as tribute to the predecessors of Montezuma.[37] When Grijalva[72] was at the Isla de los Sacrificios, near Veracruz, the Indians brought cakes and turkey pies. Diaz,[5] who accompanied the expedition, mentions that at the mouth of the Rio de Banderas (Jamapa) the Indians brought turkeys and maize bread. Turkeys were also supplied at the port of San Juan de Ulúa (Veracruz). Alvarado raided the pueblos adjacent to Costastan (Cotaxtla) and brought back turkeys. These birds were also sent by the cacique of Cempoala. When the survivors of the DeSoto expendition arrived at Pánuco in 1543, they were well supplied with turkeys by the inhabitants. All the way from Pánuco to the great city of Mestitam, when a turkey was requested of an Indian, he would give four.[73]

About 1580 Nanaguautla (Nanahuatla) furnished 60 turkeys yearly.[40] Tlacotalpan had deer, and raised turkeys and chickens; Xalapa (Jalapa), a great quantity of hens which are called turkeys in Castile *(gallinas, que en Castilla dizen gallibabos,* also called *papagallos);* Veracruz, numerous turkeys in many large flocks.[25] When Gage[43] landed at Veracruz, apparently in 1635, the inhabitants gave a dinner for the fleet for which "Turkey-cocks and Hens were prodigally lavished." During the first two days of his journey to Mexico City, turkeys were plentiful in the small towns where he lodged.

Yucatan. The people of Zamailco (Samahil), in 1549, were required to pay an annual tribute of 400 fowls, either turkeys or Castilian chickens.[7] Numerous occasions are mentioned by Ponce[74] when he was given turkeys. About 1635 Gage[43] found turkeys abundant in Yucatan.

Zacetacas. In 1580 Suchipila (Juchipila) contributed five turkeys monthly.[51]

PLACE NAMES

State or Country	Town	Latitude and Longitude
Colima	Chiametla	19°17′N, 104°10′W
	Coatlán	19°13′N, 103°56′W
	Contlán	19° 3′N, 104°12′W
	Escayamoça	18°59′N, 103°55′W
	Malacatlán	19° 5′N, 103°44′W
	Teçitlan	19°10′N, 104° 0′W
	Tecolapa	19° 3′N, 103°50′W
	Tepaçuneca	18°45′N, 103°50′W
	Tequepa	18°52′N, 103°58′W
	Tlacoloastla	19°23′N, 104° 3′W
	Quiçilapa	19°15′N, 103°50′W
	Xocotlán	18°50′N, 103°50′W
	Ystlahuacan	19° 2′N, 103°45′W
Durango	Nombre de Dios	23°51′N, 104°15′W
Guanajuato	Acanbaro	20° 2′N, 100°43′W
Guatemala	Dolores	16°32′N, 89°28′W
	Gueguetenango	15°19′N, 91°28′W
	Mixco	14°37′N, 90°38′W
	Rabinall	15° 6′N, 90°18′W
	San Luis	16°13′N, 89°25′W
	Totonicapa	14°55′N, 91°20′W
Guerrero	Acamistlauca	18°34′N, 99°33′W
	Asuchitlan	18°10′N, 100°29′W
	Alaustlan	18°34′N, 100° 2′W
	Ayutla	16°50′N, 99°14′W
	Cuetzala	18° 6′N, 99°50′W
	Nochtepeque	18°38′N, 99°42′W
	Ostuma	18°20′N, 100°12′W
	Quatepeque	16°42′N, 99° 4′W
	Tasco	18°33′N, 99°38′W
	Teloloapa	18°21′N, 99°52′W
	Tetela	17°58′N, 100° 7′W
	Tlacotepeque	17°46′N, 99°59′W
	Tzicaputzalco	18°35′N, 99°56′W
	Utatlan	18°15′N, 99°20′W
Hidalgo	Acatlan	20° 9′N, 98°26′W
	Atitalaquia	20° 4′N, 99°13′W
	Axocupan	20° 5′N, 99° 6′W
	Mizquiahuala	20°14′N, 99°13′W
	Tecpatepec	20°14′N, 99° 5′W
	Tezcatepec	20°16′N, 99°15′W
	Tlacachique	20°10′N, 99° 0′W
	Tornacustla	20°10′N, 98°52′W
	Tututepeque	20°25′N, 98°17′W
	Uexutla de Hidalgo	21° 8′N, 98°25′W
	Vauagasco	21°15′N, 98°37′W
	Yetecomac	20°12′N, 99° 1′W
	Zimapán	20°45′N, 99°21′W
Honduras	Olancho	14°45′N, 86°52′W
Jalisco	Acatitlán	20°32′N, 104°29′W
	Chapala	20°17′N, 103°12′W
	Chola	19°45′N, 105°19′W
	Cuistlán	20°47′N, 103°20′W
	Cuitzeo	20°18′N, 102°48′W

PLACE NAMES—Continued

State or Country	Town	Latitude and Longitude
Jalisco—Cont.		
	Cuynan	20°30′N, 103° 0′W App.
	Cuyutlan	19°42′N, 104°31′W
	Mechinango	20°35′N, 104°25′W
	Mizquiticacan	21°14′N, 102°44′W
	Miztlan	20°29′N, 104°20′W
	Nuchistlán	20°38′N, 103°27′W
	Ocotique	21° 3′N, 103° 4′W
	Ocotlan	20°40′N, 103°27′W
	Poçintlán	20°22′N, 102°56′W
	Purificación	19°43′N, 104°38′W
	Tequeçistlán	20°47′N, 103°27′W
	Tetitlán	19°55′N, 105°10′W
	Tlacotlán	20°47′N, 103°12′W
	Tlaxomulco	20°28′N, 103°27′W
	Tonolán	20°38′N, 103°14′W
	Yztlan	20°37′N, 103°27′W
Mexico	Aculhuacan	19°20′N, 99°11′W
	Atenco	19°32′N, 98°54′W
	Chalco	19°15′N, 98°54′W
	Cuauhquilpan	19°50′N, 98°55′W App.
	Tabuca	19°26′N, 99°13′W
	Tamazcaltepec	19° 2′N, 100° 3′W
	Taxcaltitlan	18°53′N, 99°54′W
	Tecama	19°43′N, 98°58′W
	Tecoco	19°32′N, 98°54′W
	Teotihuacán	19°42′N, 98°50′W
	Tepechpa	19°37′N, 98°56′W
	Tepepulco	19°50′N, 98°30′W
	Tequecistlan	19°37′N, 98°58′W
	Xochimilco	19°15′N, 99°10′W
Michoacan	Apapapalán	18°57′N, 103°17′W
	Aquila	18°40′N, 102°32′W
	Chilchota	19°47′N, 102° 3′W
	Chocandiran	19°53′N, 101°20′W
	Comanja	19°42′N, 101°42′W
	Estopila	18°59′N, 103°31′W
	Metalcingo	19°12′N, 101° 1′W
	Necotlán	19°38′N, 101°17′W
	Pomaro	18°20′N, 103°14′W
	Tarequato	19°52′N, 102°32′W
	Teçuatlan	18°38′N, 103°30′W App.
	Yluistlan	18°34′N, 103°27′W App.
	Yurirapundaro	20° 5′N, 101°30′W
Morelos	Ocopetlayuca	18°55′N, 98°38′W
	Tepúztlan	19° 0′N, 99° 2′W App.
Nayarit	Apetatuca	20°55′N, 105° 0′W
	Aztatlan	22°10′N, 105°20′W App.
	Camotlán	20°58′N, 104°40′W
	Cuyacán	21°35′N, 104°55′W
	Jalisco	21°27′N, 104°54′W
	Tepic	21°31′N, 104°53′W
	Tzapotzinco	21°32′N, 104°57′W
	Tzenticpac	21°45′N, 105° 2′W
	Xala	21° 8′N, 104°27′W
	Xalxocotlan	21°27′N, 105° 8′W
Oaxaca	Camotlán	17°30′N, 96°10′W
	Chinantla	17°45′N, 96°24′W
	Chiomesuchitl	17°16′N, 96°29′W

PLACE NAMES—Continued

STATE OR COUNTRY	TOWN	LATITUDE AND LONGITUDE
Oaxaca—Cont.		
	Çimatlan	16°50′N, 96°47′W
	Coatlán	16°12′N, 96°46′W
	Coquitlan	16°33′N, 96°20′W
	Cuyutepeque	16°57′N, 96°43′W
	Guaxilotitlan	17°13′N, 96°50′W
	Gueytepeque	17°13′N, 96° 7′W
	Iztepexi	17°15′N, 96°34′W
	La Chichina	17°28′N, 96°18′W
	Macuilsúchil	17° 2′N, 96°32′W
	Mitla	16°56′N, 96°23′W
	Puerto de Guatulco	15°51′N, 96°19′W
	Taliztaca	17° 5′N, 96°40′W
	Teticpac	16°56′N, 96°37′W
	Texupa	17°39′N, 97°28′W
	Tlacolula	16°56′N, 96°28′W
	Tlaquaçintepeque	17°48′N, 96°33′W
	Totolapa	16°42′N, 96°18′W
	Treutitlan de Valle	17° 3′N, 96°31′W
	Vepanapa	18° 8′N, 97°40′W
	Xaltepeque	16°52′N, 95°47′W
Puebla	Cholula	19° 5′N, 98°18′W
	Guacachula	18°45′N, 98°33′W
	Guachinango	20°12′N, 98° 3′W
	Ozucar	18°37′N, 98°27′W
	Quacholac	18°57′N, 97°38′W
	Tecamachalco	18°52′N, 97°43′W
	Tepeaca	18°58′N, 97°55′W
	Tetela	18°52′N, 98°10′W
	Xonotla	20° 3′N, 97°35′W
Sinaloa	Panuco	23°25′N, 105°55′W
	Piastla	23°51′N, 106°39′W
	Quila	24°23′N, 107°13′W
Veracruz	Costastan	18°50′N, 96°23′W
	Nanaguautla	21° 7′N, 98°37′W
	Panuco	22° 3′N, 98°10′W
	Tlacotalpan	18°37′N, 95°40′W
	Xalapa	19°32′N, 96°55′W
Yucatan	Zamailco	20°50′N, 89°55′W
Zacetacas	Suchipila	21°55′N, 103° 8′W

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THE ZENDA METEORITE

William F. Read

The Allyn Palmer family operates a 174-acre farm located half a mile west of Zenda in Walworth County, Wisconsin. In the spring of 1955, Mr. Palmer, while plowing, noticed an unusual-looking dark, heavy rock and brought it back to the house. Some time later his eldest son Jon took the rock to school and gave it to some boys who were members of the local astronomy club. The boys showed it to Dr. G. P. Kuiper at Yerkes Observatory. Suspecting that it might be a meteorite, Dr. Kuiper bought the specimen and forwarded it for positive identification to Dr. H. H. Nininger of the American Meteorite Museum at Sedona, Arizona. Dr. Nininger cut a small slice from one end, determined that this was in fact an iron meteorite, and returned the main mass to Dr. Kuiper. The writer purchased the main mass from Dr. Kuiper in March, 1960.

The original total weight was near 3.7 kg. As received by the writer, the main mass weighed 3623 g. It has since been cut into two pieces weighing 2791 g and 770 g. Dr. Nininger retained the slice which he had cut off and later sold it, along with the bulk of his collection, to Arizona State University. This slice weighs 60 g.

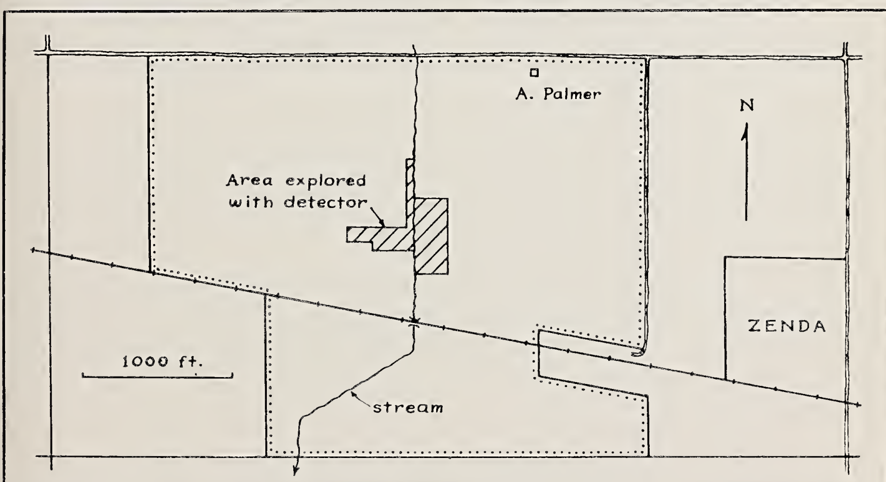

FIGURE 1. South half of Sect. 28, T 1 N, R 17 E. Stippled line is the Palmer farm boundary. The meteorite is believed to have been found in the east half of the area explored with a metal detector.

Mr. Palmer does not recall exactly where on his property he found the meteorite. Figure 1 shows the farm boundaries. Certainly the specimen came from north of the railroad tracks, and probably from east of the stream in the area which the writer later explored (unsuccessfully) with a metal detector. If so, the coordinates of the fall are Lat. 42° 30′ 48″; Long. 88° 29′ 22″. This is gently rolling farm country on the south slope of the Darien moraine of the Delavan ice lobe.

External Form

The Zenda meteorite evidently fell many years ago. A brilliant fireball is reported to have burst over Zenda the evening of February 5, 1917, (Frost, 1917) but is it doubtful that this was the source of the present meteorite. Rusting has destroyed the original fusion crust with its ablational detail. How much rust had accumulated we cannot tell since much was doubtless dislodged by farm machinery. The thickest remaining accumulation (Fig. 3) is about ¼ inch.

The overall form at present is roughly wedge-shaped. The narrow end (Fig. 2) tapers between fairly flat surfaces; the broad end is more irregular. Shallow depressions, circular to irregular in plan and up to 2 inches in diameter, occur equally on all sides. The conspicuous notch which appears on the upper left margin of the upper photograph in Figure 2 is caused by an unusually deep depression which has cut into the edge between two surfaces. Probably these depressions are ablational in origin though they have doubtless been modified by weathering.

A narrow, deep cleft may be seen parallel to the lower right margin of the upper photograph, Figure 2. This marks the former position of a thin, flat sheet of troilite, remnants of which are still visible. The black spot in the upper right corner of the lower photogroph is a hole leading into the cleft.

Some evidences of human tampering are present. The squarish projection shown on the upper right margin of the lower photograph, Figure 2, has been flattened off with a file. One inch, and again four inches, to the left of the projection, shallow notches cut with a hacksaw may be seen.

Composition and Structure

Two etched sections through the Zenda meteorite are shown in Figure 3. Octahedral structure is immediately evident. The narrower kamacite bands have a width of about .6 mm., making this a "medium" octahedrite.

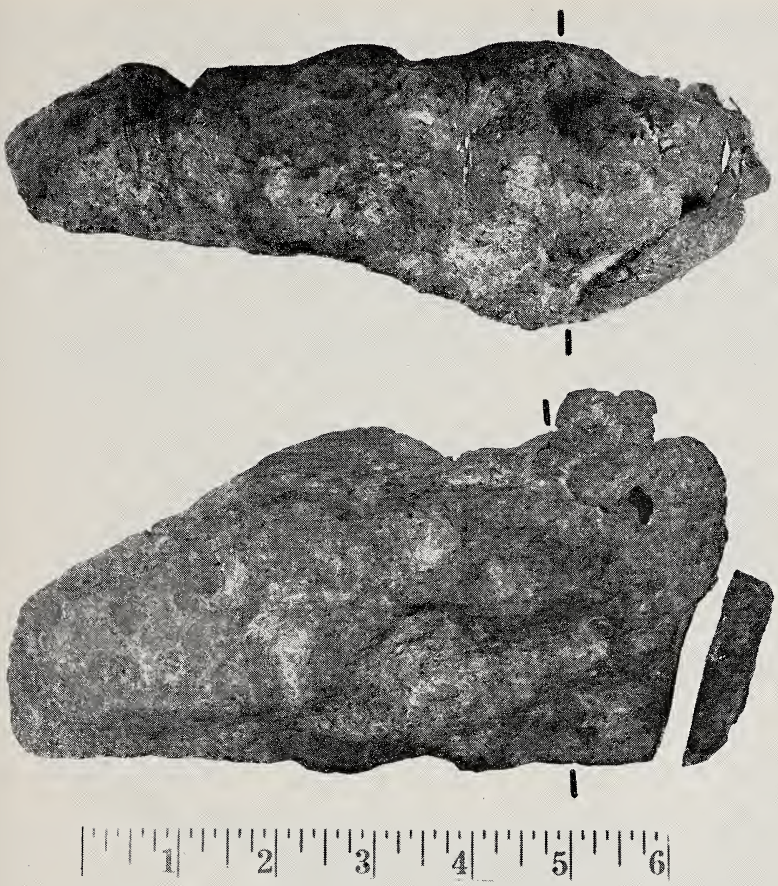

FIGURE 2. Two views of the Zenda meteorite. The upper photograph looks down toward the top edge of the specimen as shown below. In the lower photograph, the end piece belonging to Arizona State University has been restored to its approximate original position. Short, heavy lines indicate the location of the section cut by the writer.

On the larger surface, the right one third shows a different pattern of bands from the left two thirds. This is attributed to twinning, the boundary between the two contrasting parts being a composition surface. Since one set of kamacite bands (i.e., one of the octahedral directions) is common to both parts, the twin is assumed to be of the "spinel" type.

The kamacite bands are somewhat swollen between intersections. Many of them shown conspicuous Neumann lines. Also, many are divided into rounded or polygonal grains separated by fine furrows

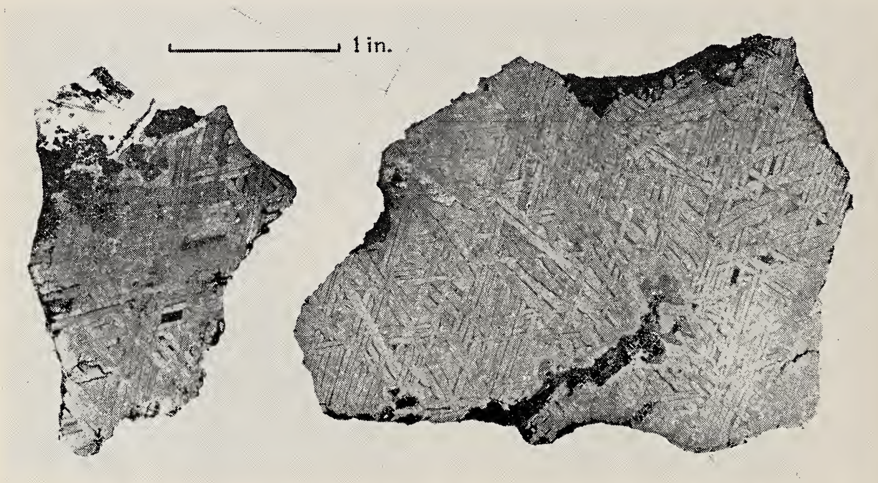

FIGURE 3. Etched sections through the Zenda meteorite. Left hand section cut by H. H. Nininger. Light area at the top is a curved surface. Note limonite "worms" due to presence of lawrencite. Right hand section cut by W. F. Read.

FIGURE 4. Tracings from photographs of etched surfaces shown in Figure 3—black: oxidation, white enclosed areas: schreibersite, dotted: troilite. Dashed line indicates composition surface between two parts of twin. Radiant diagrams show angles between kamacite bands limited to one part of twin and those shared in common (longer line).

on the etched surface. Neumann lines cross these furrows without deflection. Minute euhedral schreibersite crystals (rhabdites) are abundant as inclusions. "Swathing" kamacite surrounds the more conspicuous patches of schreibersite and troilite (Fig. 4).

Taenite lamellae are fairly uniformly developed around the kamacite plates. For some reason, they etched to a golden color on the surface cut by the writer—hence appear dark in the photograph, Figure 3. They have the usual silvery appearance on the surface cut by Dr. Nininger. Variations in width are pronounced. In some places, the taenite is about one fifth as wide as adjoining kamacite bands. Elsewhere it narrows down to a hair line or may be entirely lacking. Some sections of the taenite lamellae are replaced locally by schreibersite.

Plessite fields occupy perhaps 20 percent of the total area of a cut surface. Most show a grilled structure, with pronounced variation in the coarseness of the grill. Some are apparently structureless. Small, irregular inclusions of schreibersite may be present. A few plessite fields show partial replacement by a brittle, brownish-metallic mineral which resembles troilite but leaves no mark on a sulfur print.

The conspicuous included patches of schreibersite and troilite shown in Figure 4 are of considerable interest. Dark speckles which appear within and near them in the photographs, Figure 3, are crystals of pyroxene (black), olivine (pale brown to greenish), and graphite (grey) in approximately equal proportions. These crystals tend to be clustered together, leaving certain portions of the inclusion—most commonly the extremities—relatively clear. From the fact that the silicates and graphite occur outside the inclusions, though never very far outside, one gets the impression that nickel-iron has encroached on (replaced) the schreibersite and troilite, leaving less digestible silicates and graphite stranded beyond their original matrix. Replacement is also suggested by the presence of small spongy masses of kamacite inside the phosphide and sulfide.

No crystals of silicate or graphite are seen in the wedge-shaped mass of troilite which cuts into the upper edge of the smaller surface as shown in Figure 4. This is in line with the prominent cleft mentioned in the description of external form; hence, the troilite here belongs to a flat sheet, not an irregular patch. Unlike the troilite of the patches it fractures along parallel planes (possibly the 0001 parting) and may be a single crystal. The curved margin adjoining to the right (Fig. 4) was apparently one wall of a second mass of "sheet" troilite running at right angles to the first. The edge of the specimen is here formed by a strip of swathing kamacite.

Acknowledgements

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CHAUTAUQUA AND THE WISCONSIN IDEA

Melvin H. Miller

The purpose of this paper is to reconstruct America's only university-conducted circuit Chautauqua. The University of Wisconsin operated such a Chautauqua from 1915 to 1917 and in so doing demonstrated that bold leadership in adult education which was to become known as "The Wisconsin Idea."[1]

A Chautauqua conducted by a university is not only interesting but significant. To understand that significance one must look briefly at the phenomenon known as the Chautauqua movement.

Circuit Chautauqua was a lusty child whose father was the lyceum movement and whose mother was Lake Chautauqua. As with most children this one was a fascinating composite of good and bad, a child who grew up to have tremendous popularity for a brief time and then to die suddenly—while its less spectacular but hardier parents lived on.

Lyceum had grown up in New England in the early 1800's. At first it was a non-commercial community affair in which lectures and talks were given by local members or by visitors from other town lyceums. In 1868, James Redpath organized the first commercial lecture bureau to solve the difficulties of bringing professional lecturer and audience together. The lecture bureau flourished and thus provided two basic ingredients upon which circuit Chautauqua could eventually draw: organization and a pool of talent.

Mother Chautauqua grew up on the shores of Lake Chautauqua at Fair Point, New York. Rooted deep in the religious revival of the early nineteenth century, she was born of the Methodist camp meeting and the American Sunday School movement. Starting in 1874, Lake Chautauqua became a full-fledged summer school, one of the first in the United States. By 1900 more than two hundred courses were being offered in eight academic and special schools, housed in permanent buildings.[2] She brought to circuit Chautauqua its essentially moral and religious flavor, its earnestness and its bucolic nature.

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[1] It is unfortunate that this pioneer experiment is not chronicled even in the University's official records. *The Biennial Reports of the University Regents* during this period only mention Chautaqua. Merle Curti and Vernon Carstensen's *The University of Wisconsin;* a History, 1845–1925, mentions it only briefly. Frederick M. Rosentreter's *The Boundaries of the Campus,* A History of the University of Wisconsin Extension Division, 1885–1945, does not mention it at all. It has been necessary, therefore, to turn to the contemporary press of the day and this, along with bits and pieces of scattered reports, makes it possible to reconstruct, at least in part, this unique episode.

[2] John S. Noffsinger, *Correspondence Schools, Lyceums and Chautauquas* (New York, 1926), p. 109.

There were several off-spring who helped to spread the Chautauqua idea. One of these was the Chautauqua Literary and Scientific Circle, usually known as the C.L.S.C., forerunner of the correspondence course and dedicated to home study and consistent and serious planned reading. A half-million earnest readers have kept the idea alive to this day.

Still another child was the permanent Chautauqua Assembly, patterned after Lake Chautauqua, two hundred of which sprang up over the country.

In 1904, the last and most colorful member of the Chautauqua family was born and the one most Americans remember—the circuit or traveling Chautauqua—an idea that was to carry the big brown tents to every corner of the land and to bring an amalgam of knowledge and entertainment to one out of every eleven men, women and children in the United States sometime during every calendar year.[3]

Since the Midwest was Chautauqua's stronghold, we might expect that Wisconsin played a role in its development and this is true. Permanent Chautauqua Assemblies, such as the one at Monona Bay, were active as early as the 1880's.[4] The C.L.S.C. had chapters at Appleton, Darlington, Dartford (now Green Lake), Elkhorn, Milwaukee, Waupun, Eau Claire, Sparta and Cheboygan as well as many individual enrollees.[5] There is little doubt that attics all over Wisconsin hold dusty copies of George B. Adams' *Growth of the French Nation* or J. P. McGaffey's *A Survey of Greek Civilization.*

Finally, the tents of the commercial circuit Chautauqua dotted the landscape of Wisconsin for more than twenty years yet no Wisconsin historian has done more than glance in that direction.[6]

II

Our concern in this paper is with Chautauqua as it was conducted by the University of Wisconsin. What makes a university-run Chautauqua significant lies in the relationship of education to Chautauqua—a relationship which has always puzzled critics and historians. Was Chautauqua, as Sinclair Lewis once stated, "noth-

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[3] F. C. Bray, "Chautauqua Fifty Years Young," *Review of Reviews,* LXX (July, 1924), 71–76.

[4] The cash book for the Monona Bay Assembly shows numerous entries for monies paid to lecturers in the 1880's. An entry for July 25, 1893, shows the sum of $200.00 paid to Russell H. Conwell, author of the Classic "Acres of Diamonds" speech, State Historical Library MSS 34BX.

[5] Harrison John Thornton, "Chautauqua and the Midwest," *Wisconsin Magazine of History,* XXXIII (December, 1949), 155.

[6] The subject bibliography of Wisconsin history published by the State Historical Society of Wisconsin lists no items on the subject. Thornton's article, which only indirectly involves Wisconsin Chautauqua, is the only such article in the *Wisconsin Magazine of History.*

ing but wind and chaff and the heavy laughter of yokels?"[7] or was it an embodiment of the original idea defined by Bishop John H. Vincent: "Self-improvement in all our faculties, for all, through all time, a people's idea, a progressive idea, a millenial idea?"[8] With its talent ranging from Billy Sunday to Herbert Hoover and from the Swiss Bell Ringers to Galli-Curci, was it truly a "People's University" or was it a kind of sanctioned circus?

Wisconsin's answer was clear. Both lyceum and Chautauqua offered great educational opportunity and the University set about to demonstrate that potential in its extension offerings.

There was precedent for the development of a university-sponsored Chautauqua at Wisconsin. Gould's recent book demonstrates the relationship between Lake Chautauqua and the universities. This relationship was strongest first at the newly-formed University of Chicago under William Rainey Harper, but with his death in 1906, leadership in adult education passed to the University of Wisconsin.[9] Says Creese: "If one were thoroughly acquainted with the experience of these two universities he would know almost the whole story of university extension in this country."[10]

As with the commercial agencies, the foundation for Chautauqua was laid by the lyceum movement. Wisconsin was one of four state universities to carry on a university-sponsored lyceum program sharing its lyceum talent with Minnesota and North Dakota.[11]

By 1909, John J. Pettijohn was reporting to Dean Reber of the Wisconsin Extension Division that, "these commercial lecture and entertainment courses usually called lyceum courses will provide an avenue through which the University may bring its valuable information, its culture, and its inspiration to the people of the state and furthermore *I believe these lyceum courses are in themselves of sufficient educational, recreational and spiritual value to be worthy of institutionalizing by public taxation.*" [Italics in the original] Pettijohn stated a few years later that upon this 1909 report was built the beginnings of the University lyceum.[12]

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[7] George S. Dalgety, "Chautauqua's Contribution to American Life," *Current History* XXXIV (April, 1931), 59.

[8] Gregory Mason, "Chautauqua, its Technique," *American Mercury*, I (March, 1924), 274.

[9] Joseph E. Gould, *The Chautauqua Movement* (State University of New York, 1961).

[10] James Creese, *The Extension of University Teaching* (New York, 1941) p. 40. Creese noted that four prominent Lake Chautauqua members moved on to the universities and were responsible for much of extension development there. Those moving to Chicago, besides Harper, included Frederick Starr, Chautauqua Registrar, who became Professor of Anthropology; and George Vincent, Vice President of Lake Chautauqua and Manager of the Chautauqua Press, who was made Professor of Sociology. To Wisconsin in 1892 went Richard T. Ely as Professor of Political Economy. His strong leadership was to continue there until 1925.

[11] Noffsinger, p. 133.

[12] As reported by Pettijohn in a speech "University Extension Lyceum" delivered before the International Lyceum Association Convention in Chicago, September 17, 1913. The speech was published in pamphlet form.

By 1913 Pettijohn could report in an address before the International Lyceum Convention, that the University of Wisconsin had provided in the past year over four hundred lyceum lectures and over two hundred dates filled by concert companies. Said he: "When education is the guiding motive, instead of dividends, the lyceum and Chautauqua will step up in line with libraries, art galleries and museums. It will form part of our great expanding educational system."[13]

Pettijohn resigned that same year and was replaced by Paul H. Voelker. Voelker not only expanded the lyceum service by using non-university talent, but saw the opportunity for a university-conducted Chautauqua. After all, the administrative structure was already in existence. The lyceum programs were being scheduled by six extension districts throughout the state.[14] If lyceum was successful in the winter, wasn't Chautauqua, as someone once said, merely lyceum in the light pongee of summer?

So the Chautauqua began. Its aim, according to the Report of the Board of Regents was "to satisfy the growing demand among all classes in America for education in connection with recreational opportunities."[15] The first circuit, in the summer of 1915, was to include twenty towns.

The district representatives had done a good job of promotion and the local newspapers looked forward eagerly to what was called, "Wisconsin Week." Said an editorial in the *Evansville Review* for May 20, 1915: "We in Wisconsin ought to be glad that our great University has entered the Chautauqua field. It is one of the best things it ever did." In Bayfield the *Bayfield Progress* looked forward to a "feast of good things" and proclaimed itself "The Chautauqua City of Chequamegon Bay."[16] In Ripon the editor of the *Weekly Press* after complaining that a great many had nearly choked trying to pronounce the name Chautauqua, proclaimed it "good for the blues and will drive away any grouch."[17] And said the editor of the *Bloomer Advance* in the wonderful prose of the small town editor: "Most of the towns and cities in the better parts of Wisconsin will this year have Chautauqua, the people's university and recreation period, combined in one great jollification."[18]

The newspapers stressed over and over again that University Chautauqua was a non-profit operation and thus it could bring

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[13] Ibid.

[14] "With the opening of the year 1912–1913, the placing of lecture and entertainment courses was transferred to the districts." *Biennial Report of the University Regents*, 1914–1916. The districts included Milwaukee, Oshkosh, La Crosse, Superior, Wausau and Eau Claire.

[15] *Biennial Report*, 1914–1916, p. 191.

[16] *Bayfield Progress*, December 17, 1914; July 22, 1915.

[17] *Ripon Weekly Press*, July 1, 1915.

[18] *Bloomer Advance*, June 10, 1915.

better talent at lower cost than had been possible with the commercial kind.

The arrangements were similar for all the communities. Each town paid the University one thousand dollars for the program. For this payment the University sent a large-sized tent seating 1200, with platform, chairs and electric lamps, a smaller tent to enclose the two; a corps of four workers who remained in the community for six days and gave platform talks, conducted round table discussions, lead in community singing, displayed educational motion pictures and told the children stories and taught them games.

In addition, the University provided two popular programs every day for six days, each program preceded by a musical or literary prelude. Each community was amply supplied with advertising matter. It was originally estimated that it would require 26 days to give the six-day program in 21 towns. (One town later dropped out.)

This arrangement meant that seven tents and similar sets of equipment were required since it took one day to transport and set up the gear. Thus the Chautauqua would leap-frog its way around the state for as one community ended its program each day, a new Chautauqua opened someplace else. This was the basic principle of the commercial circuit Chautauqua, of course, and it was this circuit idea which made the peripatetic university economically possible.

A look at the program for that 1915 Chautauqua reveals that its talent was almost identical with one of the better six-day commercial circuits.

One is surprised to find only one University of Wisconsin lecturer featured although certainly an outstanding one. While Chautauqua programs were not given to the use of litotes, in the brochures sent out by the Extension Division, William H. Kiekhoefer, then Assistant Professor of Political Economy, was billed as "A typical American." One other Madisonian was on the list of lecturers. He, too, was well-known for his speaking. This was Reverend Father H. C. Hengell, the Irish pastor of University St. Paul's Chapel in Madison. Other lecturers were standard attractions on the commercial circuits. One of these was Dr. William Forbush, organizer of the Knights of King Arthur, called the largest boy fraternity in the world. Forbush's topic was "The Boy Problem."[19]

Other speakers included Congressman James Manahan of Minnesota, who had served during the preceding term in the U. S.

[19] The Boy Scout movement was incorporated in this country, February 9, 1910, and received much of its imputus from the Chautauqua movement. See my article "The Chautauqua in Lansing," *Michigan History*, XL (September, 1956), 268.

House of Representatives; William Bruce Leffingwell, a travel lecturer, who showed slides and talked about "Seeing America First" and Edwin W. Lanham, billed as "sometimes a historian, sometimes a poet, sometimes a scientist, often a humorist, but always an orator." Finally there was Lincoln Wirt, the former Territorial Superintendent of Public Instruction in Alaska, and a long time Chautauqua and lyceum lecturer.

These speakers were supplemented, for parts of the tour, by Congressman William H. "Alfalfa Bill" Murray of Oklahoma speaking on "The Philosophy of the Plow" and on several occasions by Wisconsin's Robert LaFollette giving his famous lecture on popular government. In addition Dean Louis Reber and Paul Voelker from the Extension Division would visit the Chautauqua from time to time.

Providing entertainment was Thatcher's Symphony Orchestra of twenty pieces.[20] Others included a dramatic company of five members, a male quartet complete with readings and the inevitable Swiss bells, and the Tuskegee Institute Singers, a group of eight students from that institution and billed as the best Negro singers in the world. (It was worth the cost of a season ticket, said the advertising copy, to hear them singing, "The Watermelon Hanging on the Vine.")

Two reels of motion pictures were shown after the lecture each night. *The Evansville Review* said of these: "It is quite a relief to see no one pushed off a cliff or something." Instead, reported that newspaper somewhat vaguely: "Scenes of birds—various and unusual birds of all sorts, doing all sorts of things."[21]

The circuit began in Madison on July 1, the first Chautauqua Madison had had since the days of the Monona Assembly. The big tent was set up in front of the Historical Society library. President Van Hise came down to tell the audience, "I shall never be content until the University becomes a beneficient influence to every family in the state." George Vincent, President of the University of Minnesota, also spoke. "Alfalfa Bill" Murray told this audience, "Preparedness is the surest protection against war." Even with these famous names, though, bad weather and the great number of attractions going on in the University community put attendance far below expectations.[22]

The first week had its share of troubles. In La Crosse, where the Chautauqua opened on July 4th, wind and rain collapsed the big tent just an hour before the afternoon performance was to begin. The program moved over to the smaller exhibition tent and

[20] "The biggest that has ever come to Bloomer." *Bloomer Advance*, July 22, 1915.
[21] *Evansville Review*, July 15, 1915.
[22] *Wisconsin State Journal*, July 2, 1915.

the show went on. The first speaker noting the torrential downpour going on outside said, "I have been asked to make a dry speech to offset the weather." Professor Kiekhoefer hopped up on a chair, which he noted was the smallest platform he had ever spoken from, and opened his remarks like this: "I am going to lecture to you on "The Springs of Happiness" and I'll wager that there is no place in Copeland Park where you would be happier than you are right here." And if the stringed instruments of the orchestra sounded a little strange in the damp weather—well, that was Chautauqua—university of otherwise.

And so the Chautauqua went—to such towns as Tomah and what is now Wisconsin Rapids, to Stevens Point, Ripon and Antigo, to Ladysmith and Bloomer and Rice Lake, to Bayfield and Superior, and down again to Delevan and Racine and Evansville.

As with the commercial Chautauqua, it was best received in the smaller, more isolated areas. Typical was Bayfield, a village on the shores of Lake Superior, where University Chautauqua played from July 17 to July 22, 1915. Twenty citizens had underwritten the thousand dollar cost and had set up a number of committees to get ready. One hundred rooms had been made available and arrangements had been made to meet all trains and boats. Two hundred fifty children had registered for the morning games and organized play. Catering systems had been set up in the court house to handle the overflow crowds. The cost of the three meals was one dollar per day.

The Chautauqua opened on Sunday morning with Union services, two speakers and a chorus of fifty voices including singers from Ashland and Washburn.

Next day Professor Kiekhoefer told the packed tent that: "It is not enough to say this will be the last great war; to effect that end some kind of international organization must be established." In another lecture entitled, "Crusades of Today" he suggested these topics as being crusades he was for: Peace, Women's Suffrage, Eugenics, Temperance and the Labor Movement. Those crusades he was against included Commercialism, Progressivism and Socialism. Paul F. Voelker, who had appeared the previous winter on Bayfield's lyceum program, came up from Madison to talk on "Joan of Arc." The *Bayfield Progress* reported that he held his audience spellbound.[23]

By week's end the Chautauqua was over and the local headline on July 22 read: "First Chautauqua a Grand Success." The editor said the entertainment furnished was of sterling quality and reported plans to make Bayfield a permanent Chautauqua city.

[23] *Bayfield Progress*, July 22, 1915.

The University Chautauqua returned to Bayfield in 1916 as it did to twenty-one other towns in the state. The Mayor proclaimed it Chautauqua Week and in spite of intense heat and a storm on Saturday night (weather was always the bane of Chautauqua) the thousand dollar guarantee was met. The Chief of Police kept tabs on the number of autos parked in front of the main tent during the week and reported with satisfaction that a total of 247 cars brought passengers to the Chautauqua from the adjoining county and from cities and villages to the south. The highest total for any one performance was Sunday afternoon when thirty-five cars stood outside the big tent all at the same time.[24]

Featured on the 1916 University Chautauqua were twenty-five members of the University of Wisconsin band. The band had spent the previous summer at the San Francisco World's Fair in what the brochures referred to as "successful competition with Sousa and other great bandsmen." In Bayfield the band arrived late after a harrowing and hungry ride from Superior but the results were apparently worth it, for said the editor rather breathlessly: "It [the concert] was just wonderfully fine, unsurpassably superb."[25]

Speakers for this year were drawn almost entirely from commercial talent. They included Herbert S. Bigelow, city reformer from Cincinnati, Gabriel Maguire of Boston, who had spent many years in Central Africa as a missionary, and Burt L. Newkirk of the University of Minnesota, who lectured on the gyroscope. Newkirk was representative of the popular science type of lecturer beginning to appear on the circuits. The wife of the State Superintendent of Schools, Mrs. C. P. Cary, spoke on the exceptional child. Besides the band other musical events included the Milton College Glee Club and Professor and Mrs. Von Geltch on the violin and piano.

Although successful in Bayfield, reception in the twenty-one other towns of the 1916 season was uneven. Along with the usual difficulties of heat and storms and equipment delays experienced by all Chautauquas, new problems were beginning to appear. The papers were full of war news. Typical was Tomah, where Company "K" was ready to leave for Mexico. Those who stayed home were finding other things to do. The Tomah *Monitor-Herald* for June 16, 1916 had a full-page advertisement for a Maxwell touring car which could be purchased at the Central Hardware Company for $655. The Unique Theater was showing three reels of "What Dorris Did" for just ten cents.

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[24] *Bayfield Progress,* July 25, 1916.

[25] *Bayfield Progress,* July 18, 1916.

In Evansville, which claimed the oldest lyceum course in the state dating from 1882, a commercial Redpath Chautauqua took the place of University Chautauqua in 1916.[26]

In Delevan, the Delevan Assembly brought Wisconsin Week Chautauqua to its Eighteenth Assembly season in 1915 but tried an entirely new program in 1916 entitled, "Walworth County Community Week" which, while elaborately planned, proved no more successful.[27]

University Chautauqua was just about over. The summer of 1917 saw a modified program of Chautauqua constructed around "patriotic inspiration and instruction with reference to the war emergencies"[28] but this was the last year. An item in the Extension Division's Biennial Report published on July 1, 1918, gives this terse account: "The results [of Chautauqua] were quite satisfactory but the financial outlay was so great, considering the small number of communities that were reached, that it was felt that the general community betterment was not far-reaching enough to justify the time, money, and energy expended."[29]

III

In retrospect, University Chautauqua was a daring idea, quite in keeping with the leadership in extension work for which the University of Wisconsin was becoming so well known. Its similarity to commercial Chautauqua provides us with tangible evidence that at least at one university, educators saw in the circuit Chautauqua an educationally worthwhile venture and a force for good in the life of the small towns. At the same time that similarity to the circuits provided the seeds for its own destruction for, even though it was a non-profit university service, the cost of using commercial talent and the limited one-month season brought the price of a season ticket to $1.50 to $2.00. This was the standard price for a similar-length Chautauqua on the commercial circuits. The University could not hope to compete against the large, well-entrenched circuits on their own terms and it is doubtful if Wisconsin could have continued to sponsor Chautauqua for very long even if the war had not come along.

But the war did come and by 1917 the University and particularly the Extension Division was deeply involved in the war effort. More than one-third of the Extension staff had gone to war and those who were left were busy in the activities of the Red Cross, Liberty Bond drives, instruction at military camps and in conduct-

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[26] *Evansville Review,* July 30, 1916.
[27] *Delevan Enterprise,* July 15, 1916.
[28] *Biennial Report,* 1916–1918, p. 183.
[29] *Biennial Report,* 1916–1918, p. 200.

ing correspondence school study programs for enlisted men. There was simply no time for Chautauqua.

University Chautauqua's justification and its epitaph was provided, fittingly enough, by Dean Lighty of the Extension Division, in his 1918 report to President Van Hise. Said he:

> In the last decade, University Extension teaching has undergone as profound a change and transformation as has occurred in any field of education in our own times. No longer . . . is this a movement only 'for the promotion of university teaching' . . . but something distinct and of itself, and possessed of a body of text materials and of teaching techniques of its own, and destined independent development. It is, therefore, no longer a mere transfer of intramural teaching into an extramural setting. It is not a substitute. In fact it is no longer the extension of university teaching but it has become extension teaching—a distinct instrument of the democracy of our times.[30]

[30] *Biennial Report,* 1916–1918, p. 177–178.

DISTRIBUTION AND ACCUMULATION OF COPPER FOLLOWING COPPER SULFATE APPLICATION ON LAKES

C. Joseph Antonie and Wayne H. Osness

Copper sulfate has been used for the control of algae for many years. In 1904, Moore and Kellerman[9] carried on studies to determine the dosages of copper sulfate for the control of offending types of algae. As early as 1918, copper sulfate was experimentally applied to Madison, Wisconsin, lakes for the control of algae. In 1925, Domogalla[3] began an extensive treatment program on Lake Monona and between May and September used 49,363 kilograms of commercial copper sulfate. Since this time through 1959, approximately .77 million kilograms of copper sulfate ($CuSo_45H_2O$) have been applied to Lake Monona making it the most heavily treated lake reported in the literature. (Table 1).

Numerous studies have detailed the immediate effect of copper sulfate treatment. Woodbury, Palmer and Walton[15] found that copper sulfate added to distilled water in a concentration of 1.5 ppm would kill largemouth black bass; however, in a duplicate experiment by Nichols[11], using Lake Mendota water with an alkalinity of about 170 ppm, the toxicity limit was found to be about 200 ppm of commercial copper sulfate. Nichols noted that Lake Mendota water used in the experiments dropped from pH 8.0 to pH 6.8 after the addition of 200 ppm of copper sulfate crystals. In similar treatment of distilled water the pH dropped to 5.6. Using these data, Nichols indicated that much of the copper sulfate added to lake water of notable alkalinity is precipitated as a basic copper compound. Since the alkalinity is principally due to the calcium and magnesium carbonates, it is reasonable to believe that the principal copper precipitate is in a carbonate or bicarbonate form.

Nichols further studied the distribution of the precipitated copper and found the greater concentration in the profundal region. The top layer of mud contained more copper than did deeper strata, but penetration was noted to a depth of 1.23 meters. The highest reported concentration was 1063 ppm in 1947 which is somewhat less than the 9000 ppm toxicity limit to certain types of bottom dwelling organisms reported by Machenthun[6] in 1952. Since 1947 approximately 27,300 additional kilograms of copper sulfate have been added to Lake Monona and with the passing of time continued seepage could increase the concentrations reported

TABLE 1. KILOGRAMS OF COPPER SULFATE APPLIED TO DANE COUNTY LAKES

Year	Mendota	Monona
1925	....	30,600
1926	....	34,100
1927	....	40,200
1928	....	41,500
1929	....	37,500
1930	....	40,800
1931	....	45,500
1932	....	41,800
1933	....	39,100
1934	....	45,600
1935	....	40,800
1936	....	34,500
1937	....	37,100
1938	....	31,200
1939	....	26,600
1940	....	30,600
1941	....	26,700
1942	....	26,900
1943	....	31,200
1944	....	31,700
1945	....	6,880
1946	2,810	15,370
1947	185	3,610
1948	417	3,040
1949	0	703
1950	0	11,140
1951	313	5,570
1952	0	2,880
1953	58	2,220
1954	0	0
1955	0	413
1956	0	986
1957	0	0
1958	0	0
1959	0	0

by Nichols. No determinations have since been made to ascertain whether the copper concentration is increasing or decreasing in the bottom muds due to prolonged treatment.

This study was initiated to determine the present concentration and distribution of copper in the bottom muds of Lake Monona to determine the soluble copper concentration following treatment and the effect of time on this concentration.

Procedure. To determine the copper concentration after an elapse of time since the last application of copper sulfate, the top 2.5 cm of lake mud was compared to an inch layer 15 cm to 17.5 cm below the top. This was done to avoid the top 10 cm layer of mud that may be subjected to constant mixing. Thus, by using the 15 cm to 17.5 cm much layer it is assumed that this was deposited mud and not a mixture similar in content to the top 2.5 cm. The operation was carried out by careful use of an Ekman dredge with only the two layers mentioned taken as samples.

Sampling points (Figure 1) were chosen in a definite series in the same section of the lake to show the accumulative effect on

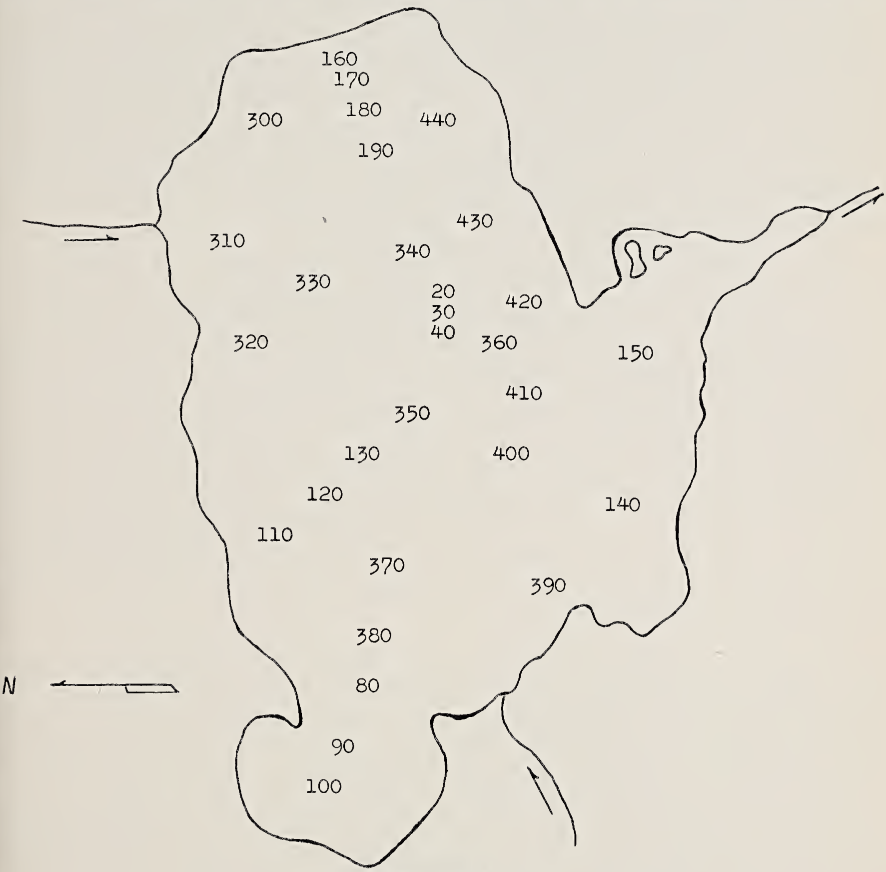

FIGURE 1.

different depths as well as in the deepest areas. None of the sampling points were located close to the shoreline because of the deposits of sand and gravel in those areas.

Three similar samples were taken from Lake Mendota to be used as controls since Lake Mendota has been treated only slightly (Table I) and the residual copper could be assumed to be similar.

Copper Determination. One gram of the finely divided dry mud was weighed on an analytical balance and transferred to a 300 ml. Kjeldahl flask. Twenty ml. of concentrated sulfuric acid were added and the mixture heated almost to the boiling point of the sulfuric acid. The sample was then digested until nearly colorless. This operation took about 3–4 hours. The sample was then cooled and 100 ml. of distilled water added. The insoluble residue was removed by filtering and the sample collected in another 300 ml. Kjeldahl flask. The clear, pale yellow filtrate was then treated with 2 ml. of 30% hydrogen peroxide. This mixture was then digested until entirely colorless. The digest was cooled and 50 ml. of distilled water added. The sample was neutralized with concentrated ammonium hydroxide using a piece of litmus paper as an indicator. After neutralization, the sample was again filtered to remove the iron which was precipitated as the hydroxide after the addition of the base. The sample was collected and stoppered in a 250 ml. Erlenmeyer flask until final treatment.

The sample containing the digested copper was transferred to a 500 ml. separatory funnel and 5 ml. of alkaline ammonium citrate (80 ml. of concentrated ammonium hydroxide and 420 ml. of distilled water are used to dissolve 20 grams of ammonium citrate) and 5 ml. of sodium diethyldithiocarbamate (5% of the reagent dissolved in distilled water) were added and the entire contents thoroughly mixed. The copper carbamate color usually developed rapidly, but five minutes were allowed before extraction to make sure the formation was complete. Ten ml. of amyl acetate were added to extract the color, and the separatory funnel was used to separate the layers. A second 10 ml. portion was added to obtain all of the color present in the sample and also to bring the total extraction to exactly 20 ml.

A portion of the extraction was placed in a photometer where the light transmission was compared to that of distilled water, which was given a reading of 100%. The amount of color present was compared to that of a known standard and the amount of copper in the unknown sample computed. In cases were a large amount of copper was present, it was necessary to dilute the extraction to 40 ml. to get an accurate reading on the photometer scale, the reading was then doubled to get the copper content. The copper content was computed in milligrams per gram and then multiplied by 1000 to determine the milligrams of copper per kilogram of dry mud sample (or ppm). Table II and III give the data that were obtained in this analysis.

Discussion of Results. As shown in Table II the amount of copper present in the top layer of mud was consistently less than that in the layer buried 15 cm deeper in the bottom of the lake. There were only four exceptions in the thirty samples. Two of these had little more than the natural copper in them (samples 140 and 150). This is explained by the fact that they were taken from the region of the lake close to the outlet of the Yahara River and carrying it downstream. The other two samples (80 and 100) were taken from areas of shallow depth near an area of greater depth. This too, may cause a scouring effect. The average copper concentration including all samples is 327 ppm in the top inch of bottom mud compared to 440 ppm in the 15 to 17.5 cm layer. Eight of the samples were reanalyzed to check accuracy of the procedure. It was found that the error averaged less than 5 ppm which is an error of about one percent.

Evidence that the copper content is less in the upper region would suggest that the constant settling of silt into the deeper areas of the lake would in time cover up the heavy concentrations of copper that were deposited at the time of application. This covering up or "healing" process would not be complete for quite a number of years, however, the trend is most apparent. Since bottom organisms inhabiting the upper limits of the mud are an important link in the food web, it seems it would be but a matter of time before they would be living in an environment with a gradual decrease in amount of artificial copper. The data also indicate that, after many years of copper sulfate application, the greatest concentration of copper is found in the lake muds of the profundal region. The resulting covering-up process tends to take place more rapidly in this area.

TABLE 2. TOTAL COPPER CONTENT IN THE BOTTOM MUDS OF LAKE MONONA AT VARIOUS DEPTHS (Table Samples number Ending in 0 is the Top 2.5 cm Portion and the Sample Numbers Ending in 1 is the 15 to 17.5 cm Deep Portion)

Sample No.	Depth	ppm Cu	Sample No.	Depth	ppm Cu	Sample No.	Depth	ppm Cu
20	70	406	150	10	113	350	34	502
21	70	470	151	10	62	351	34	588
30	74	396	160	30	250	360	32	492
31	74	450	161	30	384	361	32	528
40	70	368	170	35	296	370	38	443
41	70	456	171	35	474	371	38	464
90	20	322	180	40	284	380	18	527
81	20	318	181	40	290	381	18	732
90	8	420	190	45	220	390	15	331
91	8	550	191	45	528	391	15	487
100	5	256	300	35	231	400	20	112
101	5	196	301	35	252	401	20	145
110	30	274	310	48	315	410	15	308
111	30	530	311	48	383	411	15	539
120	50	328	320	51	367	420	12	165
121	50	480	321	51	470	421	12	180
130	55	330	330	47	389	430	31	383
131	55	660	331	47	612	431	31	438
140	15	147	340	43	482	440	42	362
141	15	97	341	43	699	441	42	742

Average: 0 numbered samples—327.
1 numbered samples—440.

TABLE 3. TOTAL COPPER CONTENT IN THE BOTTOM MUDS OF LAKE MENDOTA AT VARIOUS DEPTHS (The Sample Number Ending in 0 is the Top 2.5 cm Portion and the Sample Number Ending in 1 is the 15 to 17.5 cm Inch Deep Portion)

SAMPLE MO.	DEPTH	PPM Cu
50	82	138
51	82	104
60	83	123
61	83	53
70	82	250
71	82	112

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NATURAL LAW AS CHAUCER'S ETHICAL ABSOLUTE

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This essay advances overlooked sources for Chaucer's exposure to the *lawe of kinde*[1] defined today as a "standard of right independent and supreme over the will of man," a law both autonomous and spontaneous that proclaims "in every time and place . . . a right course of action, one eternal, immutable."[2] It will argue that allusions to natural law particularly in the General Prologue of the *Canterbury Tales* reflect the impact of this doctrine on Chaucer. Consequently, the evidence here will support the probability that the poet was one of those "that weren of lawe expert and curious."[3]

This juridical and theological concept, a legacy from the classical and medieval eras, is alive in English law, in the post-war jurisprudence of West Germany and elsewhere on the Continent.[4] Natural law enjoys a life of its own in *Black's Law Dictionary* and survives somewhat tenuously in the United Nations' *Draft Declaration of Rights and Duties of States.*[5] As in Chaucer's time, it enjoys protected status as one of the pair of commandments on which "hang all the Law and the Prophets" and by St. Paul's pronouncement in *Romans* II, 14–15, that those having not the law, are a "law unto themselves" if they do naturally those things contained

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[1] *A New English Dictionary on Historical Principles,* ed. J. A. H. Murray (Oxford, 1901). For a discussion of the relationship of the Law of Nature to the term and concept *natura* in its mediaeval context, see C. S. Lewis, *Studies in Words* (Cambridge, 1960), pp. 58–62. Lewis writes: "On the one hand, if *nature* is thought of mainly as the real (opposed to convention and legal fiction) and the laws of *nature* as those which enjoin what is really good and forbid what is really bad (as opposed to the pseudo-duties which bad governments praise and reward or the real virtues which they forbid and punish), then of course 'the law of *nature*' is conceived as an absolute moral standard against which the laws of all nations must be judged and to which they ought to conform."

[2] F. M. Taylor, "The Law of Nature," *Annals of the American Academy of Political and Social Science,* I (1890), 560, 577.

[3] J. M. Manly, *Some New Light on Chaucer* (New York, 1926), pp. 7–18. Cited hereafter as 'Manly.' See D. S. Bland, "Chaucer and the Inns of Court: A Re-examination," *English Studies,* XXXIII (1952), 3–4; R. J. Schoeck, "A Legal Reading of Chaucer's *Hous of Fame,*" *University of Toronto Quarterly,* XXIII (1953–54), 185–192, suggests that Chaucer "wrote his *Hous of Fame* for one of the ritualistic functions of the Inner Temple." See also, the same author's "Gerard Legh, Herald," *Notes and Queries,* CC (1955), p. 140.

[4] On the strong link between "natural law" and the term "natural justice" as applied in English courts of the nineteenth and twentieth centuries, see H. H. Marshall, *Natural Justice* (London, 1959), pp. 6–20. Gottfried Dietze, "Natural Law in the Modern European Constitutions," *Natural Law Forum,* I (1956), 73–91; also, Frieherr von der Heydte, "Natural Law Tendencies in Contemporary German Jurisprudence," *Natural Law Forum,* I, 115–121.

[5] *The Law of Nations,* ed. H. W. Briggs, 2nd ed. (New York, 1952), pp. 15–16. The Draft Declaration "appears to reflect the natural law approach of inherent (basic) rights of states. . . ."

in the law. Anthropologists and sociologists define natural law as "supernatural intuitionalism" and a force "not subject to objective determination," while at the same time being forced to admit it as a cultural fact and a determinative force in the law systems of primitive societies.[6] Over forty years ago, Justice Holmes criticized for their naïveté those jurists who believed in natural law.[7] Today, however, Chroust writes that no criticism "can ever succeed in denying the immemorial merits and ideological importance of Natural Law, which are to be found in the sublime meaning of its honest quest for an enduring ultimate in a world perennially contingent and confusingly relative."[8]

The Middle Ages is marked by a continuing effort to reduce the antithesis between positive law typified by "givenness" and natural law, the law that ought to be, uncritical in one sense yet admirable in that it holds consistently to "an ultimate principle of fitness with regard to the nature of man as a rational and social being which is or ought to be, the justification of every form of positive law."[9] The literature and thought of Greece, largely devoted to the dignity of man, gave rise to natural law and its stress on moral principles derived from the nature of man and the need for translating those principles into positive law. The idea of positive laws founded on natural-law morality was taken up by the Roman Jurists and then assimilated into Christian thought.[10] From the fifth through the tenth centuries the Greek and Roman concept of natural law survived in glosses and etymologies such as those of Bishop Isidore of Seville.[11] At the outset of the *Decretum* of Gratian (c. 1143) natural law is identified with the law of God, for the church did not remain aloof to Aristotle, Cicero and Justinian—important figures in the rediscovery of classical learning during the "lesser Renaissance" of the twelfth century.[12] Gratian stated: "Natural law is the law common to all peoples, in that it is

[6] E. A. Hoebel, *The Law of Primitive Man* (Cambridge, Mass., 1954), p. 5. See also Jacques Ellul, *The Theological Foundation of Law*, trans. M. Wieser (Garden City, 1960), pp. 27–28.

[7] O. W. Holmes, "Natural Law," *Harvard Law Review*, XXXII (1918–19), p. 41. See *The Mind and Faith of Justice Holmes*, ed. M. Lerner (Boston, 1943), p. 369. Nevertheless, in S. Pacific Co. vs. Jensen, Holmes refers to a "higher law," a "brooding omnipresence in the sky."

[8] A. H. Chroust, "On the Nature of Natural Law," *Interpretations of Modern Legal Philosophies*, ed. Paul Sayre (New York, 1947), p. 80. Cited as 'Chroust.'

[9] F. Pollock, "The History of the Law of Nature: A Preliminary Study," *Journal of the Society of Comparative Legislation*, II (1900), 418. Cited as 'Pollock.'

[10] See J. Leclerq, "Suggestions for Clarifying Natural Law," *Natural Law Forum*, II (1957), particularly pp. 66–73. Cited as 'Leclerq.'

[11] See *Etymologiae*, V, 4, in *Patrologiae Cursus Completus*, ed. J. P. Migne (Paris, 1850), LXXXII, Col. 199. Also, P. Vinogradoff, *Roman Law in Medieval Europe* (Oxford, 1929), p. 37. Cited as 'Vinogradoff." See O. Lottin, *Le Droit Naturel*, 2nd ed. (Bruges, 1931), pp. 9–11. Cited as 'Lottin.' As early as 1159, John of Salisbury in his political treatise, *Polycraticus* IV, 7, reflected the medieval tradition of natural law doctrine as yet unaffected by new contact with Aristotle's *Politics*. See *Joannis Saresberiensis Opera Omnia*, ed. J. A. Giles (Oxford, 1848), III, p. 241.

[12] Pollock, 422.

everywhere held by the instinct of nature, not by any enactment: as for instance, the union of man and woman, the generation and rearing of children, the common possession of all things and the one liberty of all men, the acquisition of those things which are taken from air and sky and sea; also the restitution of an article given in trust or money loaned, and the repelling of force with force. For this, or whatever is similar to this, is never considered unjust, but natural and equitable."[13]

Chaucer's first mention of *Jurisprudentia perennis* appears in the *Book of the Duchess:*

> And in this book were written fables
> That clerkes had in olde tyme,
> And other poets, put in rime
> To rede, and for to be in minde,
> While men loved the lawe of kinde. (*B D* 52–56)[14]

Chaucer's "clerkes" and "poets" include Homer, whose heroes were accorded the hospitality and protection due suppliants, thus pleasing Zeus (however, this moral duty was not performed for Ulysses at the hands of Circe in *Bo* IV, m. 3). Although there is no proof that Chaucer knew his work, Sophocles had made the conflict between moral law, the idea of the "really right" and positive law, the law of the political ruler, the basis for the *Antigone*. Antigone cries of "Unwritten laws, eternal in the heavens, Not of today or yesterday are these, but live from everlasting, and from whence they spring, none knoweth."[15]

Whether "twenty bookes . . . of Aristotle and his philosophie" lay at Chaucer's own "beddes heed" is problematical, but in one of the Clerk's books lay this definition of the *lawe of kinde:* "Now there are two kinds of laws, particular and general. By particular laws I mean those established by each people in reference to themselves, which again are divided into written and unwritten; by general laws I mean those based upon nature. In fact, there is a general idea of just and unjust in accordance with nature, as all men in a manner divine, even if there is neither communication nor agreement between them." *(Rhetoric* I, 1373b 2)[16]

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[13] *Decretum Gratiana* (Paris, 1601), *Distinctiones* I, c. 7. Translation is by E. Lewis in *Medieval Political Ideas* (New York, 1954), I, 33. Cited as 'Lewis.' See M. Villey, "Le Droit Naturel chez Gratien," *Studia Gratiana*, III (1954), 85–99.

[14] All citations from Chaucer in text are from *The Works of Geoffrey Chaucer*, ed. F. N. Robinson, 2nd ed. (Cambridge, Mass., 1957).

[15] *An Anthology of Greek Drama*, ed. C. A. Robinson, Jr. (New York, 1949), p. 115. See Leclerq, pp. 76–77: "When Antigone opposes the rights of conscience to the tyrant's decree and speaks of eternal laws, she is talking of moral laws."

[16] Aristotle, *The Art of Rhetoric,* trans. John H. Freese (London, 1926), pp. 139–141. See Max Shellens, "Aristotle on Natural Law," *Natural Law Forum*, IV (1959), p. 81: "The aim of the *Rhetoric* in regard to natural law, is to show that the term natural law is in vogue and that from a certain point of view it is considered an advantage to make use of its emotional appeal . . . . No judgment is passed on natural law. He merely introduces us to a catchword without discussing its moral significance." Shellens points out that the *Magna Moralia* and *Nicomachean Ethics* go deeper than this.

The Franklin's "Marcus Tullius Scithero" had written in *Tusculan Disputations* of a "divine power" and a "*divine nature*" which has its basis not in laws and decrees.[17] In the *Republic* (III, xxii, 33) Plato stresses the universality of law since it is based upon the common nature of men. Its eternal and immutable aspects stem from its endorsement by God. This doctrine—the *jus naturae* of the Roman jurists—later was incorporated into canon law, the body of legal rules administered by the ecclesiastical courts, as indicated in the above citation from the *Decretum*.[18] Of the trio of illustrious third-century Roman jurists, Chaucer mentions only the name of Papinian "that had ben long tyme ful myghty amonges hem of the court" (*Bo* III, pr. 5). Of the remaining pair, Gaius and Ulpian, the latter contributed the most in the way of natural law theory to the massive compilation of law sponsored by that same Justinian "eke, that made lawes."[19]

Chaucer's rendering of Boethius from Trivet's commentaries and a French source probably did not appear until shortly after 1380, but the *De Consolatione Philosophiae* had helped to preserve the classical concept of the law of nature since the sixth century A.D. Chaucer was far more than a sedulous copyist or indifferent translator of the *Boece*. He read that "verray good is naturely iplauntyd in the hertes of men, but the myswandrynge errour mysledeth hem into false goodes" (*Bo* III, pr. 2). He had perhaps been influenced to "techyn his soule that it hath, by naturel principles kyndeliche yhyd withynne itself, al the trouthe the which he ymagineth to ben in thinges withoute" (*Bo* III, m. 11).[20] Contemplative reading of the *Boece* helped shape Chaucer's view of the law of nature just as it aided the canonists and schoolmen of the twelfth, thirteenth, and fourteenth centuries in their task of reconciling the moral authority of the classical philosophers with the temporal authority proclaimed in Justinian's compilation. These scholars provided an "identification of the law of nature with the law of God revealed in human reason."[21]

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[17] *A Documentary History of Primitivism and Related Ideas*, eds. A. L. Lovejoy and G. Boas (Baltimore, 1935), I, 256. Cited as 'Lovejoy.'

[18] See M. Radin, *Handbook of Roman Law* (St. Paul, 1927), pp. 70–73; also A. P. d' Entreves, *Natural Law* (London, 1951), p. 19 and G. Tellenbach, *Church, State and Christian Society*, trans. R. Bennett (Oxford, 1940), p. 23.

[19] *The Commentaries of Gaius and Rules of Ulpian* trans. J. T. Abdy and B. Walker (Cambridge, 1876), p. 1. Also, *The Digest of Justinian*, trans. C. H. Munro (Cambridge, 1904), I, p. 5. See E. Levy, "Natural Law in Roman Thought" *Studia et Documenta Historiae et Juris*, XV (1949), 1–23.

[20] Cf. also *Bo* III, m. 11, lls. 38–43; *Bo* V, pr. 2, lls. 10–15.

[21] H. S. Maine, *Ancient Law*, new ed. (London, 1930), pp. 120–121. On the Italian school of Post-Glossators of the fourteenth century, see R. Sohm, *The Institutes, A Text-Book of the History and System of Roman Private Law*, trans. J. C. Ledlie, 2nd ed. (Oxford, 1901), pp. 144–46, 151–55. In seats at Perugia, Pavia and Padua, the Post-Glossators forged a body of national Italian law similar to the national Italian literature created by Dante, Petrarch and Boccaccio. Their jurisprudence was a philosophical one "permeated by an idea which dates far back into antiquity, the idea, namely, of a Law of Nature. . . ."

In an early commentary (1170) on the *Decretum,* Rufinus holds that natural law is restricted to human beings rather than all animals.[22] At the hands of ecclesiastical jurists it became a law to which Chaucer's Troilus was subject, but not the 'proude Bayard" who was subject only to "horses lawe" *(Tr* I, 223–224). St. Thomas Aquinas posits an eternal law and the participation of this eternal law in rational creatures is called natural law *(S. T.* q. 91, 2).[23] He construes as the first precept of natural law that "good is to be done and followed, and evil is to be avoided. And upon this are based all other precepts of the natural law." For Aquinas "all virtuous acts are prescribed in the law of nature, for each man's reason dictates to him that he should act virtuously" *(S. T.* q. 94, 2).[24] in his *De Regimine Principium,* Aegidius Romanus, a student of Aquinas, wrote of man's natural desire for "existence and the good" while shunning "non-existence and the bad," emphasizing that "other laws, whether natural or civil, originate in this and are based on this."[25] Fourteenth century canonists worked to integrate natural law idealism into canon law as Gratian had done in the *Decretum.* Thus, when Chaucer writes in the *Troilus* (I, 236–238): "For evere it was, and evere it shal byfalle,/ That Love is he that alle thing may bynde,/ For may no man fordon the lawe of kynde"/ he reflects not only his debt to the *De Consolatione* of Boethius, but also his church's recognition of classical natural law doctrine. Also, he reduces the distance between his Christian readers and the pagan Troilus, Criseyde, and Pandarus appreciably more than might at first appear.[26] However, we must examine the *Canterbury Tales,* particularly the General Prologue and the Parson's Tale, to see Chaucer's most skillful use of allusions to the *lawe of kinde.*[27]

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[22] Lewis, 37.

[23] *S. Thomae Aquino Summa Theologiae* (Ottawa, 1941), II, 1210a–1210b. See also J. Bryce, *Studies in the History of Jurisprudence* (New York, 1901), II, 595. The capstone for the work of the canonists and schoolmen in this respect is perhaps to be seen in *Tres Libri Codicis* of the Italian Post-Glossator, Lucas de Penna (d. 1390). Natural law is identified with divine law and becomes therefore the direct expression and manifestation of the divine will. Cf. W. Ullman, *The Medieval Idea of Law as Represented by Lucas de Penna* (London, 1946), p. 46.

[24] *Summa Theologiae,* II, 1225a–1225b. Leclerq writes (p. 68) that St. Thomas relates all laws, eternal, natural, positive divine law and positive human law to a single definition and "emphasizes more what unites them than what distinguishes them." Also, (p. 79): In his definition of the law, "St. Thomas draws his inspiration indirectly from Roman law and directly from the canonists, who themselves followed Roman law."

[25] Lewis, 69.

[26] See M. W. Bloomfield, "Distance and Predestination in *Troilus and Criseyde,*" *PMLA,* LXXII (1957), p. 19.

[27] Mel* 2770–75 particularly "This is to seyn, that nature deffendeth and forbedeth by right that no man make hymself riche unto the harm of another persone." On natural law and its relation to private property see B. Tierney, *Medieval Poor Law* (Berkeley and Los Angeles, 1959), pp. 28–33. See also *Pars T* 336; 526, "For soothly, nature dryveth us to loven oure freendes . . . ," 865, 920, "This is verray mariage, that was establissed by God, er that synne bigan, whan natureel lawe was in his right poynt in paradys."

Before moving to the *Tales,* two additional important sources of Chaucer's exposure to the law of nature must be mentioned. If the poet spent the years 1361–67 at the Inner Temple,[28] into his hands may have come definitions of natural law appearing in law-books such as Bracton's *De Legibus Angliae* and its subsequent epitomes, *Fleta,* and the Norman-French *Britton.* Unlike Glanvill, Bracton had incorporated large portions of Roman law into his text, carefully copying Azo of Bologna's glosses and explications of the *Institutes* and *Code* of Justinian. Bracton follows Azo very closely in his account of the law of nature, but "omits enough to show that he has not come in sight of those problems which Azo had to face when he endeavoured to give a precise meaning to the term *jus naturale.*"[29] Whereas canonists and canon law were not always popular in England, the study of Roman law had never been discontinued[30] and the definition of the law of nature adapted from Azo by Bracton was transmitted from one juridical writer to another close to Chaucer's time. For example, Fortescue, himself a Sergeant of the Law, stresses in *De Laudibus Legum Angliae* (1468–71) that the "laws of England, in those points which they sanction by reason of the law of nature, are neither better nor worse in their judgements than are all laws of other nations in like cases. For as Aristotle said, in the fifth book of the *Ethics,* 'Natural Law is that which has the same force among all men'."[31] In Pecock's *Repressor* (c. 1455) where the clergy is defended against the attacks of the Lollards, we read that it is "natural resoun . . . and not Holi Scripture [that] is the ground of alle the seid gouernauncis, deedis, vertues, and trouthis."[32] Despite incom-

[28] Robinson, xxv and Manly, p. 28. See n. 3, above. In this connection note Chaucer's reference to Giovanni da Lignaco (1310–1383) in the *Clerk's Prologue,* IV: 34–35. Lignaco was professor of canon law at Bologna. Well-paid, popular and influential, he may have been known to Chaucer through arch-deacons who had gone to Bologna from England to study canon law. See A. S. Cook, "Chaucer's 'Linian'," *Romanic Review,* VIII (1917), 353–382.

[29] *Bracton and Azo,* ed. F. W. Maitland [Selden Society] (London, 1895), VIII, 32–33. Cf. also C. Guterbock, *Bracton and His Relation to the Roman Law,* trans. B. Coxe (Philadelphia, 1866), pp. 49, 53, 64. On Bracton's acquaintance with Roman law see T. F. T. Plucknett, *Early English Legal Literature* (Cambridge, 1958), pp. 47–48. Cited as 'Plucknett.'

[30] Vinogradoff, 98. Also see S. Kuttner and E. Rathbone, "Anglo-Norman Canonists of the Twelfth Century," *Traditio,* VII (1949–51), 279–358 for evidence of "the existence in its own right of an Anglo-Norman school of canonists toward the turn of the twelfth century." On the introduction of Roman law to England see F. C. von Savigny, *Geschichte des Romischen Rechts im Mittelalter* (Heidelberg, 1834), I, 167–171. John Wyclif in his *De officio regis* (c. 1379), favors the study of English rather than Roman law by the clergy, although he is aware of the argument that there is "more subtle reasoning and more justice in Roman civilianship . . . [and] that it must needs be studied if the canon law is to be understood." See F. W. Maitland, "Wyclif on English and Roman Law," in *The Collected Papers of Frederic William Maitland,* ed. H. A. L. Fisher (Cambridge, 1911), III, pp. 50–51.

[31] Sir John Fortescue, *De Laudibus Legum Anglie,* ed. S. B. Chrimes (Cambridge, 1942), p. 39.

[32] *The Repressor of Over Much Blaming of the Clergy,* ed. C. Babington [Rolls] (London, 1860), I, 13.

plete knowledge concerning the Inns of Court in the thirteenth and fourteenth centuries, it is likely that the student met natural law tradition in the cases and writs recited by his teachers.[33]

There is also firm reason to believe that Chaucer met the natural law in the ethic of the dockside and trade fair known as law merchant. As the son of a wine merchant whose grandfather and step-grandfather had also been wholesale vintners and customs officers of the king,[34] Chaucer probably knew of law merchant long before he assumed duties after June 12, 1374 as a controller of the customs and subsidy of wool, woolfells, and hides in the city of London.[35] In addition to this post, held until December, 1386, he served with seven missions to France, Flanders and Italy—one of these involving the negotiation of a commercial treaty with Genoa that would designate a port in England with special privileges for Genoese merchants.[36] The Venetian and Genoese with eastern goods, the Italian with silks, velvet and glass, the Flemish weaver, the Spanish iron merchant, the Gascon with wine from France, Spain and Greece, the fur and amber traders from the Hanse towns as well as the three chapmen in Surry "riche, and therto sadde and trewe" were men of substance and status in medieval society.[37] To them and to public officials like Chaucer the *lawe of kinde* reflected in the law merchant was a cosmopolitan and efficacious means of insuring justice in disputes arising from transactions. To these men who "seken lond and see . . . for wynnynges," these "riche merchauntz, ful of wele been"[38] with whom Chaucer associated, the law merchant prevailed.[39] At the Merchant's Middleburgh and Orewelle, the Shipman's Dartmouth and Bordeaux (the Wife of Bath's Ypres being a singular exception) the law merchant preserved in a practicable form the essence of natural law. Like Roman law the law merchant was concerned with what was *aequum et bonum* and "what was agreeable to mores or the usages

[33] On some of the regrettably "unsolved mysteries of the thirteenth and fourteenth centuries" regarding the Inns of Court, see *Pension Book of Clement's Inn,* ed. C. Carr [Selden Society] (London, 1960), xvi-xxi. See also Plucknett, p. 114. On the persistent natural law tradition in England that extends from canon law and scholastic thinking (through Fortescue and St. Germain) to Hobbes and Locke, see Z. Epstein's review of H. Thieme's *Das Naturrecht und die Europäische Privatrechtsgeschichte* (Besel, 1 54) in *Natural Law Forum,* II (1957), p. 151.

[34] Manly, 21, 27.

[35] *Ibid.* 31–33.

[36] *Ibid.,* 32.

[37] T. A. Knott, "Chaucer's Anonymous Merchant," *Philological Quarterly,* I (1922), 1–16. Also Robinson, 657.

[38] *Prol MLT,* lls. 122–133. See E. Carus-Wilson, *Medieval Merchant Venturers* (London, 1954), pp. 239–264, for the extent of the English woolen trade in the fourteenth century.

[39] P. W. Thayer, "Comparative Law and the Law Merchant," *Brooklyn Law Review,* VI (1936–37), 41. ". . . The English Statute of the Staple [1358] expressly provided that justice was to be done [merchant strangers] according to the law merchant and not according to common law or the special customs of any town."

of honest and honorable people."[40] Like canon law the law merchant emphasized natural law concepts of "equity and good faith and the binding force of a simple promise."[41] The merchant of Chaucer's time once his goods had "comth . . . sauf unto the londe" thus had recourse to a law that was versatile, expandable, and adaptable —a law of custom.[42]

Law merchant decisions were rendered quickly through necessity. The *Little Red Book of Bristol* (c. 1344) contains the phrase "quod celerius deliberat se ipsam."[43] Quick justice is prescribed in a judicial definition of the law merchant given in 1473 where the alien merchant "is not held to sue according to the law of the land to abide a trial by 12 men and other solemnities of the law of the land; but he ought to sue here and [his suit] will be determined according to the law of Nature, in the Chancery, and he ought to sue there from hour to hour and from day [to day] because of the speed of the merchants etc."[44]

The law merchant was characterized also by a spirit of equity; the merchant whose grievance was settled at a staple, fair or piepowder court[45] could be sure that his fellow merchants serving as court members were not particularly litigious-minded men.[46] They arrived at prompt decisions based on plain justice and good faith with a disregard for abstruse technicalities that would have shocked the Manciple's "heep of lerned men" who belonged to the Temple.

Most important, the law merchant was international in character and hence true to that tradition of the law of nature. Staple and fair courts were composed of laymen who might perform their duty at Antwerp one month and find themselves sitting at St. Ives or Ipswich six months later.[47] For a dozen years Chaucer associated

[40] A. T. Carter, "The Early History of the Law Merchant in England," *The Law Quarterly Review*, XVII (1901), 240. Cited as 'Carter.'

[41] W. Mitchell, *An Essay on the Early History of the Law Merchant* (Cambridge, 1904), p. 158. Cited as 'Mitchell.'

[42] Mitchell, 10–12. Cf. also *The Little Red Book of Bristol*, ed. F. B. Bickley (Bristol, 1900), I. 60. Cited as 'Bickley." The force of custom in the law merchant is acknowledged here: ". . . set apponitur adhuc le affidauit propter antiquam consuetudinem."

[43] Bickley, I, 58.

[44] *Select Cases Concerning the Law Merchant*, ed. H. Hall [Selden Society] (London, 1930), 46, lxxxv-lxxxvi.

[45] See *Glossarium mediae et infimae Latinitatis*, ed. C. D. DuCange (Paris, 1845), V, 172. Also *The Black Book of the Admiralty*, ed. T. Twiss [Rolls] (London, 1873), II, 23 for entry regarding the piepowder court at Ipswich which dealt with "the plees be twixe straunge folk that man clepeth pypoudrous." See *Select Cases Concerning the Law Merchant*, ed. C. Gross [Selden Society] (London, 1908), I, 107–109. Also T. E. Scrutton, *The Influence of Roman Law on the Law of England* (Cambridge, 1885), p. 177. Gross's treatment of the piepowder court remains the best. See "The Court of Piepowder," *The Quarterly Journal of Economics*, XX (1906), 231–249. The institution was extant in the seventeenth and eighteenth centuries. Jonson refers to it in *Bartholomew Fair* and Defoe mentions "pyepowder courts" in the *Tour Through Great Britain* first published in 1724.

[46] Bickley, I, 70.

[47] Carter, 235.

with international merchants—men for the most part dealing in "marchandise . . . that oon is honest and leveful" according to the Parson; "as God had ordeyned that a regne or a contree is suffisaunt to hymself, thanne is it honest and leveful that of habundaunce of this contree, that men helpe another contree that is moore nedy" *(Pars T* 776–777). And Chaucer knew merchants to be of many types. There was the shrewd risk-taker depicted in the General Prologue "sownynge alwey th'encrees of his wynnyng;" the shipman's merchant of St. Denys who was ready to settle *all* debts according to tally;[48] the "marchant [who] deliteth hym moost in chaffare that he hath moost avantage of."[49] Among such men Chaucer had observed the practical application of natural law principles in the settling of disputes quickly and fairly in England and on the Continent. During his civil career Chaucer saw a law possessing the minimum "givenness" exerting maximum force in behalf of equity and fairness in transactions among men of power and prestige in the secular world.[50]

In ironic contrast to the merchants and their relatively informal judicial procedures based on natural law, stand certain characters of the Prologue to the *Canterbury Tales.* Both the Friar and the Summoner are members of a group whose daily lives were governed by canon law, a form of positive law that incorporates natural law idealism. Yet had either the Friar or the Summoner planned it, they could not have flouted natural law precept more completely.[51] Neither the Friar's instincts nor his reason dictated to him that he should act virtuously. On the contrary he thwarts the purpose and function of marriage as set forth at the head of the *Decretum* in the basest way. He makes personal gain at the expense of widows, and exploits the institution of the "love day" *(Gen Prol* 258) for his own profit.[52] It is here in his characterization of the Friar that Chaucer points up the extent of that worthy's

[48] Debt by tally was a contract according to the law merchant. Cf. *Gen Prol* 570. Note that the Man of Law has heard his tale from a merchant and merchants are in its background. See Mary Eliason, "The Peasant and the Lawyer," *Studies in Philology,* 48 (1951), pp. 525–26.

[49] *Pars T* 850.

[50] For the limited extent to which the law merchant was positive law see W. Holdsworth, *A History of English Law,* 7th ed. rev. (London, 1956). I, 527–28; also Carter, 234–35.

[51] Cf. Pollock, 423, who points out that the essence of Gratian's opening definition is that "the Law of Nature is nothing else than the Golden Rule comprised in the Law and the Gospels which bids us to do as we would be done by and forbids the contrary." The binding force of Gratian's definition for canon law long after the *Decretum* itself had been superseded seems obvious. On the acceptance of canon law by English courts Christian, see F. W. Maitland, *Roman Canon Law in the Church of England* (London, 1898), pp. 1–4.

[52] J. W. Spargo, "Chaucer's Love-Days," *Speculum,* XV (1940), 36–56. According to J. W. Bennett, "The Mediaeval Loveday," *Speculum,* XXXIII (1958), 370: "The fundamental weakness of the mediaeval institution lay in the canon law principle, 'Hoc enim ad officium Praelati spectat ut discordantes sive Clericos sive Laicos magis ad pacem quam ad Judicium coerceant.' There can never be any lasting peace without justice."

departure from natural law ideals. A cleric like the Parson could be expected to refrain from further corrupting the "love day," with its emphasis on natural law attributes of good faith, honesty and out-of-court arbitration. It is doubly ironic that the Friar whose calling is governed by laws tempered with natural law idealism not only breaks those laws but joins in the debasement of a judicial process that invokes the spirit of the *lawe of kinde*.

The Summoner, a petty officer of an ecclesiastical court, has the duty of administering canonical justice from the same body of positive law that ostensibly commands obedience of the Friar. However, the Summoner's own unethical operations, his amusing repeated shrilling of the legal tag "Questio quid iuris"[53] allow Chaucer to supply more than a hint of the corruption besetting at least one ecclesiastical court.[54] It is the Parson, he who "Cristes gospel trewely wolde preche" (*Gen Prol* 481), who restores faith in the ecclesiastics, for he shows a strict and literal acceptance of the Golden Rule and the Decalogue.[55]

At least two other members of the party, the Sergeant and the Franklin, are directly associated with positive law—secular not canon. However, law is chiefly decision, statute, and case to Chaucer's Sergeant. Chaucer has us understand this holder of "pleyn commissioun" to be a walking legal lexicon with an extraordinary retentive memory and the talent for exploiting it for his own best interest. Thus had he used the law to earn himself many "fees and robes" and with them, social status close to that held by the Knight. Although the Franklin exhibits openhanded hospitality in the oldest natural law tradition, his legal learning was primarily that needed for the conduct of his duties as a "shirreve" and "contour." He draws on this learning in the telling of his tale "much of the dramatic force of which relies on legal perceptions, and the recitation of which is couched at times in semi-legal language,"[56] but the Franklin does not seem the type to hold himself strictly to natural law ideas.

It is worth noting that the two most complete Christians whom Chaucer presents in the Prologue (aside from the Parson) lead their lives according to the *lawe of kinde*. In a day when man-made laws of chivalry are close to becoming superannuated, the Knight independently adheres to the natural law concept of "trouthe and honour" translated to mean "sense of honor, honorable dealing."[57]

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[53] J. W. Spargo, "Questio Quid Iuris," *Modern Language Notes*, LXII (1947), 121.

[54] For an analysis of one Court Christian and the apparitors who "acted as a kind of ecclesiastical gestapo," see B. L. Woodcock, *Medieval Ecclesiastical Courts in the Diocese of Canterbury* (London, 1952), pp. 49, 112.

[55] Cf. fn. 27.

[56] R. Blenner-Hassett, "Autobiographical Aspects of Chaucer's Franklin," *Speculum*, XXVIII (1953), 793.

[57] Robinson, 652.

Moreover, we learn of the Knight:

> He nevere yet no vileynye ne sayde
> In al his lyf unto no maner wight. (*Gen Prol* 70–71)

Closely related to the knight and to the Parson by his ideal Christian conduct and by blood is the Plowman, whom Chaucer depicts in the lines:

> God loved he beste with al his hoole herte
> At alle tymes, thogh him gamed or smerte,
> And thanne his neighbor right as hymselve.
> (*Gen Prol* 533–35)

There is irony in the fact that the Knight and the Plowman live in honesty and charity in contrast to the ecclesiastics whose vocation is governed in part by natural law idealism.

Other echoes of the *lawe of kinde* appear in the Chaucer canon, as in the *Parliament of Fowls* where nature appears before the birds' assembly as the "vicaire of the almyghty Lord" to implement in a benign way her "Ryghtful ordenaunce" that birds and beasts must choose their mates and rear their young.[58] The sorting out and interpreting of all the poet's allusions to natural law calls for fuller study, but the evidence developed so far suggests that for Chaucer the *lawe of kinde* was more than a theological commonplace, or a dusty inheritance from the Alfredian *Boethius* lingering on in *Cursor Mundi.* In the *Boece,* in the law merchant of the wharfside, and possibly, in dialogues between teacher and pupil at the Inner Temple, Chaucer recognized the *lawe of kinde* as the counter-balance to the extremes of materialism and covetousness reached by certain members of the Canterbury party and their contemporaries.

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[58] J. A. W. Bennett, *The Parlement of Foules* (Oxford, 1957), pp. 131–132. On this aspect of the *lawe of kinde* in Gower and Langland, see pp. 207–209.

THE COMMEMORATIVE PROPHECY OF *HYPERION*

Karl Kroeber

The question which I suspect to underlie most of the objections to *Hyperion* is this: can a sophisticated reader care about Apollo and Hyperion? I believe much of Keats's art is directed to making a virtue out of this apparent difficulty. Because we do not care about Apollo and Hyperion *per se*, we are free to respond to their situation with an appropriate ambivalence. This freedom is not available, for example, to readers of *Paradise Lost*. The meaning of the conflict between the Olympians and the Titans must be dramatically created by the poet, who cannot rely on his readers' allegiance to traditional attitudes toward the antagonists. The significance of his poem must evolve dynamically.[1] Yet he is protected against mere idiosyncrasy by the fact that his subject-matter derives from our oldest and most viable literary tradition.

Whether or not *Hyperion* is to be called an epic, its particular characteristics may be defined by contrast with our epic tradition, which began, it seems safe to say, in the humanising of what had been narratives about divinities, myths.[2] Much of the power in epics such as *Gilgamesh* and the *Iliad* derives from the way in which their human protagonists emerge, under our eyes so to speak, from purely magical and religious contexts, in which gods, not men, dominate all activity. Achilles' manhood is impressive because he stands so close to the gods. In *Hyperion* man reassumes divine proportions; epic re-approaches myth. The Titans and the Gods are, if the word may be divested of pejorative associations, super-men. Keats's monumental figures, so enormously sensual, express spiritual actions and attitudes. So their strength is curiously similar to that of Achilles or Gilgamesh. Though complex, self-conscious and aesthetic as their "primitive" forebears were not, Keats'

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[1] Hence the variety of interpretations of the poem, to many of which my study is indebted. I should perhaps single out the following as most influential: Douglas Bush, *Mythology and the Romantic Tradition* (Pageant Books reprint, New York, 1957, of the original edition, Cambridge, Mass., 1937), pp. 115–128; Kenneth Muir, "The Meaning of Hyperion" in *John Keats: A Reassessment*, ed. Muir (Liverpool, 1959), pp. 102–122; M. H. Shackford, *"Hyperion," Sewanee Review*, XXII (1925), 48–60; D. G. James, *Scepticism and Poetry* (London, 1937), pp. 198–202; James Ralston Caldwell, "The Meaning of *Hyperion*," *PMLA*, LI (1936), 1080–1097; Stuart Sperry, "Keats, Milton, and *The Fall of Hyperion*," *PMLA*, LXXVII (1962), 77–84. Bernard Blackstone's latest study, in *The Lost Travellers* (London, 1962). pp. 276–84, is disappointing after his discussion in *The Consecrated Urn*, cited below. All quotations are from H. W. Garrod, *The Poetical Works of John Keats* (Oxford, 1958) 2nd edition.

[2] See for example G. R. Levy, *The Sword from the Rock* (London, 1953).

protagonists, like the earlier heroes, have their being in a realm that is not earth, not heaven, but inseparable from both.

Hyperion narrates the birth of a new kind of divinity. Keats is not literarily archaistic; he does not ask us to admire the ancient Greek god Apollo; he asks us to see Apollo as a manifestation of the evolutionary principle which gives dynamic order and meaning to the universe. Thus the "remoteness" of the Titanomachia also serves Keats's central purpose.

For this reason the mythic, rather than symbolic, nature of the *personae* of *Hyperion* is appropriate. Apollo does not "stand for" something other than himself, yet he is not merely the old Apollo. He is not a literary reconstruction of a dead mythological figure, yet he is not fully separable from the ancient mythological figure. Keats's Apollo manifests a beauty that surpasses his individuality. He is *a* god. He is not a symbol of unchanging divinity nor is he a timeless object of adoration. Apollo must be one of many gods, not merely because there are other Olympians, but because there have been and will be other kinds of gods, other dazzling manifestations of developing beauty.

To Keats beauty is harmony, and there can be progress from simple to complex harmony. Such progress is dramatized by *Hyperion,* which moves from the description of Saturn, wherein sensory particularities are subdued to the harmony of a single mood of tranced sadness, to the narrative of Apollo's dying into godhead, which unifies in vital concord contrasting sensations, feelings, and thoughts. The Olympians, as Oceanus' says, surpass the Titans in "might" because the Olympians are "first in beauty." Titanic beauty is little more than mechanical unity; Olympian beauty is an organic unity which reconciles contraries and diversities.

But *Hyperion* is more than story, it is history—the early history of the universe.[3] The progress from Titanic to Olympian beauty reveals our cosmos to be a developing historical entity, as subject to (and a theater for) evolutionary processes. Keatsian evolution, however, differs from Darwinian. Keats thinks in purely aehthetic terms; he does not anticipate the later scientific concept. Darwin applies the theory of evolution horizontally, to one level of being at a time. Keats concentrates upon the "thresholds" of being. The scientific evolutionist seeks to connect man with the animals and the physical world, but Keats seeks to connect man with the gods and a supranatural world.

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[3] Bernard Blackstone, *The Consecrated Urn* (London and New York, 1959), p. 237: "*Hyperion* is to be a cosmogonic epic. It will 'unfold through images the theory of the world,' " Blackstone's emphasis is upon the relevance of Phato's *Timaeus.*

Nevertheless, the "system" of *Hyperion* is evolutionary;[4] in this respect Keats labors in direct opposition to Milton, and, indeed, to the entire classical-Renaissance literary tradition upon which so much of *Hyperion* depends.[5] What principally characterizes Keats's poem, in fact, is the intensity with which a commemorative, traditionalistic impulse interacts with a prophetic, progressive impulse. Keats fabricates a new "personal" mythology out of old religion and traditional literature.

Hyperion progresses from simple harmony to complex. The marvelous opening lines portray a scene in which all the details are of a piece, each contributing to a mood of sad silence appropriate to Saturn's fallen divinity.

> *Deep* in the *shady sadness* of a vale
> *Far sunken* from the healthy breath of morn,
> *Far* from the fiery noon, and eve's one star,
> Sat *gray-hair'd* Saturn, *quiet as a stone,*
> *Still* as the *silence* round about his lair;
> Forest on forest hung about his head
> Like *cloud on cloud. No stir* of air was there,
> *Not* so much life as on a summer's day
> Robs *not* one light seed from the feather'd grass,
> But where the *dead leaf fell,* there did it *rest.*
> A stream went *voiceless* by, *still deadened more*
> By reason of his *fallen* divinity
> Spreading a *shade:* the Naiad 'mid her reeds
> Press'd her *cold* finger closer to her lips.
> Along the margin-sand large foot-marks went,
> *No further* than to where his feet had stray'd,
> And *slept* there since. Upon the *sodden* ground
> His *old* right hand *lay nerveless, listless, dead,*
> *Unsceptred;* and his *realmless* eyes were *closed;*
> While his *bow'd* head *seem'd list'ning* to the Earth,
> His *ancient* mother, for *some comfort* yet.

Saturn listens to the Earth for comfort. To Hyperion words of comfort are spoken by Coelus, who is "but a voice," whose "life is but the life of winds and tides," yet who speaks "from the universal space." Coelus is more "heavenly" than Earth, and Hyperion's superiority to his fellow Titans derives from his association with the sky. He is "earth born/ And sky engendered." One must admire

[4] Two unpublished doctoral dissertations which deal with the influence of William Godwin's *Pantheon* on Keats's system of progressive evolution deserve mention: Sister Mary Carlin, *"John Keats' Knowledge of Greek Art, A Study of Several Sources,* Catholic University of America, Washington, D. C., 1951, and Norman Anderson, *Bard in Fealty: Keats' Use of Classical Mythology,* University of Wisconsin, Madison, 1962.

[5] See, of course, Bush, 115–128; also Ernest De Selincourt's edition of *The Poems of John Keats* (New York, 1921, 4th ed.), p. xlv: ". . . a story of the ancient world had to assume Elizabethan dress before it could kindle his imagination." Also, pp. xlvii–xlviii: ". . . The poems of Greek inspiration exhibit no trace of influence of classical literature, but are determined in each case by the influence of different models of English poetry." This last probably overstates an excellent point.

Keats's narrative strategy: Apollo and Hyperion are more equally matched than any other pair of God-Titan opponents and their clash ought to be the climax of an evolutionary movement in which "supranatural" gods are born out of the agony of "natural" deities. Apollo, though "Celestial," is not detached from the earth. Not only is he born on Delos but his assumption of divinity occurs under the aegis of Mnemosyne,

> an ancient Power
> Who hath forsaken old and sacred thrones
> For prophecies of thee, and for the sake
> Of loveliness new born.

The new celestial must encompass within his progressive divinity the memory of earthly powers. The old is not to be obliterated but absorbed into a more complicated and comprehensive unity, just as *Hyperion* is meant to absorb previous literary traditions into a new unity.

To understand Apollo's dying into life, therefore, we must understand Hyperion's living into death, which is the climactic representation of all the Titans' tragedy. Unlike Saturn, who is old and gray and surrounded by silence and inertness, Hyperion "flares" along, "full of wrath," in a blaze of crystalline and golden opulence to the sound of "slow-breathed melodies" from "solemn tubes." The entrance to his palace, unlike the tranced woods in which Saturn sleeps, is described with the dynamic richness of full Keatsian synaesthesia.[6]

> And like a rose in vermeil tint and shape,
> In fragrance soft, and coolness to the eye,
> That inlet to severe magnificence
> Stood full blown, for the God to enter in.

Yet one notices that "this haven" of Hyperion's "rest" and "this cradle" of his "glory," a structure of pure light, seems now strangely alien from the earth.[7] The beauties of the earthly world appear in reference to Hyperion's palace only in metaphors and similies. The palace, full of "the blaze, the splendour, and the symmetry" of artifice. suffers "death and darkness" when elements of the natural world intrude. The Titans have fallen. Natural phenomena appear to Hyperion as "effigies of pain," as "spectres," and as "phantoms." This is the effect of the Olympian triumph. Hyperion is a Titan, an earth-god. and he swears "by Tellus and her briny robes!"[8] Yet earthly nature enters his "lucent empire" as a

[6] I use the word synaesthesia in its more general sense. R. H. Fogle, *The Imagery of Keats and Shelley* (Chapel Hill, 1949), drawing on C. D. Thorpe's work, analyses with more intensity and profundity the significance of synaesthesia in Keats's art; see esp. p. 137.

[7] See Caldwell, 1093.

[8] A good discussion of the Titans' "earthliness" is to be found in Lucien Wolff, *John Keats, sa vie et son oeuvre* (Paris, 1910), p. 628. Though old, Wolff's book is still valuable.

threat, in its least attractive guise, as something sinister and suggestive of death: the "cold, cold gloom" of "black-weeded pools" and the "mist" of a "scummy marsh." Hyperion's impotence, when he finds himself unable to utter his "heavier threat" is imaged by a serpentine power usurping his supra-mundane godhead.

> . . . through all his bulk an agony
> Crept gradual, from the feet unto the crown,
> Like a lithe serpent vast and muscular
> Making slow way, with head and neck convuls'd
> From over-strained might.

Hyperion, "releas'd," in desperation attempts to disrupt the order of nature; he bids "the day begin . . . six dewy hours/ Before the dawn in season due should blush." Hyperion is "a Primeval God," but "the sacred seasons might not be disturbed." The Titans, more primitive divinities than the Olympians, are identified with purely natural processes; Hyperion's actions reveal how shaken is his divinity. The Olympians are not to be identified, however, with the anti-natural. Rather they represent nature advanced to a new level. Hence the conflict of the poem is not between good and evil but between one kind of truth and beauty and a superior kind of truth and beauty. The inert lifelessness of the opening scene where all the animation of the natural surroundings is deadened by Saturn's presence symbolizes the limitation of the primeval gods: they do not represent the progress and fulfillment of natural life. Their successors will be more "godlike" because they will carry forward and more nearly fulfill the developing natural processes of earthly life. Implicit here is the idea that increased consciousness fulfills, does not thwart, "nature"; man's supranatural life is the proper evolutionary successor to unreflective biological existence.

Hyperion, "by hard compulsion bent," no longer strides and stamps and flares.

> And all along a dismal rack of clouds,
> Upon the boundaries of day and night,
> He stretch'd himself in grief and radiance faint.

He is approaching the gray passivity of Saturn; he has reached the boundaries of day and night moving toward darkness. Apollo at the same moment, as we learn in Book III, has also reached "the boundaries of day and night," but the Olympian is moving toward light. He appears in a dim, quiet solitude analogous to that of Saturn, "I have sat alone/ In cool mid-forest," that is as much a psychological condition as a physical situation:

> For me, dark, dark,
> And painful vile painful vile oblivion seals my eyes:
> I strive to search wherefore I am so sad,
> Until a melancholy numbs my limbs.

But, contrary to Hyperion, Apollo begs that Mnemosyne may "point forth some unknown thing." The new and unknown attracts and draws forth his godhead instead of strangling it.[9] He does not stretch himself in grief and radiance faint but aspires toward the natural lights of the heavens, the inanimate "brilliance" and "splendour" of which he desires to fill with the passion of life.

> There is the sun, the sun!
> And the most patient brilliance of the mooon!
> And stars by the thousands! Point me out the way
> To any one particular beauteous star
> And I will flit into it with my lyre,
> And make its silvery splendour pant with bliss.

We travel from Hyperion to Apollo by way of the council of the Titans, which is held in a cavern far from the life and light of surface earth.[10] The most important speech in this deliberation is that of Oceanus,[11] who advises acceptance of the truth that the Titans have been overpowered by a "fresh perfection" and "a power more strong in beauty." Although Oceanus speaks the truth, the "comfort" and "consolation" he offers is bleak. "Receive the truth, and let it be your balm," he says, asserting that

> . . . to bear all naked truths,
> And to envisage circumstance, all calm,
> That is the top of sovereignty.

This stoicism is the "top of sovereignty" for the Titans. It is not the top of sovereignty for Apollo. Every Titan who speaks regrets that he, and his world, is no longer "all calm." The passivity of Saturn in defeat, ironically, reveals the limits of the life he ordered in triumph. Oceanus preaches stoicism because the characteristic quality of Titanic rule was placidity. Even fiery Enceladus urges renewed war to regain "the days of peace and slumberous calm."

Apollo, representative of the Olympians, does not seek "days of peace and slumberous calm." He hates his idleness, he wishes to make the stars "pant with bliss," he is exhilarated to godhead by the knowledge of "dire events, rebellions . . . Creations and destroyings." The life over which Apollo will preside is to be active, violent, aspiring.

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[9] Leone Vivante, *English Poetry* (London, 1950) provides a valuable definition of Keats's love for the new and unknown: "Keats describes . . . the moment of *novelty* as outstandingly representative of life and life's value . . ." (p. 182) ""Novelty" must be understood as laying stress on an intimate value of non-predeterminedness and potency, rather than on change." (p. 183).

[10] "The assembled Titans themselves approximate to the chaos surrounding them: . . . Plainly *Hyperion* . . . is a macrcosmic model of the psyche in ignorance and enlightenment." Blackstone, p. 238.

[11] "What Oceanus proclaims is the imaginative center of the fragment, . . ." Harold Bloom, *The Visionary Company* (Garden City, New York, 1961), p. 385.

Evolution, as described by Oceanus, is a process of rising and lifting, a process of increasing movement and activity, a process by which more and more vitality emerges and gives meaning to inert, disorganized matter. "From Chaos and parental Darkness came/ Light," he says. The "sullen ferment" of chaotic darkness "for wondrous ends/Was ripening in itself," and when "the ripe hour came" light was born.

> Light, engendering
> Upon its own producer, forthwith touch'd
> The whole enormous matter into life.

First chaos, then light, an ordering of inanimate matter, finally life, a further ordering of light. The Titans came into being with the appearance of life. They are now to be superseded, not because life is to vanish, but because a more intense kind of life is being born out of the old life, just as the old life (a more intense kind of "light") was born out of the older light, which, in turn, had emerged from darkness.

The new life that is being born, the life of which the Olympians are the highest representatives, is a life of increased intelligence, and, since the universe now includes life, increased consciousness of life, increased consciousness of self. "Knowledge enormous makes a God of me," cries Apollo. He is aware of becoming a god, his godhead is in large measure his self-awareness.

The intensity of Apollo's self-awareness is impossible for Oceanus. He is aware of the god who replaces him and he knows the new god is somehow superior to him, but in what this superiority consists he does not know. Were he capable of the "knowledge enormous" which fills Apollo's mind Oceanus would be an Olympian. He is not capable of that knowledge, and, because he is the wisest of his kind, he does not try for it. He retires stoically.

Clymene, not so wise, experiences the anguish of not being able to comprehend. She suffers what Oceanus would have suffered had he not possessed the wisdom to recognize his limits. In so suffering, however, Clymene prepares the reader for Apollo's apotheosis. *Hyperion* opens with a scene of complete deadness and silence, one without consciousness, for Saturn sleeps and his divine sleep trances his surroundings. When Hyperion himself appears we have action, but arrested action, awareness (Hyperion recognizes the stifling of his divinity), but arrested awareness. In the cavern we have more activity, the arrival of Saturn, the debate, and finally the appearance of Hyperion. But this activity is cramped, self-lacerating, inconclusive, and the same adjectives might be applied to the awareness developed by the arguments.[12] Oceanus' opening plea for storical endurance is finally answered by Enceladus' hopeless fulminations.[13] But the Titans' struggle into self-defeat is the matrix of agony out of which the Olympians are born, and in the unfinished third book we move upward and outward from the cavern to reach, finally, the ecstatic sufferings of Apollo dying into a more intense and harmonious life, a life fully conscious of its own power and capable, therefore, of reconciling the potent diversities of a wonderful and ever developing cosmos. Apollo's ecstasy and its significance is adumbrated by Clymene, whose plaintive speech links Oceanus' stoicism to Enceladus' rage.

Clymene dramatizes the truth of what Oceanus has said (while emphasizing the painfulness of his truth). Her story reveals how unfit are the Titans to control the new life that pervades the universe.

> I stood upon a shore, a pleasant shore,
> Where a sweet clime was breathed from a land
> Of fragrance, quietness, and trees, and flowers.
> Full of calm joy it was, as I of grief;
> Too full of joy and soft delicious warmth;
> So that I felt a movement in my heart
> To chide, and to reproach that solitude
> With songs of misery, music of our woes.

Clymene could only *reproach* the joy and warmth of nature with "songs of misery." It is not in the Titans' power to *reconcile* contraries, as it is in the Olympians' power, as is shown by the music which destroys Clymene's sad melody murmured into "a mouthed shell." "That new blissful golden melody" was, for Clymene, "a living death" which, she relates, made her "sick/ Of joy and grief at once." What sickens her and is for her "a living death" is the new harmony which enables Apollo "with fierce convulse" to "die into life."

The apotheosis of Apollo which concludes the fragmentary third book is, as one might guess from Clymene's story, the exact opposite of Saturn's trance at the opening of the poem. Saturn sleeps in silence, dimness, and inertness.[14] The apotheosis of Apollo is a

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[12] A. E. Powell (Mrs. E. R. Dodds), *The Romantic Theory of Poetry* (London, 1926), p. 229: "In their [the Titans'] very passion there is no conflict, no struggle to recreate their being out of tragedy. The "vale of Soul-making" is not for these. They are like great natural forces, which governed by an overmastering law fulfill easily and unconsciously that for which they are formed. It is not theirs to win knowledge and by art to make, with all the agony and effort of creation. The new gods seem smaller, but more vivid . . . they are convulsed in making . . . . Art and knowledge have entered into their singing, so that it is able to express their complex life, with its active, conscious effort to shape things to its intent."

[13] Bush, 124: "The Titans, however benign and beneficent, had in a crisis behaved not like deities but like frail mortals; they had lost, and deserved to lose, the sovereignty of the world because they had lost the sovereignty over themselves." Note that Keats stresses Saturn's loss of "identity," see I, 11. 112–116.

[14] "All is negative here. The divisions of the day are, as it were, obliterated: the four elements are presented in terms of silence and inaction. There is no air. The rhythms of the verse gyrate sluggishly . . ." Blackstone, *The Consecrated Urn*, p. 234.

birth full of sound, movement, and the radiant anguish of emerging consciousness. The contrast between the two passages is best told in the concluding images. Saturn, like a sculptured figure, is long bowed to the earth for comfort, whereas from Apollo's "limbs Celestial" some yet undefined power is forever about to emanate. But the contrast is not merely that Saturn retreats toward familiar consolation and Apollo yearns toward new and painful wonder. The difference between the two divinities lies in the different harmonies which unify the contrasting passages. The description of Saturn is harmonious in that nothing contrary to the mood of tranced stillness intrudes. The narrative of Apollo's apotheosis reconciles contraries. For instance, Apollo's ecstatic words contrast to Mnemosyne's "silent face," as the "wild commotions . . . of his limbs" contrast to her rigid pose, "upheld/ Her arms as one who prophesied."[15] Likewise "*dire* events . . . pour" into his brain like "some *blithe* wine"; his "level glance . . . steadfast kept/ Trembling with light." Virtually every word in this narrative of "Creations and destroyings" is matched by a contrary, so that the Dionysiac fury of the event is controlled by an Apollonian symmetry of form.

The harmony of the Saturn passage is substantive, that of the Apollo passage compositional, a total order imposed upon diverse sensations, feelings, and ideas. The beauty born with Apollo is the beauty of complex design. The particularities retain their integrity: pain remains pain, it does not become pleasure; death and life remain distinct conditions; creations and destroyings remain opposed processes. But pain and pleasure, life and death, creations and destroyings interlock in a design that reconciles them.[16] Apollo's birth is meant to transform the value, the meaning, of each of these particular elements, because the god's birth is the birth of understanding of the place of each particularity and its opposite within the scheme of cosmological history.

The comprehension of this scheme, the dying out of incomplete life into total life, should not merely change the value of the parts but should also increase it, because the formal symmetry of the whole event will reflect back upon each particle more energy than it alone can generate. Once the encompassing design is conceived, each element within it will be seen to contribute not alone to its own existence but to the ordering, the significance, of all existences

[15] On this point see D. G. James, *The Romantic Comedy* (London, 1948), p. 136.

[16] James, p. 128: "The beauty of the new Gods is a more difficult and terrible beauty than that of the old; yet it is none the less greater. The Godhead of *Hyperion* is that which acknowledges for its own the world in which Lear suffered and Cordelia was hanged, and is yet no less a principle of Beauty and Order; . . ." I think this is the point toward which Dorothy Van Ghent moves in "Keats's Myth of the Hero," *Keats-Shelley Journal,* III (1954), 7–25 (pp. 10–16 on *Hyperion*), but I confess I do not fully follow her argument. See also R. D. Havens, "Of Beauty and Reality in Keats," *ELH,* XVII (1950), 206–13, for a discussion of how the connotations of "beauty" change in Keats's later poetry.

together. The final contrast between Apollo and Hyprion is probably that life become conscious of its system of vitality is more intense and precious and enduring, more fully supranatural, self-transcending, divine, than unreflective life, life unaware of its own potency.[17]

One must speak tentatively because Keats did not finish *Hyperion.* We can only speculate as to why he was dissatisfied with it, but his own "explanations" suggest that he was more troubled by stylistic problems than by his subject-matter. Perhaps he did not control the style necessary to represent the Olympian life, a style which ought to transcend that of the first books. The logical culmination of the Keatsian Titanomachia ought to be the triumph of Apollo over Hyperion. Oceanus' stoical retirement before Neptune is not a reconcilement of contraries, not an absorption of an old, incomplete beauty into a new, more complete beauty. This reconcilement and absorption are necessary to authenticate Olympian divinity, and they should be fashioned in a manner suggested by but not fully realized in the narrative of Apollo's apotheosis.

At least partial realization of this new manner is found, perhaps, in the early portion of *The Fall of Hyperion: A Dream,* Keats's recasting of the original poem.[18] *The Fall* is certainly a more personal poem than *Hyperion,* and it might be argued that it is also more literary,[19] that it includes a wider range of literary references and incorporates a more intense appreciation of its mythological and poetic sources.[20] The key to this double development seems to me to lie in Keat's recognition that the life of full consciousness, including of course consciousness of self, must be deeply involved with visions or dreams.

Consciousness, after all, is more than mere perception. A mind fully aware is not satisfied by appearances, it strives to comprehend more than meets the eye. Consciousness is also something more than commonsense. A mind fully aware is sensitive to causes and motives which lie beyond the reach of workaday rationalism. No one could deny that scientific activity of the past one hundred and fifty years has advanced man's awareness of the workings of his universe and of his own being. And the modern understanding of the

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[17] Caldwell, 1096.

[18] Sperry, 80: "The life-and-death struggle with which the first *Hyperion* ends is carried over and expanded in the second. But its context is changed in such a way as to lead one more and more to consider Keats's allegory within a framework of sin and redemption." My only diagreement with Mr. Sperry's excellent point is that he seems to make it exclusive; without denying the relevance of "sin and redemption" to *The Fall of Hyperion,* I should say that some less orthodoxly religious conceptions are as important.

[19] See Sperry, 77.

[20] John D. Rosenberg, "Keats and Milton: The Paradox of Rejection," *Keats-Shelley Journal, VI* (1957), 87–95. Rosenberg argues that the principal change between the two *Hyperions* is to be traced to Keats's effort "to humanize the poem" (p. 91).

natural universe is founded, as A. N. Whitehead pointed out, upon a willingness to accept as truth explanations that seem to controvert "commonsense." Most important work in the physical sciences today concerns phenomena which simply cannot be observed by "the naked eye." Psychoanalysis of course, is founded upon the study of what appears to be irrational, particularly upon the study of the "truth" of dreams.

Keats was neither a proto-Freud nor a proto-Einstein. He knew little about science and contributed nothing directly to its development. In some respects he looked backward, toward Socrates, who "examined" life with the most intense rationality, who constantly sought self-awareness, and whose climactic utterances passed beyond dialectic into stories of visions. But Keats also looked forward. In *The Fall of Hyperion* he suggests a conception of poetic truth as "visionary" truth which foreshadows our contemporary interest in extra-ordinary mental conditions and in new systems of logical enquiry and organization. This is perhaps why *The Fall of Hyperion* is so complex, and why, specifically, even more than the earlier version it speaks in two voicees, one commemorative, one prophetic.

The Fall of Hyperion is above all else what Keats himself called it: a dream. In the first eighteen lines of the fragment the word "dream" appears five times.

> Fanatics have their dreams, wherewith they weave
> A paradise for a sect; the savage, too,
> From forth the loftiest fashion of his sleep
> Guesses at Heaven; pity these have not
> Trac'd upon vellum or wild Indian leaf
> The shadows of melodious utterance.
> But bare of laurel they live, dream, and die;
> For Poesy alone can tell her dreams,—
> With the fine spell of words alone can save
> Imagination from the sable charm
> And dumb enchantment. Who alive can say,
> "Thou art no Poet—mayst not tell thy dreams"?
> Since every man whose soul is not a clod
> Hath visions, and would speak, if he had lov'd
> And been well nurtured in his mother tongue.
> Whether the dream now purposed to rehearse
> Be Poet's or Fanatic's will be known
> When this warm scribe my hand is in the grave.

The distinction drawn here appears to be intended as the foundation for everything else in *The Fall.*[21] Keats distinguishes be-

[21] Bloom, p. 412: "Keats implies that the fanatic and the savage are imperfect poets, with a further suggestion that religious speculation and mythology are poetry not fully written." p. 413: "Moneta . . . is a priestess of intense consciousness doing homage to the dead faiths which have become merely materials for poetry."

tween the poet on the one hand and, on the other, the fanatic, the savage, and the "man whose soul is not a clod: but who has not "been well nurtured in his mother tongue." These latter differ from the poet only in that they do not or cannot effectively tell their dreams, so their dreams die with them. The poet is like them in that he, too, dreams. But his melodious utterance lives on after his death. "Every man," Keats says, "hath visions and would speak"—if he could. The fanatic differs from "every man" and the savage in that he does speak. The fanatic can "weave/ A paradise for a sect." The poet, then, differs from the savage and "every man" in that he does speak, with his "fine *spell* of words" he escapes the "sable charm," achieves something more than "a paradise for a sect," achieves something precious for *all* men.[22]

All men, including poets, are dreamers. The poet alone can effectively tell his dreams. Hence the poet can be certainly recognized only after his death. If what he has told results only in "a paradise for a sect" he is to be identified as a fanatic. If his melodious utterance does more than delude a few, does more than create a fantasy world of escape, and bodies forth, instead, heretofore unrecognized truth, he is to be identified as a poet.

This differentiation is not possible until the Apollo of *Hyperion* has died into life. Until life has evolved to the point where it not only exists but is conscious of its existence, the problem of "dreaming" cannot arise. As long as we are unconscious of ourselves we cannot be mistaken about ourselves. But as soon as we attain self-consciousness we are open to self-misunderstanding and self-delusion.

That Keats was interested in this problem is implied, I believe, in his dramatic strategy of presenting his story as a vision within a vision within a dream. His first words after the introduction are: "Methought I stood where trees of every clime." He is "purposed to rehearse" a dream, and the supra-reality of that dream is accentuated by its setting, an idyllic garden where, contrary to nature's practice, every species of tree flourishes. In this paradisical setting Keats drinks a "transparent juice" which he describes as "parent of my theme," because it induces a "swoon" from which he wakes, not in the garden, but in "an old sanctuary," an "eternal domed monument." There he encounters Moneta, who transports him,

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[22] Sperry, p. 78: ". . . the *true* poet, as the closing lines of the paragraph make clear, is the very opposite of the fanatic who speaks merely to a "sect." True poetry implies not only imaginative activity but the perception of value and meaning relevant to all mankind. "In dreams," Keats seems to say with Yeats, "begins responsibility," and the special obligation of the poet to society is destined to become, particularly through Moneta's urging, the major concern of Keats's dreamer."

first, to "the shady sadness of a vale" where he can observe Saturn and Thea, because

> . . . there grew
> A power within me of enormous ken,
> To see as a god sees, and take the depth
> Of things as nimbly as the outward eye
> Can size and shape pervade,

and later to Hyperion's palace where he observes in the same god-like fashion.

By presenting inspired perceptions with a vision of which he dreamed Keats makes his form functional, that is, representative of the nature and worth of that awareness which transcends ordinary observation and ordinary reason. The truth he seeks to establish, after all, is extraordinary. Ultimately it is the manner of the dream's presentation that must convince us of its substantive value. Keats seems to want his literary dream, in one way at least, to be like an actual dream, in which style is literally substance. Dreams differ from waking thoughts in that form or manner of apparition is decisive in dreams. One can rephrase an argument but not a dream. A dream can recur only by repeating its form.

Keats also discusses dreamers with Moneta, and about that discussion have gathered most of the critical controversies concerning *The Fall of Hyperion.*[23] There is too little evidence for anyone to explain with assurance Keats's meaning and intentions, but I should like to suggest some ways in which my understanding of the direction of his thinking relates to the major problems of the poem. If we accept *The Fall* in the most nearly finished form Keats achieved, that is, with the twenty-three lines beginning "Majestic shadow, tell me" (the cancelled passage comprising lines 187–210 of Book I) exised, Keats's argument is not inherently difficult, for it does not become fully engaged with the dreamer-poet distinction.[24] Keats asks by what right he has been allowed to attain the altar, and is told:

> . . . Thou hast felt
> What 'tis to die and live again before
> Thy fated hour; . . .
> None can usurp this height . . .
> But those to whom the miseries of the world
> Are misery, and will not let them rest.
> All else who find a haven in the world,
> Where they may thoughtless sleep away their days . . .
> Rot on the pavement where thou rotted'st half."

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[23] For a recent example, David Perkins, *The Quest for Permanence* (Cambridge, Mass., 1959), pp. 276–82.

[24] A most important and helpful article on this matter is that of Brian Wicker, "The Disputed Lines in *The Fall of Hyperion,*" *Essays in Criticism,* VII (1957), 28–41. A famous discussion of the lines is that of J. M. Murry, "The Poet and the Dreamer" now in *Keats* (London, 1955), pp. 238–49.

Keats then asks why he is alone, since

> "Are there not thousands in the world . . .
> Who love their fellows even to the death,
> Who feel the giant agony of the world,
> And more, like slaves to poor humanity,
> Labour for mortal good?"

These humanitarians are like Keats in that the miseries of the world will not let them rest. They are, however, more than he:

> . . . "they are no dreamers weak;
> They seek no wonder but the human face,
> No music but a happy-noted voice—
> They come not here, they have no thought to come—
> And thou art here, for thou art less than they."

We may overestimate Keats's praise of busy go-gooders. He certainly credits them with virtue, but perhaps he subtly implies their limitations, too, by having Moneta—one must remember that her wisdom is not complete, for she is not a true Olympian but "the pale Omega of a wither'd race"—praise the humanitarians in terms which recall those "who find a haven in the world." The humanitarians find their satisfaction and fulfillment, their "haven," in the world. True, they "feel the giant agony" of the world, but in a fashion that might be meant to recall the giant agony of the Titans, who were unable in *Hyperion* to sustain the feeling, as Apollo could, of pain and joy together. If so, from one point of view Keats is indeed "less" than the humanitarians, as the Olympians give the impression of being physically less than the Titans in *Hyperion,* but from another point of view he is more: he can bear "more woe than all his sins deserve," and can be "admitted oft" to paradise-like gardens.

Then in a passage which Keats (according to his good friend and careful scribe Woodhouse) meant to strike from *The Fall,* the discussion is carried from the poet-humanitarian contrast to the poet-dreamer contrast. Keats proposes that poets are not "useless," that their "melodies" do good, though he does not yet claim himself to be such a poet, a "physician to all men." Moneta replies with the query: "Art thou not of the dreamer tribe?" And she asserts:

> The poet and the dreamer are distinct,
> Diverse, sheer opposite, antipodes.
> The one pours out a balm upon the world,
> The other vexes it.

In the introductory lines Keats states plainly that the poet is a dreamer. The difference between poet and fanatic lies in the effectiveness of their expressions, but both tell their dreams. Possibly Moneta's distinction is meant to assist in refining the earlier definition. According to her the poet-dreamer pours out a balm upon the world while the fanatic-dreamer vexes it. Both, as it were, offer potions: that of the poet-dreamer heals, that of the fanatic-dreamer poisons.

At any rate, Moneta's words bring forth an angry exclamation from Keats, his first violent outburst:

> Apollo! faded! O farflown Apollo!
> Where is thy misty pestilence to creep
> Into the dwellings, through the door crannies
> Of all mock lyrists, large self-worshippers,
> And careless Hectorers in proud bad verse.

This is the first mention of Apollo in *The Fall,* and, in keeping with the pattern of imagery introduced by the word "physician" at the opening of the cancelled passage, he is invoked, not as the god of poetry, but as the god of pestilence.[25] But Keats skillfully links the god's two functions: Apollo is called upon to destroy not dreamers but bad poets, "mock lyrists," and "careless Hectorers in proud bad verse." This returns us to the problem of Moneta's words. In the introduction Keats defines the fanatic as less than the poet but not as evil. Now he condemns those who tell their dreams without genuine poetic gifts as vexatious poisoners of the world. He who weaves "a paradise for a sect" is now identified as a "self-worshipper"—not a worshipper of Apollo's supra-personal truth?—who ought to be destroyed.

> Tho' I breathe death with them it will be life
> To see them sprawl before me into graves.

It may be that the harmless fanatic is now seen to be the poisonous dreamer because Keats has reached the point where he is able to invoke Apollo, that is, he has passed the first tests of his initiation into genuine poethood. It is certain that this Apollo is not the new-born god of *Hyperion.* He is "faded" and "farflown." It appears to be the bad poets, the fanatic dreamers, who have exiled him. As remarked above, the effectiveness of a dream depends entirely upon its style. A badly told dream is a falsification, a distortion of the dream's truth. The "large self-worshippers" destroy the truth of Apollo, not because they dream, but because they recount their dreams badly. The poet recounts his dreams well and thus makes manifest the truth of his vision; by his art he invokes Apollo the healer who "pours out a balm upon the world." Keats, not claiming to be a poet yet, is nonetheless dedicated to the "objective" truth of vision. Thus it will be "life" to him, even though

[25] This imagery fits in with the pattern of sickness-medicine imagery, so far as I know unnoticed by the critics, which runs throughout the second version of *Hyperion.* For example, by Moneta's "propitious parley" the poet is "medicin'd/In sickness not ignoble," and later the face of the goddess is described as "bright blanch'd/By an immortal sickness which kills not; . . . deathwards progressing/To no death . . ."

he must personally suffer extinction in the process, to see the proud falsifiers of vision destroyed.

I do not wish to insist dogmatically on the correctness of this reading, and I propose it principally because it suggests that at the end of his career Keats may be reaffiming his faith in the truth expressed by Apollo's apotheosis in *Hyperion*. But if so Keats does not merely repeat his earlier celebration of evolutionary consciousness. He recognizes that increased consciousness leads inevitably beyond ordinary rationality to the exploration of the truth of dreams and visions.[26] And he recognizes that the best authentication of such visionary consciousness lies in the manner of its expression. The moral, then, would be that in the modern world the evil man is he who falsifies his dream or vision by telling it badly. This is no minor, aesthetic sin. It is blasphemy, the distortion of the highest truth. The genuine poet must be a good and useful man —"a sage, a humanist, a physician to all men"—for his well-told dream will embody the truth that surpasses the limited truth of sensory observation and rational discourse.[27] The dedicated poet expresses the one truth fully appropriate to modern man's capacity for conscious life.

Whatever the problems and uncertainties of *The Fall of Hyperion* may be, this faith is his art, this confidence in the worth of his poetry as something more than ornamental and entertaining, sustains all Keats's finest work.[28] In this belief, moreover, Keats is typical of his era, not unique. His contemporaries share his passionate conviction that in uttering beautifully their private visions they contribute to a better, a more fully human life for all men—that they in fact help to bring to birth the new life falsely promised by political revolutionists and social reformers, fanatic-dreamers who are not poets.

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[26] Rosenberg, 93: "He [Keats] reveals an instinctive historical sense and faith in the collective development of mind."

[27] Albert Gérard, "Coleridge, Keats and the Modern Mind," *Essays in Criticism*, I (1951), 249–61, emphasizes the general significance of this point. For example: "The Romantics . . . firmly believed that *within* 'mankind' there is room for a faculty that goes beyond reason. This is the basic assumption of romanticism." (p. 253).

[28] "*The Fall of Hyperion* must be regarded as one of the major attempts within European romanticism to reconcile the imagination with a realistic and human awareness of the suffering of mankind." (Sperry, p. 83). Mr. Sperry's insistence on the poem's adherence to the orthodox pattern of sin and redemption leads him to stress the dark side of *The Fall*—he speaks of Keats's final attitude as "closer to resignation than to hope— perhaps even despair." I wish to emphasize the element of reaffirmation within Keats's admittedly ever more tragic view of life.

PRINCIPLES OF SOIL CONSERVATION AND SOIL IMPROVEMENT AS THEY APPLY TO CERTAIN GROUPS OF SOILS IN SOUTHEASTERN WISCONSIN

M. T. Beatty and A. E. Peterson

Modern technology has made available an ever increasing number of practices for the conservation and improvement of soils. These practices are based on one or more of five fundamental principles. It is the purpose of this discussion to illustrate the application of these principles to problems in the conservation and improvement of two major groups of soils in southeastern Wisconsin.

Principles of Soil Conservation and Improvement

The many practices and techniques of soil conservation and soil improvement are based on five fundamental principles. These are:

1. The amount of soil which can be lost by erosion without serious damage to the productivity of the remaining soil varies among the many soil types.
2. Soil losses by erosion can be minimized by protecting the soil surface with living or dead organic matter, and/or by reducing the velocity or amount of water which flows over the soil.
3. Among the various kinds of soil, considerable difference exists in the ease with which the soil structure may be damaged by excessive or improper soil tillage.
4. Many soils can be improved beyond their natural state for the production or crops and/or wildlife by appropriate and timely applications of lime, fertilizer and organic matter, and by controlling the water table by drainage or flooding.
5. Appropriate combinations of practices based on one or more of the above principles are frequently needed on most soils or groups of soils.

While these five principles have been known for a considerable period of time, the importance of some of them is only now being

[1] Contribution from the Department of Soils and the Soil Survey Division, Wisconsin Geological and Natural History Survey; University of Wisconsin, published with the approval of the Director, Wis. Agr. Expt. Station, Madison, Wis.

[2] Associate Professors of Soils. Appreciation is expressed to Professor F. D. Hole for his helpful suggestions on the manuscript.

more fully recognized. Modern technological advances such as land forming, minimum soil tillage and numerous others which can be combined to produce high crop yields have greatly aided in the application of these principles to everyday agriculture.

Application of Principles to Groups of Soils

The application of the fundamental principles of soil conservation and soil improvement outlined previously, as implemented by modern technology, must be carefully fitted to particular combinations of soil type, length and gradient of slope, amount of existing topsoil and the overall physiography of the land being treated. Standards for the application of such practices have been developed from research by Agricultural Experiment Stations and by the United States Department of Agriculture. The Soil Conservation Service, U.S.D.A., has prepared standards for such practices in Wisconsin (1956, 1958).*

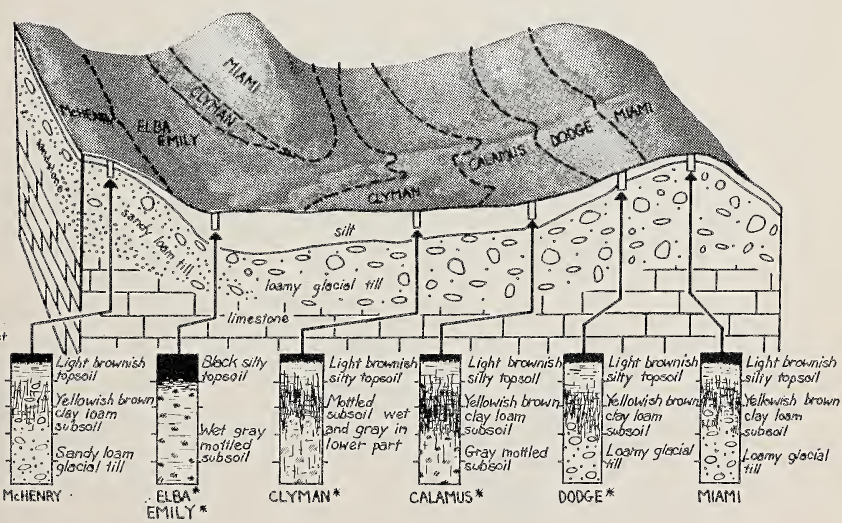
While every tract of land must be treated individually in the design and layout of soil conservation and soil improvement practices, there are certain repeating patterns of soils and slopes which are found in nature. This regularity of soil and slope patterns is a result of systematic variations in the factors of soil formation: parent material, relief, biological activity, time, and climate. These repeating patterns of soils and slopes make it possible to draw maps and diagrams of groups of related soils. Such maps and diagrams can include the major soils of landscapes throughout an area where soils have formed as a result of particular combinations of the five factors of soil formation. An example is the series of maps and accompanying landscape diagrams showing major groups of soils, and combinations of soil conserving and soil improving practices for each group, which has been prepared for the major soils of southeastern Wisconsin by Beatty and Murdock (1960). Diagrams of soils in two typical landscapes in southeastern Wisconsin illustrate the application of the principles of soil conservation and improvement outlined previously.

The most extensive group of soils in southeastern Wisconsin is one consisting of light-colored, medium textured soils formed from losses and calcareous glacial till on glaciated uplands and the poorly drained depressional soils associated with them. The areas of occurrence in this group of soils are shown in Figure 1. Figure 2 shows a cross section of a typical landscape in which these soils occur. Sketches of profiles of major soil series have been set into the diagram to portray important soil characteristics. The soils are shown in the landscape position in which they typically occur.

* Number in parentheses refer to literature cited.

Figure 3 illustrates the combination of soil conservation and improvement practices which would allow intensive development of these soils for agriculture, wildlife and forestry without excessive erosion or other permanent damage to the soil. These practices are based on the principles of soil conservation and soil improvement outlined previously, as implemented by new soil management techniques such as minimum tillage of row crops, especially on the rolling McHenry, Miami and Dodge soils, and land forming and water table control on the Elba, Emily and Clyman soils. The amounts and velocities of water flowing over the surfaces of all soils subject to erosion are controlled by terraces, diversions, waterways and by alternate contour strips of sod-forming and tilled crops. The Elba and Emily soils are recommended either for development for agriculture, for wildlife or for both simultaneously. If developed for agriculture, they can be used intensively for row crops if large amounts of fresh organic matter from crop residues or barnyard manure are returned to the soil, if pests can be adequately controlled, if high soil fertility is maintained, and if minimum soil tillage is practiced. This is possible because these soils are seldom subject to erosion, and have a structure which is not easily damaged by tillage.

Adoption of this combination of land-use practices on this group of soils, with minor modifications to fit variations in slope and



* Tentative soil name

FIGURE 1. Geographic extent of light-colored soils of the glaciated uplands.

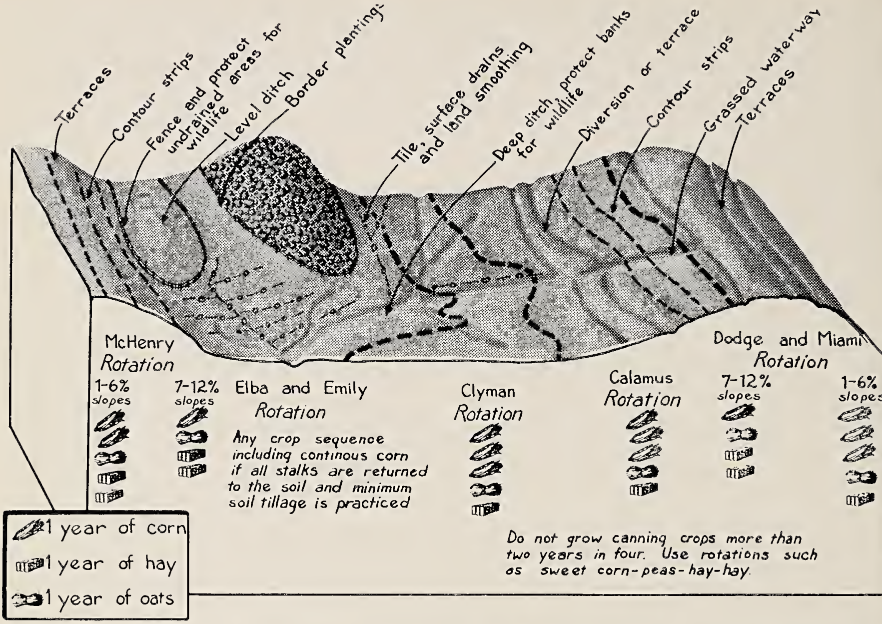


FIGURE 2. Typical landscape relationships of light-colored soils of the glaciated uplands in southeastern Wisconsin. * Tentative soil name.

other conditions, would represent an intensive program of multiple land-use development for agriculture, wildlife and forestry. All five principles of soil conservation and improvement need to be applied for the intensive multiple development of these soils.

Figure 4 shows the extent of the principal soils found in the Kettle Moraine of southeastern Wisconsin; figure 5 shows the typical landscape relationships of the soils in this group and figure 6 illustrates the combination of practices which will allow multiple land-use development for agriculture and wildlife on an intensive basis.

The intensity of recommended land use varies among the soils in the landscape in accordance with their potential for damage by erosions (see first principle above). For soils such as the McHenry, the permissible soil loss by erosion is greater than for shallow soils over sand and gravel such as the Casco. Therefore, more intensive cropping is allowed on the former soil under similar slope lengths and gradients. Permanent cover is recommended for the very shallow Rodman soil, because soil loss by erosion would almost totally destroy it. The irregular slopes in this landscape limit the use of mechanical practices for soil conservation. For this reason, rotations of crops which keep vegetative cover on the land much of the time are recommended. The structure or tilth of Boyer sandy loam is somewhat less susceptible to damage from excessive or improper tillage (see principle 3) than is that of other soils in the group. The fourth principle, that of improving the natural condition of a soil, is illustrated by the practices recommended for peat or muck. Many of these deposits occur in small depressions which have no drainage outlet. This, together with their small size,

FIGURE 3. Soil conservation and soil improvement practices adapted to light-colored soils in a typical glaciated upland landscape in southeastern Wisconsin.

greatly limits their use for agriculture, but many of them can be greatly improved as wildlife habitat. The fifth principle of using combinations of practices applies particularly well to this group of soils.

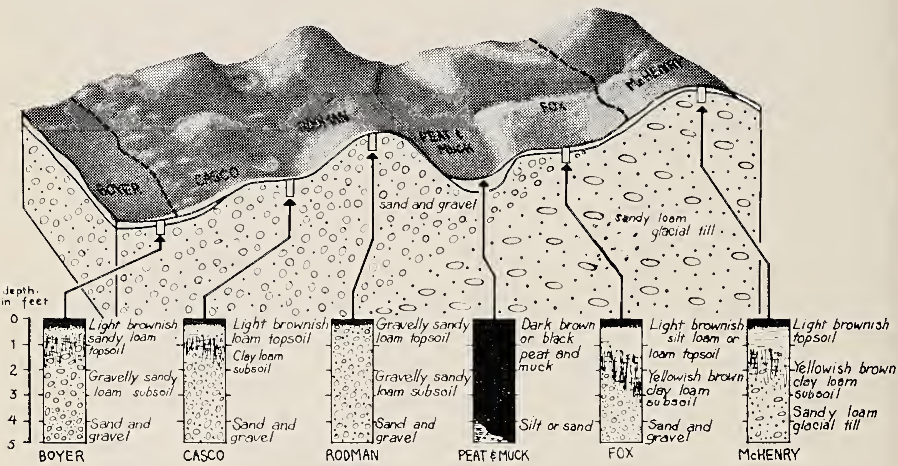


FIGURE 4. Geographic extent of soils of the Kettle Moraine.

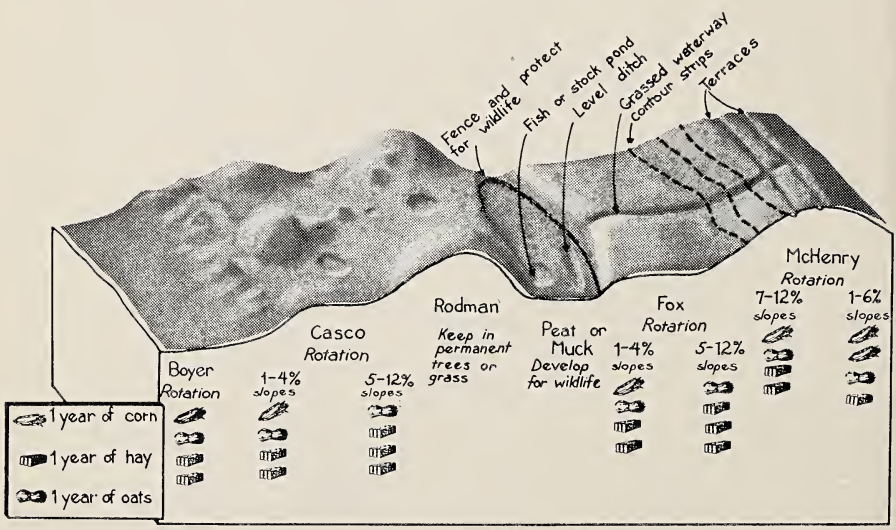


FIGURE 5. Typical landscape relationships of the major soils of the Kettle Moraine.

FIGURE 6. Soil conservation and soil improvement practices adapted to soils in a typical landscape of the Kettle Moraine.

DISCUSSION

The two groups of soils used as examples illustrate the wide range of soil and slope conditions found in parts of southeastern Wisconsin. It is also apparent from figures 3 and 6 that a variety of mechanical and vegetative soil conservation and soil improvement practices are needed for intensive development of these soils. The illustrations also show that soils in typical landscapes of the area are in many cases adapted to use for agricultural crops, for woodlands and for wildlife. Planning the land-use for tracts of land may involve assigning bodies of soil to one or more of these uses.

Comparison in the field of soil improvement and soil conservation practices now in use on typical landscapes of the soil groups with practices needed for adequate soil conservation and intensive soil development have shown that these soils are now generally far below their potential for multiple development for agriculture, forestry and wildlife. Soil conservation practices have not been applied to the extent considered necessary for adequate control of soil erosion.

Summary

The application of principles of soil conservation and improvement to a diverse group of soil and slope conditions on two landscapes in southeastern Wisconsin are illustrated. Of the two landscapes, the first is typical of much of southeastern Wisconsin, and the second contains extremes of soil and slope conditions and thus is well suited to illustrating the basic principles of soil conservation and improvement. Widespread application of the recommended practices would lead to more intensive multiple development of such soils for agriculture, woodland and wildlife, and would greatly reduce the possibility of excessive soil erosion.

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A STUDY OF THE NATURAL PROCESSES OF INCORPORATION OF ORGANIC MATTER INTO SOIL IN THE UNIVERSITY OF WISCONSIN ARBORETUM

Gerald A. Nielsen and Francis D. Hole

Soil studies on long term plots under natural vegetation in the 1200 acre University Arboretum at Madison were undertaken in 1956 at the suggestion of the late Professor John T. Curtis of the Botany Department of the University of Wisconsin. Measurements were made to determine (1) annual production of natural litter in forest and prairie areas, (2) relative contributions by roots and above ground parts of prairie plants to the store of nitrogen in the soil, and (3) rate and processes of incorporation of organic matter in forest soils (Nielsen, 1963). Twenty-six rectangular plots were established and sampled in 1956 and total soil nitrogen contents determined by W. A. Noel. Resampling of the soils and analysis of total nitrogen were done three years later by the senior author (Nielsen, 1960). Measurements of production of vegetative growth have been continued from 1956 to date.

Introduction

A soil is a three-dimensional body (Soil Survey Staff, 1951) that records past events. The record, in the form of arrangements of chemical bonds, mineral and organic compounds, soil aggregates and horizons (layers) and the soil body itself, is a summary or synthesis of pedologic changes. In this sense a soil is a "synthometer", an integrated product of a succession of external and internal conditions. Climate, flora, fauna and man himself have all left their mark upon the soil.

Prairie and forest soils of Wisconsin (Figure 1) embody a partial record of Wisconsin's natural history for a period of at least 12,500 years (Frye and Willman, 1960). This includes the deposition of Cary dolomitic glacial drift and an overlying 2- to 3- foot

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deposit of loess, and subsequent changes in vegetation and climate (Curtis, 1959) to the present. Starting with the two-layered parent material, loess over drift, widely different plant and animal communities and associated microclimates have differentiated contrasting prairie and forest soils in southeastern Wisconsin. The prairie soil, called Brunizem by Simonson, Riecken and Smith (1952) has the simpler profile of the two. It consists of an acid, deep, dark, granular surface soil, the A_1 horizon, overlying a weakly developed blocky subsoil, the B_2 horizon (see Parr silt loam, Hole, 1956, p. 55). Content of organic matter in the Brunizem soil decreases gradually with depth. The deciduous forest soil, termed Gray-Brown Podzolic by Baldwin (1927), has a shallow, nearly neutral surface soil (A_1) overlying a bleached layer (A_2) and strongly developed clayey subsoil (B_2) (see Dodge silt loam, Hole 1956, p. 40). The content of organic matter does not decline gradually with depth, as in the Brunizem, but decreases abruptly at the lower boundary of the shallow A_1 horizon.

Five plots, measuring 12 feet on a side, were created in 1956 at each of three sites on the Curtis Prairie of the University Arboretum. Prairie vegetation was established at the three sites in 1940, 1950, and 1956. Four plots were created in each of two oak stands, the Noe and Wingra woods. Prior to the 1840's in which decade plowing began on what was then the farm of Eliphalet Cramer, the soils of these areas were all forest soils (Gray-Brown Podzolics) similar to the Dodge silt loam of Figure 1. Although there is evidence that in the 1830's the forests were largely of the oak opening type with prairie vegetation between the scattred oak trees[1] (Curtis, 1951; Cottam, 1949), still the soil exhibits characteristics related to forest stands and not to prairies. The soils of the Noe and Wingra woods have never been plowed, whereas the soils of the artificial prairies were plowed repeatedly from about 1840–1926 and again at the time of establishment of the prairie stands. The brown 5- to 7-inch plow layer is still visible in the prairies, but is undergoing modification. Given sufficient time, the present vigorous prairie may be expected to produce a Brunizem soil, as the savannah of the 1830's did not. On the 23 plots the natural organic materials were manipulated, and resulting changes in nitrogen contents of the soils were measured. Manipulation included the addition or removal of plant materials above-ground. These plot treatments are described below.

It is understood that the data collected over a short period and summarized in this paper constitute a progress report.

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[1] Estimates from the original Government land survey of 1835 suggest that bur and white oak trees were more or less randomly scattered over the uplands at a rate of 15–20 trees per acre. Certain large oaks over 150 years old still remain as relics of the original oak openings (Curtis, 1951).

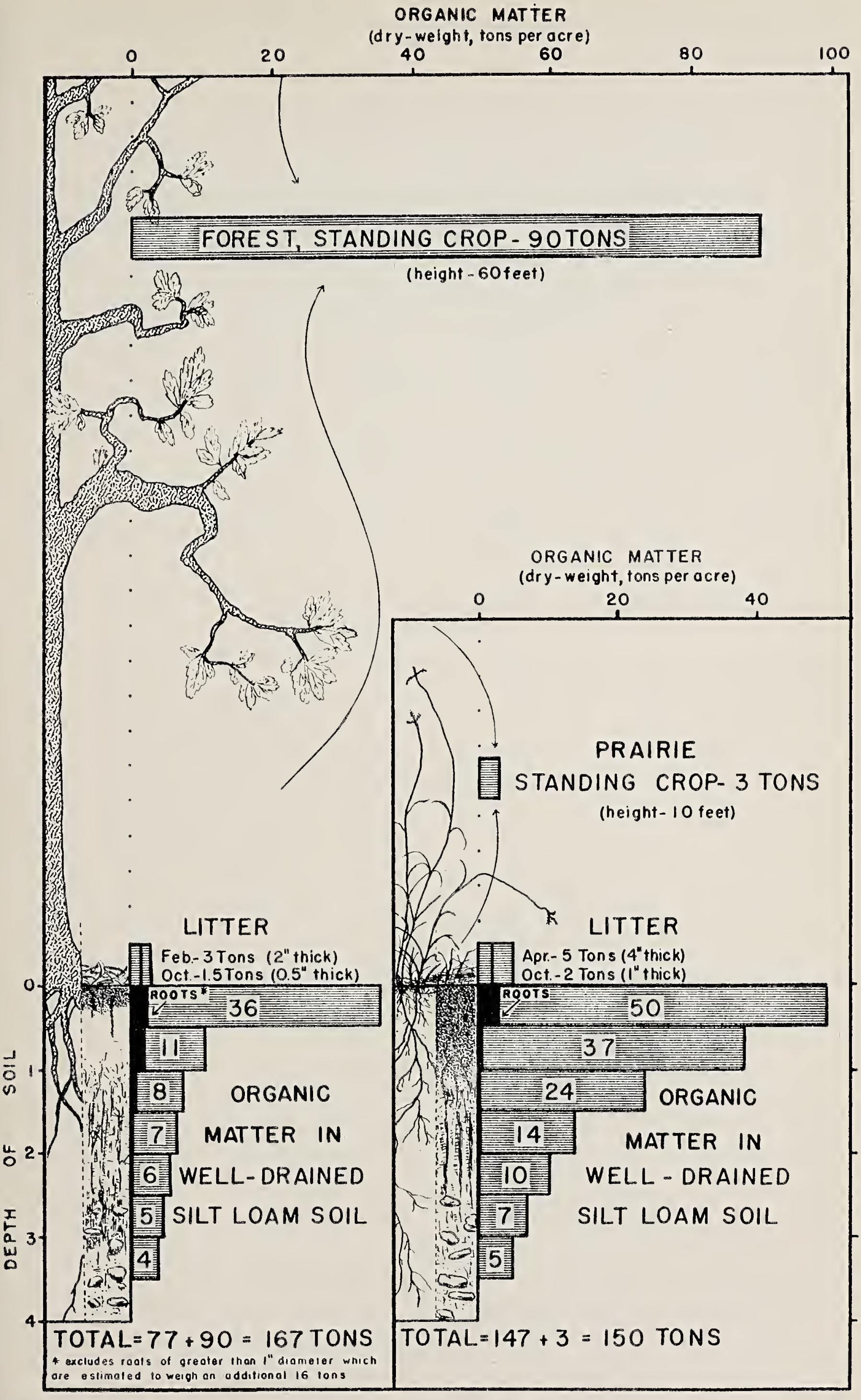
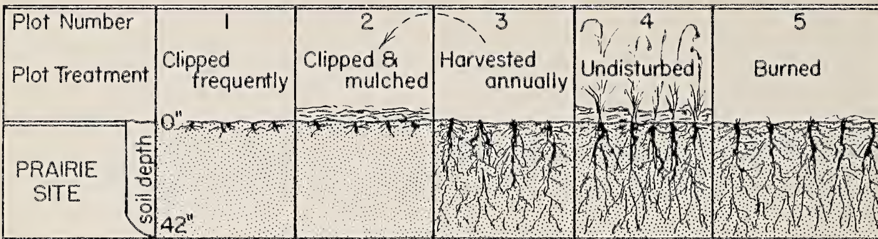


FIGURE 1. The distribution of organic matter in forest (white oak, black oak) and praire (big bluestem, Indian grass) ecosystems in south central Wisconsin: generalized presentation.

Plot Number	1	2	3	4	5
Plot Treatment	Clipped frequently	Clipped & mulched	Harvested annually	Undisturbed	Burned



	1	2	3	4	5
	Weight of Vegetation[a] (lbs/acre, oven-dried)				
1940 Prairie	1100[b]	1400[b]	4700[b]	5100[c]	6900-3800[c,d]
1950 Prairie	1800[b]	1900[b]	6800[b]	6300[c]	7600-6700[c,d]
1956 Prairie	1400[b]	1800[b]	3700[b]	5600[c]	3100-3500[c,d]
Average	1400[b]	1700[b]	5100[b]	5700[c]	5900-4700[c,d]
	Weight of Mulch[e] (lbs/acre, oven-dried)				
1940 Prairie	Trace	(4700)[f]	Trace	3000[c]	150-3000[c,d]
1950 Prairie	Trace	(6800)[f]	Trace	4900[c]	90-3400[c,d]
1956 Prairie	Trace	(3700)[f]	Trace	2500[c]	300- 350[c,d]
Average	Trace	(5100)[f]	Trace	3500[c]	180-2250[c,d]
	Depth of Mulch[g] (mm)				
1940 Prairie	6	46	10	65	5[h]
1950 Prairie	5	68	8	148	28[h]
1956 Prairie	6	30	6	69	19[h]
Average	6	48	8	94	17
	Seed stalks per Plot[i]				
1940 Prairie	0	0	465	300	830-120[d]
1950 Prairie	0	0	485	345	240[j]
1956 Prairie	0	0	305	335	243-60[d]
Average	0	0	418	327	438-90

FIGURE 2. Production of vegetation and accumulation of mulch on plots at three prairie sites in the University of Wisconsin Arboretum.

[a] Vegetation refers to above-ground organic material produced in a growing season and harvested in November, 1959, 1960, 1961.

[b] Data based on material from entire plot (16 yd^2).

[c] Data based on material from one square yard per plot.

[d] The first figure is for data obtained in the autumn after springs when the plots were burned. The second figure is for years when there was no spring burning.

[e] Mulch refers to dull brown, partially decomposed above-ground organic material remaining from previous growing seasons and measured in November, 1959, 1960, 1961.

[f] These data represent fresh harvest transferred in November from plot #3 and not weight of year-old mulch. Therefore, the data are not strictly comparable with the data from plots #4 and #5.

[g] Each figure is an average of measurements taken with a point frame apparatus at 40 points per plot in April 1961.

[h] These plots had been burned shortly before these data were taken. Variations in depth of mulch are attributable to the erratic character of burning.

[i] Average number of seed stalks of big bluestem and Indian grass as counted in August, 1960, and 1961.

[j] Average for 2 years in which plots were burned in the spring.

Investigations in the Prairies

The five treatments on the three prairie sites are shown diagrammatically at the top of Figure 2: plot #1 was kept clipped so that vegetative growth both above- and below-ground was minimal; plot #2 was likewise kept clipped, but was mulched each autumn with the total stand harvested from plot #3; plot #3 was disturbed only by removal of vegetation each autumn, as previously stated; plot #4 was undisturbed throughout; plot #5 was subjected to spring burning biennially, on the average, but was otherwise undisturbed. Corrugated galvanized iron strips, embedded about a foot in the soil and protruding 6-inches above the surface, created a vertical barrier around plots #1 and #2.

Soil sampling[2] in 1956 and 1959 in plots at prairie and forest sites was by means of an Oakfield soil sampling tube[3], and contents of total nitrogen were determined by the Kjeldahl method (Jackson, 1958; Bremner, 1960).

Production of Vegetation and Accumulation of Mulch

The field data summarized in Figure 2 indicate that production of vegetation growth on plots #1 and #2 was suppressed by clipping, although much less than anticipated. Simultaneously the composition of the vegetation changed from big bluestem *(Andropogon gerardi)*, Indian grass *(Sorghastrum nutans)* and switchgrass *(Panicum virgatum)* to quack grass, dandelion, bluegrass and other species capable of surviving severe treatment. Data for plots #3, #4 and #5 are based on material collected each November. The averages for these three plots imply that annual production of vegetation has not been greatly influenced by the different treatments during the three-year period. However, if data for the two older prairie sites are averaged, the mean annual dry weight of vegetation produced under the three treatments is 5,750 pounds on the harvested plots (#3), 5,700 pounds on the undisturbed plots (#4), and 7,250 pounds on the burned plots (#5) in the year of burning. These figures seem to substantiate the contention of some ecologists (Weaver, 1954; Curtis, 1959) that burning to remove excessive natural mulch promotes the growth of prairie vegetation. Growth on plot #5 in the two older prairies in years without burning averaged 5,250 pounds, dry weight. The 1956-prairie seeding, however, was still in the process of establishing itself in 1956–1959, and showed best growth[4] on the un-

[2] Columns of soil 42″ deep and ¾″ in diameter were taken at 15 points per plot.

[3] Description available from the Oakfield Apparatus Co. Oakfield, Wisconsin.

[4] "Best growth" refers not only to greater weights of vegetative growth, but also to the larger number of seed stalks of Indian grass and big bluestem produced in years prior to 1961. In 1960 plots 3, 4 and 5 of the 1956– prairie produced 90, 300 and 60 seed stalks respectively.

disturbed plot (#4) when a mulch was accumulating, and poorest growth where autumn harvesting (plot #3) or spring burning (plot #5) removed mulch. Robocker and Miller (1955) also found that under certain conditions burning was detrimental to the establishment of big bluestem in south central Wisconsin. The higher production of the 1950-prairie, as compared with the oldest (1940) prairie, may be attributed to the slightly more moist soil conditions and higher content of available phosphorus of the moderately-well drained Gray-Brown Podzolic soil at the 1950-prairie and 1956-prairie sites. A nearly complete cover of moss on plot #3 of the 1940 prairie may be correlated with reduced growth of prairie vegetation on that plot.

Data on numbers of seed stalks of bluestem *(Andropogon gerardi)* and Indian grass *(Sorghastrum nutans)* per plot indicate that uninterrupted accumulation of mulch, as on the undisturbed plots (#4) depressed the production of seed stalks. This is most evident on the oldest (1940) prairie, where the undisturbed plot (#4) producd 165 less stalks than the harvested plot (#3) and 530 less stalks than the burned plot (#5). The count for plot #5 of the 1950-prairie is low because switchgrass *(Panicum virgatum)* was abundant on that plot and seed stalks of that plant were not counted. The figures for the 1956-prairie plots must be interpreted in the light of the fact that the vegetation was in the process of establishing itself, as has already been mentioned. On August 29, 1958, a year when burning of the 1940-prairie did not take place, the harvested plot (#3, 1940-prairie) displayed 300 seed stalks in August, in contrast to the other near-by plots as well as the surrounding prairie, where no seed stalks of big bluestem and Indian grass were to be seen. In 1961, on both the 1950- and 1956-prairies, the grasses on the undisturbed plots (#4) in early September showed darker green leaves and delayed flowering as compared with the harvested (#3) and burned (#5) plots. These phenomena are associated with an effectively cooler and more moist soil climate than obtains in the absence of a mulch. On the same date on the oldest (1940) prairie, the grasses on the undisturbed plot (#4), as well as on the harvested plot (#3) showed slight symptoms of nitrogen and phosphorous deficiencies, whereas the vegetation of the burned plot (#5) was free of such symptoms, though lighter green than the less mature vegetation on undisturbed plots (#4) at the 1950- and 1956-prairie sites. A beneficial effect of burning on an established prairie is suggested.

Data for a wet prairie (big bluestem and Indian grass on a Humic-Gley soil) based on annual sampling from 3 quadrats, 1 square yard each, indicate an average annual production of 4,000

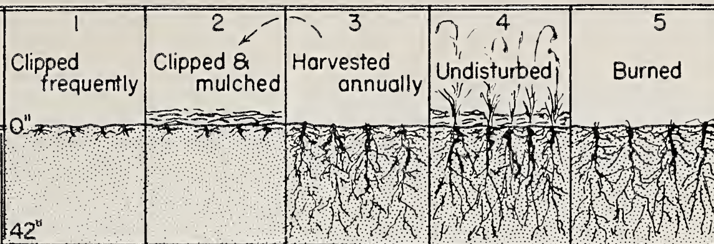
Plot Number	1	2	3	4	5
Plot Treatment	Clipped frequently	Clipped & mulched	Harvested annually	Undisturbed	Burned
SOIL DEPTH (ins)	0"  42"				
	Prairie Site Established in 1940				
0 to 3	1430 − 10	1390 +40	1290 +60	1320 +40	1390 +20
3 to 6	960 +100	990 − 10	860 +50	900 −60	1050 +80
6 to 15	1650 + 90	1590 +30	1380 +60	1530 −240	1920 +150
15 to 42	2340 + 90	2520 −180	2430 00	2700 −210	2520 00
0 to 42	6380 +270	6490 −120	5960 +170	6450 −470	6880 +250
	Prairie Site Established in 1950				
0 to 3	1240 + 60	1200 +120	1300 + 60	1250 + 80	1420 + 20
3 to 6	1080 − 10	1110 − 70	1160 + 30	1140 + 20	1200 + 30
6 to 15	2070 − 180	1980 − 120	2100 +240	2100 + 30	2160 +120
15 to 42	2340 −270	2520 − 180	2520 00	2250 + 90	2430+ 90
0 to 42	6730 −400	6810 −250	7080 +330	6740 +220	7210 +260
	Prairie Site Established in 1956				
0 to 3	1050 + 50	1040 +140	1070 +100	1050 +200	870 +170
3 to 6	920 − 20	930 − 70	940 + 50	1000 + 20	810 − 20
6 to 15	1710 + 60	1770 −150	1800 +120	1890 + 150	1140 +120
15 to 42	2070 +540	2070 −360	2160 + 90	2340 +270	1620+360
0 to 42	5750 +630	5810 −440	5970 +360	6280+640	4440+630
	Average for 1940, 1950, and 1956 Prairie Sites				
0 to 42	6287 + 167	6370 − 270	6337 +287	6490+130	6177 +380

FIGURE 3. Nitrogen content of soils (1 lb. per acre) in prairie plots, University of Wisconsin Arboretum, in 1956; and gains and losses of nitrogen, 1956–1959.

Note: In columns 1 through 5 the first of a pair of figures signifies pounds of nitrogen per acre in 1956, and the second figure represents the gain (+) or loss (—) of nitrogen during the period 1956–1959.

Data in this figure, as well as in figure 6, are based upon the percent total soil nitrogen as determined by a modified Kjeldahl method (Jackson, 1958). The first figure of the pair in each column was obtained by multiplying percent total nitrogen by an assigned soil density of 1,000,000 pounds per acre 3-inch layer. Thus the 0 to 3, 3 to 6, 6 to 15 and 15 to 42 inch layers of soil was given weights 1, 1, 3 and 9 million pounds per acre respectively. Soils of the type studied would in fact range from about 800,000 pounds for the top 3-inch layer to about 1,100,000 pounds for a 3-inch layer near the bottom of the profile, because their bulk densities range approximately from 1.2 in the top 6 inches to 1.7 at a 42 inch depth (Shields, 1955). Assignment of the same bulk density to the same bulk density to the entire soil profile introduces slight errors in the figures showing total weight of soil nitrogen. However, it has little effect on figures showing changes in content of nitrogen.

The second figure of the pair in each column of this figure, as well as of figure 6, was obtained by subtracting pounds of nitrogen in 1956 from a similar figure (not given) based on the soil samples collected in 1959.

Each figure of the 0 to 3 inch and 3 to 6 inch layers is an average of duplicate analyses of soil samples taken at three diffrent soil depths, whereas the 6 to 15 inch and 15 to 42 inch layers represent duplicate analyses of samples taken at four different depths within each of the two zones indicated (Fig. 4).

The average deviation from the mean for all duplicate analyses was 0.0015 percent nitrogen. This is equivalent to about 15 pounds of nitrogen per arce 3-inch layer of soil.

lbs per acre of above-ground prairie vegetation. This area, like that of the entire mesic prairie is burned annually or biennially.

Gains and Losses of Soil Nitrogen, 1956–1959. The data presented in Figure 3 record the status in 1956 of the soils of the prairie plots in terms of total nitrogen. The significance of the figures for gains and losses of nitrogen during the short period, 1956–1959 is as yet unclear. Future studies can be expected to show to what extent the gains and losses represent actual changes in soils, on the one hand, and experimental errors in sampling and analysis, on the other. However, the present data suggest the following trends. (1) The effect of tillage in lowering soil nitrogen content (from M.F. to C.F., Figure 8) is being erased by the increase in soil nitrogen which is occurring under prairie vegetation

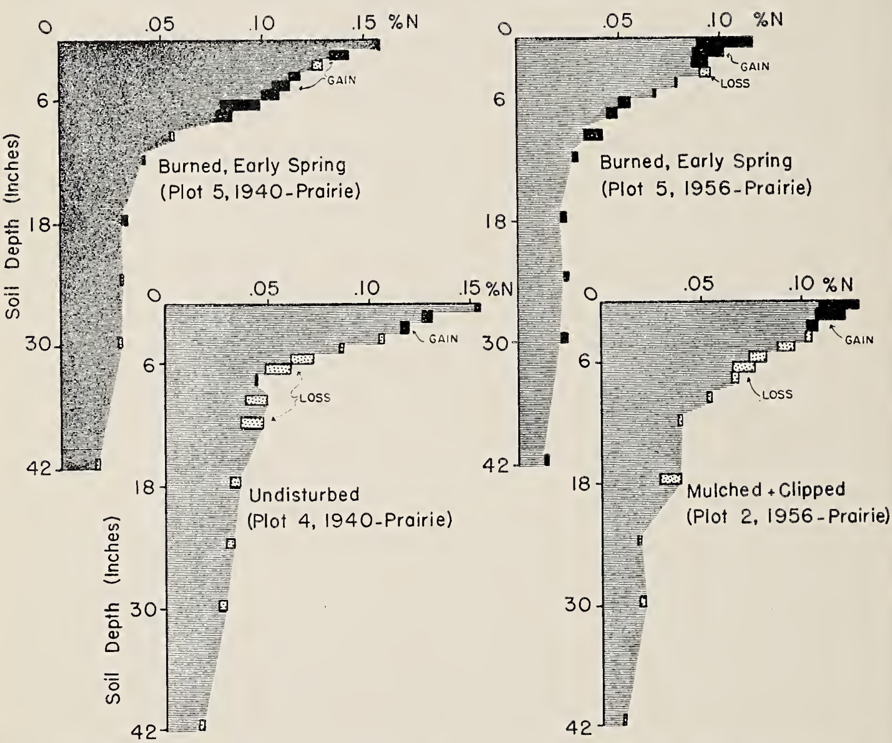


FIGURE 4. Total nitrogen content of soil in 4 plots in the reconstructed prairies, University of Wisconsin Arboretum at Madison. Bars indicate depths at which soil samples were taken in 1956 and 1959. Black bars represent gains in total soil nitrogen over the 3-year period. Dotted bars represent losses in nitrogen during the same period. Burning of plot #5 took place in late April of 1957 and 1959 on the prairie established in 1940, and in late April, 1958 at the prairie planted in 1956. Plot #2 of the 1956 prairie received each autumn the harvested prairie stand from an adjacent plot. Vegetation on plot #2 was kept clipped throughout each growing season. Plot #4 of the prairie which was established in 1940 was not clipped, harvested nor burned.

(from C.F. to Y.P. in Figure 8). This trend is further illustrated in Figure 4, plots #2 and #5 of the 1956-prairie which show a 3-year loss of nitrogen at a depth of 4 inches, and a gain above that. (2) The removal of mulch from soil has promoted increases in soil nitrogen. This is evident in the burned plots (#5) where soil profiles showed an average 3-year gain of 380 pounds of nitrogen per acre, and in the harvested plots (#3), where the gain in nitrogen averaged 287 pounds. Smaller gains or outright losses occurred under natural (plots #4) and artificial (plots #2) mulches. (3) The soils at the three prairie sites of the University Arboretum are in early stages of development with respect to nitrogen content, and are far from the steady state of mature prairie or Brunizem soil (Figures 1 and 8). Fourteen of the fifteen prairie plots gained nitrogen in the upper 3 inches of soil. Plots number 3, 4, and 5 in the 3-year-old (1956) prairie gained twice as much nitrogen in the upper 6 inches of soil, as well as in the entire profile, as did the soil at the 19-year-old (1940) prairie site.

Investigations in the Forest

The four treatments at two wooded sites are shown diagramatically at the top of Figure 5. Plot #1 was stripped of 6 inches of topsoil (A_1 and A_2) and refilled with yellowish subsoil (upper B horizon material) containing much less organic matter. Since this treatment in 1956, natural forest litter has been allowed to accumulate on this plot. Plot #2 was kept free of leaves and other litter that fell onto the surface of the A horizon. Plot #3 received a double application of litter each year. Plot #4 was left undisturbed.

The approximate weight and composition of litter received on the forest soil plots is presented in the body and footnotes of Figure 5. The litter that fell by November each year on forest plots #1 and #4 averaged 4600 pounds (oven-dry weight) per acre. This included branches and other woody materials with an equivalent diameter of less than ¾ inch.

Studies in Noe Woods of the monthly changes (Oct. 1960–Dec. 1961) in weight, depth and composition of litter have shown: 1) the total weight of litter on the forest floor to increase from a low of 2700 pounds per acre (35% leaves, 65% woody material) on October 1, 1960 to a maximum of 6300 pounds (58% leaves, 42% woody material) on April 7, 1961. 2) The depth of litter ranged from 18 mm on October 3, 1960 to 48 mm on December 3, 1960. 3) Observations at 80 points per month using a vertical point-frame with 1/16th-inch diameter rods indicated that on October 1, 1960 leaves appeared on only 46 percent of the forest floor area while wood and bare soil were exposed at 22 percent and 32 percent of the area respectively. On February 11, 1961 leaves constituted 98 percent and wood 2 percent of the exposed surface of the forest floor.

The litter depth data in Figure 5 indicate the relative amounts of litter remaining on the Noe Woods plot on October 3, 1961. A litter depth of 24 mm on the undisturbed plot #4 agrees exactly with the litter depth obtained on October 12th by measuring at 80 points along a 640-foot transect in Noe Woods. The litter depth for plots #3 and #4 measured the same on October 3 (Figure 5). This suggests that decomposers have in one years time reduced the double amount of litter on plot #3 to about the same as that on plot #4. Field observations of the A_{oo} horizons on these plots substantiate this conclusion as does the larger population of earthworm *(Lumbricus terrestris)* middens[5] and the greater weights of earthworm casts[6] deposited on the plot receiving a double amount of litter. Field observations also indicate that the low figure (15mm) for litter depth on plot #1 (Figure 5) results from the removal of leaf litter by agents of erosion. Litter remaining on the plot was concentrated in the vicinity of *Lumbricus terrestris* middens (Nielsen and Hole, 1964). Between middens there was a smooth and rather hard soil surface with few castings or plants to stabilize the litter.

Data for a 30-year-old pine *(Pinus strobus* and *Pinus resinosa)* plantation on formerly plowed Dodge silt loam soil, showed an average production since 1955 of 3300 (range 2800 to 3700) pounds (oven-dry weight) of little per acre per year. The litter consisted of 92 percent needles, 5 percent cones and 3 percent twigs. The weight of the L (upper litter) and F (fermenting) horizons or total "litter" accumulated on the forest floor averaged 10,700 (range 7200–12,400) pounds per acre and contained 90 percent needles, 6 percent cones and 4 percent twigs. Earthworms continued to mix these organic materials with the underlying mineral soil. This apparently explains the absence of a H (humus) layer below the F layer.

Gains and Losses of Soil Nitrogen, 1956–1959. The data presented in Figure 6 record the status in 1956 of the forest soil plots

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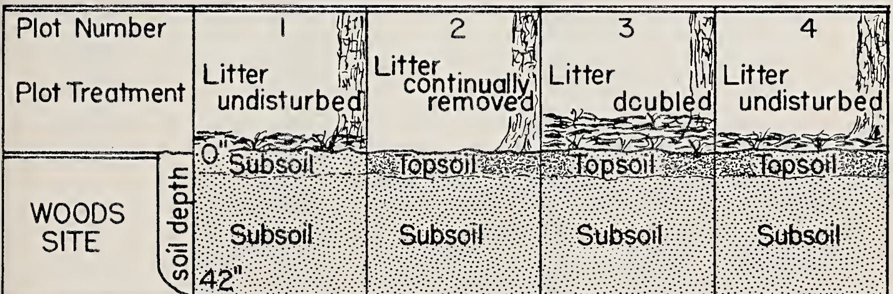
[5] The number of middens of *Lumbricus terrestris* in duplicate four-square-foot quadrats on soil plots in Noe Woods on June 23, 1962 were as follows: plot #2 (litter continually removed) 5,5; plot #1 (topsoil removed, litter undisturbed) 14, 18; plot #3 (litter doubled) 26, 30; plot #4 (litter undisturbed) 13, 16; middens counted had burrow openings at least ¼th inch in diameter.

[6] Weight (oven-dry) of casts collected 7 times between April 8 and October 3, 1961 from 3 by 20.9 inch (10^{-5} acre) staked quadrats in the Noe and Wingra Woods soil plots was as follows: for plots #1, #2, #3 and #4 the weights were 62.2, 48.8, 149.9 and 112.3 grams per quadrat or 6.8, 5.4, 16.5 and 12.7 tons per acre respectively. The average range of duplicates was 15.5 gm or 1.7 tons per acre.

in terms of total nitrogen. The figures for gains and losses of nitrogen during the period 1956–1959 suggest the following trends. 1) A new A-horizon is being formed on plot #1 of the wooded sites. The top 6-inch layer of plot #1 is the Noe Woods gained 250 pounds of nitrogen per acre after receiving a natural supply of litter for 3 years (Figure 6). This 30 percent increase in soil nitrogen is illustrated in Figure 7. At this rate of nitrogen accumulation on this plot a period of 30 to 40 years would be necessary for the nitrogen content of the new A-horizon to reach the level of that of A-horizon (0″ to 6″) in surrounding undisturbed forest



	1	2	3	4
	Average Weight of Litter[a] (lbs/acre) Received each November, 1957–1961			
Noe Woods	5500[b,c]	Trace	11000[b]	5500[b,c]
Wingra W'ds	3800[d,e]	Trace	7600[d]	3800[d,e]
Average	4600	Trace	9200	4600
	Depth of Litter[f] (mm), October 3, 1961			
Noe Woods	15	1	24	24

FIGURE 5. Weight, depth and composition of natural litter on forest soil plots of the University of Wisconsin Arboretum.

[a] Natural litter includes leaves and acorns as well as woody materials with an equivalent diameter of less than ¾ inch.

The weight of forest litter falling on the surface of plots #1 and #4 is based upon the oven-dry weight of litter that falls each year on triplicate square yard collecting screens located near the plots.

[b] The litter is predominantly from white oak *(Quercus alba)* and black oak *(Quercus velutina)*. The average composition of the litter was 75% leaves, 15% twigs, 9% bark and 0.3% acorns and cups.

[c] This figure represents a range from 4300 pounds per acre in 1957 to 5900 pounds in 1961.

[d] The litter is predominantly from red oak *(Quercus borealis)*. The average composition of the litter was 69% leaves, 11% twigs, 3% bark and 17% acorns and cups.

[e] This figure represents a range from 3300 pounds per acre (6% acorns) in 1960 to a high of 4400 pounds (29% acorns) in 1958.

[f] Depths measured at 40 points per plot with a point frame apparatus.

Plot Number	1	2	3	4
Plot Treatment	Litter undisturbed	Litter continually removed	Litter doubled	Litter undisturbed
SOIL DEPTH (ins)	0" Subsoil Subsoil 42"	Topsoil Subsoil	Topsoil Subsoil	Topsoil Subsoil
	Noe Woods			
0 to 3	370 + 130	2430 −280	2470 + 220	2600
3 to 6	490 + 120	920 + 30	880 + 350	1010
6 to 15	1710 00	1680 − 120	1680 + 120	1620
15 to 42	2880 − 360	2700 − 180	2610 00	2700
0 to 42	5450 − 110	7730 − 550	7640 + 690	7930
	Wingra Woods			
0 to 3	400 + 40	2090 − 60	2180 + 320	2130
3 to 6	550 − 70	810 − 110	690 + 70	750
6 to 15	1530 − 210	1500 − 120	1500 − 210	1280
15 to 42	2970 − 90	3420 − 360	2880 − 180	3240
0 to 42	5450 − 330	7820 − 650	7250 00	7400
	Average			
0 to 42	5450 − 220	7775 − 600	7445 + 345	7665

FIGURE 6. Nitrogen content of forest plots (lbs. per acre), University of Wisconsin Arboretum in 1956 and gains and losses of nitrogen, 1956–1959. In columns 1 to 3 the first of a pair of figures is pounds of nitrogen per acre in 1956 and the second figure is the gain (+) or loss (—) of nitrogen during the period 1956–1959. Data in column 4 are for 1959 only. (See footnote to Figure 3.)

soils. 2) The systematic removal of forest litter for 3 years resulted in a loss of 250 pounds per acre of nitrogen in the top 6-inches of plot #3. This 7 percent decrease is illustrated in Figure 7. 3) Doubling the application of litter caused the top 6-inch of soil in plot #3 to gain 570 pounds of nitrogen per acre. This 14 percent increase is illustrated in Figure 7.

SUMMARY

This progress report on a continuing study in the University of Wisconsin Arboretum of factors affecting the incorporation of organic matter into soils under natural vegetation documents the

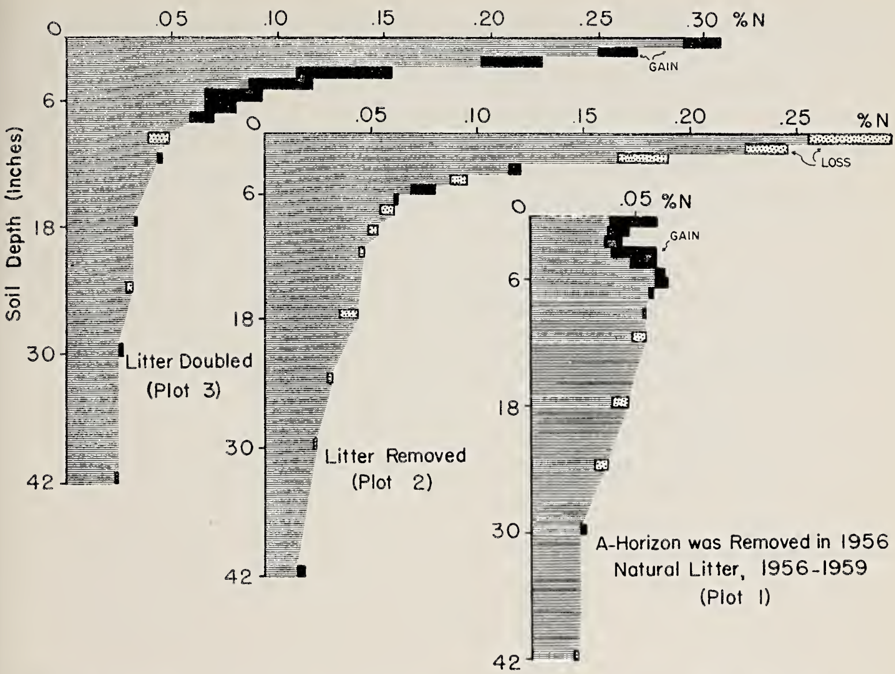


FIGURE 7. Total nitrogen content of soil in 3 plots in the Noe Woods, University of Wisconsin Arboretum at Madison. Bars indicate depths at which soil samples were taken in 1956 and 1959. Black bars represent gains in total soil nitrogen over the 3-year period. Dotted bars represent losses in nitrogen during the same period. In plot #1 B^1-horizon material was substituted for the A-horizon removed in 1956.

major contrast between soils of deciduous forests and soils of prairies. Storage of organic matter is largely above-ground at forest sites studied and largely under-ground at the prairie sites (Figure 1). The accumulation of above-ground parts of prairie plants as a mulch on the soil not only suppresses the vigorous growth of the prairie vegetation but may be of little benefit as a source of soil organic matter. Over a period of about 90 years (1840's to 1930's) under agricultural management, the forest soil studied lost about 20 tons of organic matter or 26 percent of the total organic matter in the undisturbed forest soil (Figure 8). Within a period of 19 years (1940 to 1959) under planted prairie vegetation the soil has regained about 12 tons of organic matter, or 60 percent of that lost under agricultural management (Figure 8). The abrupt lower boundary of the plow layer has been partially erased. The greatest changes in three years (1956–1959) in the organic matter content of the soils studied were associated with earthworm activity in forest soil plots. A plot receiving twice the normal weight of forest litter for 3 years gained in the 0″ to 6″ soil layer 570 pounds of nitrogen, or about 5½ ton of organic matter per acre. Investigation is being continued of the sources of soil organic matter and the processes and rates of incorporation of it into soil.

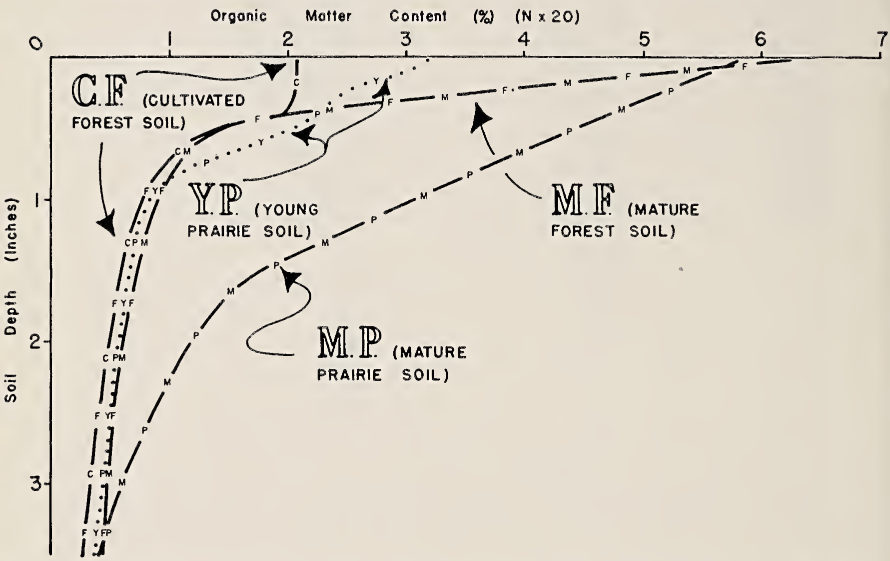


FIGURE 8. Distribution of organic matter in a mature forest soil (Noe Woods), a forest soil cropped for about 90 years (1956 prairie site), a cropped forest soil under prairie vegetation for 19 years (1940 prairie site) and a mature prairie soil (generalized from data of Shields, 1955 and Simonson, *et al*, 1952).

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NOTES ON WISCONSIN PARASITIC FUNGI, XXIX

H. C. Greene

This series of notes is based in large part on observations made on phanerogamic specimens in the Wisconsin section of the University of Wisconsin Herbarium. As a result of the activity of Professor H. H. Iltis and his students a great many new Wisconsin specimens have been added to our herbarium in the past eight years. Many of these have yielded new records of parasites, but older specimens have also been examined, with similar results. In some cases adequate material has been available for a separate fungus specimen, but in other instances where this has not been possible "(U. W. Phan.)" is appended to the record. Also included are notes on specimens collected in the season of 1962.

The following undetermined powdery mildews have been noted on hosts not previously reported as bearing these fungi in Wisconsin: 1) On *Brassica nigra*. Sauk Co., near Sauk City, September 1961. Coll. O. Glaeser; 2) Associated with pycnia of *Gymnoconia peckiana* on *Rubus occidentalis*. Dane Co., near Cross Plains, May 23, 1962; 3) On *Taraxacum erythrospermum*. Dane Co., Madison, June 5, 1962; 4) On *Sedum purpureum*. Dane Co., Madison, August 8, 1962.

ERYSIPHE GRAMINIS DC., in its conidial stage, occurs very commonly on *Poa pratensis* in Wisconsin. In the course of a long collecting career the writer has examined hundreds of such infections without observing even incipient formation of cleistothecia until collecting them in abundance on this host at a station near Cross Plains, Dane Co., June 19, 1962. As indicated by specimens in the Wisconsin Cryptogamic Herbarium, development of cleistothecia on *Poa pratensis* is probably not uncommon in northwestern America, but it is certainly most unusual in Wisconsin.

MYCOSPHAERELLA sp. occurs on dead tips of plants of *Eleocharis palustris* collected at Madison, June 25, 1962. The lower portions of the plants are still green. The perithecia are black, gregarious, lenticular, approx. 100–115 in long diam. The asci are broadly clavate, about 37–40 x 14–15 μ. The ascospores are somewhat variable, subfusoid, subcylindric, or slightly falcate, subhyaline with a faint greenish tinge, 21–24 x 3.5–4.5 μ. They are borne in a compact group in the stout ascus, usually not completely filling the upper ascus. Possibly parasitic.

MYCOSPHAERELLA sp. is present on overwintered leaves of *Cornus canadensis,* collected by H. H. Iltis, June 14, 1959, near Porcupine Lake, Florence Co. It seems possible this is connected with *Septoria canadensis Peck.* The latter is quite common on this host in Wisconsin and the spots are similar. The perithecia are black, closely gregarious, subglobose, approx. 200–250 μ diam. The asci are slender-cylindric to subfusoid, 35–42 x 6–7 μ. The ascospores have a pallid greenish tint, are subfusoid, mostly biseriately arranged, and with the septum not median, but toward the base of the spore, about ¼ to ⅓ of the distance to the apex, approx. 11–12.5 x 3.5–4 μ.

MYCOSPHAERELLA sp. occurs in profusion on the overwintered basal leaves of *Pentstemon gracilis* var. *wisconsinensis,* collected by J. Patman near Neshkoro, Marquette Co., June 14, 1959. The entire leaf surface is black from the closely crowded, globose perithecia, which are about 100 μ diam., with numerous curved—obclavate asci, 27–30 x 8–9 μ. It seems likely this is connected with *Septoria pentstemonicola* Ell. & Ev. which is very common on this host. The Wisconsin collection does not seem to bear any reation to *Mycosphaerella pentstemonis* Earle, collected on dead stems of *Pentstemon* in Colorado.

MYCOSPHAERELLA sp. was found consistently on *Galium concinnum* on rounded, translucent lesions of the type usually associated with so-called *Phyllosticta decidua* Ell. & Kell., in a specimen collected near Verona, Dane Co., June 21, 1962. The perithecia, one or two per lesion, are black, thick-walled, subglobose, approx. 125–140 μ diam., the asci cylindric to subclavate, slightly curved and short-pedicellate, about 30–35 x 6–8 μ, the ascospores hyaline, broadly fusoid and noticeably constricted at the median septum, approx. 12–13 x 3.5 μ. As in other specimens of this general type one suspects primary insect action in the formation of the lesions, yet the absence of frass and other signs of such activity leave the matter open to doubt.

LEPTOSPHAERIA sp. is present with considerable regularity on lower leaves of specimens of *Agrostis perennans* in the Wisconsin Herbarium. Such leaves are usually, but not always, brown and dead. A specimen collected near Hatfield, Jackson Co., August 23, 1940 (L. H. Shinners 2676), has mature perithecia on leaves which are, in the main, still green, indicating possible parasitism. The perithecia are brownish, thin-walled, broadly oval in outline and somewhat flattened, approx. 115–125 μ diam. The asci are cylindric, 46–48.5 x 7.5–8 μ, the ascospores greenish olivaceous, slender falcate-fusoid, 5 septate, about 20 x 3 μ.

MELANNOMA sp. occurs in an uncertain relationship to the host on hairy branchlets of *Hudsonia tomentosa,* collected by J. Patman near Prescott, Pierce Co., June 28, 1959. The superficial, black, subconic perithecia, approx. 225–300 μ diam., are scattered and firmly nested within the tomentum, appearing confined to the previous season's growth. The large asci are curved-clavate with a short pedicel, approx. 125–135 x 25–28 μ, the ascospores broadly fusoid, 3 septate and olivaceous with the two central cells of a slightly deeper tint, 35–38 x 13–15 μ.

OPHIOBOLUS INSTABILIS Ell. & Ev. on *Artemisia biennis* was described from material collected by J. J. Davis at Racine, Wis. in 1897. The type specimen has withered leaves which appear frostbitten. This same fungus has been noted on several recent Wisconsin collections of *A. biennis* where, except for the infected leaves, the hosts are still green, indicating that the fungus may be a parasite.

PSEUDOPEZIZA SALICIS (Tul.) Pat. *(Drepanopeziza salicis* (Tul.) Hoehn.), the perfect stage of *Gloeosporium salicis* West. *(Monostichella salicis* (West.) v. Arx.), was collected on overwintered leaves of *Salix* (probably *S. fragilis)* at Madison in June 1962 by A. Nelson.

PUCCINIA CORONATA Cda. is the only rust recorded up to now on *Schizachne purpurascens* in Wisconsin. However, several specimens of this grass, particularly one collected by N. C. Fassett at Ontario, Vernon Co., June 14, 1936, bear mature uredia whose spores have dimensions markedly smaller than those ascribed to *P. coronata,* leading to the supposition that they are the spores of *P. recondita,* but no positive record can be made since telia are not present.

PUCCINIA sp. ii, III is present in small amount on *Oryzopsis pungens* collected by N. C. Fassett at Necedah, Juneau Co., May 22, 1932. It is difficult to say whether the leaf on which the rust occurs was produced in 1932 or the season before, but it looks quite fresh and green. The few urediospores observed were broadly obovate to globoid, 28–30 x 22–27 μ, the wall slightly yellowish, about 2.5 μ thick, echinulate, with 3–4 equatorial pores. The teliospores are golden yellow throughout, rather variable in shape, from obovate to narrowly clavate, or almost cylindric, and from almost no constriction to moderately constricted between the cells, tip subobtuse to almost acuminate, wall 1.5–2 μ thick at sides, 5–7 μ above, pedicel not collapsed, about as long as spore and tinted near it. A good many of the teliospores have germinated, which would seem to indicate previous season's origin for the host leaf. Uredia of another rust occur on an old specimen of *O. pungens* collected by G.

Roden near Appleton, Outagamie Co., in May 1890. The sori are aparaphysate, the spores obovate to narrowly obovate or ellipsoid, the best developed about 22–25 x 16–18 μ. the wall yellowish, about 1.5 μ thick, finely echinulate(with smooth areas on some spores, pores obscure. No rusts are listed on this host in Arthur's Manual.

PUCCINIA ASPARAGI DC. I has been reported in the phytopathological literature as occurring on *Allium cepa* var. *viviparum* in Wisconsin, but there have been no specimens in our herbarium until a profuse infection on this host was discovered July 4, 1962 by H. M. Clarke on his property near Cross Plains, Dane Co. According to Arthur only the aecial stage has been collected on *Allium* in nature.

Isopyrum biternatum has had no rust recorded as occurring on it in Wisconsin, but in a collection made near Leland, Sauk Co., June 2, 1962, there are pycnia, but no aecia, of a rust which it seems very likely is *Puccinia recondita* Rob. ex Desm.

PHYLLOSTICTA GROSSULARIAE Sacc. has been reported on *Ribes sativum (R. vulgare)* in Wisconsin and such specimens as are in the Wisconsin Herbarium have well-defined, margined spots. In a collection on this host, made July 25, 1962 at Madison, the spots are immarginate, dingy brown, broadly oval, about 1.5 cm. long. Microscopically the specimen, with conidia about 5–7 x 3 μ, corresponds well with the description of *P. grossulariae* and has been so named.

PHYLLOSTICTA NUMEROSPORA H. C. Greene (Amer. Midl. Nat. 50: 506. 1953) on *Potentila argentea* has up till now been noted only on the type from Madison, but it has recently been detected on phanerogamic specimens collected in various counties, including Columbia, Grant, Marinette, Rock, Sauk and Waupaca.

PHYLLOSTICTAE indet. have been noted on a number of hosts and are reported on collectively, as follows: 1) On *Sparganium eurycarpum* coll. by H. C. Wilson near Johnson Creek, Jefferson Co., August 23, 1961. Leaf lesions are elongate, marginal, dull yellowish brown with narrow darker border, the black pycnidia innnate and, conforming to the narrow band of tissue available for their development, markedly flattened, approx. 150–175 μ diam., and scattered. The conidia are hyaline and globoid, 10–11 x 11.5–12.5 μ, with granular contents and a smooth wall about 1 μ thick. The general macroscopic aspect is very similar to that of *Stagonospora sparganii* (Fckl.) Sacc., except that in that species the pycnidia are even more deeply sunken and inconspicuous; 2) On *Sparganium chlorocarpum* coll. by W. A. Skroch near Babcock, Wood Co., June 26, 1961. Pycnidia are on brownish, but current season's, basal leaves. Pycnidia themselves are light brown, gregarious, thin-walled, somewhat flattened, about 100–115 μ diam., with a prominent ostiole. Conidia are cylindric, hyaline, mostly biguttulate, but with no evidence of septation, 7–10 x 2.5–3 μ. What appears to be the same fungus is present on a leaf of *Sparganium americanum*, coll. by J. J. Davis at Spring Green, Sauk Co., July 14, 1921; 3) In small amount on sharply defined, elongate, dark bordered, pallid tan lesions on *Aristida intermedia* coll. by T. G. Hartley in the Camp McCoy area, Monroe Co., August 19, 1956. The pycnidia are brownish, flattened, subellipsoid, approx. 75 μ in longest dimension, with prominent ostiole, the conidia hyaline, rod-shaped, of the micro- type, 4–5 x 1–1.3 μ. A very similar *Phyllosticta* has been noted on a specimen of the adventive *Bouteloua gracilis*, coll. by O. Anderson and H. C. Greene near Black Earth, Dane Co., August 1, 1950; 4) On cinereous dead areas on leaves of *Agropyron repens* coll. at Madison, June 28, 1962, where the pycnidia are pallid brownish, thin-walled, about 115–125 μ diam., the conidia hyaline, short cylindric, approx. 4–5 x 1.5–2 μ. Perhaps a microsporous stage, but the spores are somewhat wider than is usual in such forms; 5) On *Silene dichotoma*, coll. near Harrisville, Marquette Co., August 15, 1960. The conidia are up to 10 x 3.5, outside the range of *Phyllosticta nebulosa* Sacc., reported on this host in Wisconsin, and approach *P. silenes* Peck where they are 10–12.5 x 3.5–5 μ; 6) On *Astragalus canadensis* coll. by G. Struik near Juda, Green Co., August 8, 1956. The pallid-brownish pycnidia are epiphyllous and zonate, about 125–150 μ diam., with hyaline, subcylindric conidia 5–7 x 2–2.5(–3) μ. Evidently very similar to, and perhaps identical with, a fungus reported on this host by J. J. Davis (Trans. Wis. Acad. Sci. Arts Lett. 19(2): 686. 1919). Davis considered his fungus as possibly identical with *Gloeosporium davisii* Ell. & Ev. which was described from a specimen coll. in Wisconsin on pods of *Vicia americana*, but stated that he had filed the specimen provisionally under the name *Gloeosporium astragali*. There is currently no specimen in the Wisconsin Cryptogamic Herbarium under this name, nor is there any specimen on *Astragalus* filed under *G. davisii*. In his revision of *Gloeosporium* von Arx states, and I think correctly, that *G. davisii* is sphaeropsidaceous and names it *Dothiorella davisii* (Ell. & Ev.) von Arx. This fungus, however, has conidia distinctly larger than either of the specimens on *Astragalus;* 7) On rounded tan spots, 4–5 mm. diam., with narrow darker border, on *Acer saccharum* coll. near Browntown, Green Co., June 13, 1962. The light brown pycnidia are subglobose, approx. 100–175 μ diam., the hyaline conidia 5–6 x 1.8–3 μ Similar to an undetermined *Phyllosticta* on *Acer rubrum,* reported on in my Notes 24. (Trans. Wis. Acad. Sci. Arts Lett. 47: 102. 1958); 8) On *Impatiens balsamina* (cult.) coll. at Madison, August 27,

1962. The well-marked spots are rounded and cinereous, with brownish margins, about .3–.5 cm. diam. The globose, blackish pycnidia are epiphyllous and gregarious, about 125–225 μ diam., with a prominent ostiole marked by a ring of darker cells. The hyaline conidia are rod-shaped, biguttulate, approx. 4–6.5 x 1.3–1.5 μ. This is evidently not *P. balsaminae* Vogl., said to have conidia 7 x 2.5 μ and smaller pycnidia. Seemingly, no satisfactory description of *P. impatientis* Fautr. *(Depazea impatientis* Kirchn.) exists and I have been unable to locate any specimens so labeled for study; 9) On *Galium aparine* coll. June 5, 1962 near Verona, Dane Co. On sordid brownish immarginate areas, usually on only one leaf of a whorl. The pycnidia are few, scattered, pallid brownish, subglobose, prominently ostiolate, approx. 125–140 μ diam., conidia hyaline, cylindric, straight or slightly curved, 7–11 x 2.5–3 μ. This fungus has somewhat the aspect of an *Ascochyta,* but none of the apparently well-matured conidia are septate, so far as observed; 10) On *Galium triflorum,* coll. at the same time and place as 9), there is a similar, possibly identical *Phyllosticta.* The rounded, reddish-brown spots with narrow, dark margins are much more sharply defined than those on *G. aparine,* but the pycnidia are about the same. The conidia, however, are 5–8 x 1.8–2.5 μ; 11) On sordid brownish to blackish, indefinite, but rather extensive areas involving the tips of leaves of *Galium circaezans* coll. June 21, 1962 near Verona, Dane Co., in the same general location as 9) and 10). The thin-walled, flattened pycnidia are pallid brownish, approx. 90–125 μ diam., the conidia hyaline, narrow-cylindric, (4–) 5–6 (–7) x 1.3–1.7 (–2) μ; 12) In an uncertain relationship on the cinereous upper side of lesions caused primarily by the microcyclic *Puccinia silphii* Schw. on *Silphium perfoliatum* coll. near Leland, Sauk Co., July 21, 1962. The pycnidia are black when viewed with a hand lens, but translucent and merely sooty under high magnification, globose, with a ring of darker cells delimiting the rather wide ostiole, and are approx. 165–200 μ diam. The hyaline conidia are narrowly cylindric to narrowly subfusoid, straight or slightly curved, often biguttulate, (5.5–) 6.5–7.5 (–10) x 1.5–2 (–2.5) μ. Two of the eight pycnidia examined also contained some globose conidia, about 9–10 μ diam., but the cylindric type seem characteristic; 13) On *Aster sagittifolius* coll. near Verona, Dane Co., July 25, 1962. The suborbicular, sordid brownish spots are about 1 cm. diam., the pycnidia deeply immersed, thin-walled, pale yellowish brown, approx. 90–110 μ diam., the conidia hyaline, short-cylindric, 5–7.5 x 2.5–3 μ. Quite different from a *Phyllosticta* on the same host mentioned in my Notes 28.

PHOMA sp. occurs on stems of *Paronychia fastigiata* from Somerfield Island, Buffalo Co., collected August 27, 1926 by N. C. Fassett. In my Notes 20 (Trans. Wis. Acad. Sci. Arts Lett. 43: 167. 1954) I informally described this same fungus on *Paronychia canadensis*. Discovery of it on *P. fastigiata* would seem to indicate that it is probably a characteristic parasite of *Paronychia*. Neither specimen in hand is ample for formal description.

PHOMA sp. infects stems and leaves of a specimen of *Spergularia rubra*, collected by H. H. Iltis (13704) in the State Forest Nursery at Trout Lake, Vilas Co., June 16, 1959. Since the affected parts have been killed back, parasitism is uncertain. The closely gregarious pycnidia are dark brown, subglobose, prominently ostiolate, about 75–100 μ diam. Conidia are hyaline, ellipsoid to broadly ellipsoid, or occasionally subfusoid, 4–5 (–6) x 1.8–2.7 μ.

PHOMA sp. is present in small amount on stems of *Talinum rugospermum*, collected near Newark, Rock Co., July 18, 1957 (E. W. Fell 57–774). The flattened brown pycnidia are about 75 μ diam., the hyaline, elongate-fusoid conidia 13–17 x 4–5.5 μ, without any indication of incipient septation. Perhaps parasitic.

PHOMA (?) sp. occurs in profusion on the stem of an old specimen of *Portulaca oleracea*, collected at Poynette, Columbia Co., July 10, 1886 by H. L. Russell. The pycnidia are jet black and large, approx. 200–250 μ diam. and closely gregarious. The hyaline conidia are broadly ellipsoid and large, 17–19 x 11–13 (–14) μ. The general aspect of this fungus and the size and shape of the conidia suggest that it is perhaps an immature *Sphaeropsis*, but whatever its taxonomic niche, there seems little doubt it was strongly parasitic. *Phoma stigma* Cke. & Hark., described on *P. oleracea*, has minute pycnidia and conidia 6 x 3 μ.

MACROPHOMA spp. are occasionally noted on senescent or dead lower leaves of various grasses. One such has been studied on a specimen of *Bouteloua curtipendula*, collected by L. H. Shinners at Elkhart Lake, Sheboygan Co., September 2, 1940. The innate, subglobose, black pycnidia are about 175 μ diam., the large, elongate, subfusoid, hyaline conidia approx. 21–25 x 7–8 μ. What appears to be the same fungus occurs on *Agrostis scabra*, collected by Shinners at Spooner, Washburn Co., July 7, 1942. Sprague notes a number of species of *Macrophoma* on Gramineae, but considers them to be at most weakly parasitic.

PHOMOPSIS DIACHENII Sacc. has been noted occasionally on leaves and fruits of *Pastinaca sativa* in Wisconsin, but has appeared to be at most a mild parasite. In 1962, however, numerous plants of this weed in the University of Wisconsin Arboretum at Madison were killed back by profuse development of *P. diachenii* on the upper stems.

PHOMOPSIS sp. occurs on *Phyllosticta decidua*-type lesions on *Solidago canadensis,* collected at Madison, July 26, 1962. The fuscous pycnidia are approx. 140–160 μ diam., the *Phoma*-type conidia hyaline, fusoid, 7.5–9 x 2.7–4 μ, the scolecospores hyaline, from straight to strongly curved, subobtuse, 8–10 x 1.2–1.5 μ Possibly parasitic.

ASCOCHYTA sp. on dead lower leaves of a specimen of *Agrostis stolonifera* collected by N. C. Fassett at Marquette, Green Lake Co., September 18, 1929, does not correspond in spore dimensions with any of the species mentioned by Sprague in his "Diseases of Cereals and Grasses in North America". The black pycnidia are 85–110 μ diam., the hyaline conidia 7–9 x 2.5–3.5 μ.

ASCOCHYTA sp., which may be referable to *A. utahensis* Sprague, occurs on the dead lower leaves of the current season's culms of *Agropyron smithii,* collected by L. H. Shinners near Granville, Milwaukee Co., June 26, 1940. Sprague found this fungus on *Agropyron inerme* and *A. trachycaulum* in the Rocky Mountain region. He states *A. utahensis* is definitely parasitic and distinguished by its large spores which exceed in size those of any other *Ascochyta* on Gramineae. He gives pycnidial size as 110–150 μ and conidia as 22–29 x 6.5–10 μ. If anything the Wisconsin specimen has slightly larger pycnidia and the conidia are about 30–33 x 6.5–8 μ. It may be noted that *Agropyron smithii* is adventive in Wisconsin from farther west.

ASCOCHYTA, which seems close to but is probably not identical with *Ascochyta chelidonii* Kab. & Bub., occurs on more or less well-defined dead areas on leaves of *Chelidonium majus* collected near Verona, Dane Co., June 5, 1962. In the Wisconsin specimen those conidia which are septate and seem best developed are mostly about 10–13 x 3–3.5 μ, whereas Kabat and Bubak give the measurements as 10–22 x 4–6 μ.

ASCOCHYTA sp. on *Amphicarpa bracteata* from near Leland, Sauk Co., August 18, 1962, is very well marked and seems distinct from any species of *Ascochyta* reported on closely related Leguminosae. I have found no species of *Ascochyta* listed on *Amphicarpa* and if additional collections are made a formal description will probably be justified. Notes on the specimen are as follows: Spots orbicular, .3–.7 mm. diam., tissue thin, translucent, ashen-brown in center, with narrow dark brown margin; pycnidia gregarious, pallid brownish, thin-walled and translucent, subglobose, approx. 115–150 μ diam.; conidia hyaline, cylindric or broadly ellipsoid, not constricted at septum, 7–9(–10.5) x 2.5–3.5 μ.

ASCOCHYTA sp. on *Viburnum lentago,* collected near Leland, Sauk Co., July 21, 1962, is on translucent spots of the type ascribed to *Phyllosticta decidua* Ell. & Kell. The sooty, somewhat flattened pycnidia are black when viewed from above, but are quite thin-walled, approx. 180–230 μ diam., the conidia hyaline, narrowly ellipsoid to fusoid or subfusoid, 8–11 x 2.5–3 (–3.5) μ and the septum median. Possibly, but not certainly, saprophytic.

ASCOCHYTA COMPOSITARUM J. J. Davis was reported on *Solidago ulmifolia* from Madison in my Notes 26. This collection had conidia about of the size specified in Davis' description, 15–22 x 4–6 μ. In a very ample specimen on the same host, collected near Lake Lulu, Troy Twp., Walworth Co., August 13, 1962, and somewhat doubtfully referred to *A. compositarum,* those conidia which are septate run (7.5–) 9–10 x 2.7–3 μ, at the lower end of the size range of the form which Davis originally designated as *A. compositarum* var. *parva,* but later incorporated with the species. In the recent specimen only a small minority of the conidia are septate. Those which are continuous are slender-cylindric, about 6–8 x 2 μ. In some less well developed pycnidia no septate conidia are to be found and those present run even shorter than the 6–8 μ just mentioned. However, the large, blackish-brown, orbicular, more or less zonate lesions are quite characteristic for *A. compositarum.*

DIPLODIA sp. has been noted on leaves of *Chrysothamnus graveolens* from a plant in the University of Wisconsin Arboretum at Madison, June 25, 1962. Although the infected leaves are dead and brown there seems little doubt that the *Diplodia* was primary. The pycnidia are light brown, subglobose, erumpent and papillate, approx. (115–) 140–155 (–180) μ diam., the conidia pale grayish, subcylindric or broadly subfusoid, septum median and not constricted, or only slightly so, (18–) 22–26 (–28) x 10–12.5 μ. The host plant appeared to be very seriously damaged. I have found no record of any species of *Diplodia* on this or closely related hosts.

STAGONOSPORA BROMI Sm. & Ramsb. and *Ascochyta graminicola* Sacc. *(A. sorghi* Sacc.) have both been reported on species of *Bromus* and, it would seem, grade into one another. In a specimen on *Bromus japonicus* collected at Madison, August 1, 1962, many of the spores are 2 septate, but all are less than 20 μ long, so the specimen fits neither *S. bromi* nor *A. graminicola,* but is close to both.

STAGONOSPORA ZONATA J. J. Davis, noted on a specimen of *Asclepias exaltata (A. phytolaccoides),* collected near Athelstane, Marinette Co., August 11, 1956, has conidia which are 6–7 septate and

35–40 x 7–8 μ, as opposed to an earlier collection on the same host where the conidia were somewhat narrower and mostly only 1–2 septate. A highly variable, yet integrated species, as shown by numerous collections on other species of *Asclepias.*

SEPTORIA (?) sp. occurs associated with *Puccinia recondita* on leaves of *Agrostis perennans,* collected by L. H. Shinners near Tony, Rusk Co., August 24, 1940. The thin-walled, pale brown pycnidia are about 125–150 μ diam. and are somewhat flattened. The spores are hyaline, straight to slightly curved, approx. 20–30 x 3 μ, obscurely 1–3 septate. Somewhat resembling *Septoria nodorum* Berk. which, however, has thicker-walled and larger pycnidia. Still another in the confusing assemblage of forms on the borderline between *Stagonospora* and *Septoria,* so prevalent in the Gramineae.

SEPTORIA sp. occurs on leaves of *Alopecurus pratensis* collected by J. Patman near Cadott, Chippewa Co., June 26, 1959. The small black pycnidia are only about 50–65 μ diam., the hyaline acicular spores (18–)23–27 x 1.5 μ. I find no mention of any species of *Septoria* on *Alopecurus* in North America, but *S. graminum* Desm. is reported on *Alopecurus* in Europe. This species has small pycnidia and slender spores, but they are twice the length of those of the Wisconsin specimen.

SEPTORIA sp. is present in some quantity on Aster angustus collected by S. C. Wadmond at Horlicksville, Racine Co., September 30, 1898. Although some leaves are heavily infected only a few of the pycnidia contain spores indicating, perhaps, the presence of an overwintering stage. Similar structures present on the stems likewise do not have differentiated contents. The pycnidia are globose, black, with large ostiole, approx. 75–85 μ diam., the spores hyaline, slightly curved or sinuous, about 20–32 x 1.5–2 μ, 2–3 septate.

COLLETOTRICHUM sp., which appears to have been parasitic, occurs in abundance on long, pallid streaks on the fruiting stalks and capsules of *Camassia scillioides (C. esculenta)* collected by S. C. Wadmond at Dill, Green Co., July 18, 1931. The acervuli are thickly beset with coarse, subacuminate, blackish-brown setae which are only slightly curved, several septate, from 50–125 x 4–6 μ. The hyaline conidia are slender-falcate, 20–23 x 3–3.5 μ.

COLLETOTRICHUM sp., appearing parasitic, occurs on pale brownish, more or less elongate and wedge-shaped lesions located distally on the lobes of leaves of *Cryptotaenia canadensis,* collected near Albany, Green Co., July 19, 1962. The acervuli are amphigenous, scattered to gregarious, variable in diameter. The setae are blackish below, paler near the tip, long-tapering, several septate and divergent, mostly from the edge of the acervulus, approx. 60–190 μ long by 3.5–6 μ wide at the base. The conidia are hyaline, falcate, about 18–23 x 3–4 μ. The lesions tend to shred and curl toward the outer edge. Except for the infected portion the leaves are deep green and seemingly in flourishing condition. It was noted that the infected plants were all growing in deep shade, whereas closely adjacent plants in a sunny opening were free of the *Colletotrichum*. Also found near New Glarus, Green Co., the same day.

ACREMONIUM sp. had overgrown the uredia of *Kuehneola uredinis* (Lk.) Arth. on Rubus allegheniensis collected at Madison, October 24, 1961. The hyaline, ellipsoid to subfusoid conidia approx. 4–6 x 1.5–2 μ, are produced acrogenously from slender, simple side branches from the equally slender, decumbent mycelium. Possibly parasitic. It seems likely that a similar fungus on *Pucciniastrum agrimoniae,* reported by me as a possible *Monosporium* (Amer. Midl. Nat. 41: 730. 1949), would be better assigned to *Acremonium.*

EPICOCCUM NEGLECTUM Desm. has been reported as a possible weak parasite of soybean and hog-peanut in Wisconsin. The fungus occurs in a similar relationship on small, oval, sharply defined tan spots on leaves of *Erythronium americanum* collected at Madison, May 23, 1962.

RAMULARIA (?) sp. is hypophyllous on dull reddish-brown, orbicular to somewhat elongate lesions, about .5–1 cm. diam., on leaves of *Spiraea alba,* collected at Madison, September 11, 1960. This is a very delicate fungus, scarcely discernible with an ordinary pocket hand lens. The hyaline or subhyaline conidiophores are rather widely scattered, arising at right angles from mycelial threads which themselves appear superficial at the points of origin of the phores. The phores are simple, straight and quite rigid, 70–120 x 2.5–3 μ, sometimes continuous, but mostly 2–3 septate, with a cluster of spore scars at the tip and occasionally in whorls at points lower on the phores. The hyaline conidia are subfusoid, continuous so far as observed, (7.5) 10–13 (–17) μ, and show some evidence of catenulation. This seems close to, but probably not identical with, *Ramularia spiraeae* Peck which occurs on *Physocarpus (Spiraea) opulifolius* in Wisconsin and has conidia which are very similar to those of the specimen in question, but whose conidiophores are rather rudimentary. Conidiophore length is, of course, often strongly influenced by external environmental factors and the infected *Spiraea alba* was growing in a low, marshy site in a more than ordinarily wet summer. More specimens, collected in different years would be desirable for comparative study.

RAMULARIA sp., somewhat similar to *Ramularia variata* J. J. Davis, yet differing in being more delicate and in an epiphyllous habit, occurs on *Satureja vulgaris* collected by W. M. Shaughnessy near Cable, Bayfield Co., October 3, 1959. The mostly 1 septate conidia have a maximum length of 20 μ, are about 2.5–3 μ wide, and lack the subfusoid configuration found in many of the conidia of *R. variata*.

RAMULARIA VIRGAUREAE Thum. was observed in profuse fruiting on overwintered basal rosette leaves of *Solidago nemoralis* at Madison, May 16, 1962. When sections were made the conidiophores were seen to be produced from the surface of globose, perithecium-like bodies which, no doubt, developed in the fall of 1961. At the time of collection new leaves, presumably susceptible to infection, were being produced, insuring perpetuation of the parasite without intervention of a perfect stage.

STIGMINA JUNIPERINA (Georg. & Bad.) M. B. Ellis is the name applied by C. S. Hodges to the fungus on *Juniperus communis* var. *depressa,* originally cited in the Wisconsin lists as *Cercospora sequoiae* var. *juniperi* Ell. & Ev. and later referred to *Exosporium deflectens* Karst. As for the similar fungus on *Juniperus virginiana,* Hodges places it once again in *C. sequoiae* var. *juniperi.* Chupp does not consider this to be properly a species of *Cercospora,* but Hodges has made an intensive study of the group, so it seems advisable to accept his names for the time being.

CERCOSPORELLA CANA Sacc., on lower leaves of *Erigeron annuus*, collected by E. Beals near New Post, Sawyer Co., June 24, 1959, has completely killed back the leaves and on the old spots there are very numerous black, thick-walled, astomous, spherical fruiting bodies, 55–60 diam., which contain very large numbers of hyaline microconidia, approx. 3–4 x .6–.8 μ.

CERCOSPORA sp. has been observed on the stem of a specimen of *Polygonella articulata* collected by T. G. Hartley near Burr Oak, LaCrosse Co., September 5, 1956. The conidiophores are in divergent fascicles from small stromatic bases, clear deep brown in color, tortuous, rather closely multigeniculate, approx. 35–60 x 3–4 μ. Conidia are fuliginous, narrowly obclavate, truncate below, with noticeable scar, (20–)25–35(–45) x (2–)2.5–3 μ, 1–3 septate. Chupp does not report any species of *Cercospora* on *Polygonella.* This seems rather similar to *C. avicularis* Wint. on species of *Polygonum,* but *C. avicularis* has conidia 30–75 x 3–5 μ.

CERCOSPORA GEI Fckl., as interpreted by Chupp in his "Monograph of Cercospora", includes in the synonomy several species of

Ramularia which have been described on *Geum*. This may be as satisfactory a disposition as any for what is a puzzling series, the extremes of which seem distinct, yet in which there are intergrading forms. As far as Wisconsin collections are concerned, an attempt has been made to keep separate the extremes, but the more specimens examined, the less valid such treatment seems. A recent collection on *Geum allepicum* var. *strictum* has been referred to *Cercospora*, yet earlier specimens on this host have seemed more *Ramularia*-like and have been so placed.

CERCOSPORA sp. occurs on leaves of *Chelone glabra* collected by R. C. Koeppen near Middleton, Dane Co., September 7, 1956. The spots are rounded and small, with cinereous centers and dark-purplish borders. The epiphyllous conidiophores are in spreading tufts from small blackish stromata. The phores are (40–)70–100 x 4–5 μ, slightly curved, mildly tortuous and geniculate, several septate, clear light brown. The few conidia seen were hyaline, narrowly obclavate, truncate below, about 3–4 septate, approx. 50–75 x 3–4 μ. Chupp does not mention *Chelone* as a host genus.

Elymus canadensis, collected by D. Ugent on Chambers Island, Door Co., July 2, 1961, bears on the leaves elongate "char" spots, the locules of which contain a mixture of vast numbers of short, rod-shaped microconidia and considerably longer, but equally slender scolecospores. The spots suggest *Septogloeum oxysporum* Sacc., Bomm. & Rouss., common on a variety of grasses in the northwest, but in Wisconsin known so far only on *Glyceria striata*.

Aralia nudicaulis from near Verona, Dane Co., June 26, 1962, bears a so far undetermined parasite which is hypophyllous on large, suborbicular or irregularly angled, sordid brownish, subzonate blotches, 2–4 cm. diam., or sometimes more, with very narrow, dark brown borders. The scattered, more or less decumbent conidiophores are up to 3 mm. long, slender, approx. 13–15 μ wide, with occasional constricted areas, many septate, clear brown, mostly simple but sometimes branched, candelabrum-like, near the base, the fruiting tips appearing simple or, if branched, only in very rudimentary fashion. The conidia are hyaline, moderately thick-walled, broadly ellipsoid or ovoid, (8.5–)10–11(.12) x (5.5–)6.5–7 μ. No conidia have been seen attached, but it appears they may be borne successively from small protuberances clustered near the apex.

Salix humilis leaves, collected near Swan Lake, Pacific Twp., Columbia Co., September 21, 1962, bear conspicuous, applanate, shining black, non-fruiting fungus growths which may involve as much as half the area of otherwise still green leaves. The fungus appears to be intraepidermal on both surfaces, but is particularly noticeable only on the smooth upper surface. The tissues between the epidermal layers have largely disintegrated. There is no sign of insect action. *Rhytisma salicinum* (Pers.) Fr., of which this is somewhat reminiscent, is decidedly more limited in extent and is also elevated well above the leaf surface.

Additional Hosts

The following hosts have not been previously recorded as bearing the fungi mentioned in Wisconsin.

Peronospora parasitica (Pers.) Fr. on *Erysimum cheiranthoides*. Grant Co., near Platteville, June 26, 1960. Coll. R. P. Wunderli.

Sphaerotheca humuli (DC.) Burr var. fuliginea (Schl.) Salm. on *Erigeron divaricatus*. Columbia Co., near Lodi, November 16, 1929. Coll. N. C. Fassett (9202). (U.W. Phan.).

Erysiphe graminis DC. Conidia on *Poa annua*. Jackson Co., near Hatfield, June 28, 1947. Coll. D. F. Grether. (U. W. Phan.).

Pseudopeziza medicaginis (Lib.) Sacc. on *Medicago lupulina*. Manitowoc Co., near Newtonburgh, June 4, 1960. Coll. R. Bolge. Although reported for Wisconsin in the Agricultural Handbook of Plant Diseases, there is no earlier specimen on *M. lupulina* in the Wisconsin Cryptogamic Herbarium.

Venturia sporoboli H. C. Greene on *Andropogon scoparius*. Iowa Co., Gov. Dodge State Park, August 15, 1962. The elongate, fuscous lesions are strikingly similar to those produced on *Sporobolus*. The dry, narrow, strongly ribbed leaves of *A. scoparius* provide a developmental site very much like that offered by *Sporobolus cryptandrus* on which this fungus was originally described.

Phyllachora graminis (Pers.) Fckl. on *Agropyron smithii*. Dane Co., Madison, June 18, 1921. Coll. J. J. Davis. (U. W. Phan.). Although the parasite is present in only small amount it is in excellent maturity.

Elsinoe veneta (Burkh.) Jenkins. *Sphaceloma* stage on *Rubus* sp. (dewberry). Dane Co., Pine Bluff, September 7, 1962. While the host species is undetermined, it is not *Rubus allegheniensis, R. occidentalis,* or *R. strigosus,* the three species previously reported as bearing this fungus in Wisconsin.

Ustilago striiformis (West.) Niessl on *Agrostis perennans*. Grant Co., Glenhaven, September 14, 1940. Coll. N. C. Fassett (21940). (U. W. Phan.).

CINTRACTIA CARICIS (Pers.) Magn. on *Carex abdita* and on *Carex richardsoni*. Both collected May 31, 1962 in Sect. 1, Town of Verona, Dane Co., near Madison. Also on *Carex blanda*. Dane Co., near Verona, July 1, 1962. Coll. J. H. Zimmerman.

SCHIZONELLA MELANOGRAMMA (DC.) Schroet. on *Carex abdita*. Kenosha Co., 4½ mi. S. of Kenosha near Lake Michigan shore, May 27, 1962. Coll. H. H. Iltis.

ENTYLOMA DACTYLIDIS (Pass.) Cif. on *Agrostis stolonifera*. Green Lake Co., Marquette, September 18, 1929. Coll. N. C. Fassett (8573).

DOASSANSIA MARTIANOFFIANA (Thum.) Schroet. on *Potamogeton gramineus*. Grant Co., Glenhaven, September 9, 1930. Coll. N. C. Fassett (12618). U. W. Phan.).

MELAMPSORELLA CARYOPHYLLACEARUM Schroet. II on *Stellaria calycantha*. Forest Co., near Alvin, August 12, 1953. Coll. E. M. Christensen.

CRONARTIUM RIBICOLA Fisch. ii, III on *Ribes sativum*. Dane Co., Madison, September 11, 1961.

PUCCINIA RECONDITA Rob. ex Desm. II on *Agropyron psammophilum (A. dasystachum)*. Door Co., Washington Island, July 6, 1931. Coll. J. J. Davis. (U. W. Phan.).

PUCCINIA POAE-NEMORALIS Otth II on *Alopecurus carolinianus*. Vernon Co., Northwood Nurseries near Coon Valley, June 15, 1942. Coll. T. R. Koethe. Also on *Alopecurus aequalis*. Marathon Co., near Mosinee, September 10, 1940. Coll. N. C. Fassett (21189). (U. W. Phan.).

PUCCINIA CORONATA Cda. III on *Cinna latifolia*. Florence Co., near Pine Lake, July 17, 1941. Coll. J. T. Curtis. (U. W. Phan.). It seems likely that the report by J. J. Davis of *P. coronata* on *Cinna arundinacea* should be dropped, as a collection from Luck, Polk Co., of which his specimen seems to be a part, has been authoritatively re-determined as *C. latifolia*. Also on *Beckmannia syzigachne*. Milwaukee Co., Milwaukee, August 2, 1938. Coll. L. H. Shinners. On a phanerogamic specimen in the herbarium of the University of Wisconsin-Milwaukee. Comm. J. W. Baxter.

PUCCINIA GRAMINIS Pers II, III on *Oryzopsis pungens*. Vernon Co., Wildcat Mt. State Park, July 17, 1956. Coll. T. G. Hartley. (U. W. Phan.). Referred here because of the very characteristic urediospores. The teliospores observed are well within the width range for *P. graminis*, but at the lower limit of the length, as given in Arthur's Manual. However, intensive studies of grass rusts by Cummins and others in recent years have usually resulted in decided revisions, in both directions, of the spore size ranges given in the Manual. Also on *Agropyron psammophilum (A. dasystachum)*, Sheboygan Co., Terry Andrae State Park, September 1949. Coll. E. L. Loyster.

PUCCINIA DIOICAE P. Magn. I on *Oenothera strigosa.* Marathon Co., near Edgar, June 23, 1957. Coll. H. Gale. (U. W. Phan.). II, III on *Carex deweyana,* Marathan Co., near Hogarty, June 10, 1961. Coll. R. A. Schlising. (U. W. Phan.).

PUCCINIA SPOROBOLI Arth. I on *Lilium michiganense.* Jefferson Co., Faville Prairie near Lake Mills, June 9, 1947 (H. C. Greene 1166). *Uromyces holwayi* Lagh., according to Arthur's Manual, has aecia which are cupulate in groups and the writer's No. 1166, which corresponds to this account, was distributed to several herbaria as *U. holywayi.* D. B. O. Savile has examined this specimen and commented on it in a recent article (Mycologia 53: 34. 1961). He points out that Arthur's description of the aecia as cupulate is in error, since they are actually bullate, and that Arthur's description very probably was based on aecia of a grass rust, perhaps *Puccinia sporoboli.* My 1166 was collected in close proximity to a large stand of *Sporobolus heterolepis* which commonly bears *P. sporoboli* II, III in this area, so the collection is referred here, especially since *Lilium* is known to bear *P. sporoboli* and since my material corresponds very well in spore wall thickness and in other characters. It is of interest that J. J. Davis *did* collect two Wisconsin specimens on *Lilium* with the bullate aecia of *Uromyces holwayi.*

PUCCINIA ARENARIAE (Schum.) Wint. on *Spergula arvensis.* Lincoln Co., Merrill, August 12, 1956. Coll. M. H. Iwen.

PUCCINIA MARIAE-WILSONI Clint. O on *Claytonia caroliniana.* Iron Co., near Upson, May 27, 1956. Coll. P. F. Maycock. (U. W. Phan.).

PUCCINIA HELIANTHI Schw II, III on *Helianthus decapetalus.* Sauk Co., near Denzer, October 7, 1961. Coll. R. W. Berry.

UROMYCES PECKIANUS Farl. ii, III on *Aristida basiramea.* Trempealeau Co., near Whitehall, August 27, 1940. Coll. L. H. Shinners (2781).

UROMYCES STRIATUS Schroet. II on *Medicago lupulina.* Dodge Co. near Horicon, August 25, 1958. Coll. C. Martz. In September 1962 J. W. Baxter collected the rust on this host at Milwaukee.

UROMYCES TRIQUETRUS Cooke III on *Hypericum canadense*. Jackson Co., near Millston, September 9, 1958. Coll. A. M. Peterson.

XENOGLOEA ERIOPHORI (Bres.) Syd. on *Scirpus atrocinctus*. Juneau Co., near Mauston, July 12, 1962.

PELLICULARIA FILAMENTOSA (Pat.) Rogers on *Dianthus armeria*. Iowa Co., Gov. Dodge State Park, July 4, 1959. Coll. B. Wislinsky. (U. W. Phan.). Also on *Veronica serpyllifolia*. Lincoln Co., near Merrill, September 7, 1960. Coll. T. A. Ebert.

PHYLLOSTICTA AMARANTHI Ell. & Kell. on *Amaranthus tuberculatus* (Moq.) J. D. Sauer (host det. Sauer). Grant Co., Potosi, September 8, 1930. Coll. N. C. Fassett (13649). (U. W. Phan.).

PHYLLOSTICTA BOEHMERIICOLA J. J. Davis on *Urtica dioica*. Dane Co., near Pine Bluff, August 9, 1962. As in collections on *Laportea canadensis* assigned to this species, the pycnidia are almost superficial, whereas in the type on *Boehmeria* they are somewhat more deeply imbedded. More material on *Boehmeria* would be desirable. There is no question at all of the identity of the fungi on *Laportea* and *Urtica*, but it would seem they may be varietally different from the type, although similar in every way except growth habit on the host.

PHYLLOSTICTA NEBULOSA Sacc. on *Silene armeria*. Racine Co., Racine. Coll. T. J. Hale. (U. W. Phan.). The date of collection is not given, but this specimen is at least one hundred years old and well illustrates the durability of sphaeropsidaceous fungi, since after a short time in mounting fluid the conidia appeared in excellent condition and matched those of recently collected specimens of this fungus.

PHYLLOSTICTA FRAGARICOLA Desm. & Rob. on *Fragaria virginiana*. Jefferson Co., Faville Prairie near Lake Mills, August 2, 1962. The large, black, epiphyllous pycnidia are very sparingly developed on cinereous lens-shaped spots which have a rather wide purplish border. The spots are about 3–5 mm. long and tend to lie along the midrib. *Ramularia* spots are also present and somewhat confuse the picture. Previous collections of *P. fragaricola* in Wisconsin have been on species of *Potentilla*. An undetermined *Phyllosticta* on *Fragaria virginiana*, microscopically similar to this, but producing very different lesions was mentioned in my Notes 26 (Trans. Wis. Acad. Sci. Arts Lett. 49:89. 1960).

PHYLLOSTICTA PALUSTRIS Ell. & Dearn. on *Stachys hispida*. Iowa Co., Gov. Dodge State Park, August 15, 1962.

PHYLLOSTICTA VERBASCICOLA Ell. & Kell. on *Verbascum blattaria*. LaCrosse Co., Bohemian Valley, Washington Twp., June 22, 1959. Coll. A. M. Peterson.

PHYLLOSTICTA DECIDUA Ell. & Kell. on *Solidago gigantea*. Dane Co., Madison, June 18, 1962. A dubious parasite but, to my knowledge, convincing proof of saprophytism has never been presented.

PHYLLOSTICTA CACALIAE H. C. Greene on *Cacalia suaveolens*. Green Co., Decatur Lake near Brodhead, August 28, 1962.

PHOMA MARIAE Clint. on *Lonicera morrowi*. Dane Co., Madison, March 25, 1945. Coll. M. S. Bergseng. (U. W. Phan.). The characteristic bleached areas on the twigs are immediately adjacent to expanding leaf buds.

ASCOCHYTA GRAMINICOLA Sacc. on *Poa pratensis*. Milwaukee Co., Milwaukee, August 1962. Coll. F. Kroll. Comm. E. K. Wade. This is on leaves which also have presumably been attacked by *Helminthosporium vagans* Drechsler, although no conidia of that species were observed.

ASCOCHYTA SILENES Ell. & Ev. on *Silene cucubalis (S. latifolia)*. Vilas Co., near Found Lake, July 11, 1940. Coll. F. W. Stearns. (U. W. Phan.). The *Ascochyta* is present in rather small amount at the bases of leaves which have numerous perithecia of *Mycosphaerella* on their dead tips.

ASCOCHYTA RIBICOLA H. C. Greene on *Ribes missouriense*. Dane Co., Madison, October 6, 1962.

ASCOCHYTA ASCLEPIADIS Ell. & Ev. on *Asclepias (Acerates) lanuginosa*. Rock Co., near Shopiere, May 30, 1957. Coll. E. W. Fell. (U. W. Phan.). The conidia are 7–9 x 3–3.5 μ, with a faint greenish tinge.

DARLUCA FILUM (Biv.) Cast. on *Coleosporium viburni* Arth. II on *Viburnum lentago*. Dane Co., Madison, September 25, 1962.

STAGONOSPORA ARENARIA Sacc. on *Dactylis glomerata*. Dane Co., near Pine Bluff, October 2, 1962.

STAGONOSPORA CYPERICOLA H. C. Greene on *Cyperus rivularis*. Lincoln Co., near Tomahawk, September 16, 1950. Coll. F. C. Seymour. The conidia are the same in width, but slightly shorter than in the type of *Cyperus filiculmis*, and mostly 1–2 septate. Very similar in the effect on the host.

SEPTORIA NODORUM Berk. on *Agropyron repens*. Dane Co., Madison, June 28, 1962. The spores in this specimen are from 2.6–4 μ

in width, much too large to be included in *Septoria elymi* Ell. & Ev., often found on *A. repens*. Also on *Agrostis scabra*. Iowa Co., near Arena, August 10, 1945. Coll. S. C. Wadmond.

SEPTORIA ELYMI Ell. & Ev. on *Lolium multiflorum*. Dane Co., Madison, October 19, 1962.

SEPTORIA TANDILENSIS Speg. on *Panicum meridionale* var. *albemarlense*. Marquette Co., Glenoaks, September 17, 1929. Coll. N. C. Fassett (8736). (U. W. Phan.).

SEPTORIA PASSERINII Sacc. on *Elymus canadensis*. Sauk Co., near Leland, July 21, 1962. The spores are mostly about 25–30 x 2.5–3 μ, rather short for this species. Also present is a microsporous stage *(Septoria microspora* Ell.) with narrow spores not more than 10–12 μ long. Sprague (Mycologia 40: 184. 1948) identifies this as being one of two such stages connected with *S. passerinii*. Much remains unknown about the *Septoria-Stagonospora* complex on broad-leaves native grasses.

SEPTORIA DIDYMA Fckl. var. SANTONENSIS Pass. on *Salix pentandra* (cult.). Barron Co., Barron, June 20, 1917. Coll. C. Goessl. (U. W. Phan.). This variety is discussed at some length in my Notes 22 (Trans Wis. Acad. Sci. Arts Lett. 45: 182. 1956).

SEPTORIA MUSIVA Peck on *Populus simoni* (cult.) Dane Co., Madison, September 12, 1962.

SEPTORIA LYTHRINA Peck on *Lythrum salicaria*. Jefferson Co., near Sullivan, June 27, 1955. Coll. G. V. Burger. (U. W. Phan.).

SEPTORIA SII Rob. & Desm. on *Berula pusilla (B. erecta)*. Rock Co., 5 mi. N. of Milton, October 7, 1956. Coll. H. H. Iltis (8509). U. W. Phan.).

SEPTORIA PSILOSTEGA Ell. & Mart. on *Galium lanceolatum*. Sauk Co., Denzer, June 16, 1948. Coll. E. A. Steuerwald. (U. W. Phan.).

SEPTORIA CAMPANULAE Lev. on *Campanula uliginosa*. Dane Co., Madison, September 29, 1962.

LECANOSTICTA ACICOLA (Thum.) Syd. on *Pinus sylvestris*. Vilas Co., Star Lake Plantation, July 11, 1962. Coll. R. F. Patton.

HAINESIA LYTHRI (Desm.) Hoehn. on *Vitis riparia*. Dane Co., Madison, September 11, 1962. In a collection on this same host made August 13, 1962 near Lake Lulu, Troy Twp., Walworth Co., most of the fruiting bodies are strongly beaked. As Shear and Dodge point out (Mycologia 13: 144. 1921): "Though ordinarily disc-shaped or patellate the sporodochia may be elongate and slender or even cylindrical. Such forms when dried and capped with a pointed mass of spores were mistaken by Cooke and Ellis for a *Sphaeronema* and described as *S. corneum.*"

HAINESIA LYTHRI (Desm.) Hoehn. on *Fragaria virginiana.* Jefferson Co., Faville Prairie near Lake Mills, August 2, 1962. J. J. Davis collected the *Scerotiopsis* stage of this fungus on *F. virginiana* at Madison. On *Potentilla argentea.* Portage Co., near Blaine, August 24, 1945. Coll. W. E. Rogers. (U. W. Phan.). On *Cornus femina.* Dane Co., near Pine Bluff, August 9, 1962. Associated with spots caused by *Septoria cornicola* and perhaps doubtfully parasitic. On *Steironema lanceolatum.* Jackson Co., near Black River Falls, July 6, 1958. Coll. A. M. Peterson.

SCLEROTIOPSIS CONCAVA (Desm.) Shear & Dodge on *Corylus americana.* Dane Co., near Verona, September 25, 1962. The parallel *Hainesia lythri* stage is not present in this specimen.

COLLETOTRICHUM FUSARIOIDES (Ell. & Kell.) O'Gara on *Asclepias amplexicaulis.* Green Co., Monroe, June 28, 1891. Coll. C. S. Stuntz. (U. W. Phan.). The fungus is on the stem in abundance. The conidia have mostly fallen away, but the characteristic short, stout setae are present in greater numbers than in most specimens.

PHLEOSPORA PANICI H. C. Greene on *Panicum meridionale* var. *albemarlense.* Waushara Co., Wautome, September 14, 1934. Coll. N. C. Fassett (17720). Sprague equated *Phleospora panici* with *Septoria tandilensis Speg.,* but the former seems to me to be distinct.

CYLINDROSPORIUM CALAMAGROSTIDIS Ell. & Ev. on *Calamagrostis inexpansa.* Ashland Co., Manitou Island, August 7, 1896. Coll. L. S. Cheney. Also on *Muhlenbergia glomerata.* Lincoln Co., Wilson Twp., September 11, 1949. Coll. F. C. Seymour (10965). I follow Sprague who assigned western material on *Muhlenbergia filiformis* to *Cylindrosporium calamagrostidis,* since the characters of the Wisconsin specimen match his account.

RAMULARIA MITELLAE Peck on *Mitella nuda.* Oconto Co., near Oconto Falls, June 24, 1958. Coll. H. Gale.

SCOLECOTRICHUM GRAMINIS Fckl. on *Agropyron psammophilum (A. dasystachum).* Door Co., Whitefish Bay, July 27, 1933. Coll. J. J. Davis. Also on *Beckmannia syzigachne.* Douglas Co., near Brule, July 20, 1897. Coll. L. S. Cheney. (U. W. Phan.).

HELMINTHOSPORIUM GIGANTEUM Heald & Wolf on *Muhlenbergia sylvatica.* Sauk Co., Aldo Leopold Memorial Tract, Sect. 1, Town of

Honey Creek, September 15, 1962. Also on *Muhlenbergia uniflora*. Wood Co., near Dexterville, September 18, 1961, Coll. W. A. Skroch. (U. W. Phan.).

CERCOSPORA MUHLENBERGIAE Atk. on *Muhlenbergia glomerata*. Adams Co., near Oxford, July 24, 1932. Coll. N. C. Fassett (14416). (U. W. Phan.).

CERCOSPORA FUSIMACULANS Atk. on *Panicum columbianum*. Sheboygan Co., Terry Andrae State Park, June 30, 1925. Coll. A. M. Fuller. (U. W. Phan.). On most specimens as old as this the conidia would have dropped away long since, but here a few were trapped in the conidiophore fascicles and these, together with the very characteristic lesions, serve to establish identity.

CERCOSPORA ELEOCHARIDIS J. J. Davis on *Eleocharis acicularis*. LaCrosse Co., near Amsterdam, Holland Twp., August 25, 1958. Coll. A. M. Peterson. Only a single conidium observed—as usual, spores produced externally on smooth surfaces have rapidly fallen away—but the very short, compact, substomatal clusters of conidiophores are entirely characteristic for the species.

CERCOSPORA AVICULARIS Wint. on *Polygonum achoreum*. Vernon Co., Chaseburg, August 24, 1920. Coll. E. A. Baird. Earlier reports fail to distinguish satisfactorily between *Polygonum achoreum* and *P. erectum*.

CERCOSPORA LECHEAE Chupp & Greene on *Lechea stricta*. Trempeleau Co., Perrot State Park at Trempeleau, August 16, 1956. Coll. T. G. Hartley. (U. W. Phan.).

TUBERCULINA PERSICINA (Ditm.) Sacc. on *Puccinia magnusiana* Körn. I on *Anemone canadensis*. Dane Co., Mazomanie, July 18, 1931. Coll. J. J. Davis. On *Puccinia punctata* Link I on *Galium concinnum*. Dane Co., near Verona, June 21, 1962. On *Puccinia stipae* Arth. I on *Aster oblongifolius*. Columbia Co., Black Hawk's Lookout near Prairie du Sac, May 31, 1962.

ADDITIONAL SPECIES

The fungi mentioned have not been previously reported as occurring in Wisconsin.

SPHAERELLA (MYCOSPHAERELLA) BACILLIFERA Karst. occurs on a number of Wisconsin specimens of *Scheuchzeria palustris* var. *americana* in the Wisconsin Herbarium. Karsten (Hedw. 22: 179. 1883) states that the type was on dead foliage, but in the Wisconsin material the infection plainly originated in living tissue of the current season. That this fungus is a parasite common on, and characteristic of, *Scheuchzeria* in this region would seem indicated by the remarkable fact that it has been found on 14 out of the 40 Wisconsin specimens in our herbarium, specimens collected at random by various collectors over a period of 100 years, and with no thought to the fungi thereon. Plants bearing the fungus are from Ashland, Barron, Bayfield, Jackson, Manitowoc, Oconto, Sawyer and Vilas counties, the earliest collected in 1889, the last in 1960. Descriptive notes, in amplification of Karsten's meager description, are as follows: Perithecia scattered over brownish or pallid zones on the narrow leaves and bracts, inmate or nearly so, black when viewed from above, but with the wall thin and pale brown at sides and below, subglobose, ostiole wide and prominent, bounded by black, rather thick-walled cells, the perithecia approx. (150–)165–185(–200) μ diam., aparaphysate, asci hyaline, rather thick-walled, often noticeably so at apex, broadly clavate or cylindro-clavate, pedicellate, 95–105 x 23–26 μ; ascospores hyaline with a faint greenish tinge, essentially straight, broadest at midpoint and tapered gradually to the subobtuse ends, 57–62 x 4.8–5.5 μ, the septum median without constriction. The arrangement of the spores in the ascus is somewhat variable, but they tend to lie alongside of and parallel with one another. The fungus has also been noted on specimens from Nova Scotia, Maine, Minnesota and Montana in the University of Wisconsin Herbarium.

LINOSPORA BRUNELLAE Ell. & Ev. on *Prunella vulgaris*. Sauk Co., near Leland, August 18, 1962. Immature, but so completely characteristic as to leave no doubt as to identity. A devastating parasite which seems to have hitherto been reported only from far northwestern North America and from Europe.

ELSINOE PANICI Tiffany & Mathre on *Panicum virgatum*. Four specimens: Columbia Co., near Lodi, June 30, 1938; Sauk Co., Ferry Bluff, August 10, 1959; Iowa Co., near Arena, August 16, 1960; Dane Co., Madison, August 8, 1962. Tiflany and Mathre (Mycologia 53: 600. 1961) have established that this fungus, only the conidial stage of which has so far been noted in Wisconsin, has an *Elsinoe* perfect stage. In my Notes 4 (Farlowia 1: 575. 1944) I discussed the conidial stage at some length, under the assumption that it was closest to the genus *Sporonema* and might be connected with *Phyllachora graminis* (Pers.) Fckl.

THECAPHORA DEFORMANS Dur. & Mont. on *Desmodium nudiflorum*. Sauk Co., Parfrey's Glen near Merrimac, September 19, 1962. Fischer reports this on *D. nudiflorum* only from Pennsylvania, Maryland and Virginia.

The late Dr. Roderick Sprague, shortly before his death, provided the following description of a species of *Coniothyrium* on *Poa pratensis,* collected in Wisconsin in 1959 and sent to him for study.

Coniothyrium poavora R. Sprague sp. nov.

Maculis luteis, ellipticis, marginibus brunneis vel vinaceis; pycnidiis paucis, interdum sub-gregariis, depressis, erumpentibus denique, globosis vel sub-ellipsoideis, brunneis v. nigris, 85–120 (–150) x 80–100 μ, ostiolatis; conidiophoris brevis; pycnidiosporulis ellipticis, apicis utrinque acutis vel sub-obtusis, aureis-brunneis, (5–) 6.5–9 (–10) x 2.4–3.2 μ.

FIGURE 1. Segments of leaves of Poa pratensis showing lesions caused by Coniothyrium poavora R. Sprague. X 2.

Spots buff to straw color, elliptical, margin brown to vinaceous, pycnidia few, sometimes aggregated, depressed, finally erumpent, globose to somewhat ellipsoid-globose, brown to black, 85–120 (–150) x 80–100 μ, ostiolate; condiophores short, pycnidiospores elliptical, both ends pointed, or sometimes obtuse and almost truncated, walls relatively thick, golden brown, (5–) 6.5–9 (–10) x 2.4–3.2 μ.

On living leaves of *Poa pratensis.* Coll. by H. C. Greene near Cross plains, Dane County, Wisconsin, U. S. A., September 1, 1959. WSP 51152 is a slide removed from the specimen and retained at Washington State University. The rest of the type is filed at the University of Wisconsin.

Greene (Trans. Wis. Acad. Sci. Arts Lett. 49: 91. 1960) published a descriptive note on this fungus, pointing out the strikingly conspicuous nature of the lesions, as shown in the photograph, Fig. 1, and the fact that the infected leaves often show decided curvature at the point of the lesion.

Phomopsis filicina sp nov.

Maculis rufo-brunneis obscuris, in pinnulis partim vel absolute; pycnidiis sparsis vel gregariis, immersis, pallido-brunneis, muris tenuibus, pellucidis, subglobosis, ca. 115–140 μ diam.; scolecosporis curvis vel laxe sigmoideis, hyalinis, continuis, 25–45 x .8–1.5 μ; *Phoma*-conidiis hyalinis, subcylindraceis vel subfusoideis, 8–10 x (2–)2.5(–3) μ.

Lesions dark reddish-brown, involving portions of pinnules or entire pinnules; pycnidia scattered to gregarious, immersed, light brown, thin-walled and translucent, subglobose, approx. 115–140 μ diam.; scolecospores curved to laxly sigmoid, hyaline, continuous, 25–45 x .8–1.5 μ; *Phoma*-type conidia hyaline, subcylindric to subfusoid, 8–10 x (2–)2.5 (–3) μ.

On living leaves of *Athyrium angustum.* Madison School Forest near Verona, Dane County, Wisconsin, U. S. A., June 5, 1962. The lesions are very sharply defined with reference to the individual pinna and there seems no doubt of parasitism. A small collection of what is probably the same fungus was commented on in my Notes 19 (Amer. Midl. Nat. 50: 502. 1953).

Ascochyta osmundae sp. nov.

Maculis cinereo-brunneis vel virido-brunneis obscuris, in pinnulis, irregularibus; pycnidiis sparsis vel gregariis, muris tenuibus, pallido-brunneis, subglobosis, magnitudinibus variabilibus, ca. (90–)115–165(–200) diam. μ; conidiis hyalinis, uniseptatis ordinate, subfusoideis vel subcylindraceis, (9–)11–13(–16) x 2.8–3.5 μ.

Lesions ashen-brown or dull greenish-brown, often involving many pinnules, irregular in size and shape; pycnidia scattered to gregarious, thin-walled, pale brownish, subglobose, variable in size, approx. (90–)115–165(–200) μ diam.; conidia hyaline, uniformly uniseptate, subfusoid or subcylindric, (9–)11–13(–16) x 2.8–3.5 μ

On living leaves of the Interrupted Fern, *Osmunda claytoniana.* Adjacent to Decatur Lake, Sect. 15, Town of Decatur, near Brodhead, Green County, Wisconsin, U. S. A., August 28, 1962.

Numerous plants over a sizeable area were infected. Where many pinnules are involved, the pinna may show considerable curvature and distortion. A strong parasite on a host previously known only to bear a rust in Wisconsin.

SEPTORIA DIANTHICOLA Sacc. on *Dianthus barbatus.* Sauk Co., Town of Greenfield, June 1961. Coll. H. M. Clarke. (U. W. Phan.). The spores are shorter and narrower than in *Septoria dianthi* Desm.

Rhabdospora hyperici sp. nov.

Pycnidiis in caulibus, erumpentibus, seriebus comminus, nigris, muris crassis, subglobosis, applanatis infra, ostiolis parvis, (100–) 110–125(–135) μ diam; conidiis hyalinis, tenuibus, curvis plusve minusve, obscure multiseptatis, 35–75 x 1.2–1.7 μ.

Pycnidia on stems, deeply imbedded but erumpent, closely seriate, black, thick-walled, subglobose, somewhat flattened at base, ostiole small, (100–)110–125(–135) μ diam.; conidia hyaline, slender, more or less strongly curved, obscurely multiseptate, variable in length, 35–75 x 1.2–1.7 μ.

On *Hypericum gentianoides.* Columbia County, Dells of the Wisconsin River, 3 miles northwest of Portage, Wisconsin, U. S. A., October 9, 1960. Coll. H. H. Iltis (17055).

This species has pycnidia which are much larger and spores which are completely out of the range of *Septoria sphaerelloides* Ell. & Kell. *(Rhabdospora sphaerelloides* (E. & K.) Sacc.) which occurs on *Hypericum punctatum* in Wisconsin.

CERCOSPORA FUKUSHIANA (Matsuura) Yamamoto *(C. balsaminae* Kell. & Sw. in litt.) on *Impatiens balsamina* (cult.). Dane Co., Madison, August 27, 1962. The sharply defined circular grayish spots seem characteristic for the species as it is treated by Chupp in his monograph.

CERCOSPORA OENOTHERAE Ell. & Ev. on *Oenothera serrulata.* Buffalo Co., near Mondovi, August 25, 1956. Coll. H. H. Iltis (8078). (U. W. Phan.).

ALTERNARIA ZINNIAE Pape on *Zinnia elegans* (cult.). Monroe Co., Kendall, September 1, 1962. Comm. E. K. Wade. This species has spores which are distinctive in having extremely long, slender beaks.

PRELIMINARY REPORTS ON THE FLORA OF WISCONSIN NO. 48.[1] COMPOSITAE I—COMPOSITE FAMILY I

(Tribes Eupatorieae, Vernonieae, Cynarieae, and Cichorieae)

Miles F. Johnson and Hugh H. Iltis

In Wisconsin, as well as in the world as a whole, the family with the largest number of species is the *Compositae,* the family of daisy and dandelion, of lettuce and chrysanthemum. Highly specialized, its flowers are not borne singly but in groups of several to hundreds, telescoped into tight *heads* in such a way as to simulate the solitary flowers of other families. While the bee and butterfly visitor, and many a layman, look upon a daisy as *one single "flower"*, which *functionally* it is, the botanist knows that each head is structurally a bouquet of flowers, sometimes all alike as in Joe-Pye-Weed or dandelion, sometimes of two sorts as in the daisy, where the showy marginal *ray flowers* (or *rays)* resemble white petals and the many individual yellow *disk flowers* composing the central disk resemble yellow stamens. Surrounding all the flowers of each head are one or several series of variously modified, often green, *involucral bracts.* Sepals are rarely visible except in fruit, where, as the *pappus,* they are found on top of the *achene* ("seed"), sometimes as scales, hairs or barbed spines. In a few species, the pappus is lacking.

The arrangement of flowers into heads has evidently been a very successful evolutionary venture a success reflected in the very large number of species (some 20,000) and in the ecological predominance of *Compositae* in the vegetation of many parts of the world, as in some prairies and sedge meadows of Wisconsin. The species and genera of *Compositae* are legendary for the difficulty with which they are told apart, partly because of the minuteness of the morphological characters which have to be examined, but mainly because of the large number of similar species and genera, many of which have evolved recently or are still actively evolving, and as a consequence often hybridize. It should be borne in mind, therefore, that parts of the present treatment, as those of the *Liatris* and

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Hieracium hybrids, are highly tentative. A great deal of field work and laboratory analysis is yet needed before we can have an adequate taxonomic understanding of many of our *Compositae.*

This study includes the species of only four tribes, though two difficult genera, *Solidago,* the goldenrods, and *Senecio,* the ragworts, are dealt with further on in this volume. An unpublished master's study (Melchert 1960), treated members of the sunflower tribe, the *Heliantheae,* while certain individual groups, such as the difficult genus *Aster,* have been published on separately by Shinners (1941) and others. The magnitude of the task, as well as the desirability of making available to botanists and naturalists the present work without too much delay has made it expedient to publish this family in several parts.

This study is based on specimens in the herbaria of the University of Wisconsin (WIS), Milwaukee Public Museum (MIL), University of Wisconsin–Milwaukee (WISM), University of Minnesota (MIN), Chicago Natural History Museum (F), Northland College, Ashland, Platteville State College and St. Norbert's College, De Pere, Wisconsin.

Map dots represent exact locations, triangles represent county records. Small dots in Lincoln Co. represent sight records of F. C. Seymour (ms.), those in Central Wisconsin of J. W. Thomson (ms.). The numbers in the map corner insets indicate the amount of flowering and fruiting material available for this study as well as when the species may be expected to flower or fruit in Wisconsin. Plants with vegetative growth only, in bud, or with dispersed fruits are not included. Nomenclature and general descriptions generally follow those of Cronquist in "The New Britton and Brown Illustrated Flora" (Gleason 1952) and "Gray's Manual of Botany, ed. 8" (Fernald 1950). The order of tribes and genera follows that of Cronquist (Gleason 1952), to whom we are obliged for permission to modify his key to genera and illustration (Fig. 1), as published in "The New Britton and Brown Illustrated Flora".

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ARTIFICIAL KEY TO TRIBES OF WISCONSIN COMPOSITAE

Based on flowering plants
After L. H. Shinners (May, 1941, unpublished)

A. Some or all of the flowers in each head tubular; strap-shaped (ray) flowers absent, or present only around the margin of the head; plants with watery juice.
- B. Pappus of bristles or hairs.
  - C. Plants not prickly; phyllaries (involucral bracts) entire, or with ragged edges, but not deeply laciniate and not spiny or prickly.
    - D. Phyllaries in 2–5 rows, equal or unequal; or in 1 row, but conspicuous white, pink, purple, or blue rays present.
      - E. Phyllaries not scarious, or scarious only on the margins.
        - F. Rays absent; flowers white, pink, or purple.
          - G. Heads purple-flowered, corymbose; leaves alternate __TRIBE VIII. VERNONIEAE.
          - GG. Plants not with all the above characters at once ______TRIBE VII. EUPATORIEAE.
        - FF. Rays present or absent; tubular flowers yellow, orange, or brown; or purple- or red-brown, but conspicuous rays present.
          - H. Disks less than 25 mm wide __________________________TRIBE V. ASTEREAE.
          - HH. Disks more than 25 mm wide ___________________________TRIBE VI. INULEAE.
      - EE. Phyllaries either entirely scarious except for a central green line not extending to the tip, or with scarious tips $1/3$ or more their length.
        - I. Involucres 10–16 mm high.

J. Phyllaries loose, crisped, and rounded; heads spicate or racemose ______________ TRIBE VII. EUPATORIEAE (*Liatris* sp.).

JJ. Phyllaries appressed, acute; heads loosely corymbose-paniculate __________________ TRIBE IX. CYNAREAE (*Centaurea repens*).

II. Involucres 3–8 mm high __________________ __TRIBE VI. INULEAE. (GNAPHALIEAE).

DD. Phyllaries equal and in 1 row (sometimes with a few slender recurved bractlets below them); rays yellow, or rays absent.

K. Leaves opposite ___TRIBE VII. EUPATORIEAE (*Eupatorium rugosum*).

KK. Leaves alternate, or all basal ________________ __________________TRIBE IV. SENECIONEAE.

CC. Plants prickly, or with deeply laciniate, spiny, or prickly phyllaries __________________TRIBE IX. CYNAREAE.

BB. Pappus of awns, scales, or teeth; or pappus absent.

L. Phyllaries not at all scarious.

M. Anthers not united; rays absent, flowers not showy ____TRIBE I. HELIANTHEAE (AMBROSIEAE).

MM. Anthers united; rays present or absent, flowers often showy.

N. Rays absent; or rays present and pointed, ragged, or sharply 2-toothed at the apex, widest near the middle or about the same width throughout ___ __________________TRIBE I. HELIANTHEAE.

NN. Rays present, widest at the 3- to 5-lobed apex.

O. Leaves opposite __TRIBE I. HELIANTHEAE (*Polymnia & Coreopsis*).

OO. Leaves alternate ___TRIBE II. HELENIEAE.

LL. Phyllaries scarious, at least around the margins.

P. Leaves opposite ________TRIBE I. HELIANTHEAE (*Cosmos & Coreopsis*).

PP. Leaves alternate.

Q. Leaves toothed, lobed, or finely divided ________ _________________TRIBE III. ANTHEMIDEAE.

QQ. Leaves not toothed or divided ________________ ____________TRIBE V. ASTEREAE (*Boltonia*).

AA. Flowers all strap-shaped; plants with milky juice __________ _______________________________TRIBE X. CICHORIEAE.

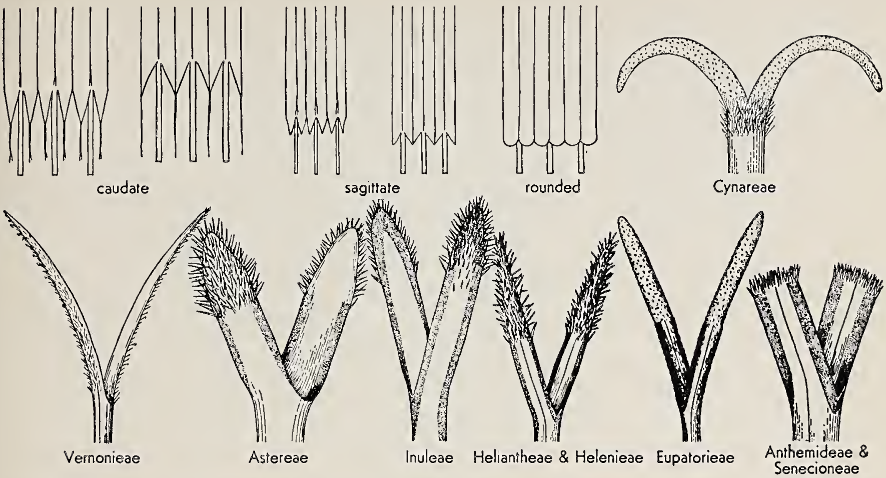


FIG. 1. CHARACTERISTIC STYLE-BRANCHES AND ANTHER-BASES IN THE COMPOSITAE. (FROM A. J. CRONQUIST, IN GLEASON 1952, 3: 324, WITH PERMISSION).

DESCRIPTIVE KEY TO THE TRIBES OF COMPOSITAE IN WISCONSIN[2]

(Wisconsin Genera grouped accordingly)

A. Flowers, or some of them, tubular and eligulate; juice watery, very rarely milky.

B. Style without any ring of hairs or distinct thickened ring below the branches; anthers (except in *Inuleae)* not tailed; plants seldom prickly; receptacle chaffy or naked, rarely somewhat bristly.

C. Style-branches more or less flattened, commonly but not always stigmatic to the middle or beyond, the stigmatic portion often conspicuously defined; flowers generally not all alike, some of them tubular and hermaphrodite (sometimes sterile), others pistillate or neutral and usually also ligulate, or, if occasionally all tubular and hermaphrodite, then yellow.

D. Anthers truncate to sagittate at base, but scarcely tailed; style-branches often but not always with terminal appendages.

E. Style-branches either exappendiculate and with a ring of hairs at the end, or with the appendages hairy on both sides.

[2] Modified after A. J. Cronquist's key in Gleason (1952).

F. Pappus chaffy or of awns or none, never capillary; style-branches chiefly with appendages, but sometimes without them.

G. Involucral bracts without scarious or hyaline margins, commonly green and somewhat herbaceous, seldom much imbricate; leaves, or the lower ones, often but not always opposite; style-branches usually but not always with appendages.

H. Receptacle chaffy ____________________________Tribe I. HELIANTHEAE.

1. Helianthus
2. Eclipta
3. Heliopsis
4. Rudbeckia
5. Echinacea
6. Ratibida
7. Bidens
8. Megalodonta
9. Coreopsis
10. Galinsoga
11. Polymnia
12. Silphium
13. Parthenium
14. Iva
15. Ambrosia
16. Xanthium
17. Madia

HH. Receptacle naked ____________________________Tribe II. HELENIEAE.

18. Helenium

GG. Involucral bracts with scarious or hyaline margins, scarcely herbaceous, usually well imbricate; leaves alternate; receptacle chaffy or naked; style-branches exappendiculate, as in the *Senecioneae* ________________Tribe III. ANTHEMIDEAE.

19. Anthemis
20. Achillea
21. Chrysanthemum
22. Tanacetum
23. Matricaria
24. Artemisia

FF. Pappus of capillary bristles; style-branches mostly truncate, exappendiculate, with a ring of hairs at the end; leaves alternate or opposite; receptacle naked; involucre chiefly of equal uniseriate bracts, often with a few much smaller ones at the base ____________________________Tribe IV. SENECIONEAE.

25. Arnica
26. Senecio
27. Erechtites
28. Cacalia
29. Tussilago
30. Petasites

EE. Style branches with the appendages glabrous within; leaves alternate; receptacle naked; involucral bracts commonly but not always in several series and partly or wholly herbaceous ---------------------------Tribe V. ASTEREAE.

31. Solidago
32. Chrysopsis
33. Grindelia
34. Erigeron
35. Aster
36. Conyza
37. Boltonia

DD. Anthers tailed at base; style-branches rounded or truncate, exappendiculate; leaves alternate; receptacle naked or chaffy; corollas all tubular, or, in the large yellow heads of *Inula,* the outer ligulate; plants more or less white-woolly; leaves alternate ------------------------------Tribe VI. INULEAE.

38. Antennaria
39. Anaphalis
40. Gnaphalium
41. Inula

CC. Style-branches terete, clavate, or filiform, seldom strongly flattened, stigmatic only near the base, the stigmatic portion usually not sharply differentiated in appearance; flowers all tubular and perfect, never yellow; receptacle naked.

I. Style-branches terete or clavate, obtuse to acutish, papillate, not hairy; anthers rounded at the base; leaves opposite, alternate, or whorled ---------------------------------Tribe VII. EUPATORIEAE.

42. Eupatorium
43. Kuhnia
44. Liatris

II. Style-branches filiform, acute or acuminate, hispidulous; anthers distinctly sagittate; leaves alternate ----------------------Tribe VIII. VERNONIEAE.

45. Vernonia

BB. Stype with a ring of hairs, or sometimes merely with a thickened ring, below the branches, papillate thence to the tip, the branches apparently stigmatic to the tip; anthers tailed at the base; plants often prickly or spiny; receptacle densely bristly or sometimes naked; leaves alternate. ----------------------------------Tribe IX. CYNAREAE.

46. Arctium
47. Carduus
48. Cirsium
49. Onopordium
50. Centaurea

AA. Flowers all ligulate and perfect; juice milky or colored ------ -------------------------------Tribe X. CICHORIEAE.

51. Prenanthes	57. Cichorium
52. Hieracium	58. Microseris
53. Crepis	59. Krigia
54. Taraxacum	60. Lapsana
55. Sonchus	61. Leontodon
56. Lactuca	62. Tragopogon

NOTE: ONLY TRIBES VII–X ARE TREATED IN THIS PRELIMINARY REPORT.

TRIBE VII. EUPATORIEAE Cass.

Perennials with watery juice; flowers all tubular, perfect, purple, rose, white or whitish. Style branches clavate. Leaves alternate, opposite or whorled. Pappus bristly.

KEY TO GENERA

A. Leaves opposite or whorled; roots fibrous; achenes 5-angled; pappus of capillary bristles; involucral bracts not ribbed --- -----------------------------------42. EUPATORIUM.

AA. Leaves alternate; plants from a stout taproot or enlarged corm; achenes 10-ribbed; pappus of plumose or barbellate bristles; involucral bracts weakly or strongly ribbed.

B. Plants from stout taproots; pappus plumose; involucral bracts strongly ribbed; inflorescence corymbiform, the heads creamy-white ---------------------43. KUHNIA.

BB. Plants from enlarged corms; pappus plumose or barbellate; involucral bracts strongly imbricate, weakly ribbed; inflorescence spicate or racemose, the heads purple and often very showy. ---------------------------44. LIATRIS.

42. EUPATORIUM L. Thoroughwort; Joe-Pye-Weed

Perennials with opposite or whorled leaves, often resin-dotted on involucre and undersides of leaves. Heads small, usually many, in corymbiform inflorescences, the flowers all tubular, white, pink or purple. Involucre cylindrical-campanulate, the bracts imbricate, unequal. Achenes 5-ribbed. Pappus bristles uniseriate, capillary.

Key to Species

A. Leaves in whorls of 3, 4, or 5; heads purple or dull rose, cylindric.
  B. Stem *purple throughout or purple spotted;* flowers *9–24 per head;* very common throughout, wet habitats --1. *E. MACULATUM.*
  BB. Stem *green, purple only at nodes, not spotted;* flowers *3–6 (–8) per head; dry woods* ----------2. *E. PURPUREUM.*
AA. Leaves opposite (rarely in 3's in No. 5); heads white (rarely purple in No. 5).
  C. Leaves sessile or very short-petioled, narrowly lanceolate.
    D. Leaves free at base and not fused.
      E. Leaves attenuate to the winged petiole, broadest near middle, with *3 prominent veins beneath;* plants pubescent; SW Wisconsin ----3. *E. ALTISSIMUM.*
      EE. Leaves sessile, broadest at the rounded base.
        F. Plants glabrous; leaves with very prominent white midrib beneath; S. Wisconsin ------------------------------4. *E. SESSILIFOLIUM.*
        FF. Plants pubescent; leaves with midrib not very prominent beneath --------------------------5c. *E. PERFOLIATUM* forma *TRUNCATUM.*
    DD. Leaves perfoliate, their bases fused around the stem; very common throughout -----5. *E. PERFOLIATUM.*
  CC. Leaves long-petioled, broadly lanceolate to ovate.
    G. Leaves lanceolate, scabrous-pilose, thickish; plants branched above; rare in S. Wisconsin ---6. *E. SEROTINUM.*
    GG. Leaves ovate, glabrous, membranaceous; plants branched at inflorescence, rarely below; throughout Wisconsin, except the Northwest ---7. *E. RUGOSUM.*

1. Eupatorium maculatum L. Joe-Pye-Weed. Map 1.

Perennial 1–2 m or more tall. Stem unbranched, glabrous, *mottled with purple or purple throughout.* Leaves in *whorls or 4 or 5,* rarely 2 or 3, lanceolate to elliptic, gradually tapering to the petiole, the lower (8–)12–22(–26) cm long, 3–7 cm wide, *with coarsely serrate margins, the teeth usually incurved,* glabrous above, with bright orange resin dots (atoms) beneath (10X).[3] Inflorescences usually flat-topped; heads numerous, 7–10 mm high, with 9–16(–24) flowers of varying shades of *reddish-purple;* bracts obtuse, purple

[3] According to Fernald (1950:1365), leaves of *E. maculatum* are "rarely atomiferous." In Wisconsin, however, they are rarely, if ever, without resinous dots!

to green. Peduncles bright purple. Pappus of numerous capillary bristles, dull white to brown.

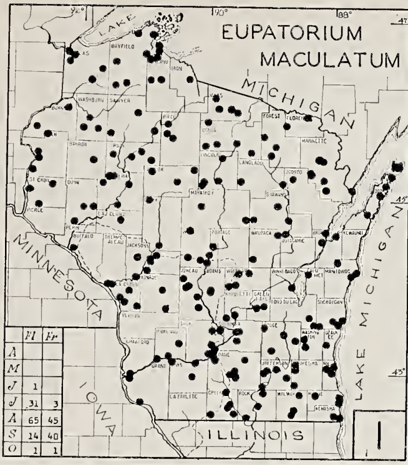
Throughout Wisconsin, characteristic of wet prairies (Curtis 1955) and especially the northern sedge meadows (Curtis 1959), in marshes, wet woods, low lands, and along streams and lakes, less commonly in bogs or drier habitats. Flowering from (early) mid-July through September (peak in early August); fruiting from late July into October. Very similar to *E. purpureum.*

2. EUPATORIUM PURPUREUM L. Sweet or Green-stemmed Joe-Pye-Weed. Map 2.

Perennial 1–2 m tall. Stem unbranched, glabrous, *purple only at nodes or green throughout.* Leaves, in whorls of 4, rarely 3 or 5, lanceolate to oblanceolate, *coarsely crenate, abruptly tapering to winged petiole,* 14–25 cm long, glabrous to sparsely pubescent above, with bright orange dots (atoms) below (10x). Inflorescences rounded, the numerous narrowly cylindric heads 8–13 mm long, each with *(4–)5–6(–8) pink to pale purple (rarely cream or whitish) flowers;* bracts light purple to tawny, with bright green to brown nerves. Peduncles tan, pubescent. Pappus of numerous tawny capillary bristles. $2n=20, 40$ (Grant 1953, ex Darlington 1955); $2n=20$ (Cooper & Mahoney 1935, presumably from Wisconsin material).

Southern Wisconsin, mainly in the southern dry-mesic oak forests (Curtis 1959) and in mesic to damp maple, basswood, and elm woods south of the "Tension Zone," less common in white cedar-hardwoods, on bluffs, damp lake shores, marshes, and in the Wisconsin river bottoms in dense underbrush of moist sloughs subject to occasional inundation to a depth of 4–8 feet (Adams Co.), seemingly completely lacking from the region of the Central Sand Plains. The Wood Co. collection, "high dry woods, Arpin, Sept. 22, 1915 *C. Goessl*" (MIL, WIS), needs verification. Wiegand (1920b) cites albino-flowered specimens (corollas white) from Brown Co. and Kaukauna, Outagamie Co. Flowering from (mid-) late July to mid-August; fruiting from August through September.

Eupatorium purpureum and *E. maculatum* are often confused in field and herbarium. Distinguishing field characters include stem color (green with purple nodes in *E. purpureum,* purple or purple-spotted in *E. maculatum),* head color (pale in *E. purpureum,* more purple in *E. maculatum),* number of flowers per head, as well as habitat preference *(E. purpureum* in mesic or drier woods; *E. maculatum* in moist to wet thickets, wet prairies, and meadows).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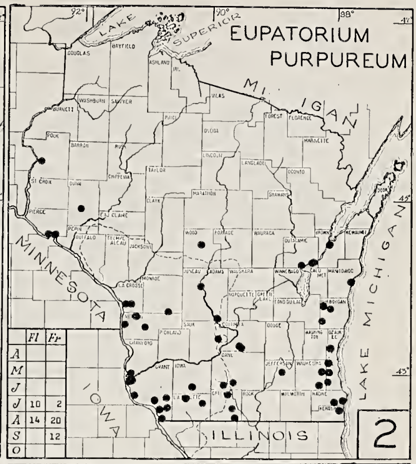
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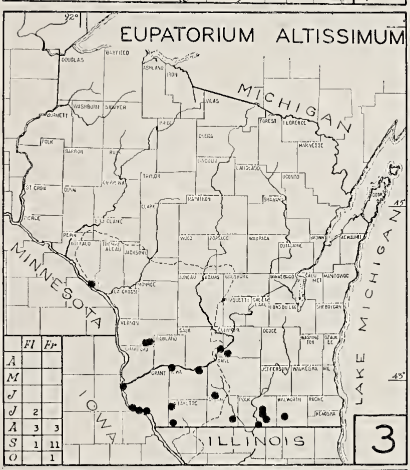
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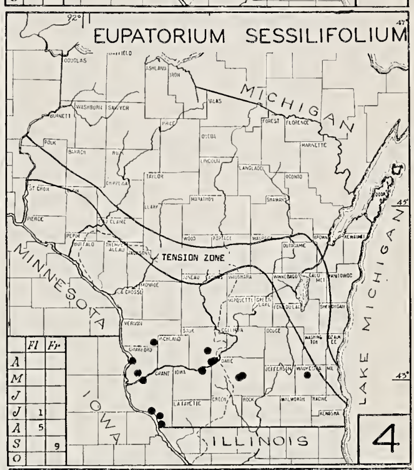
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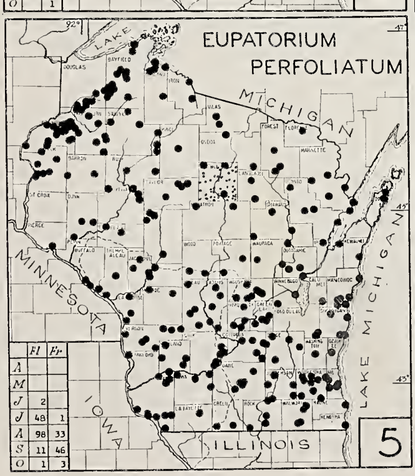
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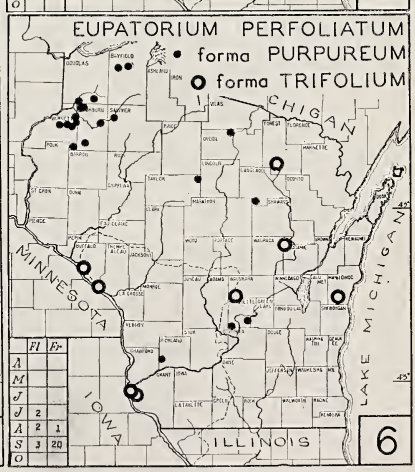
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3. EUPATORIUM ALTISSIMUM L. Map 3.

Leafy perennial somewhat resembling *Kuhnia eupatorioides,* 6–10 dm tall, pubescent throughout. Leaves opposite, narrowly lanceolate, 6–11 cm long, 1–1.4 cm wide, *tapering to winged petioles,* coarsely *toothed along the upper half,* pilose-punctate and with *three prominent veins beneath.* Heads numerous, *white.* Involucral bracts and *achenes with light yellow resin dots.*

Rather infrequent in SW. Wisconsin on dry rocky limestone (dolomite) prairies, less often on mesic prairies (Curtis 1959) and on bluffs; according to Dr. H. C. Greene, locally abundant at Benton, Lafayette Co., on bare sterile mine talings. Flowering from late July into early September; fruiting from mid-August through September.

4. EUPATORIUM SESSILIFOLIUM L. var. BRITTONIANUM Porter. Upland Boneset. Map 4.

Perennials 7–10 dm tall, glabrous except in the upper branches. Leaves opposite, *sessile, lanceolate,* 9–13 cm long, *the rounded base* 2–4.5 cm wide, long acuminate, denticulate to dentate, the *lower midrib white and very prominent.* Corymb spreading; heads numerous, white, the bracts obtuse, densely white pubescent with intermixed golden resin "atoms"; achenes also atomiferous (10X).

Uncommon in southern Wisconsin in dry, open, often sandy upland woods on tops and slopes of bluffs, mainly in the "Driftless Area", rarely in prairie relics. Flowering in early or mid-August; fruiting in September.

Because of pubescent inflorescence branches, our specimens all belong with var. *Brittonianum,* the glabrous typical variety occurring in the eastern and southern U.S.

5. EUPATORIUM PERFOLIATUM L. Boneset; Throughwort; Thoroughwort. Map 5, 6.

Coarse to slender, villous to hairy perennials 3–9(–11) dm tall. *Leaves opposite* (rarely in 3's), *all, except sometimes the upper, perfoliate (i.e., fused at the base and thus surrounding the stem,* hence the specific epithet), lanceolate, 8–14 cm long, 1.5–4 cm wide at the base, long-acuminate, crenate-serrate. Heads numerous, in flat-topped inflorescences. 2n=20 (Grant 1953, ex Darlington 1955).

KEY TO FORMS

a. Leaves opposite.
  b. Leaves fused at the base.
    c. Heads white ______________ 5a. forma *PERFOLIATUM.*
    cc. Heads purplish ______________ 5b. forma *PURPUREUM.*
  bb. Leaves not fused at the base, at least above, the heads white ________________________________ 5c. forma *TRUNCATUM.*
aa. Leaves in 3's ______________________ 5d. forma *TRIFOLIUM.*

5a. EUPATORIUM PERFOLIATUM L. forma PERFOLIATUM Map 5.

Leaves 2 at a node; corollas white.

Throughout Wisconsin, common in open moist habitats such as sandy lake shores, sand bars, beaches, sedge meadows, wet prairies (Curtis 1955), fens, southern lowland forests, northern damp Cedar-Hemlock or Tamarack-Spruce-Poplar woods, shrub carrs with *Potentilla fruticosa,* swamps, marshes, streamsides, and wet cliffs, rarer in drier habitats, though often very weedy in heavily grazed pastures or gravelly dry hillsides. Flowering from late June through September (peak in mid-August); fruiting from late July to early October.

5b. EUPATORIUM PERFOLIATUM L. forma PURPUREUM Britt. Map 6.

Flowers purple or purplish, rather than white, the bracts, inflorescences, stems and leaves sometimes purple as well, otherwise exactly as typical *E. perfoliatum.* Flowering and fruiting in August and September.

In Wisconsin this form is most common on sandy shores of the many lakes within the limits of post-glacial "Lake Barrens" (see Map 6; cf. McLaughlin 1932), which extended over much of the present-day sand barrens of NW. Wisconsin and adjacent Minnesota. *Bidens connata* Muhl. var. *pinnata* Wats. (Melchert 1960; Sherff 1962) and *Polygonum punctatum* L. var. *littorale* Fassett (Fassett 1948), minor endemics of the "Lake Barrens" region, have similar distributions, as do many of Wisconsin's otherwise local "Atlantic Coastal Plain Elements", e.g. *Xyris torta* and *Lycopodium inundatum,* and certain European weeds, e.g. *Crepis tectorum* (Map 49). For some, this area does represent an ideal "Coastal Plain" habitat. It is likely that post-glacially this area was a large "open habitat" in which plants adapted to moist, sandy, acid "Coastal Plain" conditions could find an ideal situation for rapid population expansion. The reasons for the many peculiarities found here may include the greatly expanded evolutionary opportunity that such an open habitat offers. Here, under low competition, an otherwise rare genotype could, on chance introductions, produce relatively large and uniform populations. Mutations causing anthocyanin accumulation in *E. perfoliatum,* thus, have no doubt occurred elsewhere too (see Map 6), but conditions for an extensive population buildup were particularly favorable only here. What we have been describing here, in short, is the operation of the "founder principle" of E. Mayr (cf. Goodhart 1963), where large and distinctive populations owe their peculiarities to being originally founded by only one or very few seeds selected by chance, the populations therefore genotypically poor, and hence uniform and distinctive. The "founder principle" would seem to apply also to the origin of the micro- or neo-endemics of the Great Lakes, discussed elsewhere in this paper (cf. *Cirsium pitcheri,* pp. 291–292).

5c. EUPATORIUM PERFOLIATUM L. forma TRUNCATUM (Muhl.) Fassett.

Leaves free at base, or only the lower fused, sometimes alternate above, thus not perfoliate. A rather meaningless taxon including occasional abnormal plants of the typical variety, e.g.: Grant Co.: Mississippi River bottoms, Bagley, September 10, 1930, *Fassett 14804* (WIS). In most plants of forma *perfoliatum* the upper-most leaves and sometimes those of side branches are free at the base!

5d. EUPATORIUM PERFOLIATUM L. forma TRIFOLIUM Fassett. Map 6.

Leaves 3 at a node, their bases fused, otherwise as forma *perfoliatum.*

Rare and sporadic in Wisconsin on river bottoms, meadows, lake shores and low woods. Originally described from Maine. Flowering from July to September; fruiting in September.

Cronquist (1952) thinks that these and other oddities in *E. perfoliatum* may be the result of hybridization with some other species. In Wisconsin there is no support whatever for this supposition.

6. EUPATORIUM SEROTINUM Michx.

Leafy, tall perennials. Stem ribbed, pilose at least above. Leaves opposite, petioled, *broadly lanceolate,* prominently *irregularly toothed,* the lower surface pilose, the upper essentially glabrous. Corollas pale violet to white.

Native of the eastern and southern United States, very rarely introduced in southern Wisconsin. Collected three times: Dane Co.: Madison, drainage ditch, Olbrich Park, Aug. 1956 (fr). *Richards s.n.* (WIS). Grant Co.: Potosi, Sept. 1862 (fr), *George Engelmann s.n.* (WIS). Milwaukee Co.: Grant Park Nursery, Oct. 18, 1933 (fr), *Wolf s.n.* (MIL).

7. EUPATORIUM RUGOSUM Houtt. var. TOMENTELLUM (Robinson) Blake White Snakeroot. Map 7.

Perennial 3–7(–10) dm tall. *Leaves opposite, petioled, broadly ovate* to *deltoid,* 7–12 cm long, *5–9 cm wide,* the margins crenate-dentate. Inflorescence cymose, the numerous *heads borne on tomentose peduncles;* corrollas white. 2n=34 (Grant 1953); 2n=36 (Cooper and Mahoney 1935, presumably from Wisconsin material).

Abundant throughout Wisconsin, except in the extreme northwest, in rich, dry, mesic or moist woods, most prevalent in the southern dry-mesic forest (Curtis 1959), on shady river banks, in thickets, less commonly on lake shores, bluffs, and limestone cliffs. Flowering from late July through September; fruiting from (late July–) August to early October.

All Wisconsin specimens have tomentose peduncles (var. *tomentellum),* the typical variety with glabrous peduncles occuring south and east of Wisconsin.

White Snakeroot may cause a sometimes fatal disease of cattle, "trembles," caused by *tremetol,* one of the higher alcohols found in its leaves and stems. *Tremetol* is soluble in milk fat, and, transmitted to other animals or humans, may cause "milk sickness" (Muenscher 1951), which in the early days of settlement of the Middle West reached near-epidemic proportions (Blake 1941).

43. KUHNIA L. FALSE BONESET

[Shinners, L. H. Revision of the genus *Kuhnia* L. Wrightia 1:122–144. 1947.]

1. KUHNIA EUPATORIOIDES L. var. CORYMBULOSA T. & G. False Boneset. Map 8.

Densely and finely puberulent leafy perennials 6–10 dm tall. *Leaves mostly alternate,* subsessile to sessile, *linear to lanceolate,* 3–7(–8.5) cm long, 0.7–2.5 cm wide, *variously* toothed, villous beneath, *abundantly black resin-dotted* (10X). *Inflorescences* dense to open corymbs. Involucral bracts (7–)8–10 mm *high, oblong to lanceolate, strongly 3–5 nerved, finely pubescent with scattered yellow resinous dots* (10X). Pappus of white to brown plumose bristles. Achenes cylindrical, *10-ribbed,* finely pubescent, *without resinous atoms.*

In Wisconsin a widespread prairie species south of the "Tension Zone", most common in dry and dry-mesic prairies (Curtis 1959), in prairie relics on bluffs, roadsides or railroads, and sand dunes. Flowering from (July–) August through October; fruiting from late August through September (–October).

Shinners divided the species into four geographic varieties, of which only the common "prairies and plains" variety *corymbulosa* occurs in Wisconsin. Scatter diagrams and graphs based on Wisconsin plants indicate that tightly packed corymbs are more abundant than open ones, and that the number of flowers per head ranges from 13–24 (mode 18–19), all clearly within the limits of var. *corymbulosa*. Some correlation exists between inflorescence form and leaf denticulation, plants with compact inflorescences having leaves more nearly entire, the open inflorescence, toothed-leaved forms perhaps representing shade plants.

44. LIATRIS Schreb. BLAZING STAR

[Gaiser, L. O., The Genus *Liatris*. Rhodora 48: Aug.–Dec. 1946][4]

North American perennials from enlarged underground stems. Leaves alternate, narrow, entire. Inflorescences spicate or racemose, the rose-purple heads showy. Involucral bracts strongly imbricated, at times with reflexed tips or margins. Achenes conical, 10-ribbed, pubescent. Pappus barbellate or plumose.

KEY TO SPECIES

A. Pappus barbellate, not plumose, the lateral cilia 3–6 times the diameter of the bristle.

- B. Inflorescence a usually dense spike; heads sessile, small, the involucre 7–11 mm high.
  - C. Inflorescence rachis glabrous; involucral bracts obtuse, erect, appressed, *the tips not reflexed*, 7–8 mm high; SE-most Wisconsin .... 1. *L. SPICATA*.[5]
  - CC. Inflorescence rachis pilose-hirsute; involucral bracts acute, the *acuminate tips reflexed*, 9–11 mm high .... 2. *L. PYCNOSTACHYA*.[5]
- BB. Inflorescence an open spike or raceme; heads larger, the involucre 9–20 mm high.
  - D. Inflorescence a raceme, rarely spiciform, long-pedunculate; *corolla glabrous within;* involucres 12–20 mm high, *the terminal head often much larger;* leaves scabrous-pubescent, the margins harshly ciliate .... 3. *L. LIGULISTYLIS*.[6]

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[4] Wisconsin specimens cited by Dr. Gaiser, though not examined, have been mapped.

[5] Plants intermediate between 1 and 2 are known from SE Wisconsin (see note under *L. pycnostachya*).

[6] Plants intermediate between 3 and 4 are known from NW. Wisconsin (see discussion under *L. ligulistylis*).

DD. Inflorescence spicate, rarely racemose, the heads short-pedunculate or sessile; *corolla pilose within;* involucres 9–15 mm high; leaves scabrous to glabrous, the margins not harsh ____________________ 4. *L. ASPERA.*[6]

AA. Pappus plumose, the lateral cilia 15 or more times the diameter of the bristle.

E. Heads campanulate, the bracts rounded, glabrous with scarious margins; a rare hybrid of 4 and 6 ____ 5. *L.* X *GLADEWITZII.*

EE. Heads cylindrical; involucral bracts mucronate to acuminate, the margins ciliate.

F. Inflorescence racemose, the heads 15–60 flowered; bracts mucronate; leaves not crowded, more lax, weakly punctate, not ciliate, 9–22 cm long, 3–7 mm wide; dry prairies, southern Wisconsin ___ 6. *L. CYLINDRACEA.*

FF. Inflorescence a dense to loose spike, the heads 3–8 flowered; bracts acuminate; leaves crowded, rigid, conspicuously punctate, ciliate, 6–15 cm long, 1–2 mm wide; prairies of Pierce and St. Croix counties ____ 7. *L. PUNCTATA.*

1. LIATRIS SPICATA (L.) Willd. Blazing Star. Map 9.

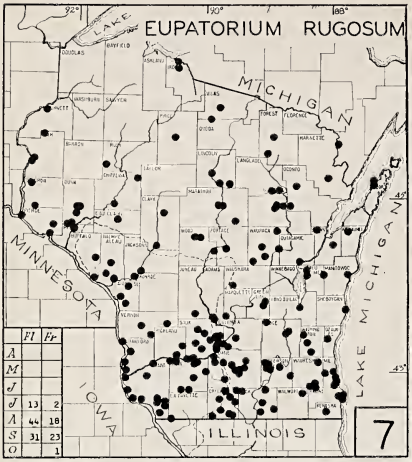
Stems stiffly erect, glabrous, 4–12 dm tall. Leaves numerous, linear-lanceolate to linear, the lower ones 12–20 cm long, 4–9 mm wide, glabrous to sparingly pilose on lower veins, the upper reduced and bractlike, *all punctate. Inflorescence a dense spike,* the heads cylindric to subcylindric. Corollas glabrous within, rich purple (white in forma ALBIFLORA Britt.). *Involucral bracts appressed, oblong to elliptic-oblong, the obtuse tips not spreading,* 7–8 mm high, green to purple, often with a scarious purple margin. Achenes 3.5–4.5 mm long. 2n=20 (Gaiser 1949).

Eastern United States, in Wisconsin rare, only in the extreme southeast, in sandy, moist, rather calcareous prairies, often with other rare plants, as on the Kenosha prairie with *Phlox glaberrima, Calamintha glabella* and *Allium cernuum,* and with *Lythrum "alatum", Pycnanthemum virginianum, Solidago rigida, S. ohioensis, S. ridellii, S. graminifolia, Aster ptarmicoides, Dodecatheon meadii, Lespedeza capitata,* and *Ratibida pinnata.* Flowering in late July and early August; fruiting in August.

Similar to *Liatris pycnostachya,* with which it may hybridize in Wisconsin, but glabrous and with appressed involucral bracts.

2. LIATRIS PYCNOSTACHYA Michx. Gay Feather. Map 10.

Stiffly erect perennials (5–)7–9 dm tall, from an enlarged woody corm, *pilose-hirsute (especially on inflorescence rachis).* Leaves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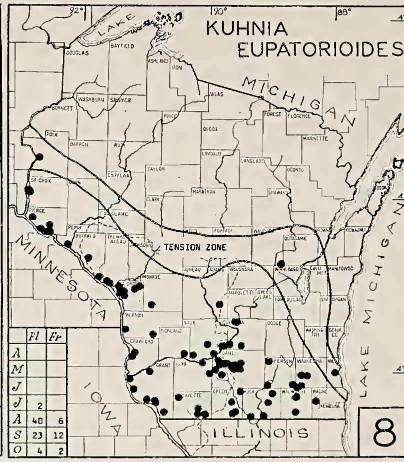
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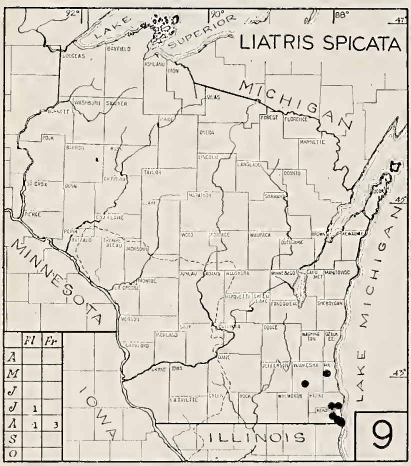
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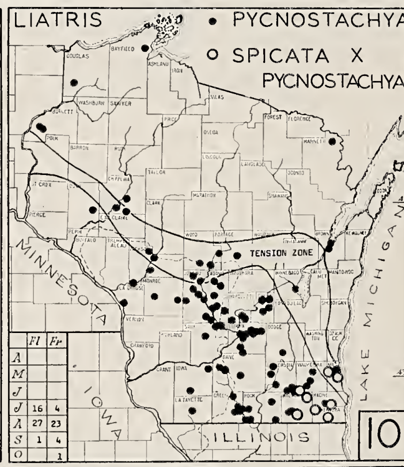
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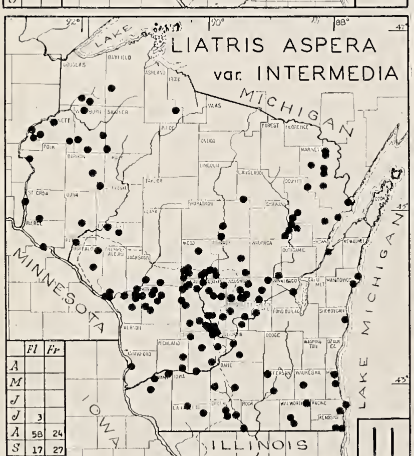
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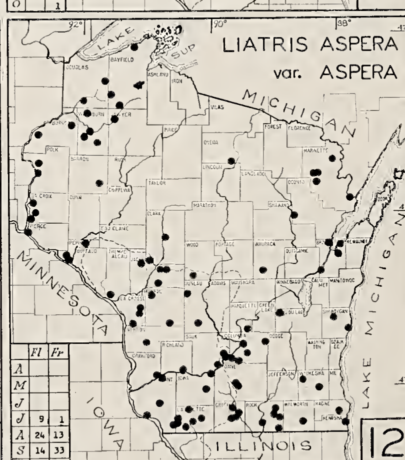
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A 24 13
S 14 33
O 4
12

numerous, crowded, linear-lanceolate to linear, punctate-pilose beneath to glabrous, the lower 13–35 cm long, 7–11 mm wide, the upper reduced. *Inflorescence a crowded (rarely loose) spike, the heads cylindric.* Corollas usually non-pilose within, rose-purple (white in forma HUBRICHTI E. Anderson). Involucral bracts green or purplish, *oblong to oblong-lanceolate with ciliate margins, the acute tips pronouncedly spreading,* 9–11 mm high. Achenes 3.5–4.5 mm long. 2n=20 (Gaiser 1949).

Typical of low (wet and wet-mesic) prairies (Curtis 1955), locally common on mesic prairies, in wet, sometimes rather calcareous sedge-grass meadows (fens), peat marshes, bogs, wet roadsides and wet railroad prairie relics south of the "Tension Zone", sometimes with *Liatris aspera, L. ligulistylis, L. spicata,* and *Cirsium muticum.* Often growing with many very rare species, the prairie habitat of this, one of our most showy species is in desperate need of protection! Flowering from July to early September; fruiting from (mid-July–) August through September.

Plants of *Liatris pycnostachya* from within the range of *L. spicata* are atypical, their inflorescence rachis less pilose and involucral bracts more often only slightly reflexed, all variations suggesting introgression from *L. spicata.* Natural hybridization is known to occur, the species sometimes growing together (e.g. *Runge 6331 & 6332,* Milwaukee Co. [MIL]), but the offspring are so variable that no attempt has been made to describe or name them. Gaiser (1946:245) treats these forms simply as intermediates between *L. pycnostachya* and *L. spicata.*

Though preferring more moist prairies, *Liatris pycnostachya* often grows with *L. aspera.* The two species are not known to hybridize in Wisconsin probably because of seasonal isolation, the flowering period of *L. pycnostachya* only exceptionally, if at all, overlapping that of *L. aspera.*

3. LIATRIS LIGULISTYLIS (Nels) K. Sch. Showy Blazing Star. Map 13.

Robust to slender, 8–10 dm tall; stems glabrous below, pilose on the reddish inflorescence branches, single or numerous from a shallow globose corm. Leaves glabrous to pilose, nearly always *ciliate on margins, the lower broadly spatulate to oblanceolate,* 14–36 cm long, 1.5–4 cm wide, *tapering to a long petiole,* the upper lanceolate to linear-lanceolate, sessile. *Inflorescence racemose, the heads on peduncles 1–6 (–12) cm long. Corolla* purple, GLABROUS WITHIN. Involucre campanulate, 1.2–2 cm high, 2–2.8 cm wide *(terminal head sometimes larger), the bracts glabrous, or ciliate on margin, erect,* *ovate to spatulate with irregular erose margins, usually purple.* Achenes 4.5–5.5 mm long. 2n=20 (Gaiser 1951).

Native to Wisconsin but rather sporadic, most abundant in mesic prairies (Curtis 1959), especially deep soil railroad prairies with *Stipa spartea, Andropogon scoparius, A. gerardi, Danthonia spicata,* and *Ambrosia psilostachya,* on roadsides with *Aster* and *Solidago* spp., less common on shores of lakes and swamps, low prairies and in sandy soils, in N. Wisconsin adventive on sandy roadsides and railroad embankments (Shinners 1943). Flowering in July and August; fruiting from August to early September.

Liatris aspera and *L. ligulistylis* seem to hybridize (introgress) freely in Wisconsin. These hybrids include L. X SPHAEROIDEA Michx. as recognized by Gaiser for plants rather close to *L. aspera* and L. X NIEUWLANDII (Lunnell) Gaiser for plants close to *L. ligulistylis.* These hybrids in turn reportedly back-cross to either parent, as well as to *L. spicata* or *L. cylindracea,* producing a veritable continuum of forms. In Wisconsin, where *L. aspera* is very common and *L. ligulistylis* not rare, many specimens show indications, sometimes in one, sometimes in several characters, of hybridization. Clear intermediates, as well as those listed by Gaiser (pp. 314, 326), are shown on Map 14. Many specimens of either species apparently contain minute amounts of the other's germ plasm; these are mapped with the species they most resemble, for it was not possible to formally recognize these hybrids, or to include them in a workable key. This problem is very complex and detailed population analyses are needed in areas where this hybridity is known, such as near Eagle, Waukesha County, or in NW. Wisconsin. With some plants, as those that have corollas pilose within and squarrose bracts (as in *L. aspera),* yet have heads on long peduncles in large inflorescences (as in *L. ligulistylis),* we have arbitrarily emphasized floral characters, placing them with *L. aspera.*

4. LIATRIS ASPERA Michx. Rough Blazing Star. Maps 11, 12.
Liatris sphaeroidea sensu Shinners, not Michx.

Stems slender to stout, glabrous to hirsute in the inflorescence, 4–8(–12) dm tall, singly from a rounded to irregularly elongate corm. Basal leaves lanceolate to linear, long petioled to sessile, 10–16(–27) cm long (incl. petiole), 6–17(–34) mm wide, scabrous [var. ASPERA] to glabrous [var. INTERMEDIA (Lunn.) Gaiser], the upper sessile, reduced. Inflorescence a loose spike of sessile to short-(rarely long–) pedunculate, globose to campanulate heads. Corollas purple [rarely white in forma BENKII Macbr., as in *Finger s.n.* (MIL), Sparta, or *Fassett 4482* (GH, WIS), Pepin Co.], *pilose within at base of filaments.* Involucre glabrous, green to purple, 9–15 mm high, *the outer bracts oblong to spatulate with broadly scarious, sometimes laciniate, purple margins,* the inner ones elongate, all appearing more or less blister-like and inflated (squarrose). Achenes 4–5(–5.5) mm long. 2n=20(22) (Gaiser 1951).

Throughout most of Wisconsin except the "Northern Highland," but most common on mesic prairies (Curtis 1959) and sandy prairies with *Selaginella ruprestris, Polygala polygama, Hieracium longipilum, Monarda punctata, Solidago missouriensis, Artemisia ludoviciana* and *Cladonia* spp., along mesic railroad prairies with *Andropogon gerardi, Leptoloma cognatum, Solidago rigida, Helianthus, Aster* and *Stipa spartea,* on dry prairie relics with *Bouteloua curtipendula, B. hirsuta, Silphium laciniatum, Scutellaria leonardii, Castilleja sessiliflora* and *Sporobolus* spp., becoming less common in open woods, on bluffs and river banks, and in willow thickets, often associated with Jack Pine and Scrub Oak. Flowering from mid-July to mid-September (–October); fruiting from (late July–) August through September (–October). Apparently hybridizes readily with *L. ligulistylis* (which see).

5. LIATRIS X GLADEWITZII (Farwell) Shinners
Liatris aspera Michx. (or *Liatris X sphaeroidea* Michx.) *X Liatris cylindracea* Michx.

Stems slender, pilose-hirsute, 3–5 dm tall, single or many from an irregular corm. Leaves numerous, lanceolate to linear, the lower 13–15 cm long, 6–8 mm wide, sessile, glabrous to pilose beneath, glabrous above, the upper similar but reduced and linear. *Inflorescence loosely racemose, the short-pedunculate heads cylindrical to campanulate. Involucral bracts glabrous, oblong to spatulate, with erose purple scarious margins, the lowest bracts with ciliate margin. Corolla purple, the lobes and tube pilose.* Achenes 5–6 mm long. *Pappus short-plumose,* midway between the barbellate pappus of *L. aspera* and the plumose one of *L. cylindracea.* 2n=20 (Gaiser 1951).

Reported from Ontario, Michigan and Wisconsin, here apparently rare, collected once: Crawford Co.: Dry summit of limestone bluff, Prairie du Chien, Aug. 20, 1927 [fr], *Fassett 4478* (WIS), there collected with *L. cylindracea, Fassett 4479* (WIS).

Though often growing together (e.g. Oliver Prairie Scientific Area, Green Co.), the parental species of this hybrid only very rarely hybridize. It may be significant that they are somewhat ecologically isolated, *L. cylindracea* growing in dry, *L. aspera* more in mesic prairies (cf. Curtis 1955, graph p. 563), with the latter species blooming somewhat later, though blooming dates overlap considerably.

6. LIATRIS CYLINDRACEA Michx. Blazing Star. Map 15.

Stems slender, usually unbranched, glabrous to very sparsely puberulent, 2–5(–6) dm tall, from a globose corm. Leaves glabrous to sparsely ciliate beneath or on the basal margin, 9–22 cm long, 3–5(–7) mm wide, numerous and ascending. *Inflorescence racemose, the cylindrical heads short pedunculate, subtended by a leafy bract. Corollas* purple (rarely pink or white), *pubescent on the* *inner surface.* Involucre 1–2 cm high, 6–11 mm wide, the *bracts purple to green with closely appressed, ovate, mucronate tips.* Achenes (4.5–) 5–7.5 mm long. *Pappus gray, plumose.* 2n=20 (Gaiser 1951).

A species of dry sandy soils, extending from the East Coast to the Mississippi River, in Wisconsin reaching greatest prevalence on dry prairies south of the "Tension Zone" (Curtis 1959), also on dry limestone bluffs, sandy river banks, rarely on roadsides on railroads, the range extensions north into Burnett County [there with *Petalostemum villosum* at its eastern-most extension (Fassett 1939)] and Marinette County correlated with the presence of dry sandy areas. Flowering from mid-July to early September (–October); fruiting from August to September (–October).

7. LIATRIS PUNCTATA Hook. var. NEBRASKANA Gaiser Map 14.

Stems slender, glabrous, 3–5 dm tall, several to many from a *stout vertical underground stem. Leaves numerous, stiffly ascending,* glabrous to sparingly ciliate on the margins, the lower ones 6–15 cm long, 1–2 mm wide, *conspicuously punctate.* Inflorescence a dense to loose spike, the heads narrowly cylindric. Involucral bracts ovate-acuminate, appressed *except for the spreading acuminate tip, densely punctae,* 1–1.5 cm high, the margins usually long ciliate. Achenes (4–) 6–8 mm long. *Pappus plumose.* 2n=20 (30) (Gaiser 1950).

Rare in the state in sand prairie relics and on sandstone bluffs and terraces along the St. Croix and Mississippi Rivers in St. Croix and Pierce Counties. Flowering in August; fruiting in August and September. The typical variety, to the west and south, has broader leaves with conspicuous ciliate margins.

TRIBE VIII. VERNONIEAE CASS.

Perennials with watery juice. *Flowers all tubular, perfect, purple;* style branches filiform, acute or acuminate, hispidulous. *Leaves alternate.* Pappus bristly, brown.

45. VERNONIA Schreb. IRONWEED

1. VERNONIA FASCICULATA Michx. Ironweed. Map 16.

Perennials 9–16 dm tall, with scaley underground offshoots, glabrous throughout, the stems often purplish. Leaves numerous, lanceolate to lancelinear, long-acuminate, sharply and finely toothed, 9–15 cm long, 1–3 cm wide, the *underside densely punctate* (10X). Inflorescences dense, flattopped, the numerous heads on short, thin, tomentose peduncles. *Involucral bracts numerous, green or purple, closely appressed and imbricate.* Heads 18–25 flowered, the *corolla rich purple.* Achenes cylindrical, farinose between ribs. *Pappus bristles purple when young, becoming brown,* 6–7 mm long.

Locally abundant south of the "Tension Zone", occasional in the North, especially in wet-mesic prairies (Curtis 1959), tall forb communities along railroads, open lake shores and river banks, open river bottom forests, swamps and marshes, and often a prominent weed in low overgrazed pastures. Flowering from mid-July into September (peak in early August); fruiting from late July through September (peak in late August).

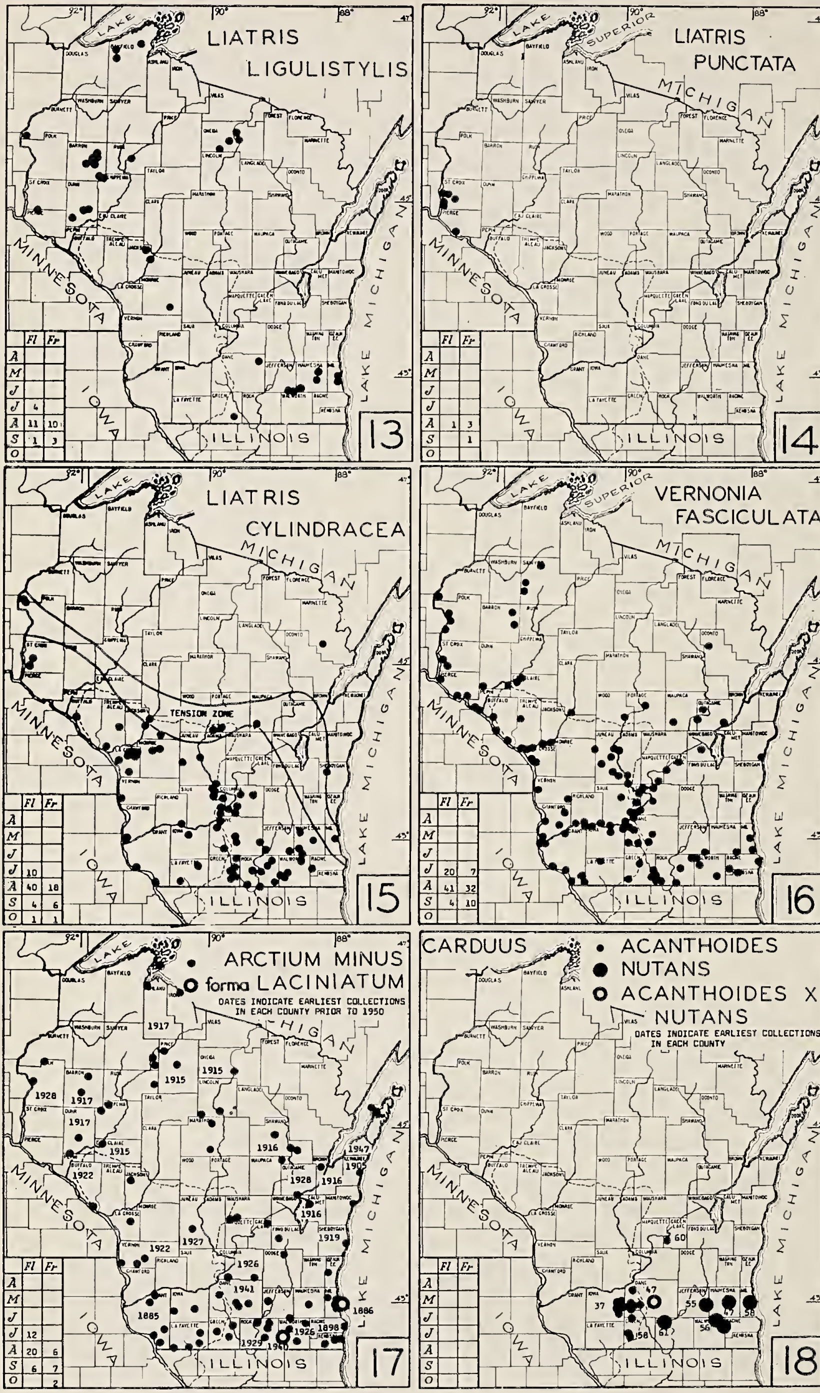
VERNONIA CRINITA Raf., a perennial, whose large round heads have loose involucral bracts with elongate linear tips, a native of Missouri, Kansas, Arkansas and Oklahoma, reputedly has been collected once in Wisconsin; Manitowoc Co.: Cleveland, along railroad, August, 1907 [fl] *Goessl s.n.* (WIS), a record possibly based on error. *Vernonia altissima* Nutt. and *V. missurica* Raf. have been collected from the Illinois counties bordering Wisconsin within the past five years, and may soon be expected in southern Wisconsin.

TRIBE XI. CYNAREAE Spreng.

Annuals, biennials or perennials with basal rosettes or alternate cauline leaves. *Corollas all tubular, often deeply cleft, purple, rarely blue, yellow or white. Style bearing ring of hairs or thickened ring, above which the branches are papillate and stigmatic to the tip. Anther bases tailed.* Heads globose to campanulate, the involucre imbricated, the bracts tipped with spines, hooks, or appendages, Achenes stout, truncate, the pappus bristly.

KEY TO GENERA

A. Achenes attached by the base to the receptacle; flowers all alike; bracts entire, sometimes hooked or spiny, not laciniate at tip; pappus various, usually more than 5 mm long.
  B. Leaves broadly rounded at base, unarmed; involucral bracts terminated by a hook *(Burdocks)* -- 46. ARCTIUM.
  BB. Leaves lanceolate to ovate, prickly, the bases decurrent or not; involucral bract each terminated by a rounded or flattened straight spine or merely mucronate *(Thistles)*.
    C. Involucral bracts with needle-like spiny tips or merely mucronate, often with a glutinous ridge on back; pappus plumose -------------------------- 48. CIRSIUM.


LIATRIS
LIGULISTYLIS
13
LIATRIS
PUNCTATA
14
LIATRIS
CYLINDRACEA
TENSION ZONE
15
VERNONIA
FASCICULATA
16
ARCTIUM MINUS
forma LACINIATUM
DATES INDICATE EARLIEST COLLECTIONS IN EACH COUNTY PRIOR TO 1950
17
CARDUUS
ACANTHOIDES
NUTANS
ACANTHOIDES X NUTANS
DATES INDICATE EARLIEST COLLECTIONS IN EACH COUNTY
18
MINNESOTA
IOWA
ILLINOIS
LAKE MICHIGAN
LAKE SUPERIOR
MICHIGAN

CC. Involucral bracts with flattened spiny tips, not glutinous; pappus barbellate to capillary.
D. Leaves and stem wings glabrous or nearly so; pappus capillary; receptacle bristly --47. CARDUUS.
DD. Leaves and stem wings densely cottony-velutinous; pappus barbellate; receptacle fleshy, not bristly ------------------------------49. ONOPORDUM.
AA. Achenes obliquely attached to the receptacle; marginal flowers often enlarged and ray-like; bracts often deeply cleft on margins of tip (laciniate), the tip occasionally spiny; pappus mostly less than 3 mm long or lacking ----50. CENTAUREA.

46. ARCTIUM L. Burdock

Robust biennials with large long-petioled ovate-cordate leaves pilose-villous and atomiferous beneath. Heads numerous, the purple flowers tubular and perfect, the involucre globose with the firm, lanceolate bracts *terminated by a hook, the whole head breaking off as a bur.* Achenes flattened, irregularly furrowed; pappus of minute coarse bristles. Old World genus; all our species introduced weeds.

Key to Species

A. Heads 1–1.6 cm high, (1.5–) 2–2.5 cm wide, subsessile or short pedunculate, in a racemose inflorescence; common weed --1. *A. MINUS.*
AA. Heads 1.5–2.5 cm high, 1.5–2.5 cm wide, long pedunculate, in a corymbose inflorescence; rare weeds.
B. Heads 1.5–1.7 cm high. 1.5–2.1 cm wide, the bracts densely cottony-pubescent ---------------2. *A. TOMENTOSUM.*
BB. Heads ca. 2.5 cm high, 3–3.5 cm wide, the bracts glabrous --------------------------------------3. *A. LAPPA.*

1. Arctium minus (Hill) Bernh. Common Burdock. Map 17.

Coarse robust biennials, 2 m tall or more, branched above. Basal rosette leaves large, broadly ovate-cordate, cottony and frequently atomiferous to glabrate beneath, glabrous to floccose above, entire. Heads numerous, crowded on mostly very short peduncles; corolla rose to purple. Involucre 1–1.6 cm high, (1.5–) 2–2.5 cm. wide (from tip to tip of bracts); bracts glabrous or arachnoid, linear, rigid, with hooked tips, usually exceeding the corollas. Achenes 4.5–5 mm long, irregularly rugulose. 2n=32 (Wulff 1937, ex Darlington 1955).

Native to temperate Europe and east to the Caucasus, naturalized in Wisconsin as a weed indicative of nitrogenous soils (Curtis 1959), common in roadside communities, abandoned fields, heavily grazed pasture, and often along cow paths and other disturbed habitats where relatively free from competition. Flowering from July through September (–November), fruiting from August through November.

ARCTIUM MINUS forma LACINIATUM Clute, rare in Wisconsin, has abnormal leaves variously lobed, cleft, irregularly toothed, or reduced to the midrib, and immature sterile heads, and is evidently caused by a virus infection. That such plants may reoccur in the same area for consecutive seasons is shown by *Wadmond s.n.*, Sept. 3, 1940 and August 9, 1942, both from the same vacant lot in Delavan.

2. ARCTIUM TOMENTOSUM Mill. Hairy Burdock.

Similar to *A. minus,* but inflorescences corymbose, the bracts densely cottony-pubescent. 2n=36 (Poddubnaja 1944, ex Darlington 1955).

Native to temperature Europe, Caucasus and Siberia (Hegi), in the United States more common to the south and east. Collected three times in Wisconsin: Ashland Co.: Weed at Berkshire Mine, Mellen, Sept. 7, 1927 [fr], *Fassett 10084* (WIS); Town of Morse, Aug. 31, 1939 [fl], *McIntosh c-812* (MIL, WISM). Fond du Lac Co.: Campbellsport, near railroad sta., Aug. 1911 [fr], *Ogden 24994* (MIL).

3. ARCTIUM LAPPA L. Great Burdock.

Similar to *A. minus, but with larger glabrous heads 3–3.5 cm wide,, 2.5–3 cm high, on long peduncles in corymbose inflorescences.* 2n=32 (Darlington 1955).

Native of temperate Eurasia, collected but twice in Wisconsin: Iowa Co.: Roadside, July 27, 1961 [fl], *Brady & Maduewesi s.n.* (WIS). Lincoln Co.: Abandoned farm, Harrison Twp. *Seymour 12693* (WIS).

47. CARDUUS L. PLUMELESS THISTLE

Spiny-leaved herbs closely resembling *Cirsium,* but distinguished by the non-plumose, capillary pappus.

Key to Species

A. Involucre 2.8–3 cm high, the heads solitary; peduncles wingless immediately beneath the head ____1. *C. NUTANS var. LEIOPHYLLUS.*

AA. Involucre 1.5–1.7 cm high, the heads clustered; peduncles winged immediately beneath head ____2. *C. ACANTHOIDES.*

1. Carduus nutans L. var. leiophyllus (Petrovic) Arenes
Smooth Nodding Thistle; Musk Thistle. Map 18.

Robust biennial 1–2 m tall, the *large solitary heads with showy purple corollas.* Leaves lanceolate to oblanceolate, shallowly to deeply undulate-pinnatifid, *the primary and secondary lobes obtuse, armed with stout, white spines,* glabrous, the bases decurrent forming *spiny wings along the stem except on the cottony peduncles.* Heads 5–8 cm wide; involucre 1.5–3 cm high; bracts glabrous, *wide above, contracted near the base and reflexed,* tapering to a stout spine. Achenes ca 3.5 mm long, yellowish, slightly furrowed. 2n=16 (Poddubnaja 1931, ex Darlington 1955).

Native to Europe, Asia and Northern Africa, in SE Wisconsin a recent introduction (see map), rare though locally abundant in Jefferson, Waukesha and Walworth counties, where it may produce impenetrable stands in abandoned hog pastures [cf. *Johnson, Beery, & F. S. Iltis* 27–61 (WIS) from near Troy], and sporadic in disturbed fields or roadsides, Flowering from mid-June to early July; fruiting from mid-June to August.

The typical variety, not known from Wisconsin, has pubescent leaves, smaller heads and cobwebby involucral bracts.

2. Carduus acanthoides L. Plumeless Thistle. Map 18.

Very spiny annuals or biennials, usually less than 1 m tall. Leaves lanceolate, deeply undulate-pinnatifid, the acuminate lobes armed with stiff yellowish spines, glabrous to sparsely pilose beneath, *the bases decurrent, forming several conspicuous spiny wings along the entire stem. Heads clustered;* involucres 1.5–1.7 cm high, *the bracts narrow, erect,* the corollas bright rose-purple. Achenes 2.5–2.7 mm long, tannish and shallowly furrowed. 2n=22 (Poddubnaja 1931, ex Darlington 1955).

Native of Europe and Southern Russia (Hegi), very recently introduced and only locally abundant in south-central Wisconsin where becoming a serious pest, mainly in valley bottom pastures and grazed calcareous hillsides in Iowa and Green Co's., on railroads and prairies in Dane Co., and near Marquette [Green Lake Co.:

Ugent s.n. (WIS)] in open oak-maple woods, on thin soil at base of granite outcrops, with *Oenothera biennis, Celastrus scandens, Circaea quadrisulcata,* and *Geum canadense!* Flowering from mid-July to early August; fruiting to September.

Resembling *Cirsium vulgare* and *C. palustre* in the spiny stem wings, but differing from *C. vulgare* by less spiny involucres and the capillary pappus, and from *C. palustre* by larger, less clustered heads and the capillary pappus.

3. CARDUUS ACANTHOIDES L. X CARDUUS NUTANS L. Map 18.

Plants pilose to cottony above, the leaves sparsely pilose at least on the lower midrib, deeply pinnatified, the lobes terminated by yellowish spines, the bases decurrent, *forming wings immediately below the head on one peduncle (branch), but with wings absent below the other heads of the plant;* heads somewhat clustered, the involucre ca. 2 cm high.

This description is based on *Zimmerman 1879* from a Dane Co. pasture (T6N, R9E, S.3), Aug. 3, 1947 (WIS), the only Wisconsin collection.

Moore and Mulligan (1956) determined hybrid populations naturally occurring in Canada by evaluating morphological variation and erecting the following hybrid index:

CARDUUS ACANTHOIDES		ZIMMERMAN 1879	CARDUUS NUTANS	
Heads clustered	0	1	Heads solitary	2
Heads erect	0	2	Heads nodding	4
Peduncles spiny-winged	0	2	Peduncles not spiny winged	4
Phyllaries spreading	0	2	Phyllaries reflexed	4
Phyllaries marked	0	1	Phyllaries unmarked	1
Phyllaries not contracted	0	2	Phyllaries contracted at base	4
	0	10		19

Using this hybrid index, "typical *C. acanthoides* has an index of O and typical *C. nutans* has an index of 19 points. Hybrids would have intermediate values. First generation hybrids might be expected to have an index in the middle of the range, for example 7–11; later generations or backcross hybrids might have an index approaching that of one of the parental species." The hybrid index value suggests that the Wisconsin specimen is a first generation hybrid.

48. CIRSIUM Mill. THISTLES

Spiny biennials or perennials. Leaves alternate, sessile, usually pinnatifid and spiny. Flowers all tubular, perfect, or (in *C. arvense)* dioecious, rose to purple, rarely white or cream. Involucral bracts imbricated in many rows, at least the outer ones tipped with a spine or mucro, often with a glutinous dorsal ridge. Pappus plumose. Name from the Greek, applied by Dioscorides to a thistle used as a reputed remedy for varicose veins.

KEY TO SPECIES*

A. Involucral bracts distinctly spine-tipped (at least the outer and middle), the spine usually more than 2 mm long, but when very short the larger involucres 20 mm or more in diameter.

B. Leaves scabrous-hispid or crisped-hispid and also sometimes silky-pubescent above, more or less cobwebby and sometimes crisped-hispid or tomentose beneath.

C. Leaves scabrous-hispid above, sparsely to densely cobwebby beneath, the cauline conspicuously decurrent;[7] involucral bracts herbaceous, spreading, gradually tapered into elongate spiny tips, lacking a dorsal glutinous ridge; common introduced weed __1. *C. VULGARE.*

CC. Leaves crisped-hispid with multicellular hairs and also sometimes sparingly silky-pubescent above, not decurrent, the stems not winged; involucral bracts not herbaceous, appressed, with a dorsal glutinous ridge.

D. Leaves crisped-hispid on both surfaces, green; involucral bracts with an erect apical spine; involucres 30–50 mm high; stem 3–5 dm tall, from persistent basal rosettes; dry or mesic prairies, rare. ________________________________2. *C. PUMILUM*

DD. Leaves crisped-hispid above, white-tomentose beneath; involucral bracts with an abruptly spreading apical spine; involucres 25–35 mm high; stem mostly 6–15 dm tall, the basal rosettes not persistent.

E. All leaves deeply lobed (except in juvenile forms), the lobes linear-acuminate, terminating in stout spines, the thickish margins involute; involucral spines 3–7 mm long; plants mostly of open places ______________3. *C. DISCOLOR.*[8,9]

EE. Leaves shallowly lobed, irregularly dentate, serrate or entire, with small, weak spines, the margins thin, not involute, the lower leaves (and

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* In the construction of this key, the help of Dr. Gerald Ownbey is gratefully acknowledged.

[7] See also *Carduus acanthoides.*

[8] F_1 hybrids with *C. muticum* have involucral spines averaging 1.3 mm long, intermediate corolla color, and very low fertility (see text).

[9] *Cirsium discolor* also hybridizes with *C. altissimum* (see text).

those of juvenile forms) sometimes deeply lobed, then lobes wide, broadly acute; involucral spines 2.5–4.5 mm long; plants mostly of woods ------ ------------------------4. *C. ALTISSIMUM.*[9]

BB. Leaves white-tomentose on both surfaces, often more thinly so above, totally lacking hispidity; dorsal glutinous ridge present on involucral bracts.

F. Leaves not decurrent on stem or only very shortly so (to 1 cm), the lobes lanceolate or deltoid; corollas purple or lavender, rarely white; rare introduced weeds.

G. Leaves narrowed to the base, rarely clasping; anthers 6.5–11.8 mm, florets 21–36 mm long, achenes 3.5–5 mm long, yellowish brown with apical yellow band ca ½ mm wide; involucres 20–27 mm high, the bracts narrow and slender; leaves lobed nearly to midrib, the lobes narrowly triangular, usually less than 7 mm wide at base; plants strongly perennating by root sprouts. ----------5. *C. FLODMANII.*

GG. Leaves broadest near the base, partially clasping; anthers 9.4–13.3 mm, florets 27–40 mm long, achenes 5–7 mm long, brown, the yellow apical band lacking or very narrow; involucres 30–35 mm high, the bracts broad and stout; leaves shallowly lobed, the lobes broadly triangular, usually more than 7 mm wide at base; plants weakly perennating by root sprouts. ------------------6. *C. UNDULATUM.*

FF. Middle cauline leaves conspicuously decurrent, the narrowly linear to oblong lobes very distant, the leaf blade divided nearly to the midrib, the decurrent wing often similarly lobed; corollas cream-colored; plants not conspicuously spinescent; dunes of Lake Michigan ------ ---------------------------------7. *C. PITCHERI.*

AA. Outer and middle involucral bracts with at most a short spine or mucro, this up to 1 mm long (and then involucre about 10 mm in diameter).

I. Biennials (at least monocarpic); flowers perfect; plants of moist habitats.

J. Leaf bases strongly decurrent into prominent wings on stem; heads many, sessile or sub-sessile, crowded into a dense terminal inflorescence; involucre 9–12 mm high, the bracts neither conspicuously glutinous nor cobwebby; rare, N. Wisconsin ---------------10. *C. PALUSTRE.*

JJ. Leaf bases not decurrent; heads solitary or several, pedicellate, not crowded; involucre 22–27 mm high, 12–19 mm wide at base when in flower, cobwebby with prominent glutinous dorsal ridge; wet prairies and sedge meadows, common .... 9. *C. MUTICUM.*[8]

II. Perennials from proliferating underground parts; heads numerous, crowded in 2's to 4's or short pedunculate; involucre 10–20 (–26) mm high, 8–11 mm wide at base when in flower, the bracts usually glabrous and with a narrow dorsal glutinous ridge; very common weed .... 11. *C. ARVENSE.*

1. CIRSIUM VULGARE (Savi) Airy-Shaw Bull Thistle. Map 19.
Cirsium lanceolatum (L.) Scop.

Very spiny robust biennials 1–2 m tall, with taproots. Leaves oblong-lanceolate to obovate, white-arachnoid to subglabrous and green beneath, *scabrous-hispid and appressed-spinulose above, undulate-pinnatifid,* the lobes and tip acuminate with firm, straw-colored spines, *the bases decurrent into conspicuous spiny wings.* Corollas deep rose-purple; involucre 2.5–3.5 (–4) cm high, *the herbaceous bracts widely divergent from near or below the middle,* all long-attenuate into a stout spine. Achenes 3–4 mm long, yellow-brown, finely striped with black. 2n=68 (Löve & Löve 1948).

An abundant aggressive weed throughout Wisconsin, on roadsides, grazed pastures, and disturbed open or wooded areas, becoming less abundant in wet to mesic prairies, marshes, bogs or swampy woods. Flowering from mid-July to early October; fruiting from late July to mid-October.

2. CIRSIUM PUMILUM (Nutt.) Spreng. Small Prairie Thistle; Hill's Thistle. Map 20.
Cirsium Hillii (Canby) Fernald

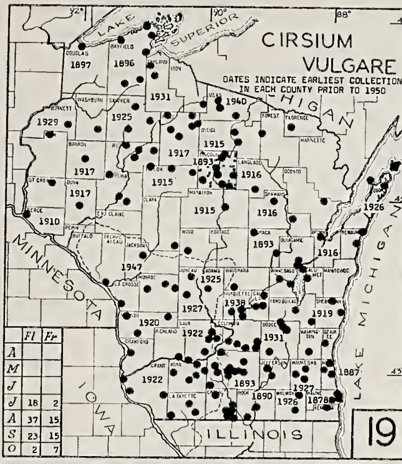
Stout stocky spiny perennials 2–5 dm tall, from a deep, hollow taproot, to 7 dm long. *Stem prominently and densely white-pilose,* each of the 1–3 (–5) branches terminated by a *single large purple-flowered head.* Cauline and basal rosette leaves green, sparsely crisped-hispid above and beneath, oblanceolate, repand to shallowly or deeply undulate-pinnatifid, the lobes oblong, rounded to acute with spiny margins. Heads light rose-purple; involucre (3–) 3.5–4.6 cm high, the bracts lanceolate, with a dark glutinous dorsal ridge (difficult to determine in old heads), loosely appressed, the outer tipped by short spines. Achenes (3–) 3.5–5 mm long, light brown, yellow at the base of pappus. 2n = 30 (Ownbey and Hsi 1963).

S. and SW. Wisconsin, now rare and local on dry, steep, calcareous hill prairies, as well as in deep soil or sandy prairie relics along railroads, apparently introduced in Douglas and Racine Counties and probably also in Marinette County. Flowering from mid-June through July (–August); fruiting from late July to mid-August (–September). This beautiful and very characteristic species of dry prairies needs protection from extinction.

C. pumilum, the name long applied to the eastern population, has been adopted for ours as well, since the supposed differences between it and *C. hillii* seem rather trivial. Frankton and Moore annotated all our material in 1962 with this name. However, Ownbey and Hsi (1963) state that "*C. hillii* is perennial by means of root and crown spouts and this has been and still remains the most useful way to distinguish it from its closest relative, *C. pumilum* (Nutt.) Spreng., a biennial." Whether these differences are ecotypic (genetic) or phenotypic (enviromental) remains to be seen. It is of interest to compare this situation with that in *C. canescens* (cf. Ownbey and Hsi 1963), where the monocarpic form *(C. plattense,* which blooms once after two or three years and then dies) is restricted to the open, unstable sandy habitats of Nebraska's "Sandhills", while the perennial form *(C. canescens s.s.)* is more widespread westward and north; i.e. the monocarpic form occurs in the ecologically open habitat, while the perennial form in the more closed prairie communities, communities which are characterized by plants of perennial habit, and have very few annuals or biennials. Perhaps *C. pumila* exhibits a homologous variation in growth form, in that the plants (ecotypes) adapted to the prairie habitat (i.e. *C. hillii)* have been selected towards the perennial habit, thus circumventing the yearly difficulties of establishment in a closed community, while the mostly eastern populations *(C. pumilum sensu stricto)*, growing in sand, fields or other ecologically open habitats, can "afford" to be biennial (monocarpic).

3. CIRSIUM DISCOLOR (Muhl.) Spreng. Prairie Thistle Map 21.

Very spiny biennials 1–3 m tall, with taproot and spreading fibrous lateral roots. Stem deeply ridged, sub-glabrous to glabrous, much branched. Leaves ovate to lanceolate, 11–40 cm long, *all deeply undulate-pinnatifid, the caudate-acuminate primary and secondary lobes tipped by elongate yellow spines, the margins more or less strongly revolute, densely white-woolly beneath,* crisped-hispid to subglabrous above. Heads with *rather light rose-purple corollas* [white in the rare *forma* ALBIFLORUM (Britt.) House], usually solitary at the end of leafy branches. Involucre 2–3.5 cm long, the *bracts lanceolate* with narrow glutinous ridge, *acute, the outer abruptly contracted into slightly reflexed or divergent slender*


CIRSIUM
VULGARE
DATES INDICATE EARLIEST COLLECTIONS
IN EACH COUNTY PRIOR TO 1950
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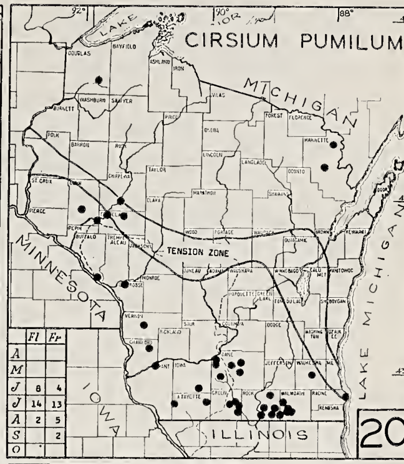
MICHIGAN
MINNESOTA
IOWA
ILLINOIS
LAKE MICHIGAN
19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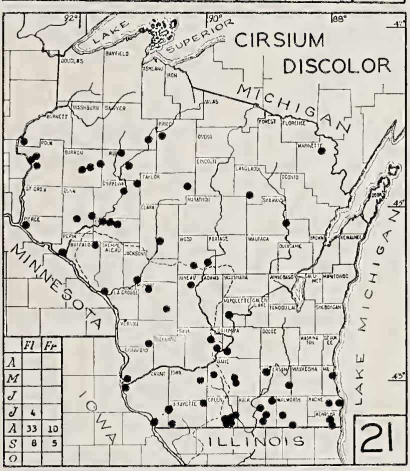
TENSION ZONE
LAKE SUPERIOR
MICHIGAN
MINNESOTA
IOWA
ILLINOIS
LAKE MICHIGAN
20


CIRSIUM
DISCOLOR
LAKE SUPERIOR
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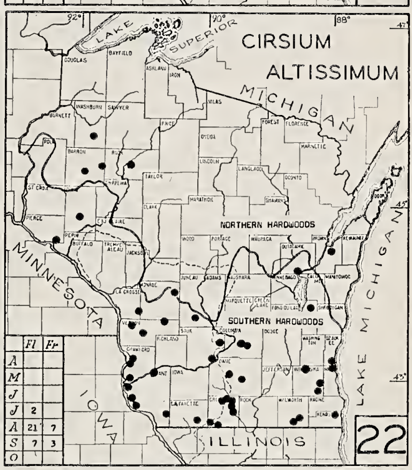
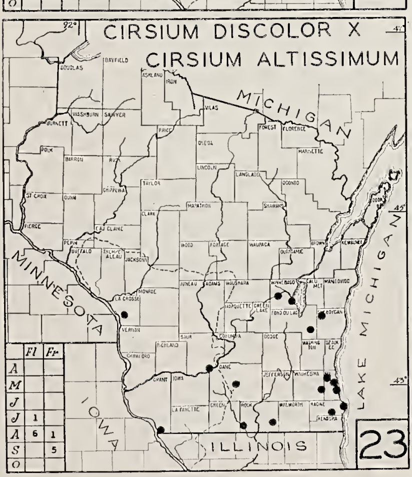
MINNESOTA
IOWA
ILLINOIS
LAKE MICHIGAN
21


CIRSIUM
ALTISSIMUM
NORTHERN HARDWOODS
SOUTHERN HARDWOODS
LAKE SUPERIOR
MICHIGAN
MINNESOTA
IOWA
ILLINOIS
LAKE MICHIGAN
22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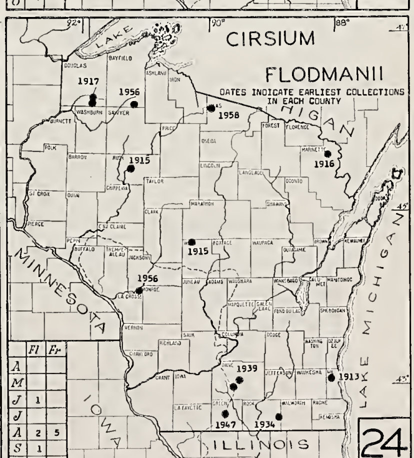
CIRSIUM ALTISSIMUM
MICHIGAN
MINNESOTA
IOWA
ILLINOIS
LAKE MICHIGAN
23


CIRSIUM
FLODMANII
DATES INDICATE EARLIEST COLLECTIONS
IN EACH COUNTY
LAKE
MICHIGAN
MINNESOTA
IOWA
ILLINOIS
LAKE MICHIGAN
24

spines 3–7 mm long, the inner with erose-scarious tips. Achenes 4–5 mm long. 2n=20 (Ownbey 1951).

Not uncommon in S and SW Wisconsin in sunny habitats, in wet to mesic-dry-prairies, an indicator of mesic prairie (Curtis 1955, 1959), often on railroads, lake shores, in sedge meadows, and occasionally weedy in roadside ditches and well-drained, light soil. Flowering from mid-July to early September; fruiting from early August through September.

This species hybridizes with *Cirsium altissimum.*

4. CIRSIUM ALTISSIMUM (L.) Spreng. Wood Thistle. Map 22.

Robust biennials 1–3 m tall, the stems pilose-puberulent, weakly ridged, mostly unbranched except in the inflorescense. *Leaves broadly oblanceolate to elliptic, unlobed and serrate or shallowly lobed,* the large lower basal ones rarely pinnatifid, especially at the base of blade, the lobes wide and broadly acute, 9–40(–70) cm long (including long petiole of basal leaves), 3–19 cm wide, *the margins with weak prickles, densely white-tomentose beneath,* glabrate to pilose and crisped-hispid above. Heads nearly identical to those of *Cirsium discolor,* one to several on leafy peduncles; corollas pink-purple; involucre 2–2.7 cm high, *each outer bract with a dark glandular ridge, obtuse, abruptly contracted into a slender spine 2–4 mm long,* the inner-most bracts attenuate, with scarious, entire tip. Achenes 3.5–5 mm long. 2n = 18, 20 (Ownbey and Hsi 1963).

Mostly in the southern Wisconsin hardwood forests, reaching greatest abundance in the southern dry-mesic forest (Curtis 1959), in Red, Black and White Oak communities, in E. Wisconsin frequently in maple-beech woods and shady wooded ravines, occasionally along roadsides and railroads. Flowering from (mid-July) August through September; fruiting from mid-August through September.

Similar to *Cirsium discolor* in its heads, leaf pubescence and spine-tipped involucral bracts (which average a little shorter), but differing in the mostly unlobed leaves (especially the upper), and a preference for mesic woods.

The morphological intergradation between these species is probably due to introgressive hybridization. Specimens of *Cirsium altissimum* (Map 23) with at least some leaves pinnatifid and bearing longer prickles resemble *C. discolor,* and lend support to Cronquist's (1952) suggestion that these two species are part of one continuum. Most floras recognize two species, however. Both Ownbey and Davidson (1963), the latter in a very careful study, have detailed evidence of hybridization, the former stating that he had "conclusive proof that *Cirsium discolor* and *Cirsium altissimum* hybridize in Wisconsin. On the basis of herbarium specimens one may, however, encounter considerable difficulty in distinguishing the putative hybrids from more extreme forms of *Cirsium altissimum*".[10]

5. CIRSIUM FLODMANII (Rydb.) Arthur Flodman's Thistle
Cirsium canescens sensu Gleason 1952, not Nutt. Map 24.

Slender woolly-stemmed perennial 3–6(–9) dm tall, spreading prolifically by root sprouts. Leaves lanceolate, *densely permanently white-woolly beneath*, less so and often glabrate above, subentire to deeply undulate-pinnatifid (then very spiny), the *lobes narrowly lanceolate to triangular, usually less than 7 mm wide at the base* (rarely wider in rosette leaves), ending in firm yellow spines. *Heads with bright purple corollas*, the involucre 2–2.7 cm high, *the narrow bracts to 2.5 mm wide, glutinous-ridged and flocculose*, the outer abruptly contracted, the apical spines divergent, the inner acuminate. Achenes 2.5–3.5 mm long, *light brown with a distinct yellow apical band more than ½ mm wide.* 2n=22 (D. Löve, ex Frankton 1955).

Native of the Great Plains, recently introduced in Wisconsin on sandy roadsides, along railroads, and disturbed areas, and rarely established in native prairie [*Shinners 1173*, Dane Co. (WIS)]. Flowering from late June to early October; fruiting from August through October. This species is very similar to the more robust *C. undulatum*. A careful analysis of their differences may be found in Frankton and Moore (1961).

6. CIRSIUM UNDULATUM (Nutt.) Spreng. Map 25.
Cirsium undulatum (Nutt.) Spreng. var. *megacephalum* (Gray) Fern.

Stout, white-woolly stemmed perennials 3–7 dm tall. Leaves lanceolate to oblanceolate, *tomentose beneath*, more thinly so above, *shallowly lobed to undulate-pinnatifid, the lobes broadly triangular, usually more than 7 mm wide at base*, ending in a short, firm spine, *the lower midrib conspicuous*. Heads solitary to several with pink-purple corollas; involucre 3–3.5 cm high; *bracts 2–4 mm wide, glutinous-ridged, woolly on the margins, the outer obtuse with a flattened broad-based spine*, the innermost attenuate into erose tips. *Achenes with very narrow yellow apical band.* 2n=26 (Frankton & Moore 1961).

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[10] Using a pollen stain technique, Ownbey recognized one intermediate specimen from Wisconsin [Racine Co.: Clay soil, brush-covered bluff of "Cedar Bend" of Root River, Aug. 24, 1906, *Heddle 279* (WIS)] as "certainly a hybrid, and probably an F_1, as all the pollen in the preparation made was abortive."

Often confused with *Cirsium flodmanii,* but with more shallowly and wider lobed leaves, the middle cauline half-clasping, larger heads, longer florets and anthers, and wider involucral bracts.

Native of the western Great Plains (cf. Frankton & Moore 1961), rarely adventive eastward, in Wisconsin local, very sporadic mostly along railroads and probably not anywhere permantly established. Flowering in June and July; fruiting in August.

Cirsium ochrocentrum Gray, a western Great Plains species, is represented by two sheets (WIS), one from "Prairie du Chien, 1921," and the other from "Marshfield, 1915," both collected by *Chas. Goessl* and appearing as if they came from the same plant. The species, a perennial, resembles *C. undulatum* but with heads like *C. pumilum.* These collections are probably not from Wisconsin.

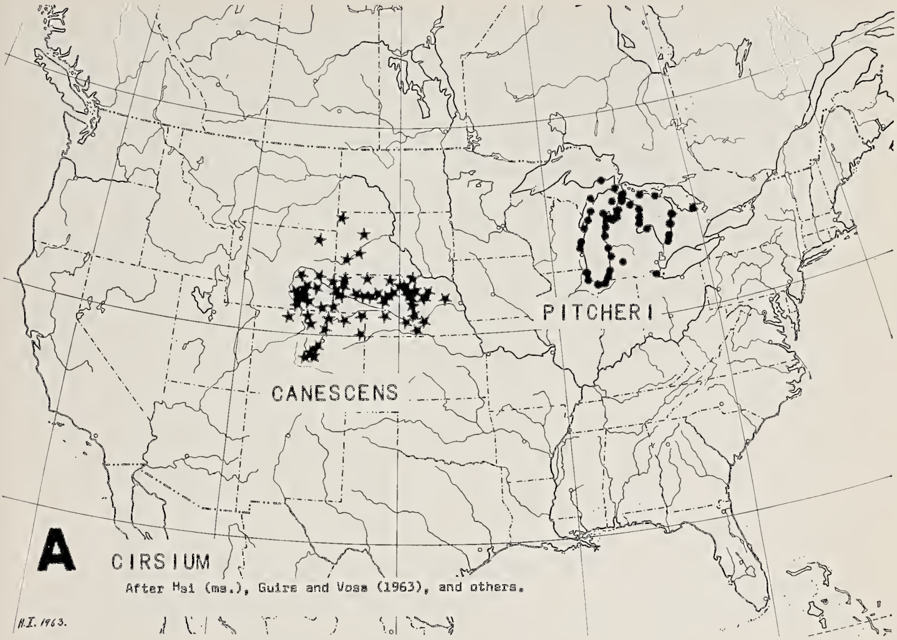
Cirsium canescens Nutt., another Great Plains species, was collected once, by *Chas. Goessl* (*s.n.* & no date, in WIS), in a "R. R. yard, Sheboygan." Like in the above species, this collection was probably not made in Wisconsin either.

7. Cirsium pitcheri (Torr.) T. & G. Dune Thistle. Map 26.

Densely white-woolly biennial (or at least monocarpic) to 7 dm tall, *from a very long straight taproot* to over 20 dm long! Leaves long-petioled, the bases at times decurrent on the stem, *densely woolly beneath,* less so above, *lobed to the midrib, the lobes distant, linear to narrowly oblong,* entire, or rarely with a lateral lobe near base, *terminated by a minute brown bristle. Heads with pale yellow or cream corollas,* solitary to several crowded on the branches. Involucre 2–2.5(–3) cm high, the outer bracts ovate-lanceolate, terminated by short firm spines, the inner lanceolate, terminated by weak spines. *Achenes 6–6.6 mm long,* light brown. $2n = 34$ (Ownbey and Hsi 1963).

A beautiful species, endemic to the outer dunes of the Great Lakes, in Wisconsin restricted to those of Lake Michigan. Flowering from mid-June through July; fruiting from (late June–) July through August (–September).

On the loose sand of the outer dunes, *Cirsium Pitcheri* is often associated with other endemics (mostly neo-endemics) of the dunes, such as *Agropyron psammophilum* Senn & Gillett (=*A. dasystachyum* of Fassett 1951) and *Calamovilfa longifolia* var. *magna,* as well as with *Elymus canadensis, Ammophila breviligulata, Agropyron trachycaulon, Artemisia caudata, Lathyrus maritimus, Oenothera parviflora, Potentilla anserina, Juncus balticus* and occasionally *Cakile edentula,* vars. *edentula* and *lacustris* (cf. Patman & Iltis 1961) and *Corispermum hyssopifolium,* the latter two genera more on the periodically inundated flat beach, where *Cirsium Pitcheri* is rarely found.



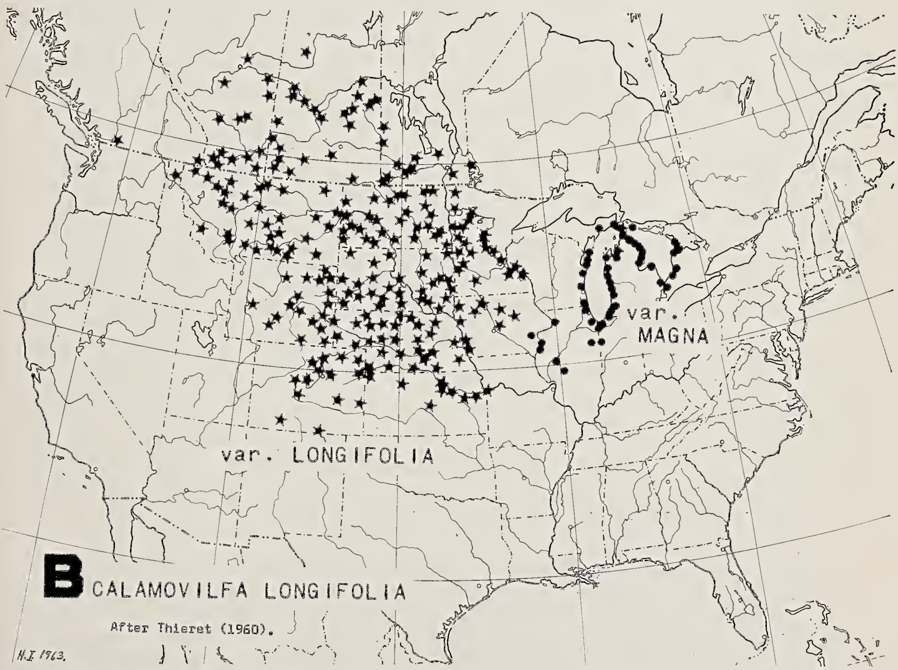


FIG. 2. A DISTRIBUTION OF *Cirsium canescens* AND *C. pitcheri.* (DATA COURTESY OF DRS. EUGENE HSI AND GERALD OWNBEY) B. DISTRIBUTION OF *Calamovilfa longifolia* AND ITS VAR. *magna.* (DATA COURTESY OF DR. JOHN W. THIERET)

Cirsium Pitcheri and the endemic grasses listed above show western affinities. Ownbey (personal communication) is of the opinion that *C. Pitcheri* and certain biotypes of *C. canescens* are closely related. Both have a rather similar ecology,[11] the relevant monocarpic biotypes of *C. canescens (Cirsium plattense* (Rydb.) Cock. ex Daniels) being mostly restricted to the rather unstable sand of the Nebraska "Sandhills" region, and *C. Pitcheri* to the dunes of the Great Lakes. Almost exactly the same relationship holds for the *Calamovilfa* varieties. As a matter of fact, in the Nebraska Sandhills, *Cirsium canescens* commonly grows together with *Calmovilfa longifolia* var. *longifolia,* just as their derived taxa do in Wisconsin. Both thistles die following fruiting. Assuming this relationship, *it is evident that C. Pitcheri must have evolved since the last glaciation about 10,000 years or less ago.* One may postulate that a small, isolated, inbreeding population of *C. canescens,* perhaps only a single seed, was brought to the shores of the Great Lakes sometime after the final glacial recession and became established in this ecologically receptive habitat. With limited genetic material, and lacking opportunity for introgression, this "founder population" (E. Mayr, cf. Goodhart 1963) differentiated rapidly into the strikingly distinct *C. Pitcheri.* The uniformity and environmental severity, as well as the "openess" of the beach habitat need also be considered to account for the rapid speciation and uniformity of this species, as well as for that of the endemic *Calamovilfa, Agropyron* (cf. Senn and Gillett 1961), *Iris lacustris,* and *Hypericum Kalmianum* (cf. also pp. 267–268 of this study).

Even though the historical evidence is circumstantial, considering the glacial history of the Great Lakes and the highly peculiar ecological situation of the lakeshores, these species do furnish the evolutionist with the rare opportunity to evaluate accurately evolutionary rates, in this case rapid speciation. The Dune or Pitcher's Thistle is therefore *one of Wisconsin's most interesting species, deserving protection from eradication,* especially from the well-meaning but botanically uneducated owners of lakeshore cabins, and from unsophisticated weed specialists and county agents, to whom any thistle is a "weed." Unless protection is given to its last remaining colonies in Door County, the Dune Thistle will, like many other of Wisconsin's native plants, become extinct, its beauty and interest notwithstanding. And that would be a pity!

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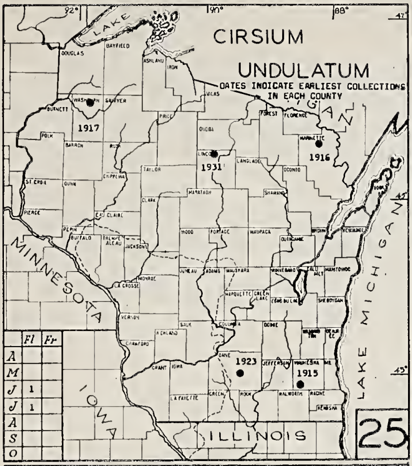
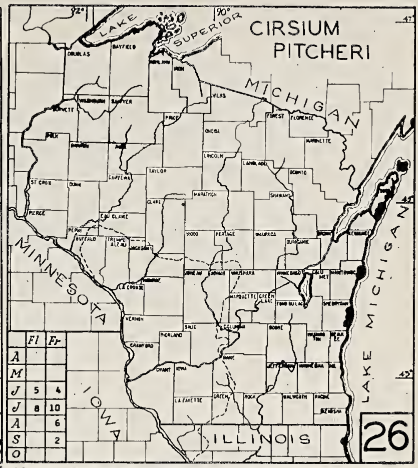
[11] However, "There is something very peculiar about the habitat of *C. Pitcheri.* Why is it confined to the unstable dunes just back of the shore line? *Cirsium canescens,* even in the sandhills, is not so restricted to actively moving sand dunes." (Ownbey 1961, personal communication.) See also the interesting comment on *C. pitcheri* in cultivation by Deam (1940: 1001). We wish to thank Dr. Eugene Hsi, Northland College, Ashland, for the privilege of using his manuscript map of *Cirsium pitcheri.* The map in Guire and Voss' (1963) interesting study of Great Lakes shore plants is nearly identical.


CIRSIUM UNDULATUM
DATES INDICATE EARLIEST COLLECTIONS IN EACH COUNTY
1917
1931
1916
1923
1915
LAKE SUPERIOR
MICHIGAN
MINNESOTA
IOWA
ILLINOIS
LAKE MICHIGAN
Fl Fr
25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LAKE SUPERIOR
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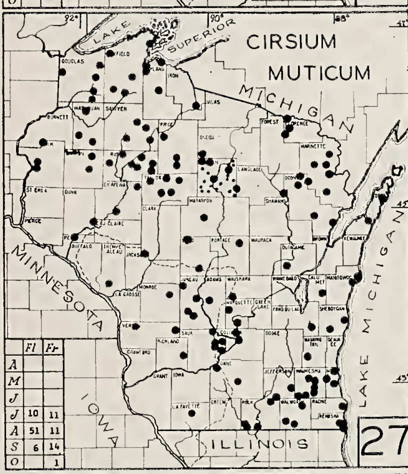
IOWA
ILLINOIS
LAKE MICHIGAN
Fl Fr
26


CIRSIUM MUTICUM
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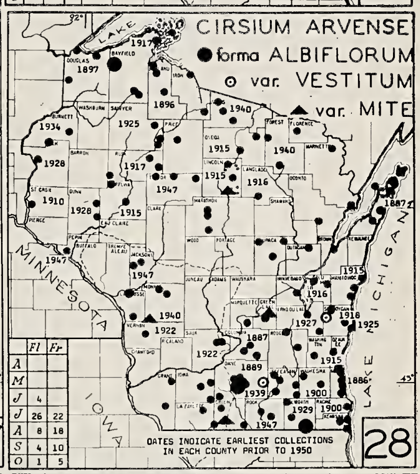
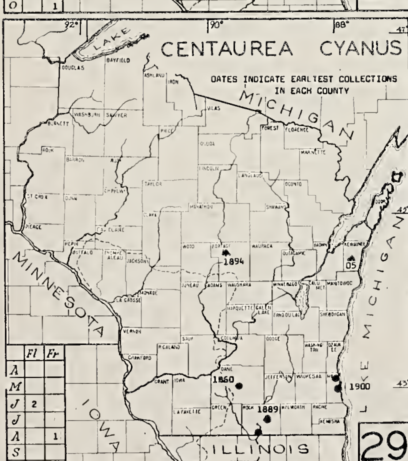
MINNESOTA
IOWA
ILLINOIS
LAKE MICHIGAN
Fl Fr
27


CIRSIUM ARVENSE
forma ALBIFLORUM
var. VESTITUM
var. MITE
DATES INDICATE EARLIEST COLLECTIONS IN EACH COUNTY PRIOR TO 1950
LAKE SUPERIOR
MINNESOTA
IOWA
LAKE MICHIGAN
Fl Fr
28


CENTAUREA CYANUS
DATES INDICATE EARLIEST COLLECTIONS IN EACH COUNTY
1894
05
1860
1900
1889
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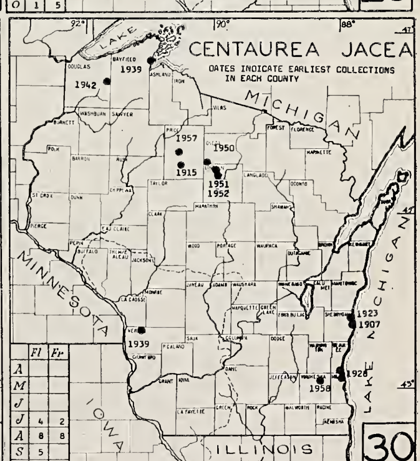
MICHIGAN
MINNESOTA
IOWA
ILLINOIS
LAKE MICHIGAN
Fl Fr
29


CENTAUREA JACEA
DATES INDICATE EARLIEST COLLECTIONS IN EACH COUNTY
1939
1942
1957
1950
1915
1951
1952
1923
1907
1939
1928
1958
LAKE SUPERIOR
MICHIGAN
MINNESOTA
IOWA
ILLINOIS
LAKE MICHIGAN
Fl Fr
30

8. CIRSIUM MUTICUM (Muhl.) Spreng. X CIRSIUM DISCOLOR Michx.

Morphologically intermediate between the parental species. Stem slender, slightly ridged, subglabrous, branching above or simple. Leaves lanceolate to oblanceolate, pinnatifid, *the primary lobes*

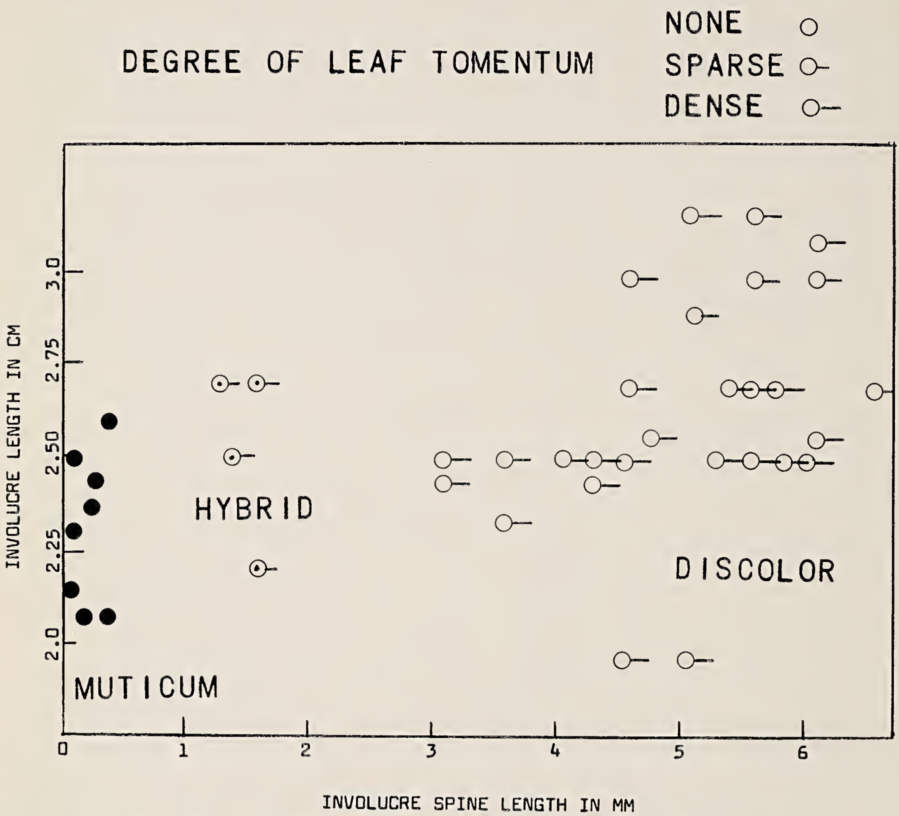


FIG. 3. HYBRIDIZATION BETWEEN *Cirsium muticum* AND *Cirsium discolor.*

lanceolate to cuneate, usually with opposite cuneate to lanceolate secondary lobes, all with short, firm spines, the *pubescence beneath sparsely cobwebby,* sub-glabrous above. Heads *lavender, intermediate between the parental colors.* Involucre 22–27 mm high, *the outer bracts glutinous, short, obtuse, terminated by spines only 1.2–1.5 mm long,* the inner ones elongate-acuminate. Achenes brown, 4–4.5 mm long.

The hybrids are intermediate between the parents in leaf pubescence, flower color, and length of involucral bract spines, as can be seen in Fig. 3. Almost all achenes in the Wisconsin collections are aborted, indicating hybridity. Though their overall ranges overlap, the parents are ecologically isolated, *C. muticum* occurring in wet prairies, *C. discolor* in mesic or dry prairies. Ownbey (1951) showed that in Minnesota the parental species (and with them numerous hybrids) grow sympatrically only where the habitat was disturbed by roadbuilding operations. The Wisconsin hybrids cited below give no indication of any association with the parental forms, though this must be assumed: Dane Co.: Dry hillside, C. & NW. RR, 4 mi. SW. of Madison, Sept. 24, 1939 [fl], *Shinners 1173* (WIS, WISM). La Crosse Co.: Moist acid meadow, Sept. 7, 1956 [fr], *Hartley 3114* (WIS). Marquette Co.: Germania, *Hartwell s.n.* (WIS).

9. CIRSIUM MUTICUM Michx. Swamp Thistle. Map 27.

Robust to slender biennials 8–18(–20) dm tall, with a shallow lateral root system and weak ephemeral taproot. *Stem hollow,* pubescent at base, glabrate above. *Leaves thin,* ovate to lanceolate, 10–30 cm long, *green and sparsely crisped-hispid above, tomentulose beneath, deeply pinnatifid, the lobes lanceolate to oblong-ovate, often with alternate secondary lobes,* tipped with short spines and with prickly margins. Heads with *deep purple corollas* (white in forma LACTIFLORUM Fern.), rather few, mostly solitary or rarely clustered on cobwebby peduncles. Involucre 22–27 mm high, the bracts *cobwebby with very prominent glutinous ridges and without mucronate tips* (or these only 0.1–0.3 mm long [10X]), the outer bracts obtuse, the inner lanceolate with erose tips. Achenes 3.3–4.5 mm long, black. 2n=20 (Ownbey 1951).

Throughout Wisconsin in open moist habitats, most prevalent, especially in the south, in open wet prairies and rather rare in wet-mesic and mesic prairies (Curtis 1955), common in poorly drained soil at the edge of bogs, in wet sedge meadows, there with *Carex* spp., *Solidago uliginosa, S. patula, S. gigantea* and *Spiraea tomentosa,* around springs, and in tamarack swamps, in N. Wisconsin often in most spruce-fir-White Cedar or aspen-Paper Birch woods, usually in highly organic, mucky soil, rarely as a roadside weed in burned, second-growth, sandy woods. Flowering from mid-July to mid-September; fruiting from mid-August to early October.

This species hybridizes with *Cirsium discolor.*

10. CIRSIUM PALUSTRE (L.) Scop. European Swamp Thistle.

Mostly unbranched biennials, 1–2 m tall, with *decurrent leaf bases forming conspicuous green, spiny wings on the stem.* Leaves scattered, lanceolate, pilose beneath, pilose to glabrous above, deeply pinnatifid, the lobes obtuse to lanceolate, terminated by a short, firm spine. *Heads numerous and very crowded,* usually sessile or subsessile, or occasionally on cobwebby peduncles; involucres 9–12 mm high, *the bracts without spine tips,* or the outer and middle with a spine 1 mm or less long; corollas purple. Achenes 2–3 mm long, white. 2n=34 (ex Löve & Löve 1948).

Native of temperate Europe to W. Siberia, weedy in the NE. United States, recently spread to Wisconsin, probably from Northern Michigan, where it has been known since 1935 (cf. Voss 1957: 97). Collected once in Vilas Co.: edge of *Larix laricina, Picea mariana, Ledum groenlandicum, Sarracenia purpurea, Calopogon pulchellus, Vaccinium oxycoccus* sphagnum bog and in adjoining moist to wet roadside ditches, east end of Lac Vieux Desert on Michigan border at entrance to Simpson Estate, July 16, 1961 [fl & fr], *Iltis 18212* (WIS) and seen there again in 1962.

11. CIRSIUM ARVENSE (L.) Scop. Canada Thistle; Creeping Thistle. Map 28.

Spiny perennials from *spreading, extensively creeping underground roots.* Stem slender, 5–10 dm tall, sub-pilose to glabrous. Leaves lanceolate to oblong, generally pinnatifid, the lobes acuminate and spiny margined, tipped by a firm straw-colored spine, or entire with few, short slender spines [in var. MITE Wimm. & Grab.], generally glabrous to woolly-pubescent beneath [in var. VESTITUM (Rand & Redf.) R. Hoffm.]. *Heads most often with pale purple corollas,* rarely white [in forma ALBIFLORUM (Rand & Redf.) R. Hoffm.], *usually crowded in 2's, 3's or 4's on cobwebby, often leafy peduncles, imperfectly dioecious,* the female heads with short corollas and long pappus, the male with long corollas and shorter pappus. Involucre 1–2(–3) cm high, *the bracts numerous, appressed, generally spineless or the outermost with short spines.* Achenes 2–3 mm long. 2n=34 (Ehrenberg 1945, ex Darlington 1955).

A native of Asia and Europe, *not of Canada* (cf. Hegi), in Wisconsin a terrible and ubiquitous weed especially in good, deep agricultural soil. The forms and varieties of this highly variable species are distributed without any apparent geographic pattern. Flowering from late June to early August (to early October); fruiting from early July through late October.

49. ONOPORDUM L.

1. ONOPORDUM ACANTHIUM L. COTTON OR SCOTCH THISTLE.

Robust, sparsely branched *giant* biennials or perennials 1–3 m tall, *cottony-velutinous* and prickly throughout. *Leaves* ovate-elliptic, 10–40 cm long, 4–16 cm wide, *shallowly undulate-pinnatifid, the lobes broadly triangular* with firm terminal spines, *the bases decurrent into very prominent broad spiny wings on the stem. Heads large and solitary, the corollas bright purplish-blue;* involucre 2–3 cm high, the bracts flocculose, tapered to a spine tip. *Pappus barbellate, reddish.* 2n=34 (ex Darlington and Wylie 1955).

Native of Europe and E. Asia, sparsely naturalized over much of the United States, collected once in Wisconsin: Fond du Lac Co.: pasture 2 mi. S. of Waucousta, July 11, 1941 [fl & fr], *Fuller F–41–9* (MIL). Chas. Goessl (WIS) grew it in his Sheboygan garden in 1919.

50. CENTAUREA L. Star Thistle; Bachelor's Button

Annuals, biennials or perennials with alternate, entire to pinnatifid, non-spiny leaves and solitary rose-purple, blue (rarely white or yellow) heads. *Flowers all discoid and perfect,* though the marginal ones at times enlarged, ray-like and sterile. Involucre imbricated, the *bracts tipped with spines or various apical appendages with conspicuous colored or laciniate margins.* Achenes attached laterally to the bristly receptacle.

A large and difficult genus, chiefly Mediterranean, not native to Wisconsin.

Key to Species

A. Involucral bracts tipped by long divergent spines; leaf bases conspicuously decurrent on the more or less winged stem; heads yellow; rare.

B. Central spines of bracts stout, 17–20 mm long, with minute secondary spinules near the terete base ---------------- 1. *C. SOLSTITIALIS.*

BB. Central spines of bracts very slender, 4–6(–9) mm long, with conspicuous secondary spines near their flattened base ---------------- 2. *C. MELITENSIS.*

AA. Involucral bracts variously laciniate, but not spine-tipped; leaf bases not decurrent; heads rose-purple, blue or white.

C. Leaves, at least lower, pinnatifid with linear-elliptic lobes; involucral bracts longitudinally striate, the black-brown acute appendages fringed with 10–14 delicate white to brown teeth; gray-green perenials with rose-purple (rarely white) flowers; common weed ---------- 8. *C. MACULOSA.*

CC. Leaves generally not pinnatifid, but repand, toothed, or entire, the lobes broad; involucral bracts not striate, stramineous to brown, variously fringed.

D. Plants annual; flowers blue or rose-purple.

E. Flowers usually deep blue; involucres 10–15 mm high, ovoid to cylindrical, on slender, mostly leafless peduncles; upper leaves linear, flocculose-pubescent. entire; pappus only 2–3 mm long; common in cultivation ---------------------- 3. *C. CYANUS.*

EE. Flowers rose-purple; involucre 15–30 mm high, subglobose, on very leafy peduncles pronouncedly inflated at the top; leaves broadly lanceolate to oblong-lancelate, scabrous-puberulent, subentire to entire; pappus well developed, 6–10 mm long; rare adventive ------------------ 9. *C. AMERICANA.*

DD. Plants perennial; flowers rose-purple.

F. Involucre yellowish-white or yellowish-green, the outer bracts entire, orbicular, the inner linear-lanceolate with soft plumose tips; pappus capillary, generally 5–11 mm long; involucre 9–12 mm high -------------------------------- 4. *C. REPENS.*

FF. Involucre brown to black, the outer bracts laciniate to pectinate, the inner various, but not plumose; pappus of very short bristles or none; involucre (10–) 13–18 mm high.

G. Outermost involucral bracts deltoid to deltoid-ovate, the dark appendages deeply and regularly cut (pectinate); pappus very short (ca 1 mm) or none.

H. Outer involucral bracts green, the dark triangular pectinate appendage ca 1–3 mm long, not obscuring the inner bracts -------------------------------- 7. *C. VOCHINENSIS.*

HH. Outer involucral bracts dark brown to nearly black, the dark broadly triangular pectinate appendage 3–4 mm long, obscuring the inner bracts --------------------- 6. *C. NIGRA.*

GG. Outermost involucral bracts rounded to rounded ovate, the light brown scarious appendages entire or irregularly toothed to laciniate with very fine irregular cilia; pappus none -- 5. *C. JACEA.*

1. CENTAUREA SOLSTITIALIS L. Yellow Star Thistle; St. Barnaby's Thistle.

Coarse, canescent biennials (or annuals) ca. 5 dm or more tall. Basal leaves repand to pinnatifid, the upper entire, cottony above and beneath, *the winged bases decurrent into undulate wings on stem and smaller branches. Heads yellow; involucre globose, 12–15 mm high;* outer bracts *each terminated by a stiff yellowish spine 17–20 mm long.* 2n=16 (Heiser & Whitaker 1948, ex Darlington 1955).

Native of S. and SW. Europe to W. and central Asia (Mediterranian-Asiatic steppe element, *fide* Hegi), local in the United States along both coasts and inland as far as Iowa. Collected once in Wisconsin: Crawford Co.: East of De Soto, Freeman Township, Sect. 24, W. L. Hanson farm, "the only plant the farmer saw," Aug. 1958 [fl & fr], *Richards s.n.* (WIS).

2. Centaurea melitensis L.

Branched, gray-villous annual resembling *C. solstitialis,* but with *more slender involcural spines 4–6(–9) mm long, these with conspicuous paired secondary spines at the base.* Collected once in a meadow near Falk's Brewery, Milwaukee County [ca. 1900], *Runge s. n.* (MIL). Native to Europe and the Mediterranean area, established in California. 2n=22 (Darlington 1955).

3. Centaurea cyanus L. Blue Bottle; Bachelor's Button; Corn Flower. Map 29.

Slender, gray-villous to cottony annuals 2–8 dm tall. Leaves sessile, the upper *lanceolate to linear-elliptic,* the lowest lyrate-pinnatifid, entire, *woolly beneath, cottony to sub-glabrous above.* Heads showy, *the outer flowers deep blue* (rarely pink or white), *large and ray-like, the inner reddish-purple and more discoid.* Involucre ovoid to cylindrical, 11–15 mm high; *outer bracts acute and with a decurrent tip cut into sharp silvery to black scarious marginal teeth, the inner with erose scarious tips and entire margins.* Achenes ca 3.5 mm long, grayish to brown, the pappus shorter, reddish-brown to white. 2n=24 (Clapham et al. 1952).

Native to Europe and the Middle East (a common weed in rye fields, hence "Corn Flower," "*Korn*" being commonly applied to rye in German), now often cultivated as "Bachelor's Button," in Wisconsin rarely escaping and temporarily established especially on weedy railroad embankments.

4. Centaurea repens L. Russian Knapweed.

Pilose to sub-glabrous perennials ca 1 m tall, from a deep root. Lower leaves petioled, lanceolate to ovate-lanceolate, coarsely lobed, the upper sessile, toothed to entire, all pilose when young, glabrate. Heads rose to purple, terminating the *numerous stiffly ascending* *leafy branches. Involucre ovoid to cylindrical,* 9–12 mm high, *the outer bracts broadly rounded,* light green with broad, scarious, erose to entire, *yellowish margins, the inner with white-plumose tips.* Achenes ca 3 mm long, whitish, the pappus deciduous. 2n=26 (Moore & Frankton 1954, ex Darlington 1955).

Native of the Caucasus, introduced with alfalfa to the United States and reportedly spread from the West Coast inland to Michigan, collected once in Wisconsin: Milwaukee Co.: R. R. at House of Correction, North Milwaukee, July 26, 1940 [fl & mature fr], *Shinners 2331* (MIL, WIS, WISM).

5. CENTAUREA JACEA L. Brown Knapweed. Map 30.

Robust, glabrous, flocculose, or sparsely scabrous perennials 4–12 dm tall. Leaves sessile, entire to subentire, linear to lanceolate-ovate, scabrous at least on the margins. Heads rose-purple, often subtended by a "whorl" of reduced leaves, the outer flowers large and ray-like. *Involucre globose, brown, 10–18 mm high, the rounded scarious bract-appendages large, light brown, irregularly toothed to deeply (but usually irregularly) laciniate or rarely pectinate* (in var. PECTINATA Neilr.). Achenes 2.5–3 mm long, whitish; *pappus completely lacking.* 2n=44 (Marsden-Jones and Turrill 1954).

Native of Europe, N. Africa and N. to W. Asia, very sporadic in Wisconsin (first collected in 1915) along sandy roadsides, railroads, in fields and disturbed wooded places, in "Fairy Chasm" (Ozaukee Co.) collected regularly since 1928. Flowering from mid-July to early October.

Intergrading with *C. nigra,* both species being aggregates of great taxonomic complexity. *Centaurea jacea* generally has thin-papery, round, irregularly cut, brown appendages, the outer sometimes with *very fine* fringes; *Centaurea jacea* var. *pectinata* has appendages much more deeply and regularly cut, their strong resemblance to forms of *C. nigra* suggesting hybridity, which is known from Europe (Hegi).

6. CENTAUREA NIGRA L. Black Knapweed. Map 31.

Coarse, stiffly branched perennials. Basal leaves petioled, spatulate, coarsely lobed, the upper ones sessile, lanceolate, entire, all pilose-scabrous. Heads red-purple, the marginal florets often enlarged and sterile. Involucre sub-globose, 15–17 mm high, *the dark brown to black triangular appendage of the outer bracts 3–4 mm long and with sharply and regularly cut pectinate margins. Achenes light brown to gray; pappus of 1 mm long white bristles.* 2n=44 (Marsden-Jones and Turrill 1954).

Typical *C. nigra* has been collected once, in Milwaukee Co.: St. Frances, June 23, 1911 [fl], *Katze-Miller s.n.* (MIL).

CENTAUREA NIGRA var. RADIATA DC., differing from the typical form by light brown, rather than black, involucral bracts, is known from Dodge Co.: Fox Lake, Aug. 26, 1908 [fr] *Ward s.n.* (MIL); Sheboygan Co.: Terry Andrae State Park, July 5, 1938 [fl], *Throne 4941* (WISM), July 4, 1925 [fl], *Fuller 432* (MIL, WIS), and [ca 1920] *s.n.* (WIS).

Very similar to *C. jacea*, but with darker, more deeply and regularly cut involucral bract appendages and short, bristly pappus.

7. CENTAUREA VOCHINENSIS Bernh.

Robust, pilose-hirsute to glabrous perennials similar to *C. jacea* or *C. nigra*. Basal leaves long-petioled, obovate, repand to lobed, the upper ones sessile, oblanceolate to lanceolate, entire, all scabrous beneath or at least on the margins. Heads solitary or clustered, rose-purple; involucre cylindrical to campanulate, 13–15 mm high; bracts weakly ribbed, the dark triangular appendages ca 1(–5) mm long, not obscuring the bracts proper, the margins laciniate. Achenes 2.5–3 mm long, gray-white.

A native of Europe, established in the United States E. and S. of Wisconsin, here collected but four times: Dane Co.: fire lane 200 yards SE. of headquarters area, U. of Wis. Arboretum, Madison, Aug. 17, 1952 [fl], *Greene s.n.* (WIS). Milwaukee Co.: Menomonee Valley, Wauwatosa, sandy loam meadow, Aug. 31, 1938 [fl], *Pohl 1212* (WIS, MIL); City Dump, Wauwatosa, Aug. 25, 1934 [fl], *Pohl s.n.* (MIL), Aug. 31, 1938 [fl & fr], *Shinners s.n.* (WISM). Walworth Co.: Delavan, Sept. 20, 1908 [fl & fr], *Wadmond 4509* (MIN, WIS). The last cited collection, placed here with trepidation, differs from Wisconsin plants in the long-arching bract appendages, but closely resembles *Blake 10642* (WIS) from Clarendon, Virginia, determined as *C. vochinensis* by the collector.

8. CENTAUREA MACULOSA Lam. Spotted Knapweed Map 32.

Coarse, stiffly branched, gray-pubescent biennials or short-lived perennials 3–13 dm tall. Leaves sessile, cobwebby when young, glabrate, black-punctate, *deeply pinnatifid below, entire and greatly reduced above*. Heads light reddish-purple or rose, rarely white (in forma ALBIFLORUM J. Wagner: gravel roadside, Poynette, Columbia Co., July 19, 1961 [fr], *Johnson, Iltis, & Beery 44–61* [WIS]), the outer flowers enlarged and ray-like. Involucres cylindrical-campanulate, 10–14 mm high, *the outer bracts with 3(–5) longitudinal ribs, acute, the black-brown tips bearing short black, brown or white filiform teeth, the inner bracts longer, obtuse with lighter, erose tips*. Achenes 2.4–3 mm long, gray to brown, the white pappus, 0.5–

2.7 mm long. 2n=36 (Moore and Frankton 1954, ex Darlington 1955); 2n=18 (Löve & Löve 1961).

Native of Europe to W. Siberia and the Caucasus, on limestone, loess, and in *Stipa* grassland (cf. Hegi), in Wisconsin locally abundant in sandy or gravelly (probably mostly calcareous) roadsides, dry abandoned or unplowed sandy fields, and in pastures, rarely in deep soil prairies and in Jack Pine stands, in Door Co. on thin soil over dolomite, the earliest collections dating from 1915 (Vilas County) and 1925 (Iowa County), since the 1930's rapidly spreading. Flowering from mid-July through mid-October; fruiting from August through October.

Hegi distinguishes three subspecies native to Europe, based on head size, shape and relative size of bract tips and appendages, and size of pappus in relation to the achene. Most wide-spread in Europe is *Centaurea maculosa* ssp. *rhenana* (Boreau) Gugler, a name applied to Wisconsin plants. Wisconsin plants, however, do not have the characters in the appropriate combinations as used by Hegi, and thus are yet to be identified with the proper Eurasian subspecies.

9. CENTAUREA AMERICANA Nutt. American Basket Flower.

Smooth to scabrous, slender to robust, sparingly branched annuals; *stem conspicuously enlarged beneath the terminal, solitary rose-purple heads.* Lower leaves petioled, ovate, the upper sessile, ovate-lanceolate, becoming clustered beneath the head, all pilose to glabrous, sparsely toothed to entire. *Involucre globose,* 1.5–1.7 cm high, *the outer bracts much shorter than their deeply laciniate scarious appendages,* the inner with spatulate erose tips.

Native to the S.W. and S.-central United States and Mexico, rare N.E. of the Great Plains. Collected once in Wisconsin: Waukesha Co.: Waukcowis Farm, Big Bend, July 13, 1929 [fl], *Wadmond s.n.* (WIS).

TRIBE X. CICHORIEAE SPRENG.

Milky-juiced annuals, biennials or perennials with basal or alternate leaves. Heads yellow, orange, red-orange, blue, rarely creamy, white, pink or purplish, the *flowers all ligulate (flat, strapshaped) and perfect.*

KEY TO GENERA

A. Pappus absent ---------------------------- 60. LAPSANA.
AA. Pappus present.
  B. Pappus of numerous simple hairlike (capillary) bristles only.
    C. Achenes flattened or compressed.

D. Achenes beaked or unbeaked, but enlarged at the tip; heads blue or yellow, with relatively few flowers ---------------------------56. LACTUCA.

DD. Achenes not beaked, not enlarged at the tip; heads yellow with many flowers --------55. SONCHUS.

CC. Achenes cylindrical, fusiform, or terete, not flattened.

E. Stems branched or unbranched and leafy or subscapose; achenes truncate or tapered, rarely short-beaked; pappus pale yellow, red-brown, tannish or white; involucral bracts uni- or biseriate.

F. Perennials; cauline leaves lanceolate to palmately lobed, or unlobed and dentate to entire; inflorescences branched racemes, panicles of cylindrical drooping heads, or corymbs with erect campanulate heads; pappus tawny to brown, not pure snowy white; main involucral bracts biseriate.

G. Leaves lanceolate to palmately lobed; heads cylindrical, nodding; corolla pink, purplish to yellow or white; pappus pale yellow to red-brown; plants sometimes tomentose, not glandular ------------51. PRENANTHES.

GG. Leaves spatulate to oblanceolate, not lobed; heads campanulate, erect; corolla yellow to red-orange; pappus tannish; plants usually glandular-pubescent -----52. HIERACIUM.

FF. Annuals or biennials with well developed, usually pinnatifid basal leaves; inflorescences open corymbs or panicles of yellow campanulate heads; pappus white; main involucral bracts uniseriate ----------------------53. CREPIS.

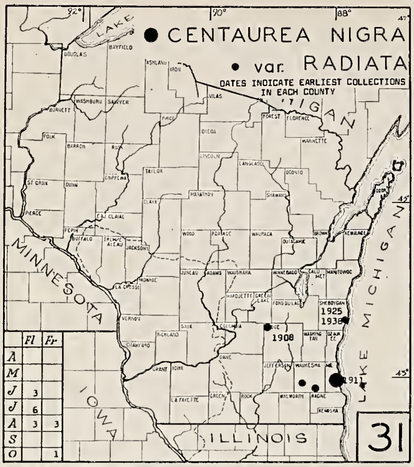
EE. Plants scapose; achenes beaked, or tapered and the beak lacking; pappus white; involucral bracts in more than one series.

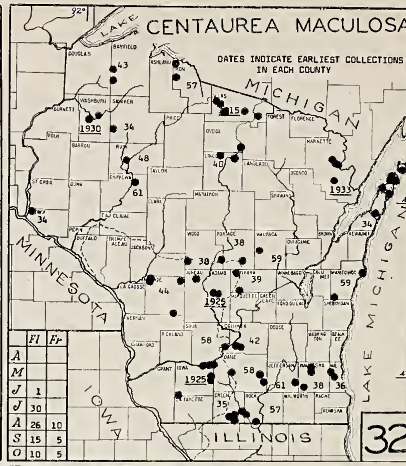
H. Achenes tuberculate-muricate above with a long filiform beak; heads many flowered on hollow scapes; leaves variously runcinate-pinnatifid. -- --------------------------54. TARAXACUM.

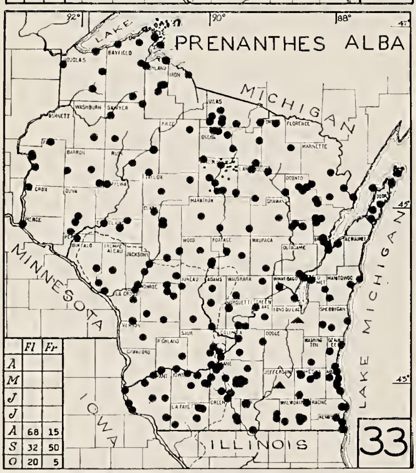
HH. Achenes not tuberculate-muricate above, slightly tapered, but not beaked; heads many flowered on solid scapes; leaves grasslike, the margins pubescent --------------------58. MICROSERIS.

BB. Pappus of plumose bristles, scales mixed with bristles, or scales only.

I. Pappus of plumose (feathery) bristles only.


CENTAUREA NIGRA
var. RADIATA
DATES INDICATE EARLIEST COLLECTIONS IN EACH COUNTY
1925
1938
1908
1911
MINNESOTA
IOWA
ILLINOIS
LAKE MICHIGAN
Fl Fr
J 3
J 6
A 3 3
O 1
31


CENTAUREA MACULOSA
DATES INDICATE EARLIEST COLLECTIONS IN EACH COUNTY
MINNESOTA
IOWA
ILLINOIS
LAKE MICHIGAN
Fl Fr
J 1
J 30
A 26 10
S 15 5
O 10 5
32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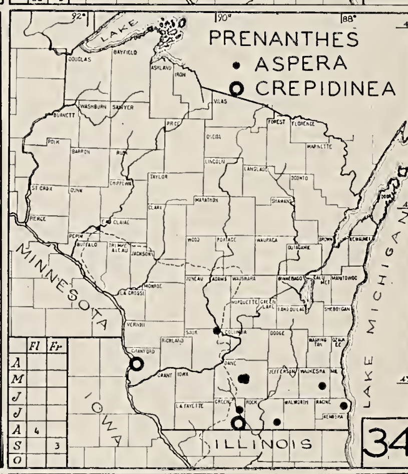
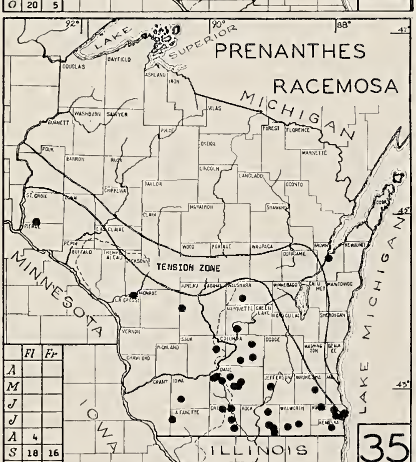
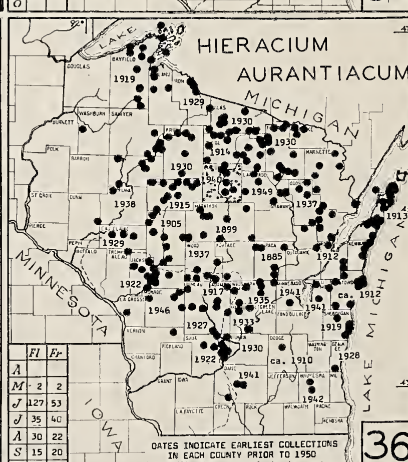
MINNESOTA
IOWA
ILLINOIS
LAKE MICHIGAN
Fl Fr
A 68 15
S 32 50
O 20 5
33


PRENANTHES
ASPERA
CREPIDINEA
MINNESOTA
IOWA
ILLINOIS
LAKE MICHIGAN
Fl Fr
A 4
S 3
34


PRENANTHES
RACEMOSA
TENSION ZONE
MINNESOTA
IOWA
ILLINOIS
LAKE MICHIGAN
Fl Fr
A 4
S 18 16
O 3
35


HIERACIUM
AURANTIACUM
DATES INDICATE EARLIEST COLLECTIONS IN EACH COUNTY PRIOR TO 1950
MINNESOTA
IOWA
LAKE MICHIGAN
Fl Fr
M 2 2
J 127 53
J 35 40
A 30 22
S 15 20
O 1 3
36

J. Plants scapose, scaly bracted above; leaves basal, coarsely dentate ________________61. LEONTODON.

JJ. Plants leafy stemmed, branched, not scaly-bracted above; leaves cauline, grasslike _62. TRAGOPOGON.

II. Pappus of scales mixed with bristles or scales only.

K. Pappus of 5 to numerous outer scales alternating with 5 to numerous scabrous hairs; plants scapose or sub-scapose, branched or not branched; corolla yellow ________________________________59. KRIGIA.

KK. Pappus of numerous minute scales; plants profusely branched; corolla blue, rarely pink or white ______ _________________________________57. CICHORIUM.

51. PRENANTHES L.[12] White Lettuce

Perennial caulescent herbs with fusiform roots. Leaves deltoid, spatulate or lanceolate and often palmately lobed. Inflorescence a racemose panicle (thyrse) or open panicle, the nodding cylindrical heads subtended by an inner uniseriate involucre of bracts about 4 times the length of the outer secondary bractlets. Corolla pink, purplish, white or yellow. Achenes columnar, longitudinally grooved, slightly constricted at the summit or truncate. Pappus of pale yellow to red-brown capillary bristles. Name from the Greek *prenes* (drooping) and *anthes* (flower), in reference to the nodding heads.

Key to Species

A. Inflorescence an open panicle; leaves, at least the lower, long-petiolate, broadly ovate, deltoid to sagittate, or hastate.

B. Basal leaves deeply palmately lobed; plants glabrous or nearly so; involucral bracts purplish; pappus rich red-brown; very common throughout ___________1. *P. ALBA*.

BB. Basal leaves coarsely and irregularly dentate; plants pubescent in inflorescence; involucral bracts green; pappus pale yellow to brown; rare, S. Wisconsin __2. *P. CREPIDINEA*.

AA. Inflorescence a dense, strict, elongate racemose panicle (thyrse); leaves, at least the lower, spatulate, the rounded blades gradually attenuate into the petiole; uncommon species of prairies.

C. Leaves of inflorescence with broad sessile auriculate bases; flowers 8–13 mm long, white to purplish; leaves and stem glabrous and glaucous except in the uppermost inflorescence; S. and W. Wisconsin __________3. *P. RACEMOSA*.

[12] Based in part on an unpublished manuscript of W. L. Milstead, Purdue University.

CC. Leaves of inflorescence lanceolate, with attenuate narrow bases; flowers (8–)11–15(–19) mm long, yellow; stem, at least the upper parts, and leaves scabrous, not glaucous; S. Wisconsin .... 4. *P. ASPERA.*

1. PRENANTHES ALBA L. White Lettuce; Rattlesnake Root; Lion's Foot Map 33.

Glabrous perennials 3–10 dm tall. Lower leaves *ovate or deltoid to cordate, entire to deeply palmately lobed* with dentate and deeply incised margins, *the petioles winged,* the upper oblong, entire to dentate. Panicle open to elongate; heads 10–14 mm long, *the 6–8 primary bracts glabrous, glaucous, usually purplish.* Flowers (7–)10–11(–13) per head, whitish to purplish-white; *pappus brown to red-brown.* 2n=32 (Babcock 1947, ex Darlington 1955).

Very common throughout Wisconsin in many habitats, most abundant and prevalent in the southern dry-mesic, dry, and mesic forests (Curtis 1959), as well as in low woods, also abundant in lowland prairie where ". . . the high level of soil moisture [may] compensate in some way for the great evaporation and insolation of the prairie . . ." when compared to that of the forest (Curtis 1959: 285–6), often on roadsides, limestone bluffs, sandy shores, less common in northern coniferous forests and deer yards, Jack Pine woods, alder thickets and white cedar-hardwoods. Flowering from early August to early October; fruiting from mid-August through October.

2. PRENANTHES CREPIDINEA Michx. Map 34.

Perennials 1–2 m tall, *glabrous except in the inflorescence. Leaves with long winged petioles,* the lower generally *deltoid to sagittate or hastate, coarsely and irregularly dentate,* the upper elliptic to ovate, entire. *Panicle large and open;* heads 10–14 mm long, the *primary bracts usually 13, pilose,* green. *Flowers 20–35/head,* white; pappus light brown.

A very rare and distinctive species of the wet-mesic prairie, collected twice: Crawford Co.: Lynxville, Sept. 1, 1915 [fl & full fr], *Denniston s.n.* (WIS). Green Co.: dense community of tall perennials, low wet prairie in ditch along railroad, 5 mi. WSW of Brodhead, Aug. 15, 1956 [early fl], *Greene s.n.* (WIS).

3. PRENANTHES ASPERA Michx. Rough White Lettuce. Map 34.

Perennials 3–10 dm tall, from thickened *roots, the unbranched strict stem rough pilose to hirsute at least in the upper half.* Lower leaves sessile or petioled, *oblanceolate to spatulate, entire to coarsely dentate, scabrous beneath and on the margins, those of the inflorescence mostly lanceolate and narrow at base.* Panicle (thyrse) a *dense raceme; heads (8–)11–15(–19) mm long,* and 8–10 primary *bracts pilose,* yellow-green. *Flowers 11–19/head, yellow;* pappus pale yellow.

A very rare prairie species strongly resembling *P. racemosa,* collected last in Dunn Co.: Caryville, Aug. 15, 1920, *Wadmond 1927* (MIN); Rock Co.: along right-of-way, C. M. St.P. & Pac. RR., Clinton, Sept. 5, 1927, *Wadmond s.n.* (ILL, MIN); and Green Co.: low prairie, railroad right-of-way, Albany twp., 1948, *Curtis & Greene s.n.* (WIS). The following collection was seen by Milstead; Sauk Co.: vicinity of Kilbourn, on Wisconsin R., no date, *Steele 59* (US).

4. PRENANTHES RACEMOSA Michx. Glaucous White Lettuce. Map 35.

Perennials 3–15 dm tall from deep, occasionally thickened taproots, the unbranched strict *stem glabrous except in the uppermost inflorescence.* Leaves *glabrous and glaucous,* the lower mostly spatulate, entire or irregularly dentate, wing-petioled, the upper ones and *those of the inflorescence sessile, oblong to deltoid with auriculate clasping bases. Panicle* (thyrse) *a dense raceme, the heads 8–13 mm long,* the 7–17 *primary bracts pilose,* green or purplish. *Flowers 11–24 per head,* white to purple; pappus pale yellow.

At one time a prevalent species of deep soil, wet-mesic to dry-mesic prairies (Curtis 1959), now restricted to relic prairies mostly on railroad rights-of-way south of the "Tension Zone." Flowering from late August or early September through September, about three weeks later than *P. aspera;* fruiting from mid-September to mid-October.

Prenanthes racemosa, though very similar to *P. aspera,* can be distinguished by broader inflorescence leaves, glaucousness and smaller flowers. There are no intermediates known from Wisconsin, the species probably seasonally isolated. The few dated collections of *P. aspera* indicate full bloom from the first to the third week in August and very rarely into early September, while *P. racemosa,* though occasionally in bloom by the end of August, often doesn't begin to bloom until after the first week of September. While this does not apply to the flowering of the species in Maine, for example, where *P. racemosa* blooms from the middle of August, it holds true in Wisconsin and nearby Indiana (cf. Deam 1940: maps 2234, 2235, pp. 1015–6). Both species have been collected on Sept. 5, 1927 in the prairie along the railroad right-of-way at Clinton, Rock Co., by *Wadmond* (MIN). At that time, *P. aspera* was mostly past flowering except for a few heads on the lowest branches, while *P. racemosa* (ILL, MIN) was still in bud except for the top two of the 16 branches.

Both species are rare and, like P. crepidinea, on the verge of extinction, no doubt because the mesic, deep soil prairies, where they could survive, have all been plowed.

52. HIERACIUM L.[13] Hawkweed

Scapose or leafy stemmed, often pubescent and glandular, slender perennials with fibrous roots from horizontal rootstocks. Leaves in basal rosettes or alternate, entire to dentate, pubescent. Inflorescence paniculate-corymbiform, commonly of several to numerous orange to yellow heads, rarely of one. Achenes 2–3 mm long, cylindrical. Pappus of one series of tawny to nearly white simple bristles.

Name referring to the Greek legend in which hawks, soaring high, would focus their eyes on these bright flowers, thereby strengthening their vision. A large genus with few well-defined species, especially difficult in Europe where ". . . technical specialists with eyesight stimulated beyond that of the ancient hawks . . ." (Fernald, 1950:1562) have split the genus into ca 20,000 species, subspecies, varieties, and forms based mostly on the degree and character of the pubescence. Many species are apomictic.

Key to Species

A. Plants scapose; leaves clustered at base, linear to spatulate or oblanceolate, sessile, pilose or glabrous, entire; heads red-orange or yellow; hairs less than 1 cm long or absent; introduced weeds.

B. Flowers bright red-orange; involucre densely covered with black-glandular and eglandular hairs; leaves spatulate to oblanceolate, with rusty-red pubescence; stolons present ---------------------------------- 1. *H. AURANTIACUM.*

BB. Flowers yellow; leaves oblanceolate to spatulate.

C. Leaves narrowly oblanceolate to spatulate, essentially glabrous, stolons lacking, short rhizomes present; peduncles minutely white-stellate ---------------------------------- 2. *H. FLORENTINUM.*

CC. Leaves oblanceolate with tawny-white hairs on both surfaces; stolons erect or arching with abundant fine

[13] Many of the Wisconsin collections have been checked by Father Ernest Lepage, Ecole d'Agriculture, Rimouski, Quebec, Canada.

pubescence; rhizomes lacking or inconspicuous; peduncles glandular hirsute ....3. *H. CAESPITOSUM.*

AA. Plants not scapose; leaves not clustered at base, or if so, then plants with abundant hairs 7–20 mm long; leaves lanceolate to elliptic or spatulate, petioled or sessile-clasping, pilose to glabrous, the margins dentate to denticulate or subentire; rhizomes and stolons lacking (except *H. vulgatum*); North American natives (except *H. vulgatum*).

D. Leaves chiefly basal, abruptly reduced upward; plants, except the inflorescence, densely long-pilose, the hairs (7–) 10–20 mm long; peduncles with yellow-orange gland-tipped hairs; prairies, S. and central Wisconsin ....8. *H. LONGIPILUM.*

DD. Leaves often cauline; plants with hairs to 3 mm long or glabrous; peduncles glabrous, scabrous, stellate or appressed-pubescent, sometimes glandular.

E. Leaves broadly elliptic, tapering to long and villous petioles, coarsely dentate; involucres 6–8 mm high, the hairs stellate; stem glabrous; rare introd. weed ....4. *H. VULGATUM.*

EE. Leaves various, tapering to shorter petioles or sessile, toothed to subentire; involucres 5–13 mm high, glabrous to glandular; stem glabrous or hairy; common.

F. Leaves spatulate, the upper sessile, the lower petioled subentire; involucres (and peduncles) black-glandular, 5–8 mm high; stem setose ....7. *H. SCABRUM.*[14]

FF. Leaves lanceolate to oblanceolate, sessile, toothed; involucres (and peduncles) rarely glandular, 8–13 mm high; stem glabrous to villous-hispid or setose below.

G. Lower leaf surface or margin pilose to glabrous, never scabrous; peduncles stellate, not scabrous; stems glabrous to setose below .5. *H. KALMII.*[14]

GG. Lower leaf surface and especially margin scabrous; peduncles scabrous and stellate; stem glabrous to pilose below ....6. *H. SCABRIUSCULUM.*[14]

1. Hieracium aurantiacum L. Orange Hawkweed; Devil's Paintbrush; Grim-the-Collier; Red Daisy. Map 36.

Hairy-glandular scapose perennials 1–6(–8) dm tall with arched, horizontal, leafy or subterranean, slender stolons. *Leaves basal*

[14] Hybrids between species 5, 6 and 7 are not uncommon (see p. 317).

(rarely one or two cauline), *spatulate to oblong,* 10–35 mm wide, *densely covered with long reddish-brown to white hairs.* Inflorescence a compact corymb, becoming open with age, the few to many *heads bright red-orange.* Involucres 4–6(–7) mm high, *densely covered with long black and short glandular hairs.* 2n=36 (cf. Löve & Löve 1961); apomictic (Christoff 1942).

Very weedy, aggressive and common throughout all but NW and S Wisconsin; though beautiful, one of the most troublesome weeds, occurring most often in sandy roadsides, abandoned fields and overgrazed pastures, often in cut-over Northern Hardwoods and sandy open Jack Pine woods. Flowering from late May to late September; fruiting from mid-June to October.

The ability of *H. aurantiacum* to compete is believed to stem from a potent antibiotic produced by the roots, which kills all but a few species such as Bracken Fern *(Pteridum)* (Curtis 1959: 316). A specimen from the Chicago Natural History Museum carries the following information: "Species rapidly spreading; rare a quarter century ago in region of Mishicot (Manitowoc Co.), June 21, 1938" *(Benke 5918).* The *Brillion* (Calumet Co.) *News* of July 5, 1929, printed a front page story reporting that in the late 1890's and early 1900's *H. aurantiacum* was rare or unknown in Calumet and Manitowoc Counties. The first colony was seen near Denmark (Brown Co.) and sometime later east of Maribel (Manitowoc Co.). Its spreading ability was attributed to the runners, numerous viable seeds, and basal rosettes which choke most competitors. This species very rarely hybridizes with No. 2.

2. HIERACIUM FLORENTINUM All. Yellow Devil's Paintbrush; King Devil. Map 37.

Perennials from a short stout erect rhizome, the basal off-shoots many, but very short, not stoloniferous; stems 3–9 dm tall, *sparsely glandular-pubescent and setose above. Leaves in a basal rosette,* 1–3 on the scape, narrowly oblanceolate, 6–18 cm long, *6–18 mm wide,* glabrous except *sparingly pilose* on margin and midrib below, *entire.* Inflorescence, when old, an open corymb; *heads yellow,* several to many, the involucre cylindrical-campanulate, the bracts 5–7 mm high, more or less black-glandular hairy and white-margined.

Locally very common in N. Wisconsin, often with *H. aurantiacum,* mostly along sandy roadsides (with *Salix, Pteridium, Populus,* and *Pinus*), gravelly-sandy lake shores, lawns, sandstone cliffs (Ashland Co.), railroad yards, marshes and open fields. Flowering from early June through September, fruiting from mid-June through September.

Often confused with *H. caespitosum,* but distinguished by short erect rhizomes, lack of stolons, essentially glabrous stems and leaves, and smaller heads.

This species was first noted as a weed in a hayfield at Cutler, Maine, occurring as a small patch only a few feet in diameter (Hansen 1922). Now, in Wisconsin, it is actively spreading (see Map 37).

3. HIERACIUM CAESPITOSUM Dumort. King Devil. Map 38.
Hieracium pratense Tauch.

Glandular-hirsute scapose perennials, 4–6 dm tall, *with a short erect rootstock, often with arched or erect leafy stolons. Leaves all basal* (or rarely with 1–3 well-developed scape leaves), oblanceolate, (7–) 9–19 mm long, *(11–)15–24 mm wide, setulose to pilose, entire.* Inflorescence a compact to open corymb; *heads yellow;* involucres cylindrical, 6–8 mm high, the bracts dark green with black midrib and with long white or brown, short glandular hairs. Mature achenes truncate, the pappus 5 mm high, white to sordid. 2n=36 (cf. Löve & Löve 1961).

Native of N. Eurasia, scattered in N. Wisconsin in patches of weeds, sedges and rushes, wet sedge meadows, bogs, sand, and along roadsides. In Juneau Co., *Hieracium caespitosum* has been collected in 1940 (earliest record), and again in 1961 and 1962, on a moist cut-over meadow and roadside in abundance with weedy *H. aurantiacum,* the continual cutting apparently having no disadvantageous effect on either species. In Forest Co., one collection dates from 1941, all others from 1959, the species evidently persisting. Flowering from mid-June to August.

4. HIERACIUM VULGATUM Fries.

Slender perennials ca 6–7 dm tall, *the few leaves on the lower half of the stem. Leaves elliptic-ovate, 10–15 cm long, distantly toothed except toward apex, the lower ones often purplish.* Inflorescence a few-headed, open corymbose, glandular to glabrous panicle.

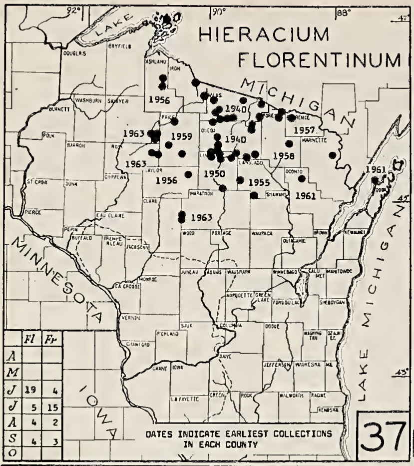
Native of Europe, collected once in Wisconsin: Walworth Co.: Woods, Covenant Harbour, Lake Geneva, July 4, 1953, *Swink 2287* (F).

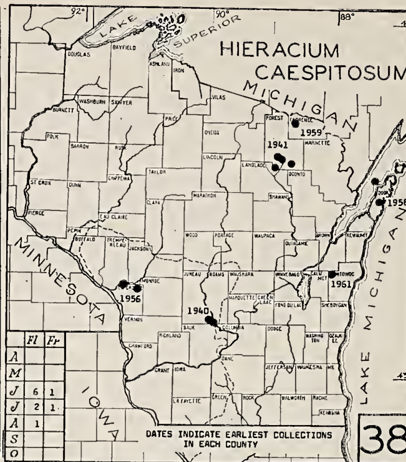
Gray's Manual (1950) and Gleason (1952) do not list *H. vulgatum* from Wisconsin, the species reported from Newfoundland to Michigan. Because of its many gardens, various interesting adventives occur in the Lake Geneva region, e.g. *Lysimachia clethroides* (Iltis & Shaughnessy, 1960).

5. HIERACIUM KALMII L. Kalm's Hawkweed. Map 39.

Hieracium canadense sensu older U.S. floras, not Michx.
Hieracium canadense var. *fasciculatum* (Pursh) Fern.
Hieracium Kalmii L. var. *fasciculatum* (Pursh) Lepage.
Hieracium Kalmii L. var. *subintegrum* (Lepage) Lepage.
[Lepage, Ernest. *Hieracium canadense* Michx. et ses Alliées en Amérique du Nord. Naturaliste Canadien 87: 59–107. 1960]

Slender to robust perennials 3–11 (–12) dm tall; *stem leafy, pilose at base, becoming less so toward the inflorescence.* Leaves elliptical


HIERACIUM FLORENTINUM
LAKE
MICHIGAN
MINNESOTA
IOWA
LAKE MICHIGAN
1956
1940
1963
1959
1940
1963
1957
1958
1950
1956
1955
1961
1961
1963
Fl Fr
J 19 4
J 5 15
A 4 2
S 4 3
DATES INDICATE EARLIEST COLLECTIONS IN EACH COUNTY
37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MICHIGAN
MINNESOTA
IOWA
LAKE MICHIGAN
1959
1941
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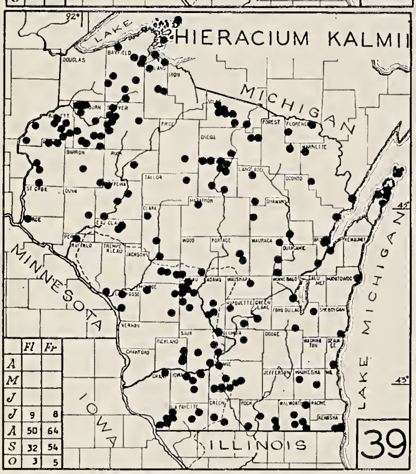
1956
1961
1940
Fl Fr
J 6 1
J 2 1
A 1
DATES INDICATE EARLIEST COLLECTIONS IN EACH COUNTY
38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IOWA
ILLINOIS
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Fl Fr
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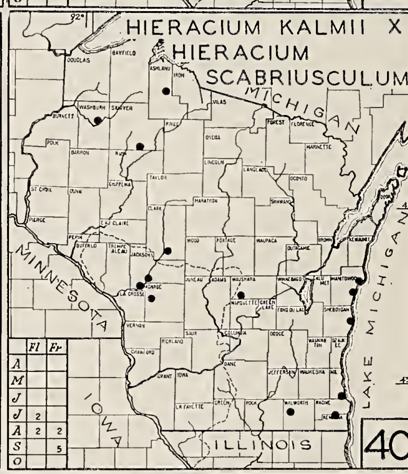
S 32 54
O 3 5
39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ILLINOIS
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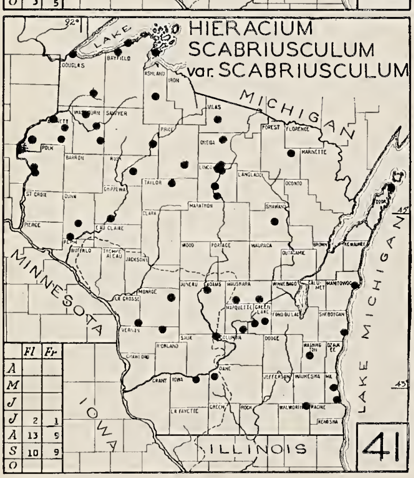
J 2
A 2 2
S 5
40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IOWA
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Fl Fr
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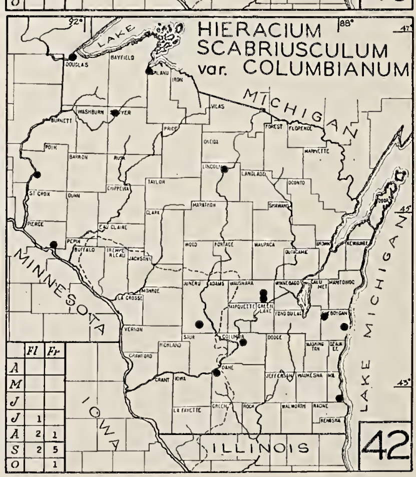
A 13 5
S 10 9
41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MICHIGAN
MINNESOTA
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ILLINOIS
LAKE MICHIGAN
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J 1
A 2 1
S 2 5
O 1
42

to lanceolate or lance-ovate, 3–11(–13) cm long, 8–25(–27) mm wide, entire to distantly toothed, prominently so in robust plants, sessile, *the bases rounded to cuneate,* the lower pilose beneath, subpilose to glabrous above. Inflorescence paniculate, few to many headed (then much branched); heads yellow, *the involucre spreading-campanulate, (6–)8–13 mm high,* the green to dark olive *bracts 0.7–1.5(–1.8) mm wide, glabrous to slightly glandular.* Achenes 1.9–2.9 mm long, the pappus yellow-brown.

Common throughout Wisconsin, especially in the Bracken-grassland north of the "Tension Zone" (Curtis 1959), mostly on *sandy slightly acid soil* (cf. Deam 1940), with Jack Pine, oaks and pines, and aspen, on sandy lakeshores and rivers, weedy on sandy roadsides, railroad tracks, in pastures, gravel pits, quarries, and sandy fields. Flowering from mid-July through late September (mid-October); fruiting from late July through October.

H. Kalmii is very similar to the sub-arctic *H. canadense* Michx., which occurs throughout E. Canada and from Maine to Lake Superior (Isle Royale; Keweenaw P. I.) and Cook Co., Minn. The two species differ in the upper leaves, triangular with cordate to truncate bases in *H. canadense,* lanceolate with rounded to cuneate bases in *H. Kalmii.* The involucre is glandular in *H. canadense,* glandular to glabrous in *H. Kalmii.* The distinctive style color, reported as yellow in *H. canadense* and brown in *H. Kalmii,* can not be ascertained from dried material.

In Wisconsin, Lepage (l.c.) recognized two varieties in addition to typical *H. Kalmii:* Var. SUBINTEGRUM (Lepage) Lepage, with three specimens, we believe to be quite untenable even as a form, representing simply plants with more entire leaves. One sheet so named, however [Ashland Co.: Rocky SE. shores of Outer Island, Lake Superior, *Cottam & Vogl 633* (WIS)], is most unusual in its nearly linear leaves, smooth as in *H. Kalmii,* but with large heads strongly resembling those of *H. scabriusculum.* Var. FASCICULATUM (Pursh) Lepage has been applied to robust extremes, with larger leaves, longer, more irregular teeth, and more branched, larger inflorescences bearing 30 to 40 heads. Since there are all possible intermediates between this and the typical variety, it hardly deserves recognition. *H. Kalmii* hybridizes with *H. scabriusculum* (see p. 317).

6. HIERACIUM SCABRIUSCULUM Schwein. Maps 41, 42.
Hieracium umbellatum of authors, not L.

Slender, scabrous (rarely pilose), leafy perennials 5–11 dm tall. Leaves ovate, obovate, or lanceolate, with acute tips, rounded sessile bases, 2–10 cm long, 0.7–2 cm wide, the involute, more or less *toothed margins and surfaces conspicuously scabrous.* Inflorescence *umbellate-paniculate, the peduncles appressed pubescent, scabrous; involucre 8–12 mm high, the bracts (1.1–)1.3–2.6 mm wide,* green, most often glabrous or with few gland-tipped hairs. Achenes 2.5–3.2 mm long; pappus yellow-white.

Hieracium scabriusculum closely resembles *H. Kalmii* (with which it hybridizes; cf. p. 317), but can be distinguished by very scabrous leaves, especially the lower, and generally wider bracts. Though width of the median involucral bracts is of taxonomic importance, immature heads may be subtended by phyllaries more narrow than indicated in the key.

Key to Varieties (After Lepage)

a. Stem and leaves all without long hairs --6a. var. *SCABRIUSCULUM.*

aa. Stem and leaves on lower part of plant pilose --6b. var. *COLUMBIANUM.*

6a. Hieracium scabriusculum Schwein. var. scabriusculum Map 41.

Stem and leaves not pilose, or only very slightly so.

Scattered throughout Wisconsin, common along roadsides, on sandy lake shores, in dry sand, on open wooded slopes and in vacant city lots (Douglas Co.: Superior). Flowering and fruiting from late July through September.

6b. Hieracium scabriusculum Schwein. var. columbianum (Rydb.) Lepage Map 42.

Lower stem and leaves white pilose. A weak taxon of uncertain validity, sporadic in Wisconsin, in sandy fields or on gravelly lake shores, roadsides, and rocky woods. Flowering from late July through September, and fruiting from late August to early October.

7. Hieracium scabrum Michx. Rough Hawkweed. Maps 43, 44.

Coarse, stiffly-pilose glandular perennials (2–)3–9 dm tall. *Leaves spatulate to obovate,* (3–)3.5–13 cm long, 1.4–4.5 cm wide, *rusty-pilose to glabrous, entire* or rarely minutely and distantly denticulate, the lower petioled, the upper sessile. Inflorescence paniculate, the *branches thickish, densely glandular with appressed brown pubescence,* the rather small heads yellow; *involucre 5–8 mm high,* dark green, glandular (cf. Rhodora 16:182–183. 1914).

Key to Varieties

a. Hairs of lower internodes, petioles and lower midribs 2–3 mm long ________________________________ 7a. var. *SCABRUM.*

aa. Hairs of lower internodes 0.2–0.5 mm long; leaf surfaces usually glabrous to very slightly pilose ________ 7b. var. *TONSUM.*

7a. Hieracium scabrum Michx. var. scabrum Map 43.

Coarse, the stem generally stiffly pilose-glandular, the usually scattered leaves rusty-pilose.

Relatively common throughout Wisconsin, especially in the southern dry-mesic forest (Curtis 1959) and in the Northern Hardwoods region, mostly in dry sandy soil, Jack Pine or Red Pine woods, oak woods and oak openings, rarely in more mesic woods, lake shores, stream banks, sandy prairies, and sunny hillsides, pastures, fields, and railroads, both on sandstone and limestone. Flowering from the third week of July to late September; fruiting into early October.

7b. Hieracium scabrum Michx. var. tonsum Fern. & St. John Map 44.

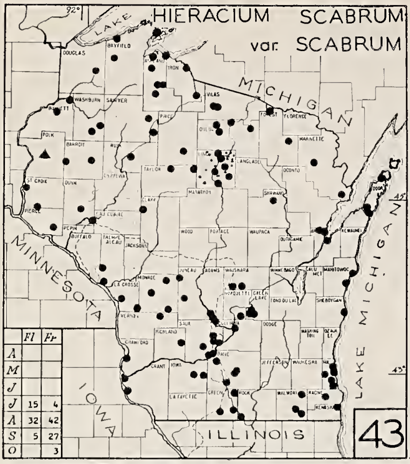
Rather delicate with sub-scapose to scapose sub-glabrous stems, the leaves usually glabrous and often more clustered at the base than in var. *scabrum.*

Scattered through Wisconsin with habitats similar to those of var. *scabrum,* but more abundant in the Northern Hardwood region, in Black Oak, Sugar Maple, *Acer-Populus,* and spruce-fir-hemlock-*Thuja* woods, sandy plains, lake shores, and pastures. Flowering from late July to early September; fruiting to late September.

The two varieties may occur together in Iron, Vilas and Washburn Counties (all collected by Fassett), the latter collection intermediate between the varieties.

8. Hieracium longipilum Torr. Long-Beard Hawkweed; Prairie Hawkweed. Map 45.

Strict perennials 4–14 dm tall, *densely covered with stiff more or less ascending rusty-red to white hairs 7–20 mm long.* Leaves crowded near base of stem, spatulate to oblanceolate, 5–18 cm long, 1–3.3 cm wide, ascending, entire, abundantly pilose, the lowest petioled, the upper sessile. *Inflorescence an elongate to compact panicle,* the branches appressed-glandular pubescent; heads yellow; involucre cylindrical to spreading, 6–9 mm high. Achenes 2.5–3.2 mm long, slightly tapered at summit.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A 32 42
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O 3
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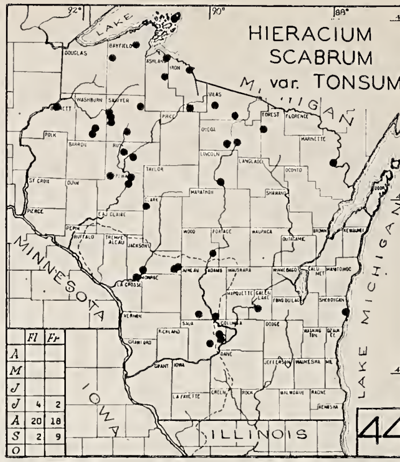
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S 2 9
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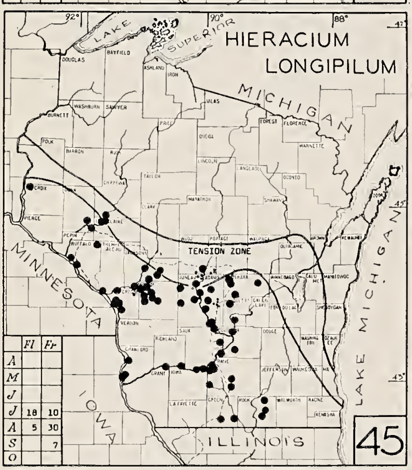
44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MICHIGAN
TENSION ZONE
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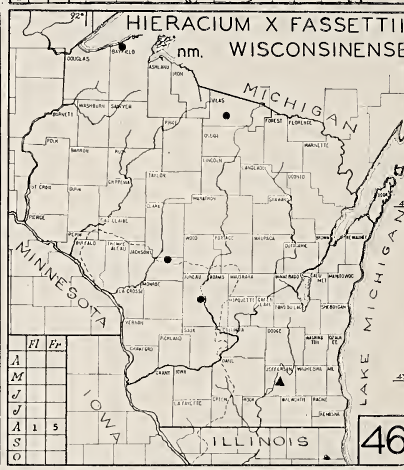
HIERACIUM X FASSETTII nm. WISCONSINENSE
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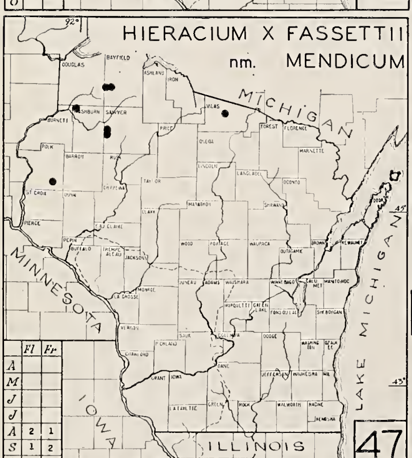
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A 2 1
S 1 2
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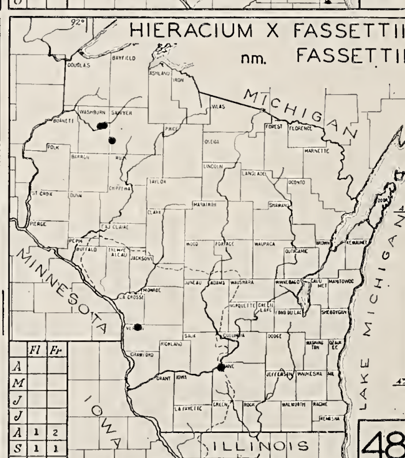
47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MINNESOTA
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ILLINOIS
LAKE MICHIGAN
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A 1 2
S 1 1
O
48

SW. Wisconsin, most prevalent in, and characteristic of sandy prairies, especially along the Chippewa, Wisconsin, and Trempeleau Rivers and on railroad rights-of-ways, occasionally on steep dry prairies, in Jack Pine woods, abandoned fields, and rarely as a roadside weed. Flowering from early July through mid-August; fruiting from late July through late September.

NATURAL HYBRIDS IN HIERACIUM.

I. HIERACIUM AURANTIACUM L. X H. FLORENTINUM All.

Closely resembling the parents except for the ligules which are yellow with red tips.

A single collection: Taylor Co.: roadside 3 miles north of Rib Lake, June 29, 1947 [fl] *Anderson* 319 (WIS).

II. HIERACIUM KALMII L. X H. SCABRIUSCULUM Schwein. Map 40.

This hybrid, proposed by Lepage (1960), can be distinguished by the sparsely scabrous leaves and the intermediate width of the involucral bracts. Rare in Wisconsin, in secondary Red Maple woods, dunes, outwash sand prairies, and wooded hills.

III. HIERACIUM SCABRIUSCULUM Schwein. X H. SCABRUM Michx.

Leaves subdentate, scabrous or pilose on margins, the peduncles scabrous and red-pilose, the characters intermediate between the parents.

Two collections: Ashland Co.: La Point, Lake Superior, *Lapham s.n.* (WIS). Washburn Co.: Jack Pine woods, Gilmore Lake, Minong, *Fassett 15151* (WIS).

IV. HIERACIUM KALMII L. X H. SCABRUM Michx.

Hieracium X *Fassettii* Lepage

Included here is a diversity of forms which have properties of both parents, i.e. they may look like *H. Kalmii* but have hairy peduncles, leaf margins and stem bases (as *H. scabrum*); or they may look like *H. scabrum* but lack glandular hairs and have larger heads (as *H. Kalmii*). Three NOTOMORPHS, groupings representing supposedly stable, apomictic segregates or back-crosses, based on type and quantity of gland-tipped hairs have been separated by Lepage (1960) who has annotate our specimens and who cites all collections.

a. nm. FASSETTII Lepage (1960:94) Map 48.

Like *H. Kalmii*, but stems red-pilose below, less so above, the lower leaves red hairy above and beneath, the upper glabrous, the margins ciliate. Heads more than 5, the peduncles and involucres dark glandular-pilose (as in *H. scabrum*). Scattered and rare in Wisconsin on sandy banks and in Jack Pine Woods.

b. nm. WISCONSINENSE Lepage (1960:97) Map 46.
Like *H. Kalmii,* but stems more or less villous-hispid, lower leaves pilose beneath, the upper ones glabrous, the peduncles with minute colorless or light brown stipitate glands. Heads few, the involucres sparsely glandular. Only in Wisconsin, scattered and rare in Red Pine woods, on clay bluffs and along creeks. [Type: Summit of clay bluff along Lake Superior, Port Wing, Bayfield Co., *Fassett 14924* (WIS)]

c. nm. MENDICUM Lepage (1960:99) Map 47.
Stem totally glabrous to hirsute-vilous at the base. Leaves sub-entire glabrous. Peduncles elongate, glabrous or puberulent, eglandular. Heads many, small. ". . . distinguished from nm. *wisconsinense* by the absence of the tiny glands on the peduncles and the absence of the rigid, red hairs at the top of the stem; the hairs of the involucre are occasionally glandular, also more robust." (Lepage 1961). Rare in NE. Wisconsin on sandy lake shores and banks. [Type: Sandy bank, Sand Lake, 10 mi. S. of Hayward, Sawyer Co., *Fassett & Gilbert 15155* (WIS)]

HIERACIUM GRONOVII L., the Hairy Hawkweed, a perennial resembling *H. scabrum* with fewer leaves on lower stem and thinner, less glandular peduncles, has been collected once in Wisconsin (Sauk Co.: Bluffs, Devil's Lake, Aug. 11, 1897 [fr] *Umbach s.n.* (F)) This record is no doubt based on error, for the abundant botanizing in that area during the last 50 years has never yielded another *H. Gronovii.* The closest reported stations are in Cook County, Illinois (Jones & Fuller 1955). One may assume a label mix-up with interchange of material from northern Indiana, Umbach's main collecting grounds, where the species is common.

HIERACIUM (ALBIFLORUM Hook.?)
Young, sterile plant; stem with dense, long golden-brown pilose hairs; leaves spatulate with same pilosity on lower midrib and margins, less so on upper and lower surfaces. Douglas Co.: Sandy, low quite dry ravine at Nebagamon, July 12, 1917, *Goessl 7656* (MIL). This specimen very closely resembles certain collections of the western *H. albiflorum* Hook. (e.g. *Sandburg 5619,* Kootenai, Idaho, July, 1892 (WIS)).

53. CREPIS L. HAWK'S BEARD

[Babcock, E. The Genus *Crepis.* U. of Calif. Press, 1947.]

Annuals (ours) with well developed basal rosettes or leafy glabrous to hispidulous branching stems. Involucral bracts in two series, the outer becoming thickened at base. Corollas yellow. Achenes fusiform, beaked or the beak lacking. Introduced weeds.

KEY TO SPECIES

A. Achene not beaked; plants glabrous to hispidulous, at least above, not setose.
B. Ligules yellow; inner surface of inner series of bracts microscopically appressed-puberulent; common, NW. Wisconsin ____________________________1. *C. TECTORUM.*

BB. Ligules yellow, minutely tipped with red; inner surface of inner series of bracts glabrous; rare. -2. *C. CAPILLARIS.*

AA. Achene slenderly beaked; stem and involucre strongly setose with stiff yellow bristles; rare. ---------------3. *C. SETOSA.*

1. CREPIS TECTORUM L. Hawk's Beard. Map 49.

Annual or biennial 2–5 (–9) dm tall, branching above. Lower stem glabrous, pilose to hispid-tomentose on peduncles. Basal and lower cauline leaves 6–16 cm long, 1–3 cm wide, short-petioled, pinnatifid or dentate to entire, sparsely pilose on upper surface. Upper cauline leaves sessile, linear. Corymbs open, much-branched, with several to many (–80) small heads, these when in flower ca. 25–30 mm in diam.; outermost bracts very short, the inner in a single series, 5.5–8.8 mm high, glandular-pubescent and minutely arachnoid on outer surface, with *minute (20x) silky appressed hairs on the inner.* Achenes narrowed toward summit, but not beaked, scabrous on the ribs. Pappus of numerous glistening white bristles. 2n=8 (Babcock 1947).

Native of Eurasia, locally abundant in NW. Wisconsin (esp. in area of "Glacial Lake Barrens"; cf. p. 267) on roadsides, in sand or gravel in Jack Pine woods, lake shores, river banks, cultivated or abandoned fields, low pastures, bogs, dumps and deer yards. Flowering from early June through early October; fruiting from mid-June to mid-October.

Crepis tectorum can be confused with species of *Hieracium,* especially *H. florentinum,* but has many cauline leaves, the lower lobed to dentate, while *H. florentinum* has all leaves entire and usually only 2 or 3 on the scape.

2. CREPIS CAPILLARIS (L.) Wallr.

Our plants small (ca. 15 cm tall), resembling *C. tectorum,* but ligules minutely *tipped with red, and inner surface of inner series of bracts glabrous;* generally more pubescent than *C. tectorum, in* more robust specimens the peduncles noticeably enlarged (fistulose). 2n=6 (Babcock 1947).

Native of Central Europe, naturalized along the U.S. West Coast, a rare adventive in Wisconsin, collected twice: Dane Co.: Madison, University Farms, July 11, 1916, [y.fr] *Denniston s.n.,* (WIS). Fond du Lac Co.: Single plant, yard at 722 Woodside Ave., Ripon; "probably an impurity in grass seed sown June, 1950." Oct. 3, 1951 [f l] *Cors. s.n.* (WIS). A specimen from Illinois was also thought to be introduced as an impurity in grass seed (cf. Jones and Fuller 1955: 486).

3. CREPIS SETOSA Hall f.

Branched annual, ca. 5 dm tall, with long slender taproot. Leaves, stems, and involucres hispid with stiff yellow hairs. Achenes beaked, light brown. Pappus copious, of numerous white bristles. 2n=8 (Babcock 1947).

Native of SE. Europe, occasionally introduced but not persistent in the United States, rare in Wisconsin, collected once in Fond du Lac Co.:" lawn weed, impurity in grass seed sown June, 1950; two plants of this species bloomed in July and August, 1951," *Cors s.n.* (WIS). Note citation of previous species.

54. TARAXACUM Zinn. DANDELION

Deep-rooted perennials with pinnatifid leaves in basal rosettes and showy, solitary, yellow heads on hollow scapes. Involucre biseriate, the outer row reflexed or erect, the inner erect. Achenes tuberculate above, cylindrical to fusiform, topped with a small pyramidal projection subtending the elongate slender beak. Pappus copious, of white to tawny bristles. Naturalized from the temperate Old World.

KEY TO SPECIES

A. Mature achenes reddish to deep brown or purplish; leaves generally deeply lobed or cut to midrib ____1. *T. ERYTHROSPERMUM.*

AA. Mature achenes tan to olivaceous, not red; leaves various, deeply lobed to entire _________________2. *T. OFFICINALE.*

1. TARAXACUM ERYTHROSPERMUM Andrz. Red-Seeded Dandelion
Map 50.

Taraxacum laevigatum of many authors, not of (Willd.) DC.

Weedy scapose perennials 5–20(–30) cm tall, with deep straight taproots. *Leaves* lanceolate to oblanceolate, *deeply runcinate-pinnatifid,* 4–21 cm long, 1–3 cm wide, sessile to short-petioled. Inner series of bracts 10–15 mm long, at times with a small apical projection (corniculate), *not reflexed, the outer series shorter, erect to reflexed. Achenes red to reddish-brown or purplish,* the body 3–3.7 mm long, the beak 7–11 mm long. 2n=24 (Poddubnaja & Dionowa 1937, ex Darlington 1955).

Naturalized from Europe, rather common as a weed in Wisconsin. Flowering from late April through May and from late August to September; fruiting from May through mid-October. One may assume that this species is more common in Wisconsin than Map 50 indicates.

2. TARAXACUM OFFICINALE Weber Common Dandelion. Map 51.

Very common weedy scapose perenials 1–4(–6) dm tall. *Leaves* in a basal rosette, lanceolae to oblanceolate, *variously sinuately lobed (usually not to the midrib)* to entire, 11–35 cm long, 2–3 cm wide, *tapering to slightly winged petioles.* Inner series of bracts erect, 1–17 mm long, *the outer series shorter, strongly reflexed in fruit. Achenes tan to olivaceous,* the body 2.5–3.1 mm long, the beak 7–11 mm long. Sexual micro-species: diploid 2n=16. Apomicts: triploid 2n=24; tetraploid 2n=32; pentaploid 2n=40; hexaploid 2n=48 (Gustafson ex Löve & Löve 1947).

Naturalized from Europe, a ubiquitous weed throughout Wisconsin. Flowering mainly from April to June, occasionally in September; fruiting from May through September (–November).

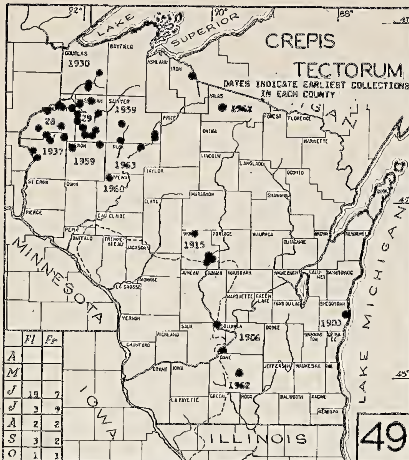
Taraxacum officinale, has been divided, especially in N. Europe, into innumerable apomictic micro-species, based on shapes of involucral bracts, shape of leaves, extent of lobing, etc., all characters difficult to determine objectively. It is best, therefore, to consider all Wisconsin *Taxaxaca* with tannish to olivaceous achenes the highly polymorphic *T. officinale.* Fernald (1950) and Sherff (1920) use the corniculate bracts of *T. erythrospermum* to distinguish it from *T. officinale.* Since Wisconsin plants show this rarely it has not been used as a key character. Fernald considered the extent of leaf lobing to be important, leaves of *T. erythrospermum* being shorter and generally more deeply lobed than those of *T. officinale.*

55. SONCHUS L. Sow Thistle

Annual or perennial leafy weeds, mostly glabrous, sometimes glandular above. Leaves alternate, sessile, lobed or unlobed, with spinulose-dentate margins. Heads yellow, many flowered, the involucral bracts imbricated in 2–3 series. Achenes laterally compressed, beakless. Pappus bristles abundant, glistening white. An Old World genus, all our species introduced weeds.

Key to Species

A. Perennials with underground horizontal rootstocks; heads large, the involucre 12–20 mm high; leaf bases auriculate, more or less clasping the stem, the rounded auricles small and inconspicuous; achenes 5-nerved; terminal leaf lobe elongate-triangular to oblong.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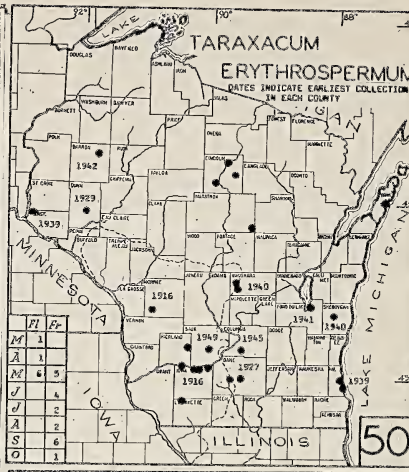
IOWA
ILLINOIS
LAKE MICHIGAN
49


TARAXACUM
ERYTHROSPERMUM
DATES INDICATE EARLIEST COLLECTIONS IN EACH COUNTY
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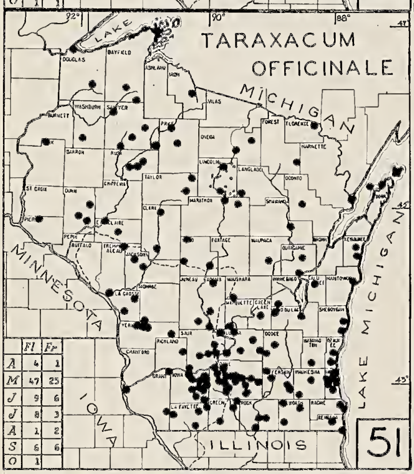
MINNESOTA
IOWA
ILLINOIS
LAKE MICHIGAN
50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OFFICINALE
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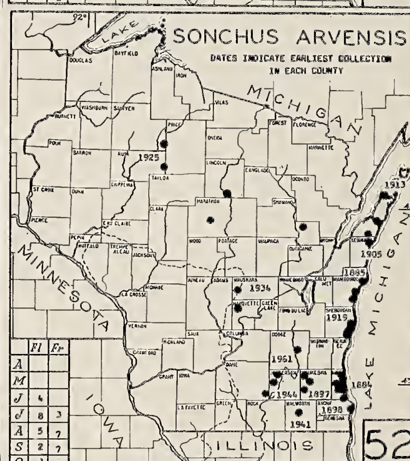
MINNESOTA
IOWA
ILLINOIS
LAKE MICHIGAN
51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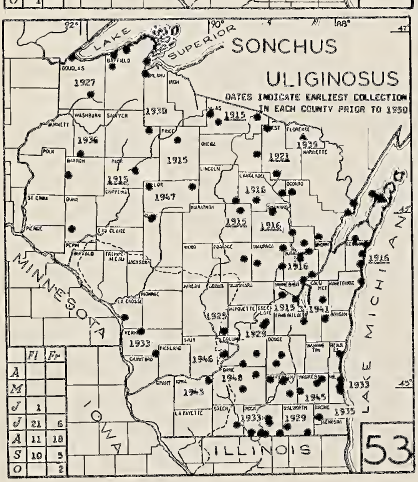
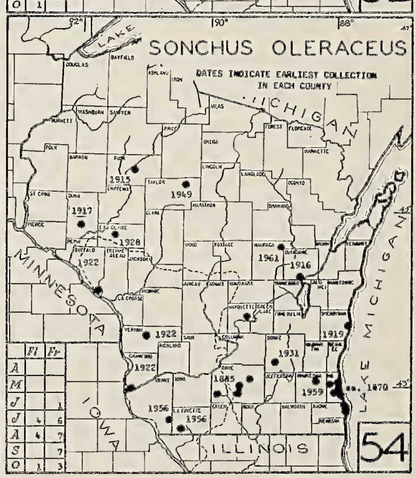
MINNESOTA
IOWA
ILLINOIS
LAKE MICHIGAN
52


SONCHUS
ULIGINOSUS
DATES INDICATE EARLIEST COLLECTION IN EACH COUNTY PRIOR TO 1950
LAKE SUPERIOR
MINNESOTA
IOWA
ILLINOIS
LAKE MICHIGAN
53


SONCHUS OLERACEUS
DATES INDICATE EARLIEST COLLECTION IN EACH COUNTY
LAKE
MICHIGAN
MINNESOTA
IOWA
ILLINOIS
LAKE MICHIGAN
54

B. Peduncles and involucre glandular _____ 1. *S. ARVENSIS.*

BB. Peduncles and involucre glabrous ____ 2. *S. ULIGINOSUS.*

AA. Annuals with elongate taproots; heads smaller, mostly 9–12 (–14) mm high; leaf bases auriculate-clasping, the acute or rounded auricles large and conspicuous; achenes 3- to 5-nerved; terminal leaf lobe triangular.

C. Auriculate leaf bases acute, the leaf margins sparsely prickly; achenes striate with 5 weak nerves; terminal leaf lobe sharply equilaterally triangular, cut nearly to midrib ________________________________ 3. *S. OLERACEUS.*

CC. Auriculate leaf bases rounded, the leaf margins abundantly spinulose-dentate; achenes 3-nerved; leaves mostly unlobed, or if lobed, terminal leaf lobe broadly or irregularly triangular, the leaf cut about halfway to midrib __________ ____________________________________ 4. *S. ASPER.*

1. SONCHUS ARVENSIS L. Field Sow Thistle. Map 52.

Perennials from long horizontal underground rootstocks, 5–13 dm tall, leafy mostly on lower half of glabrous stem. *Leaves* glabrous, oblanceolate, the upper lanceolate, *generally deeply lobed or sometimes entire, the margins spinulose-dentate, the small basal lobes rounded, short-auriculate.* Inflorescence an open corymbiform panicle, *the few to many heads on glandular peduncles. Involucral bracts* dark to pale green, (10–) 14–18 (–23) mm high, *glandular.* Achenes dark brown, 5-nerved, rugulose-papillose, 0.8–1.1 mm wide, 2.3–3.1 mm long. 2n=54 (Mulligan 1957, ex Löve & Löve 1961); 2n=64 (Darlington 1955).

Native of Europe and Western Asia, in Wisconsin infrequent on roadsides, river banks, beaches and abandoned low pastures, first collected in 1884. Flowering from (mid-) late June through September; fruiting from July through September.

2. SONCHUS ULIGINOSUS Bieb. Smooth Sow Thistle. Map 53.
Sonchus arvensis L. var. *glabrescens* Guenth., Grab. & Wimm.

Very similar to *S. arvensis* but 6–13 (–25) dm tall, from long horizontal underground rootstocks, the few to many heads on *glabrous peduncles, the involucral bracts glabrous, 11–16 mm high, with wide scarious white margins.* Achenes 2.0–3.1 mm long, 0.9–1.4 mm wide. 2n=36 (Löve & Löve 1961).

Common in E. and N. Wisconsin as a weed in railroad yards and on roadsides, *generally in moister habitats than S. arvensis,* such as lake shores, river banks, marshes, low wet fields and pastures, as well as in Oak-Hickory and Oak-Basswood woods, roadsides in sandy aspen stands and near houses in Northern Wisconsin; first collected in 1915. Flowering from early July to September; fruiting from July to early October.

3. SONCHUS OLERACEUS L. Common Sow Thistle; Milk Thistle. Map 54.

Slender to robust annuals 5–13 dm tall, from taproots, glabrous (rarely glandular) above. *Leaves oblanceolate with soft spiny teeth and large acute clasping basal auricles, the lower generally more or less deeply lyrate-lobed, the terminal lobe sharply broad-triangular, cut nearly to midrib,* the upper lanceolate, often unlobed. Inflorescence corymbiform-paniculate; heads solitary or several, on glabrous or rarely glandular peduncles, the involucre glabrous, 8–12 mm high. *Achenes* transversely rugose with usually *5 ribs or nerves,* including the two marginal (10X), light brown, 2.3–3.3 mm long. 2n=32 (Cooper & Mahoney 1935, probably from Wisconsin material).

Native of Europe, W. Asia and N. Africa, naturalized generally south of the "Tension Zone" in disturbed open weedy areas such as gardens, gravelly roadsides, railroad ballast and beaches. Flowering sporadically from (late June-) July to October; fruiting from June into November.

Most distinguishing field characters of *Sonchus oleraceus* are lyrate-lobed thin leaves resembling those of *Lactuca floridana,* and large, very acute, clasping leaf auricles.

Sonchus oleraceus has long been considered closely related to *S. asper,* Bentham and Hooker treating *S. asper* as its variety. Barber (1941) listed four characters to distinguish *S. oleraceus* from *S. asper:* 1) looser growth habit, 2) less spinose leaf margins, 3) sagittate spreading leaf bases, and 4) transverse achene ribs, and often more deeply lobed leaves. Their rare hybrids are sterile because the 9 chromosomes of *S. asper* and the 16 of *S. oleraceus* do not properly pair at meiosis. The *S. oleraceus* characters are all highly developed in *S. tenerrimus,* an annual of Southern Europe. Stebbins, *et al.* (1953) suggest that *S. oleraceus* (2n = 32) is an amphidiploid of *S. asper* (2n = 18) and *S. tenerrimus* (2n = 14).

4. SONCHUS ASPER (L.) Hill Spiny Sow Thistle. Map 55.

Annuals from long taproots, 3–10 dm tall. *Lower leaves lanceolate to spatulate-oblanceolate, mostly unlobed* [forma INERMIS (Bisch.) G. Beck] to sometimes shallowly runcinate-lobed *(the lobes usually cut less than halfway to the midrib, the terminal lobe* *broadly and irregularly triangular), the margins strongly spinescent-dentate, the large rounded spiny bases auriculate-clasping.* Inflorescences umbellate; heads solitary or crowded on glabrous or glandular peduncles [forma GLANDULOSIS Beckh.], the involucres 10–15 mm high, glabrous, gray-green, the innermost bracts often with white scarious margins. *Achenes 2–3 mm long, 3-nerved* (10x), *otherwise smooth.* 2n=18 (Barber, 1941).

A native of Europe, N. Africa and W. Asia, in Wisconsin not infrequent in roadsides, moist sand, damp woods, cedar swamps, bogs, railroad yards and embankments, lawns, and pastures. Flowering and fruiting from July to October.

56. LACTUCA L. Wild Lettuce

Leafy-stemmed annuals, biennials or short-lived perennials with paniculate inflorescences. Involucre urn-shaped to cylindrical, the bracts in two or more unequal series. Achenes laterally compressed, beaked or unbeaked, with pappus attached to the enlarged tip. Heads usually numerous, the few flowers yellow, blue, or rarely white. Latin name for Lettuce, from *Lac*—milk, alluding to the milky juice.

Key to Species

A. Mature achenes with distinct filiform beak; leaves variously lobed or entire, the bases sagittate-clasping, or leaves petioled; corollas yellow, blue or purple.

B. Achenes with short white bristles near summit; lower leaves lobed, the upper entire, with leaf margins, midribs and often lower stems spinulose; common weed --1. *L. SERRIOLA*.

BB. Achenes lacking bristles near summit; leaves lobed to entire, neither margins, midrib nor lower stem spinulose (except in *L. ludoviciana).*

C. Mature achenes 1.5–3 mm, the beak 0.5–2 mm long; pappus 9–11 mm long; involucre 13–20 mm high; leaves thickish, mostly entire or the lower runcinate; corollas blue or purple; introduced perennial, rare --4. *L. PULCHELLA*.

CC. Mature achenes 2.5–4 mm, the beak 1–3 mm long; pappus 4–9 mm long; involucre 6–19 mm high; leaves lobed to dentate or rarely entire with sagittate bases.

D. Achenes 2.5–3.4 mm long, the beak 1–2 mm long; pappus 4–6 mm long; involucre 6–12 mm high; leaves petioled, lobed or the upper unlobed, the margins dentate to entire; corollas yellow; very common ---------------------2. *L. CANADENSIS.*

DD. Achenes 3.4–4 mm long, the beak 2.5–3 mm long; pappus 7–9 mm long; involucre (10–) 14–19 mm high; leaves lobed to dentate, pronouncedly glaucous and rather thick-textured, spinulose on margin and midrib beneath; corollas blue or yellow; prairies -------------------------3. *L. LUDOVICIANA.*

AA. Mature achenes with short stout beak or beak lacking; leaves deeply lobed, rarely sessile, the bases not sagittate-clasping; corolla blue to whitish; tall woodland species.

E. Pappus white; leaves lyrately lobed, petioled; flowers blue; S. Wisconsin ----------------------5. *L. FLORIDANA.*

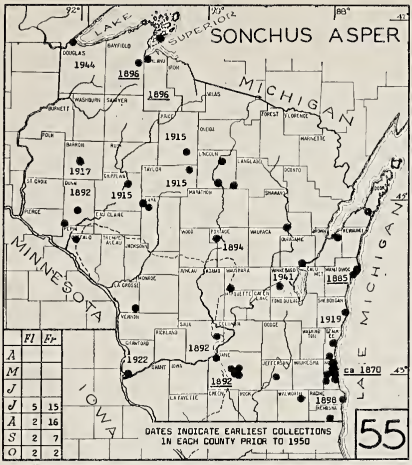
EE. Pappus brown or tawny, never white; leaves sessile, the lower lobed, the upper entire; flowers very pale bluish to ivory or whitish, inconspicuous; common throughout ----------------------------------6. *L. BIENNIS.*

1. Lactuca serriola L. Prickly Lettuce; Compass Plant. Map 56.
Lactuca scariola L.

Slender to robust glaucous annuals or biennials 4–11 dm tall, the *lower stem occasionally with prickly hairs.* Lower leaves lobed, broadly sagittate-clasping at base, *the margins and midrib beneath spinulose-ciliate,* the upper minutely serrulate, 5–16 cm long, 2–10 cm wide. Inflorescence an open panicle; heads narrowly cylindrical, the corollas pale yellow; involucre 9–14 mm high, the narrow bracts spreading in fruit. *Achenes 5–7-ribbed, bristly near summit,* 2.5–4 mm long, with a beak 3–4.5 mm long. 2n=18 (Thompson, ex Darlington 1955).

Native of Eurasia to the Himalayas, in S. Wisconsin a prevalent weed on roadsides, vacant lots, side walks, railroads (especially in r.r. yards), disturbed prairies, woods, Lake Michigan dunes, and (Curtis 1959), "one of the unusual features of the bracken-grassland community." Flowering from mid-July through September; fruiting from late July to October.

This species, easily distinguished by its prickliness, has a tendency, when growing in the open, for the stem leaves to be held vertically in a north–south plane, hence "Compass Plant." *Lactuca serriola* is the wild ancestor of cultivated lettuce, *L. sativa* (cf. Whitaker et al. 1939, 1941), and its great variability in Wisconsin may well be due to introgression from the cultivar.


SONCHUS ASPER
LAKE SUPERIOR
MICHIGAN
MINNESOTA
IOWA
LAKE MICHIGAN
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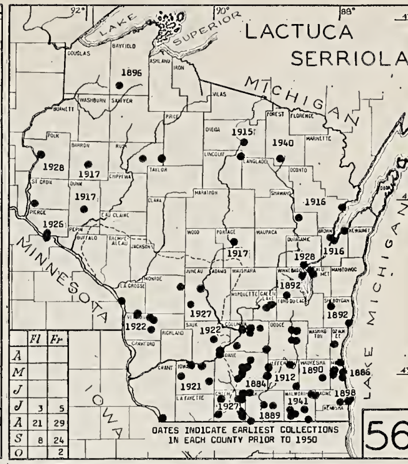
A 2 16
S 2 7
O 2 2
DATES INDICATE EARLIEST COLLECTIONS IN EACH COUNTY PRIOR TO 1950
55


LACTUCA SERRIOLA
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MICHIGAN
MINNESOTA
IOWA
LAKE MICHIGAN
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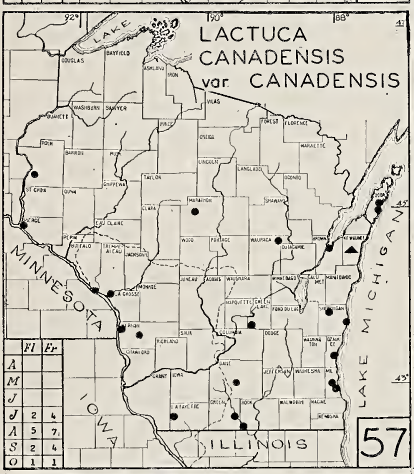
S 8 24
O 2
DATES INDICATE EARLIEST COLLECTIONS IN EACH COUNTY PRIOR TO 1950
56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IOWA
ILLINOIS
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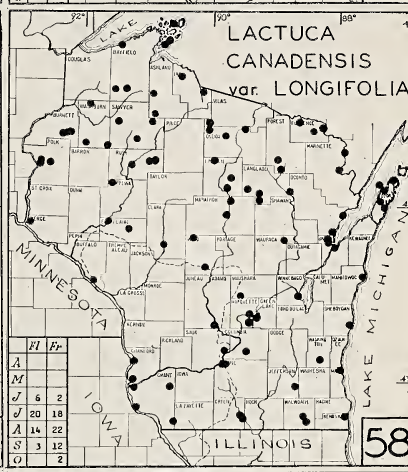
S 2 4
O 1 1
57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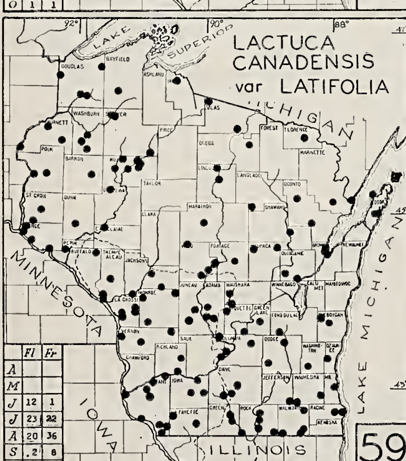
58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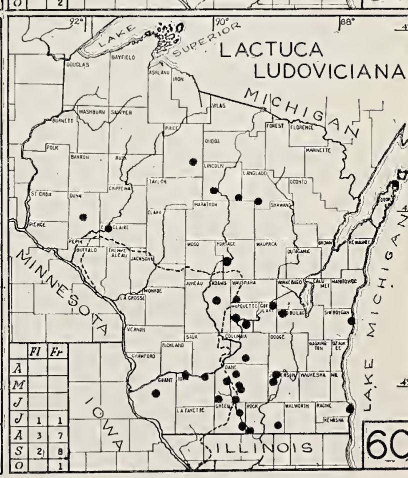
LACTUCA LUDOVICIANA
LAKE SUPERIOR
MICHIGAN
MINNESOTA
IOWA
ILLINOIS
LAKE MICHIGAN
Fl Fr
J 1 1
A 3 7
S 2 8
O 1
60

2. LACTUCA CANADENSIS L. Wild Lettuce, Wild Opium.
Maps 57–59.

Glabrous leafy biennials 8–16 dm tall. Leaves 6–40 cm long, the lower oblanceolate, petioled and lobed, the upper usually lanceolate, entire, sessile-sagittate. *Inflorescences variable* from open pyramidal panicles to dense spike-like racemes; *corollas pale yellow; mature involucre narrow,* 6–13 mm high, *the bracts often green with purple margins. Mature achenes with 1 median rib, 2.5–3.5 mm long, the beak 1–3 mm long,* frequently drying green. Pappus 4–6 mm long, glistening white. 2n=34 (Whitaker & Jagger 1939).

Throughout Wisconsin in a great variety of habitats, prevalent in wet to wet-mesic prairies (Curtis 1959), on roadsides, sandy fields, limestone bluffs, and in disturbed maple-hemlock, aspen and river bottom woods, shaded ravines and marshes. Flowering from late June through September; fruiting from July through September.

Divisible, strictly on the basis of leaf lobing and toothing, into the following rather weak varieties (after Fernald 1950).

KEY TO VARIETIES

a. Most leaves lobed.
  b. Lower most leaves with lobes entire, 3–7(–10) mm wide ---------------------------------- 2b. var. *LONGIFOLIA.*
  bb. Lowermost leaves with lobes dentate, (6–) 14–25(–40) mm wide, the upper leaves usually lobed -- 2c. var. *LATIFOLIA.*
aa. All but the lowermost leaves not lobed, the margins entire ---------------------------------- 2a. var. *CANADENSIS.*

2a. LACTUCA CANADENSIS L. var. CANADENSIS Map 57.

Lactuca integrifolia (Bigel.) Gray *sensu* Wiegand (1920) and Am. authors.

All leaves entire or rarely the lowest coarsely incised. Mostly in E. Wisconsin.

2b. LACTUCA CANADENSIS L. var. LONGIFOLIA (Michx.) Farw.
Map 58.

Lactuca canadensis L. var. *typica sensu* Wiegand (1920), not L.

Principal *leaves lobed, the lobes entire, rarely 1 cm wide,* the upper leaves lanceolate and entire. Throughout Wisconsin, though more common in the north.

2c. LACTUCA CANADENSIS L. var. LATIFOLIA Ktze. Map 59.

Principal *leaves lobed, the lobes dentate, and wider than in var. longifolia,* the upper ones lobed or entire. Throughout Wisconsin.

Two northern sheets of *Lactuca canadensis* [Marinette Co.: *Schuette s.n.* (F). Douglas Co.: Brule Barrens, *Thomson 5186* (WIS)] closely resemble *L. ludoviciana* in the large spreading inflorescences and large heads, but are more like *L. canadensis* var. *latifolia* in the coarsely lobed, not spinulose-dentate leaves.

3. LACTUCA LUDOVICIANA (Nutt.) Ridd. Prairie Lettuce. Map 60.

Robust biennials or short-lived perennials 4–12 dm tall. Leaves 6–17(–28) cm long, 2–6(–9) cm wide, crowded, sessile-sagittate, *thickish, conspicuously glaucous, the lower with midrib spinulose beneath, deeply lobed, the lobes acute to obtuse, sharply dentate,* the teeth and lobes more or less falcate, the upper mostly unlobed, dentate. Inflorescences paniculate-racemose; corollas yellow or blue (Gleason, 1952; Wisconsin plants mainly in fruit, their color mostly not established); *involucre cylindrical to ovate (12–)14–20 mm high. Achenes with one lateral rib, 3.4–4 mm long, the beak 2.5–3 mm long, very similar to those of Lactuca canadensis, but larger.* Pappus snowy white. $2n=34$ (Stebbins *et al.* 1953, ex Darlington 1955).

Scattered or locally common through S. and central Wisconsin, most abundant in dry-mesic upland prairies (Curtis, 1959), mesic deep-soil and in sandy prairies, often on railroads or roadsides, in N. Wisconsin introduced on roadsides, railroads, coal yards, and sandy fields. Flowering from July through mid-September; fruiting from late July to October.[15]

Vegetatively resembling *L. serriola* and *L. canadensis,* but differing by the wider, very glaucous leaves, with the larger teeth lacking the many smaller secondary teeth of *L. serriola,* and the wider, more robust, abrupt inflorescences with much larger heads.

4. LACTUCA PULCHELLA (Pursh.) DC. Map 61.

Slender leafy glabrous perennials with deep taproots, 3–6 dm tall. *Leaves sessile, thickish,* 5–10(–13) cm long, 1–2(–3) cm wide, *the lower quite entire to deeply runcinate-pinnatifid,* the lobes entire or nearly so, the upper lanceolate, entire. Inflorescences open panicu-

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[15] It is possible that this species is seasonally isolated from *L. canadensis.* Field observations by the second author, on July 31, 1962, in Central Wisconsin (Marquette Co.), showed that *L. ludoviciana,* which there is not uncommon on sandy roadsides and open oak woods and often grows with *L. canadensis,* blooms earlier, with almost all inflorescences past flowering, while most plants of *L. canadensis* were just at beginning of anthesis.

late-racemose, the *few large heads on scaly-bracted peduncles; corollas bright blue to blue-violet. Involucre* cylindrical, *13–20 mm high.* Achenes thickish, 1.5–3 mm long, with short firm beak 0.5–2 mm long; pappus white.

Native of the grasslands of the Western United States, in Wisconsin occasional and sporadic along railroad rights-of-way or railroad yards. Flowering from early July to late August; fruiting from mid-August.

5. LACTUCA FLORIDANA (L.) Gaertn. Blue Lettuce. Map 62.
Lactuc villosa Jacq.

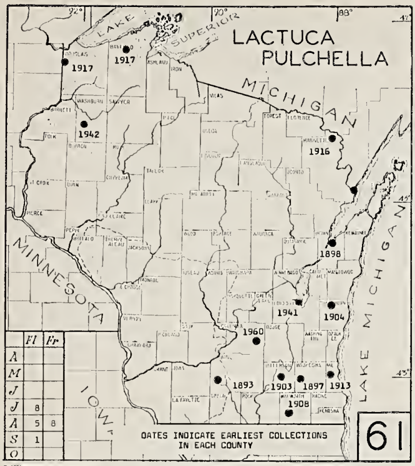
Slender biennials 1–2 m tall, similar to *L. biennis. Leaves thin, deeply lyrate-lobed,* 7–28 cm long, 3–12 cm wide, *the margins dentate, the midrib often pilose beneath. Inflorescences spreading paniculate-racemose; corollas light blue,* often with purplish tinge; involucre cylindrical to spreading, 6–10 mm high. Mature achenes *brown or mottled,* 3–4 mm long, the *beak very short or lacking. Pappus white (never brownish),* 5–7 mm long.

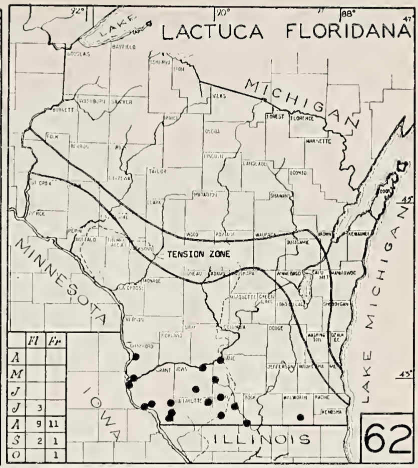
Rather common in SW. Wisconsin in rich mesic oak woods, river bottoms, forests, on roadsides, and cultivated areas. Flowering from late July through early (late) September; fruiting from August into October.

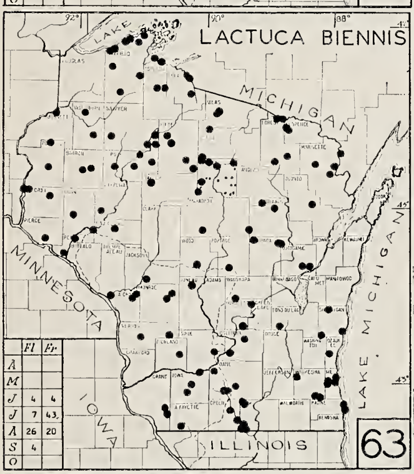
6. LACTUCA BIENNIS L. Woodland Lettuce. Map 63.
Lactuca spicata (Lam.) Hitchc., *sensu* Am. authors, not Lam.

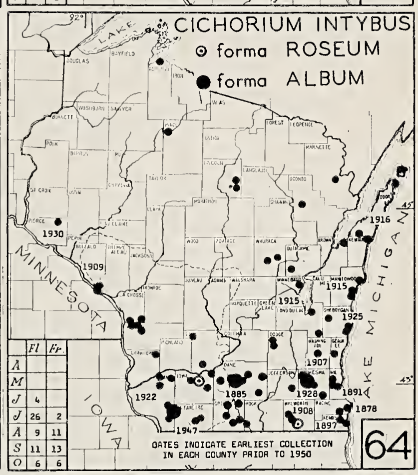
Slender to very robust leafy biennials 1–3 m or more tall. *Lower leaves often lyrately lobed, the falcate lobes often alternate,* (7–) 9–18(–51) cm long, 3–10(–16) cm wide, the upper lanceolate, entire. Panicles elongate, *the corollas very pale blue to translucent ivory or whitish, the limb often very small and corollas therefore very inconspicuous,* the open head ca. 8–10 mm diam.; involucre cylindrical to campanulate, 8–12 mm high. *Achenes* thickish, ca 4 mm long, the beak lacking. *Pappus tawny or brown, sometimes reddish, never white,* 4–5(–9) mm long. 2n=34 (Thompson, ex Darlington 1955).

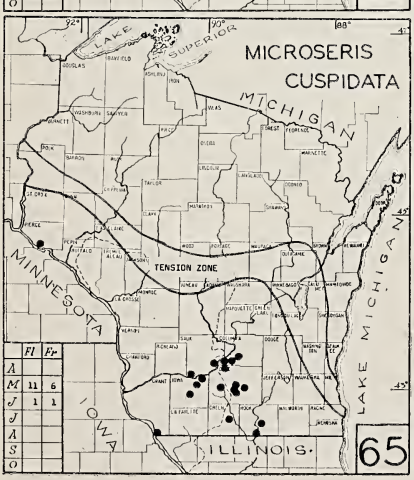
A woodland species, most common in the southern dry mesic oak forest and low flood plain forests, in the north not uncommon in maple-basswood and low maple-elm-ash forests, tamarack-spruce-white cedar-hemlock-hardwoods, *Rubus* thickets, on wooded shores of lakes, streams and rivers, and roadsides, there to over 5 m tall! Flowering from mid-June to mid-September; fruiting from late July to late September.

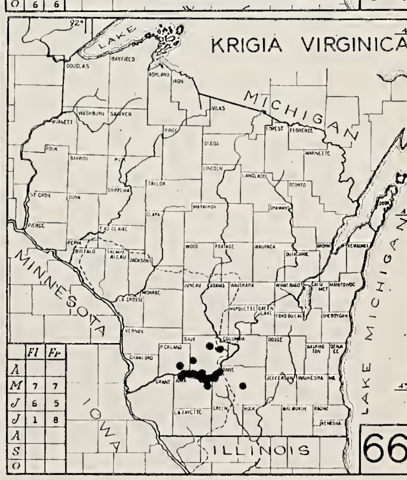

LACTUCA PULCHELLA
LAKE SUPERIOR
MICHIGAN
MINNESOTA
IOWA
LAKE MICHIGAN
1917
1917
1942
1916
1898
1941
1904
1960
1893
1903
1897
1913
1908
DATES INDICATE EARLIEST COLLECTIONS IN EACH COUNTY
Fl Fr
A
M
J
J 8
A 5 8
S 1
O
61


LACTUCA FLORIDANA
LAKE
MICHIGAN
TENSION ZONE
MINNESOTA
IOWA
ILLINOIS
LAKE MICHIGAN
Fl Fr
A
M
J
J 3
A 9 11
S 2 1
O 1
62


LACTUCA BIENNIS
LAKE
MICHIGAN
MINNESOTA
IOWA
ILLINOIS
LAKE MICHIGAN
Fl Fr
A
M
J 4 4
J 7 43
A 26 20
S 4
O
63


CICHORIUM INTYBUS
forma ROSEUM
forma ALBUM
LAKE
MINNESOTA
IOWA
LAKE MICHIGAN
1916
1930
1909
1915
1915
1925
1907
1922
1885
1928
1891
1878
1908
1897
1947
DATES INDICATE EARLIEST COLLECTION IN EACH COUNTY PRIOR TO 1950
Fl Fr
A
M
J 4
J 26 2
A 9 11
S 11 13
O 6 6
64


MICROSERIS CUSPIDATA
LAKE SUPERIOR
MICHIGAN
TENSION ZONE
MINNESOTA
IOWA
ILLINOIS
LAKE MICHIGAN
Fl Fr
A
M 11 6
J 1 1
J
A
S
O
65


KRIGIA VIRGINICA
LAKE
MICHIGAN
MINNESOTA
IOWA
ILLINOIS
LAKE MICHIGAN
Fl Fr
A
M 7 7
J 6 5
J 1 8
A
S
O
66

57. CICHORIUM L. CHICORY

1. CICHORIUM INTYBUS L. Chicory; Blue Sailors. Map 64.

Branched, glabrous to densely pilose, robust perennial, to 1 m tall, the deep taproot used as an adulterant or substitute for coffee. Leaves alternate, variously lobed. *Heads* 3–4 cm diam., *showy, bright blue* [white in forma ALBIFLORUM Neum.; pink in forma ROSEUM Neum.], *in sessile clusters of 2–3 in the axils of upper leaves or terminal on erect, hollow, glandular peduncles, each with 1–2 sessile heads.* Involucre biseriate, the outer series glandular. *Pappus of numerous minute chaffy scales.* 2n=18 (Stebbins, ex Darlington 1955).

Native to the Mediterranean Region, abundant in S. and E. Wisconsin along roadsides and in disturbed areas in cities. Flowering from (mid-) late June through October; fruiting from late July through October.

58. MICROSERIS D. Don

1. MICROSERIS CUSPIDATA (Pursh) Schultz Bip. Map 65.
Agoseris cuspidata (Pursh) Steud.

Scapose perennials with deep taproots. *Scape glabrous below, abundantly pilose above,* 1–5 dm tall. *Leaves basal, grass-like to linear-elliptic,* 11–27 cm long, 4–11(–22) mm wide, the margins woolly-pubescent. Heads solitary, large, 3–5 cm in diam.; corollas yellow. x=9 (Darlington 1955).

Native of the western Great Plains, in S. Wisconsin rather rare and sporadic, mainly on sandy, or dry rocky calcareous prairies and bluffs, gravelly hillsides, and along railroads, in Pierce County (Hager City) on the Mississippi River sand terraces with *Anemone patens* and *A. caroliniana* [*Wadmond s.n.* (WIS)]. Flowering throughout May (–June); fruiting from mid-May to June.

Microseris cuspidata can be distinguished from *Tragopogon* by the scapose habit, beakless achenes, and woolly leaf margins.

59. KRIGIA Schreb. DWARF DANDELION.

[Shinners, Lloyd H. Revision of the genus *Krigia* Schreber. Wrightia 1: 187–206. 1947.]

Scapose annuals or perennials. Leaves basal, variously lobed to entire, glabrous or glandular. Heads solitary to clustered, the corollas yellow to yellow-orange. Involucral bracts biseriate. Achenes cylindrical to conical, truncate. Pappus double, the outer series of minute scales, the inner of few to numerous scabrous bristles.

KEY TO SPECIES

A. Plants annual; achene conical; pappus of 5 outer scales alternating with 5 inner scabrous hairs; scape leafless; rare, S. Wisconsin .... 1. *K. VIRGINICA.*

AA. Plants perennial; achene cylindrical; pappus of more numerous scales and scabrous hairs; scape bearing 1–2 reduced sessile leaves; peduncles glabrous or glandular; common throughout .... 2. *K. BIFLORA.*

1. KRIGIA VIRGINICA (L.) Willd. Dwarf Dandelion. Map 66.

Very slender scapose annual (5–) 9–29 cm tall, from long taproot. Stem glandular at base and at base of involucre, sparsely so in midportion. Leaves numerous, basal, oblong to spatulate, often with remote acute teeth, glandular over both surfaces or at least on the margins, often black-punctate. Heads solitary, when flowering 18–20 mm in diam. (fresh). Involucral bracts of fruiting plant translucent, often with red or purple center line. *Pappus of 5 outer white or brownish 1 mm long scales alternating with 5 inner scabrous 4–6 mm long bristles.*

Locally abundant in S.-central Wisconsin, in sandy soil along roads, railroads and Jack Pine barrens along the Wisconsin River in Dane, Sauk, Iowa and Richland counties, the range closely paralleling that of *Opuntia compressa* var. *macrorhiza* (Ugent, 1962), at Arena, Iowa Co., on sand dunes and flats with *Diodia teres* var. *setifera* (only Wisc. station), *Polygonella articulata, Polanisia dodecandra, Hudsonia tomentosa, Hypericum gentianoides, Cycloloma atriplicifolia. Cyperus schweinitzii, Cenchrus pauciflorus,* etc., the Madison record presumably an introduction in the University of Wisconsin Arboretum [1947, *Greene s.n.* (WIS)].

2. KRIGIA BIFLORA (Walt.) Blake Dwarf Dandelion. Maps 67, 68.

Slender perennials 2–6 dm tall, the stem scape-like; leaves mostly basal, *except for 1–2 mostly reduced, sessile-clasping bracts subtending inflorescence branches,* spatulate-lanceolate with winged petioles, glabrous (rarely pilose), entire, repand to variously lobed. Heads few, orange-yellow, 2–3 cm in diam. when in flower, on elongate peduncles arising singly or several in the axil of 1–3 short leafy bracts. *Pappus double, the outer series of numerous tawny minute scales, the inner of scabrous bristles.* $2n=10$ (cf. p. 336).

KEY TO SUBSPECIES

a. Inflorescence branches and involucre completely glabrous; leaves nearly always entire ______________2a. ssp. *BIFLORA*.
aa. Inflorescence branches and at times the involucre sparsely to densely glandular; leaves entire to often deeply lobed ____2b. ssp. *GLANDULIFERA*.

2a. KRIGIA BILFORA (Walt.) Blake, ssp. BIFLORA. Map 67.

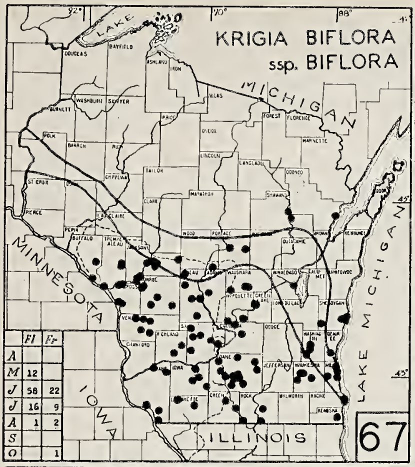
Common in Wisconsin in the southern "forest-prairie province", in open oak-hickory, maple-basswood, and Jack Pine-Jack Oak woods, sandy prairies, roadsides, railroads, and thickets. Flowering from late May to mid-July (-August) ; fruiting from June through July (-October).

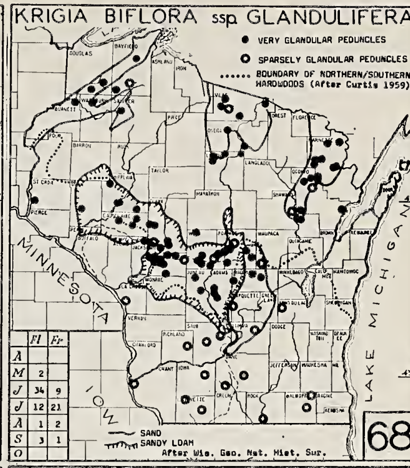
2b. KRIGIA BIFLORA (Walt.) Blake, ssp. **GLANDULIFERA** (Fern.) Iltis, *stat. nov.* Map 68.
Krigia biflora (Walt.) Blake, forma *glandulifera* Fern. Rhodora 37:337. 1935

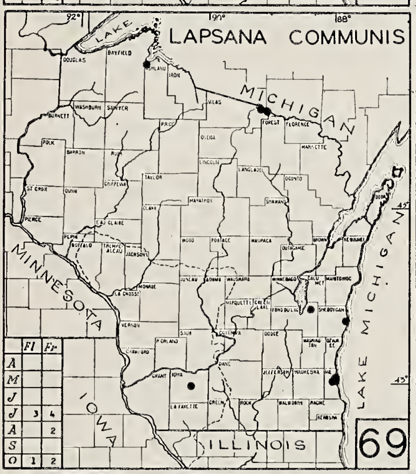
Relatively common in sandy areas north of, or within the "Tension Zone", on roadsides, lake shores, or in oak or Jack Pine woods, on sandy hillsides and open fields, less common in aspen woods, sedge meadows and alder-White Cedar swamps. Flowering from (late May-) early June to mid-July (-September), the peak about 10 days later than in ssp. *biflora*, this perhaps related to its more northerly range; fruiting from June sporadically through August (-October).

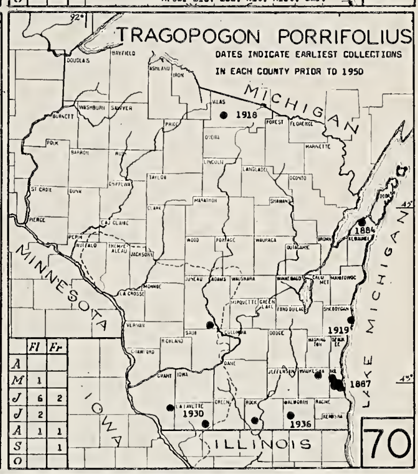
In a recent revision of the genus, Shinners (1947b) considered the glandularity of the peduncles to be of no taxonomic or geographic significance and relegates Fernald's form to synonomy. A glance at the great similarity of the glandular to the non-glandular plants makes this view understandable. Yet there are several reasons to think that the two forms have had separate histories, and that it would be better to recognize them as geographic subspecies.

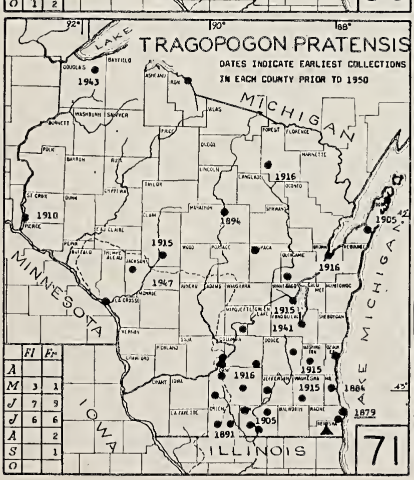
Morphologically, the only differences are those outlined in the key. The glandularity varies from plants densely glandular on involucral bracts, peduncles and even scapes, to plants that have just a few hairs at the very base of the head, or none at all. Linked with glandularity is a strong tendency for deep lobing of the leaf, a tendency noted by Fernald (1935: 337–8). While all but a very few plants of ssp. *biflora* have entire (unlobed) leaves, as do many plants of ssp. *glandulifera,* deeply lobed leaves are a common tendency of the latter taxon only. It is likely that detailed measure-

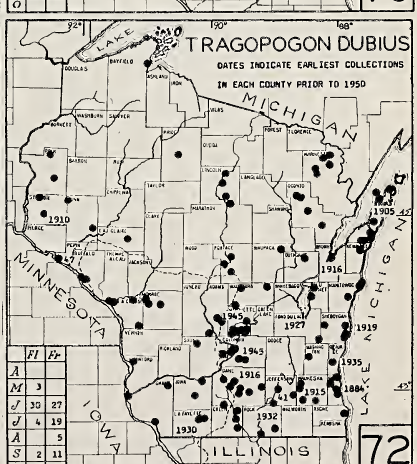

KRIGIA BIFLORA
ssp. BIFLORA
MICHIGAN
MINNESOTA
IOWA
ILLINOIS
LAKE MICHIGAN
Fl Fr
A
M 12
J 58 22
J 16 9
A 1 2
S
O 1
67


KRIGIA BIFLORA ssp. GLANDULIFERA
VERY GLANDULAR PEDUNCLES
SPARSELY GLANDULAR PEDUNCLES
BOUNDARY OF NORTHERN/SOUTHERN HARDWOODS (After Curtis 1959)
MINNESOTA
IOWA
LAKE MICHIGAN
SAND
SANDY LOAM
After Wis. Geo. Nat. Hist. Sur.
Fl Fr
A
M 2
J 34 9
J 12 21
A 1 2
S 3 1
O
68


LAPSANA COMMUNIS
MICHIGAN
MINNESOTA
IOWA
ILLINOIS
LAKE MICHIGAN
Fl Fr
A
M
J
J 3 4
A 2
S
O 1 2
69


TRAGOPOGON PORRIFOLIUS
DATES INDICATE EARLIEST COLLECTIONS IN EACH COUNTY PRIOR TO 1950
MICHIGAN
1918
1884
1919
1887
1930
1936
MINNESOTA
IOWA
ILLINOIS
LAKE MICHIGAN
Fl Fr
A
M 1
J 6 2
J 2
A 1 1
S 1
O
70


TRAGOPOGON PRATENSIS
DATES INDICATE EARLIEST COLLECTIONS IN EACH COUNTY PRIOR TO 1950
MICHIGAN
1943
1916
1910
1894
1915
1947
1905
1916
1915
1941
1916
1915
1915
1884
1879
1905
1891
MINNESOTA
IOWA
ILLINOIS
LAKE MICHIGAN
Fl Fr
A
M 3 1
J 7 9
J 6 6
A 2
S 1
O
71


TRAGOPOGON DUBIUS
DATES INDICATE EARLIEST COLLECTIONS IN EACH COUNTY PRIOR TO 1950
MICHIGAN
1910
1905
1916
1945
1927
1919
1945
1935
1916
1915
1884
1932
1930
MINNESOTA
IOWA
ILLINOIS
LAKE MICHIGAN
Fl Fr
A
M 3
J 30 27
J 4 19
A 5
S 2 11
O 2 5
72

ments will in the future add other characters to these distinctions. Chromosome number of ssp. *glandulifera* is 2n=10, counted recently on Wisconsin specimens (Vilas Co.) by Dr. S. Kawano at the Univ. of Wis. Herbarium. The number for ssp. *biflora* is unknown.

Though the total range of either subspecies is not known to us, their distribution in Wisconsin in relation to the above characters is significant (cf. maps 67, 68). Good ssp. *biflora,* with no glandular hairs whatsoever, is restricted to rocky woods and sand areas *south* or within the floristic "Tension Zone" (cf. Desmarais 1952: 377–8; Curtis 1959; and others), i.e. to south of the Northern Hardwood region. On the other hand, heavily glandular plants are restricted to sandy areas within and *north* of the "Tension Zone", in effect, to areas within the Northern Hardwoods. From within the Wisconsin area of good ssp. *biflora* there are a number of specimens that have only 5 mm of peduncle beneath the head that is glandular, or sometimes less, with only 2 or 3 hairs! These are mostly restricted to south of the "Tension Zone" (Map 68, stars), and, since in every other way they are ssp. *biflora* plants, it seems reasonable to suppose that their weakly expressed glandularity represent introgression from ssp. *glandulifera.* In Wisconsin, *Krigia biflora* often acts as a pioneer. This attribute, together with wind-borne fruits, would facilitate establishment, migration, and hybridization.

While throughout most of Wisconsin the mass ranges of the subspecies do not overlap, in the "Tension Zone" in Central Wisconsin both may grow within the same population. In eight mass collections from Jackson County, Fassett (ms., ca. 1948) calculated percentages of glandular plants in a given population, finding that five stations were 100% glandular, one was 98%, one was 95% and one, in eastern Jackson County, 57% glandular. This last station also had plants with both slightly glandular and glabrous peduncles on the same plant.

While ssp. *biflora* is widespread in the eastern U.S., we have only few records of glandular plants in the University of Wisconsin Herbarium south of the region of the Northern Hardwoods. One sheet from Peoria, Illinois (a wooded valley), and a few from eastern Kentucky and the Southern Appalachians have hairy peduncles. Intermediates, like those of southern Wisconsin, are not rare in Iowa or Minnesota. These observations essentially agree with those Fernald (1935) who also reports the Colorado and New Mexico plants to be glandular, as does Scoggan (1957) for those from Manitoba. All in all, it suggests that these subspecies were once segregated along the lines of the Northern Hardwoods or perhaps Rocky Mountains area (ssp. *glandulifera)* vs. Southern Deciduous Forest area (ssp. *biflora),* but have in recent times begun to reintegrate. In Wisconsin, near the western limit of the Northern Hardwoods, where the more northern (or western) ssp. *glandulifera* may have met the southern ssp. *biflora* only recently, the distinctions of morphology on a geographic basis are still quite clear.

60. LAPSANA L.

1. LAPSANA COMMUNIS L. Nipple Wort. Map 69.

Slender weedy annual 4–6 dm tall, branched above. *Stem pilose below, glandular-pilose above.* Lower leaves lyrately-lobed to ovate, long petioled, the upper sub-sessile to sessile, ovate to lanceolate, *the dentate margins pilose.* Inflorescence an open panicle. Heads few flowered, small, the corollas yellow; involucre glabrous, biseriate, *the inner series of 8 erect, keeled bracts 6–7 mm high, the outer ca 1/10 as long.* Achenes narrowed toward summit, but not beaked. *Pappus none.* 2x=14 (Löve & Löve 1961).

Naturalized from Europe, rare in Wisconsin in mesic or moist habitats, on refuse heaps, roadsides, fence lines, deciduous or coniferous woods, and street corners in Milwaukee. Flowering in July; fruiting in July and August.

61. LEONTODON L.

1. LEONTODON AUTUMNALIS L. Autumn Dandelion; Hawkbit.

Slender, simple or branched scapose perennial ca 5 dm tall. Leaves basal, oblanceolate, their lobes distant, linear, entire, glabrous to sparsely pilose. Heads *subtended by swollen, scaley-bracted sparsely pilose peduncles,* the corollas yellow. Involucre campanulate, ca 9 mm high, the bracts narrow, glandular-pubescent. Achenes columnar, faintly nerved, rugulose. Pappus uniseriate, the bristles plumose. Native of Eurasia, established on the E. U.S. coast but rarely inland, in Wisconsin collected once in Sheboygan, June, 1903 [fr] *Goessl s.n.* (WIS) (very possibly in the collector's garden!?).

62. TRAGOPOGON L. GOAT'S BEARD

[Ownbey, Marion. Natural Hybridization and Amphidiploidy in the Genus *Tragopogon*. Am. Jour. Bot. 37: 487–499. 1950]

Branched or unbranched glabrous perennials with a long straight taproot. Leaves alternate, grass- or ribbon-like, the sessile bases clasping. Heads large, the numerous flowers yellow or purple. Involucre uniseriate. Achenes cylindrical, long beaked. Pappus of numerous plumose bristles. Eurasian genus, with several species common weeds.

Key to Species

A. Ligules pale violet to deep purple; achenes abruptly tapering to beak longer than achene body; involucral bracts 7–11; cultivated and rarely escaped ____________1. *T. PORRIFOLIUS.*

AA. Ligules yellow; achenes gradually tapering to a beak longer or shorter than the achene body; common weeds.

B. Bracts generally 8 or 9, margined with red or purple, about equal to the corollas; achene beak shorter than body; peduncle slender, not enlarged below the head; leaf tips recurved __________________________2. *T. PRATENSIS.*

BB. Bracts generally 11–13, not margined with red or purple; achene beak longer than body; peduncle strongly enlarged (inflated) below the head; leaf tips not recurved ________ __________________________________3. *T. DUBIUS.*

1. Tragopogon porrifolius L. Salsify; Oyster Plant. Map 70.

Glabrous perennial to 8 dm or more tall, with *pale violet to purple ligules shorter than the involucral bracts, the flowering heads borne on somewhat swollen hollow peduncles.* Leaves to 34 cm long, to 1 cm wide, narrow-lanceolate to linear. Involucre of (7–)*8–9(11) bracts,* 2.5–3 cm long, becoming longer in fruit. Achenes *tapering abruptly to a slender beak somewhat longer to twice the length of the achene body.* 2n=12 (Ownbey 1950).

Introduced from Europe, rarely found in Wisconsin on open roadsides and railroads as an escape, the plants often grown as root vegetables. Flowering from late May to early August; fruiting from August to September.

2. Tragopogon pratensis L. Lesser Goat's Beard. Map 71.

Perennial branching from midway on stem, 5–8 dm tall, with *yellow ligules about equaling the involucral bracts, the fruiting peduncles remaining thin and cylindrical.* Leaves 17–26 cm long, to 1.7 cm wide at the base, *the tips recurved.* Involucre 21–23 mm long in flower, extending to 32 mm in fruit, *the (7–)8–9(–11) bracts margined with red or purple.* Achenes gradually tapering to a thin beak shorter than achene body. Fruiting head abruptly and pronouncedly thickened. 2n=12 (Winge 1926, ex Ownbey 1950).

Native of Europe, mainly in southern and eastern Wisconsin as a weed along roadsides, vacant lots, on railroad prairies, hayfields, and with *Juniperus virginiana*, etc. on sandstone bluffs. Flowering from late May through mid-July; fruiting from June to mid-August.

3. TRAGOPOGON DUBIUS Scop. Greater Goat's Beard. Map 72.

Perennial branching from near base, 5–9 dm tall, with *yellow ligules all shorter than the involucral bracts, the peduncles enlarged and hollow* (in late plants or late shoots less so). Leaves to 30 cm long, 8–12 mm wide at the base. Involucre 25–35 mm long lengthening to as much as 67 mm in fruit, *the 13 bracts green throughout*. Achenes abundantly scabrous, gradually tapering to a thin beak equalling or slightly longer than the achene body. 2n=12 (Ownbey 1950).

Naturalized from Europe, mainly in S. and E. Wisconsin as a common weed of roadsides, sandy prairies, sandstone cliffs, railroad ballasts, abandoned fields, orchards, dry sandy oak woods, Sugar Maple-Basswood woods, and pastures. Flowering from late May to mid-July, sporadically through September and October; fruiting from late June through October.

Tragopogon dubius, quite similar to *T. pratensis*, may be distinguished, aside from key characters and generally longer fruits, as follows (after Ownbey 1950):

	T. DUBIUS	T. PRATENSIS
LEAVES:	Tips straight	Tips recurved
BRACTS:	Long, narrow, not margined with red or purple, 13	Shorter, wider, red or purple margins, 8 or 9
BRANCHING:	From near base	From midway on stem
LIGULES:	Shorter than bracts	Equalling bracts
ACHENES:	Slender	Thicker

Ownbey (1950) reports natural hybrids and their amphidiploids in Washington State, where all three species are found sympatrically. Hybrids, then, may occur in southern Wisconsin, though none have been recognized to date.

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PRELIMINARY REPORTS ON THE FLORA OF WISCONSIN NO. 49. COMPOSITAE II—COMPOSITE FAMILY II

THE GENUS *Senecio*—THE RAGWORTS—IN WISCONSIN[1,2]

T. M. Barkley

Senecio is a world-wide genus of some one thousand or more species, exhibiting great morphological and ecological diversity. It varies from tropical trees to small arctic herbs, and includes wide-spread weedy species and narrow endemics. Many native temperate North American *Senecio* species are biologically complicated in that they readily intergrade with each other.

The distribution maps are based on specimens in the University of Wisconsin (WIS), Milwaukee Public Museum (MIL) and Northland College, Ashland (NC) herbaria, and on my revision (1962) of *Senecio aureus* and allied species, which includes *S. aureus, S. pseudaureus* var. *semicordatus, S. pauperculus, S. plattensis,* and *S. indecorus* of the Wisconsin flora. I am grateful to Hugh H. Iltis, University of Wisconsin, Emil P. Kruschke, Milwaukee Public Museum, and Eugene Hsi, Northland College for making the specimens of their respective institutions available to me. Mrs. Roberta Kirkpatrick, Ollie Weber, and Barbara Elder assisted in preparation of the manuscript.

Genus 26. SENECIO LINN. Groundsel, Ragwort, Butterweed

Annual, biennial or perennial herbs with alternate, toothed or divided to entire leaves and few to numerous cylindric or campanulate heads. Heads radiate or eradiate; rays yellow to whitish-yellow. Principal involucral bracts green, equal in size or nearly so, appearing in a single series, usually subtended by a few small calyculate bracts; receptacle naked. Disk florets perfect and fertile; style branches flattened and penicillate; ray florets pistillate and fertile. Pappus of fine, smooth or very lightly barbellate bristles. Achenes terete or nearly so at maturity, 5–10 nerved.

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Key to Species

A. Leaves more or less equally distributed on the stem; annuals, or perhaps rarely biennials.

B. Rays conspicuous; leaves entire to weakly toothed; pubescence often copious. Rare native, N. Wisconsin -- 1. *S. congestus.*

BB. Rays inconspicuous or absent; leaves, or some of them, lobed to pinnatified; pubescence short and often scant, crisp. Introduced weeds.

C. Rays absent; calyculate bracts well developed with distinct black tips ------------------------2. *S. vulgaris.*

CC. Rays present, small; calyculate bracts usually without distinct black tips ------------------3. *S. sylvaticus.*

AA. Cauline leaves relatively few, progressively reduced upward, usually smaller and more toothed than the basal leaves; perennials or sometimes biennials with short, erect, or spreading underground parts.

D. Basal leaves cordate or abruptly contracted to the petiole.

E. Inflorescence a loose to congested corymbose cyme, rarely conspicuously subumbellate.

F. Basal leaves typically cordate, occasionally subcordate or truncate; caudex weakly spreading to suberect. Common and widespread ------ 4. *S. aureus.*

FF. Basal leaves truncate to abruptly contracted; caudex simple, very short, erect or suberect. Sandy lakeshore prairies, Kenosha and Racine Co.s, rare ------------------5. *S. pseudaureus* var. *semicordatus.*

EE. Inflorescence subumbellate; basal leaf blades usually abruptly contracted to the petiole. Apostle Islands, Lake Superior, rare ------------------------8. *S. indecorus.*

DD. Basal leaves rounded or obtuse to tapering at the base, rarely subtruncate. Common and widespread species.

G. Pubescence normally persistent, at least along the upper stem, among the heads in the inflorescence, and in and near the axils of the basal leaves; caudex usually short and simple, erect or suberect; lower cauline leaves usually well developed, pinnatifid --------6. *S. plattensis.*[3]

GG. Glabrous or nearly so at maturity, caudex weakly branching and often elongated; cauline leaves usually reduced ----------7. *S. pauperculus* var. *pauperculus.*[3]

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[3] Species 6 and 7 intergrade freely and intermediates are common (cf. text).

1. SENECIO CONGESTUS (R.Br.) DC. Marsh Fleabane Map 1.
S. palustris (Linn.) Hook. 1834, not of Velloso, 1827.
S. congestus var. *tonsus* Fern. (TYPE: La Chapelle, Wisconsin, July 16, 1897, *Cheney 7419* (GH, WIS)).

Annual (sometimes biennial?) herbs, 3–8 dm tall, densely lanate-tomentose with long, jointed hairs, especially on the upper stem and among the heads in the inflorescence, or occasionally rather sparsely tomentose (var. TONSUS Fern.); stems thick and soft, unbranched, arising singly from a cluster of fibrous roots. Leaves linear-spatulate to narrowly oblanceolate, the lowermost to 12 cm long, progressively shorter up the stem; margins shallowly pinnatifid to merely undulate or subentire. Inflorescence congested to occasionally rather open; heads frequently numerous, to 50 or more; involucral bracts narrow, 4–7 mm long (calyculate bracts absent); rays light yellow, the ligule 5–6 mm long (dry); pappus long and abundant, conspicuous in mature plants.

NW. Wisconsin and Door Co., in swamps, edge of streams, etc., rather rare. Flowering from late May through July. A distinctive, circumpolar species, occuring in North America as far south as Iowa.

2. SENECIO VULGARIS Linn. Common Groundsel Map 2.

Annual weed to 3(–4) dm tall, lightly crisp-pubescent, glabrate and smooth in age; stem leafy throughout, unbranched to strongly branched, from a more or less distinct taproot. Leaves fleshy, 1–8 cm long, the margins undulate to pinnatilobate, the lobes often denticulate; lower leaves petiolate, becoming progressively more sessile and clasping upward. Heads strictly discoid, cylindrical; principal involucral bracts 4–7 mm long, about 21 in number; *calyculate bracts much shorter than the principal involucral bracts, conhpicuously black-tipped.*

SE. and extreme N. Wisconsin, in waste ground, roadsides, gardens, etc., a native of the Old World, now established throughout much of the temperate zone. Flowering from mid-May to early in July, and from the second week in September to mid-November.

3. SENECIO SYLVATICUS Linn. Wood Groundsel Map 1.

Annual weed to 8 dm tall, moderately crisp-pubescent to subglabrous; stems leafy througout, usually unbranched, arising singly from a taproot. Leaves more or less distinctly pinnatifid, the segments often denticulate. Heads cylindrical; involucral bracts 5–7 mm long, about 13 in number; *calyculate bracts* usually present but *very small, narrow, and inconspicuous, usually lacking distinct black tips;* rays present, small, the ligule often less than 1 mm long.

A native of the Old World, now widely established as a weed, in North America most abundant in the northeastern U.S., adjacent Canada, and along the Pacific Coast, known from Wisconsin by a single collection, viz. *Fassett 9558,* talus, gabbro knob, Hurley, Iron County (S25 T46N R2E), Aug. 21, 1929 (WIS).

Senecio sylvaticus is readily distinguished from the similar *S. vulgaris* by the presence of small rays, as well as a pronounced oily scent, which is lacking in fresh material of *S. vulgaris.*

4. SENECIO AUREUS Linn. Golden Ragwort Map 3.
 S. gracilis Pursh
 S. aureus var. *gracilis* (Pursh) Hook.

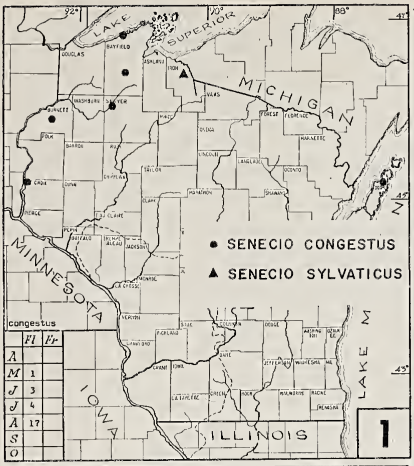
Perennial herbs 2–6 dm tall, glabrous or occasionally lightly tomentose in and near the axils of the basal leaves and among the heads in the inflorescence; stems single or loosely clustered from a horizontal, more or less branched and rhizomatous caudex. Basal leaf-blades rotund-ovate, cordate or sometimes subcordate, crenate to serrate-dentate, 1–6+ cm long, 1–6+ cm wide; petiole commonly 2–4 times as long as blade; cauline leaves reduced upward. Inflorescence a loose to congested corymbose cyme of 6–20 heads, the ligule 5–15 mm long, or ray florets absent in occasional individuals.

Throughout Wisconsin, frequent in rich woods, pastures, bogs, and other damp or wet areas. Flowering from mid-May in the southern part of the state to the second week in July in the north. Common and widespread, with many races and local variants, ranging from Newfoundland to Florida and west to the limit of the deciduous forest.

In SE. Wisconsin, especially in Dane, Jefferson, Kenosha, and Racine counties, occasional individuals bear a marked, somewhat intangible resemblance to *Senecio pseudaureus* var. *semicordatus.* In these individuals (hollow circles, Map 4) the basal leaf blade is rather abruptly contracted to the petiole, the petiole is relatively long and slender, and the underground portions tend to be reduced to a short caudex.

A slender, small-leaved phase, *S. aureus* var. *gracilis* or *S. gracilis,* uncommon in Wisconsin, though rather frequent in the Middle Atlantic States, is not sufficiently well defined morphologically or geographically to warrant taxonomic recognition.

5. SENECIO PSEUDAUREUS Rydb. var. SEMICORDATUS (Mack. & Bush) T. M. Barkley Western Golden Ragwort Map 4.
 S. semicordatus Mack. & Bush
 S. aureus var. *semicordatus* (Mack. & Bush) Greenm.


LAKE SUPERIOR
MICHIGAN
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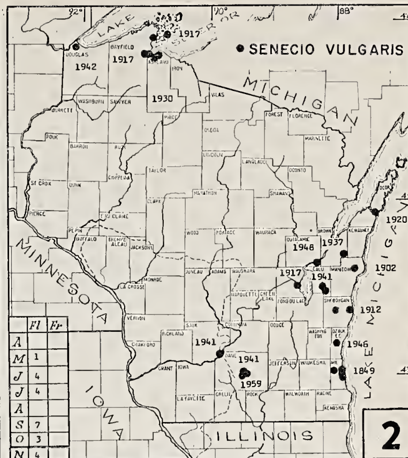
● SENECIO CONGESTUS
▲ SENECIO SYLVATICUS
congestus
1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LAKE SUPERIOR
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ILLINOIS
LAKE MICHIGAN
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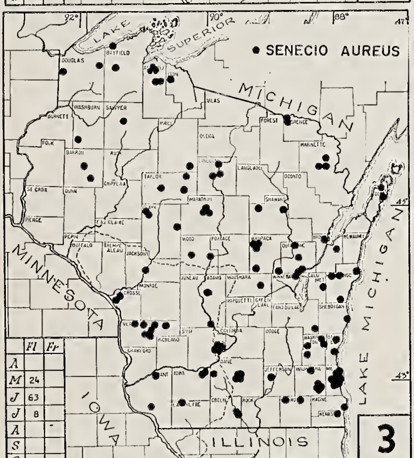
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LAKE MICHIGAN
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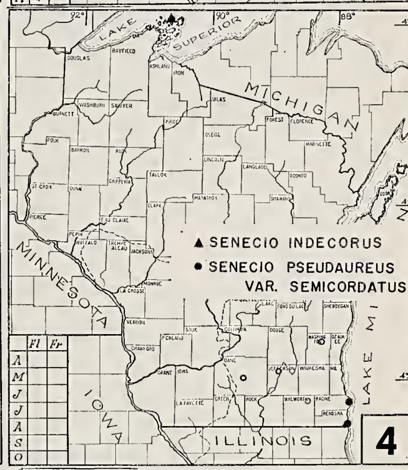
▲ SENECIO INDECORUS
● SENECIO PSEUDAUREUS VAR. SEMICORDATUS
LAKE SUPERIOR
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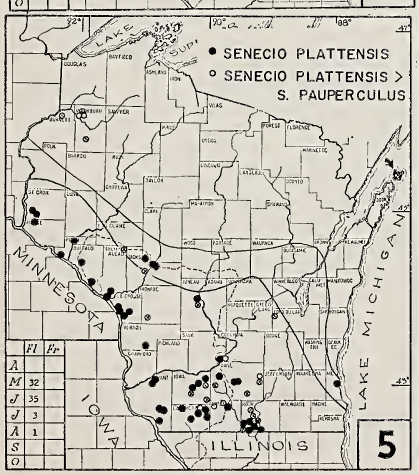
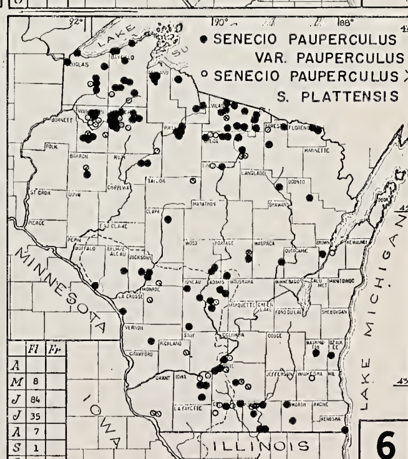
4


● SENECIO PLATTENSIS
○ SENECIO PLATTENSIS > S. PAUPERCULUS
MINNESOTA
IOWA
ILLINOIS
LAKE MICHIGAN
5


● SENECIO PAUPERCULUS VAR. PAUPERCULUS
○ SENECIO PAUPERCULUS > S. PLATTENSIS
MINNESOTA
IOWA
ILLINOIS
LAKE MICHIGAN
6

Thin, slender, perennial herbs, seldom over 5 dm tall, glabrous or only slightly tomentose; stems single or rarely loosely clustered from a stout, short, erect to weakly spreading caudex. Basal leaves with margins often crenate to shallowly dentate, the blades 2–4 cm long and 1–2 cm wide or sometimes smaller, abruptly contracted to a thin petiole. Inflorescence a loose to subcongested corymbose cyme, often somewhat subumbellate; heads 6–12; principal involucral bracts 4–6 mm long; ray florets with ligules 5–7 mm long (dry).

Senecio pseudaureus var. *semicordatus* occurs from Manitoba and Minnesota, south through the Missouri River Valley to Kansas and Missouri. Its occurence in Wisconsin is doubtful, and its inclusion in this treatment rests on a few specimens from two localities on the shore of Lake Michigan: Racine Co.: Barnes Prairie at Mygatts Corner.[4] Kenosha Co.: 4 m S. of Kenosha, May 31, 1939, *A. M. Fuller C–424* (F, MIL). These differ from typical *S. pseudaureus* var. *semicordatus* of the northern prairies in their somewhat smaller leaves, shorter petioles of basal leaves, more conspicuously sharp but shallow dentation on the lower cauline leaves and more pronouncedly subumbellate inflorescences. Plants with strong morphological tendencies toward *S. pseudaureus* var. *semicordatus* occur, especially in southern Wisconsin, in certain populations of otherwise typical *S. aureus*, (cf. *S. aureus;* hollow circles, Map 4).

7. SENECIO PLATTENSIS Nutt. Prairie Ragwort Map 5, 7; fig. 1

Herbaceous perennial, 2–5+ dm tall, more or less persistently floccose-tomentose, especially underneath the leaves, in the leaf axils, and among the heads of the inflorescence, sometimes subglabrate in age; stems single or occasionally loosely clustered from a short erect caudex, this occasionally stolon-producing. Basal leaf blades subelliptic to oblanceolate, crenate to serrate-dentate or occasionally subentire, 1–6+ cm long and 0.5–3+ cm wide, the petiole about as long to twice as long as the blade. Cauline leaves progressively reduced up the stem, the lower and middle often nearly as large as the basal leaves and sub-lyrate to deeply pinnatisect, the uppermost irregularly dissected to subentire. Inflorescence a rather congested to open corymbose cyme of 6–20 heads; principal involucral bracts 5–7 mm long; ray florets with ligules 5–10 mm long. Achenes hirtellous, especially along the angles, or occasionally glabrous.

North American prairies and plains; in Wisconsin in prairies and prairie-like habitats in the south and west and in Door County. Flowering from mid-May to the third week in June (rarely later).

[4] Collection and herbarium data for this collection have been misplaced.

Senecio plattensis and *S. pauperculus* are distinct species, each with its own range and morphological characteristics (cf. Map 7). In the upper Mississippi Valley, from Minnesota and Wisconsin south to Missouri, where their ranges overlap, the two species intergrade morphologically. The extent of the intergradation varies from locality to locality, with most intergradant specimens not precisely midway between *S. plattensis* and *S. pauperculus,* but usually rather strongly resembling one of the two taxa, with some slight morphological tendencies toward the other. With sufficient comparative material, most of the intermediate specimens are readily referable to one taxon or the other.

Hybrids of S. plattensis and S. pauperculus

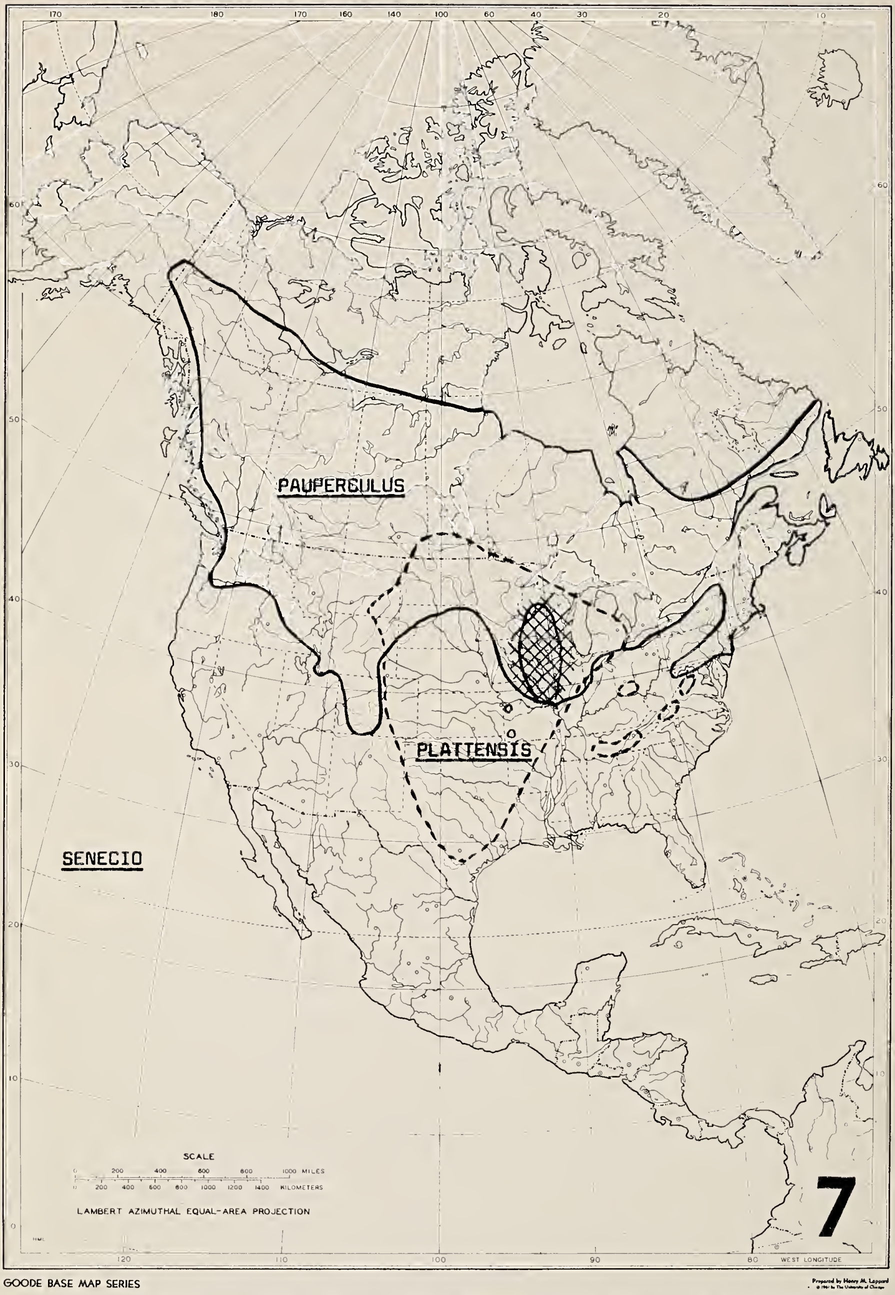
Senecio plattensis is most frequent in western Wisconsin, from St. Croix county to Rock county south of the Tension Zone and within the region of prairies (Curtis, 1959). However, intermediates tending toward *S. pauperculus* may be found nearly throughout Wisconsin (hollow circles on Maps 5 and 6). These flower at nearly the same time as the typical *S. plattensis* and/or *S. pauperculus* of the region (see Fig. 1). The species are somewhat seasonally isolated in Wisconsin, though at the present time the intermediates effectively bridge the gap between them.[5]

7. Senecio pauperculus Michx., var. pauperculus Northern Ragwort Map 6, 7; fig. 1.

S. balsamitae Muhl. ex Willd.
S. pauperculus var. *balsamitae* (Muhl.) Fernald
S. aureus var. *balsamitae* (Muhl.) T. & G.

Herbaceous short-lived perennial, 2–6+ dm tall, glabrous to sometimes lightly tomentose in and near the leaf axils and in the inflorescence; occasionally lightly tomentose throughout; stems single or frequently loosely clustered from a simple to weakly spreading caudex. Basal leaf-blades lanceolate or oblanceolate to subelliptic, crenate-dentate to subentire, 1–6+ cm long and 0.5–2+ cm wide, the petiole as long to sometimes twice as long as the blade. Cauline leaves reduced up the stem, becoming sessile; margins variously dissected to subentire. Inflorescence a loose to sometimes congested corymbose cyme of 2–10+ heads; principal involucral bracts

[5] Note by H. H. Iltis: *S. pauperculus,* as Barkley (1962) so well points out, is evidently a Cordilleran element which migrated eastward post-glacially. The ease with which it apparently hybridized with *S. plattensis* is therefore doubly significant, and is direct, genetic proof that the migration is indeed post-glacial, since a long period of contact would have resulted in mutual merging.



MAP. 7. Geographic ranges of *Senecio pauperculus* and *S. plattensis*. Cross-hatched area in the region of geographic overlap represents area of conspicuous morphological intergradation.

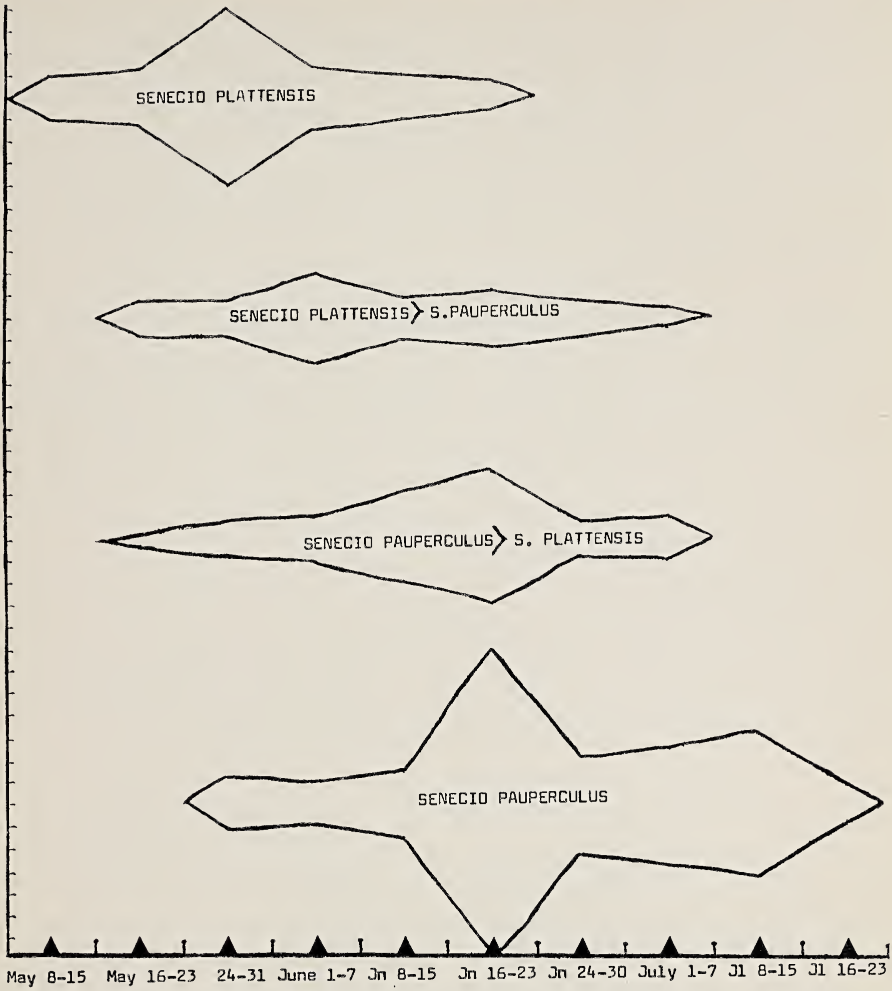


FIG. 1. Flowering dates of *Senecio plattensis* and *S. pauperculus* in Wisconsin. One vertical division (left hand margin) on each weekly coordinant (triangles at base) represents two collections. Only collections with accurate and complete label data were used. The seasonal isolation of the two parental species may be partially due to differences in latitude, *S. plattensis* being southern, *S. pauperculus* mainly northern (cf. maps 5 and 6).

3.5–8 mm long; ray florets with ligules 5–10 mm long, or rarely absent. Achenes glabrous, rarely hispidulous along the angles.

Throughout Wisconsin in meadows, bogs, streambanks, and open woods. Flowering from late May in southern Wisconsin to mid-July or exceptionally later in the north.

A widespread, northern and western species encompassing many morphological phases and intergrading with related species in areas of range overlap. The more or less typical representatives of *Senecio pauperculus* are most frequent north of the Tension Zone, in the northern third of Wisconsin. Southward and especially in the southwest half of Wisconsin, *S. pauperculus* intergrades with *S. plattensis* (cf. *S. plattensis*). These intergradants (hollow circles on Map 6) flower nearly at the same time as typical *S. pauperculus* of the region (Fig. 1).

8. SENECIO INDECORUS Greene Northern Squaw-weed Map 4.

Herbaceous perennial 2–5 dm tall; glabrous or essentially so; stems single from a short caudex. Basal leaf blades ovate to obovate, abruptly contracted at the base, 1–2 cm long, 1–2 cm wide; cauline leaves reduced upward, often lyrate or subpinnatifid. Inflorescence distinctly subumbellate, the peduncles 1–1.5 cm long; heads about 6–20; involucral bracts 5–7 mm long; rays normally absent, but present in all Wisconsin material.[6]

Streambanks and open areas in boreal North America, known from Wisconsin by only two collections, both from North Twin Island in the Apostle Islands of Lake Superior. Ashland Co. [*Lane 2192,* June 21, 1955 (WIS); *Lane 2458,* July 13, 1955 (NC)]. *Senecio indecorus* occurs also along the northern edge of Lake Superior and on the Keweenaw Peninsula of Michigan.

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[6] Throughout its range, most individuals in any population are eradiate, with a few radiate individuals, however, usually present. Whether *S. indecorus* behaves abnormally in Wisconsin, or whether collectors merely happened to select radiate individuals, has not been determined.

PRELIMINARY REPORTS ON THE FLORA OF WISCONSIN, No. 50. COMPOSITAE III—COMPOSITE FAMILY III

THE GENUS *Solidago*—GOLDENROD

Peter J. Salamun

The distribution of the species and varieties of the genus *Solidago* in Wisconsin, habitat information and dates of flowering and fruiting were compiled from specimens in the herbaria of the University of Wisconsin (WIS), University of Wisconsin—Milwaukee (UWM), Milwaukee Public Museum (MIL), and the University of Minnesota (MIN). Other sources of information are cited in the text. Each dot, circle or cross on the maps indicates a specific location where a specimen was collected. The numbers within the squares in the lower lefthand corner of each map represent the number of specimens noted that were flowering or fruiting in the respective months. Specimens in vegetative condition, in bud or with immature fruit are not included. These indicate approximately when a species or variety is apt to flower or fruit in Wisconsin.

The nomenclature, phylogenetic sequence, and descriptive features generally follow the *New Britton and Brown Illustrated Flora* (Cronquist, in Gleason, 1952) and *Gray's Manual of Botany*, Ed. 8 (Fernald, 1950). Where the names differ in these references, those in the first are usually given priority and those of the latter are listed underneath in italics. More recent treatments of certain taxa are discussed in the text.

Grateful acknowledgement is made to the curators. Dr. Hugh H. Iltis, University of Wisconsin, Professor Alvin L. Throne, University of Wisconsin–Milwaukee, Mr. Albert Fuller, Milwaukee Public Museum, and Dr. Gerald B. Ownbey, University of Minnesota, for the loan of their Wisconsin specimens; to Dr. Lorin I. Nevling, Associate Curator, Gray Herbarium of Harvard University and Dr. Bassett Maguire, Curator, New York Botanical Garden, for the loan of supplementary specimens; to Drs. Arthur Cronquist, Jean R. Beaudry, and Lloyd H. Shinners for helpful comments concerning certain taxa; and to Dr. Hugh H. Iltis for his suggestions in the preparation of this report as well as his critical reading of the manuscript.

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31. SOLIDAGO L. Goldenrod

Perennial herbs with rhizomes or caudices and fibrous roots, the erect wandlike stems, single or clustered, bearing simple, alternate, entire or variously toothed leaves, and few to many small campanulate to subcylindric, racemed, corymbed or clustered heads. Heads small, radiate (in our species) ; both ray and disk flowers yellow (except in *S. bicolor* and a few albino forms). Rays pistillate and fertile. Disk flowers perfect and fertile; anthers entire at base; style branches somewhat flattened, and with lanceolate hairy appendages. Achenes many ribbed, nearly terete, glabrous or hairy; pappus of many equal, usually white, capillary bristles. Receptacles small, flat or slightly convex, not chaffy. Involucral bracts more or less imbricate in everal series, appressed, somewhat chartaceous at the base, sometimes with herbaceous green tips.

A genus of approximately 100 species, most in North America with a few in South America, Azores and Eurasia, reaching its greatest complexity in eastern United States where taxonomically it is one of the most difficult genera. The genus may be subdivided into two sections, *Virgaurea* Endl. and *Euthamia* Nutt., with species 1 to 19 included in the first, and 20 to 21 in the second section.

Key to Wisconsin Species of *SOLIDAGO*

[Adapted chiefly from Cronquist, A. C., in Gleason, 1952 (Vol. 3:414–416) and Fernald, 1950 (1381–1389).]

A. Heads in clusters or short racemes in the axils of upper leaves or on elongate branches forming racemose, thyrsoid or spreading panicles.

B. Inflorescence a series of clusters or short racemes in the axils of upper cauline leaves or, if a terminal panicle or thyrse, with erect summit, the *heads spirally arranged on the branches, thus not secund.*

C. Inflorescence a series of axillary clusters or short racemes, all but the uppermost of which are exceeded by their subtending leaves.

D. Cauline leaves lanceolate, acuminate, tapering to a sessile or obscurely short-petiolate base; stem glabrous, glaucous, terete; rare, in Southeasternmost Wisconsin ---------------------1. *S. caesia.*

DD. Cauline leaves ovate to elliptic, abruptly acuminate at the tip, abruptly narrowed to a short winged petiole; stem glabrous or slightly pubescent above, somewhat angled; widespread ---2. *S. flexicaulis.*

CC. Inflorescence a terminal panicle or thyrse, or if of axillary clusters or racemes only the lowermost exceeded by the subtending leaves.

E. Lower cauline leaves, including petioles, seldom more than 7 times as long as wide, if longer, then without sheathing petioles; plants chiefly of upland areas.

F. Involucres mostly 3–5 mm (sometimes 6 mm) high; pedicels mostly less than 5 mm long.

G. Stems pubescent from base through inflorescence; leaves pubescent above and below ------------------------------3. *S. hispida.*

GG. Stems glabrous except for occasional sparse puberulence in the inflorescence and uppermost stem; leaves glabrous except for hispidulous margins and sometimes sparse pubescence beneath.

H. Achenes short-hairy; basal and lower cauline leaves broadly spatulate to obovate; mostly on cliffs, in the Driftless Area of southwestern Wisconsin ------------------------------4. *S. sciaphila.*

HH. Achenes glabrous; basal and lower cauline leaves ovate to oblong-lanceolate; widespread --------------5. *S. speciosa.*

FF. Involucres mostly 5–9 mm high; many pedicels 5–15 mm long; very local, Door County ------------------------------------6. *S. spathulata.*

EE. Lower cauline leaves, including petioles, mostly 7–15 times as long as wide, petioles with sheathing bases; plants of marshes and bogs --7. *S. uliginosa.*

BB. Inflorescence a terminal panicle with nodding summit and with at least the lower branches more or less recurved; *heads secund* (one sided), viz., *borne on the upper side of the branches.*

I. Leaves triple-nerved, i.e., the two obvious lateral nerves prolonged parallel with the midrib.

J. Stems more or less pubescent or scabrous, at least in the upper portion below the inflorescence.

K. Cauline leaves obovate, oblanceolate to linear, entire or sparingly serrate, obscurely 3-nerved; basal leaves present at flowering time; very widespread ------------------------8. *S. nemoralis.*

KK. Cauline leaves mostly lanceolate to ovate, evidently 3-nerved; basal leaves wanting or deciduous at flowering time.

L. Cauline leaves canescent on both surfaces, mostly ovate to elliptic, acute to roundish at the tips; very rare, adventive ---9. *S. mollis.*

LL. Cauline leaves glabrous to puberulent beneath, glabrous or scabrous above, mostly narrowly lance-elliptic, acuminate at the tips; widespread species.

M. Involucres 2–3 mm high 10. *S. canadensis.*

MM. Involucres 3–6 mm high.

N. Leaves glabrous or scabrous above, pubescent on the veins beneath; stem pilose chiefly above the middle ------------------------10. *S. canadensis.*

NN. Leaves scabrous above, densely pubescent beneath; stem grayish with close puberulence throughout, except sometime near the base ---11. *S. altissima.*

JJ. Stems glabrous below the inflorescence.

O. Basal and lower cauline leaves the largest, persistent at flowering time; cauline leaves progressively reduced upwards.

P. Basal and lower cauline leaves mostly 2–7.5 cm wide, scarcely 3-nerved, glabrous except for ciliate margins, sometimes sparingly hirsute on one or both surfaces; achenes short-hairy; throughout Wisconsin --12. *S. juncea.*

PP. Basal and lower cauline leaves mostly 0.5–2 cm wide, more or less strongly 3-nerved, glabrous except for ciliate margins; achenes glabrous or sparsely-hairy; prairies south of Tension Zone ----------13. *S. missouriensis.*

OO. Basal and lower cauline leaves mostly smaller than the middle ones, deciduous and lacking at flowering time; cauline leaves reduced only slightly upwards.

Q. Branchlets of panicle and pedicels glabrous; prairies south of Tension Zone ------------------------------------13. *S. missouriensis.*

QQ. Branchlets of panicle and pedicels more or less pilose; throughout Wisconsin -------------------------------------14. *S. gigantea.*

II. Leaves pinnately veined, the lateral veins not conspicuously prolonged parallel with the midrib.

R. Stems glabrous or only slightly pubescent in the upper portion below the inflorescence.

S. Upper surface of leaves strongly scabrous; upper portions of stems strongly angled __15. *S. patula*

SS. Upper surface of leaves only slightly pubescent or glabrous; stems terete.

T. Basal and lower cauline leaves with long-tapering bases, glabrous or sometimes short hirsute on both surfaces; inflorescence more or less compact.

U. Plant with stout branched caudex and fibrous roots; basal and lower cauline leaves mostly 2–7.5 cm wide; achenes short-hairy; throughout Wisconsin ____ ________________________12. *S. juncea.*

UU. Plant with creeping rhizome; basal and lower cauline leaves mostly 0.5–2 cm wide; achenes glabrous or sparsely-hairy, prairies south of Tension Zone ____________ __________________13. *S. missouriensis.*

TT. Basal and lower cauline leaves elliptic or elliptic-ovate and abruptly tapering to the petiole, loosely hirsute on midrib and main veins beneath; inflorescence an open panicle with a few long, slender and strongly divergent or arched ascending branches __16. *S. ulmifolia.*

RR. Stems pubescent or scabrous their entire length; very widespread __________________8. *S. nemoralis.*

AA. Heads in flat corymbiform inflorescences.

V. Basal and lower cauline leaves with either petioles or sheathing bases, middle and upper cauline ones progressively reduced and less petiolate or sessile; involucral bracts obtuse or broadly rounded, more or less longitudinally striate.

W. Cauline leaves elliptic, broadly lanceolate to broadly ovate, densely pubescent above and below; stems densely pubescent; plants of mesic-dry habitats, common, mostly south of Tension Zone ____17. *S. rigida.*

WW. Cauline leaves narrowly elliptic to linear-lanceolate, glabrous except for scabrous margins; stems glabrous or slightly puberulent below the inflorescence; plants of marshes, swamps, wet prairies and moist calcareous meadows.

X. Basal and lower cauline leaves narrowly elliptic, flat, obtuse or rounded at the tip, often serrate above the middle, not triple nerved; southeastern Wisconsin and Door County ______18. *S. ohioensis.*

XX. Basal and lower cauline leaves linear-lanceolate, often longitudinally folded, acute, entire, tending to be triple-nerved; southeastern Wisconsin _______ ______________________________19. *S. Riddellii.*

VV. Leaves uniform, only slightly reduced upwards, linear to narrowly lanceolate or narrowly oblong, tapering abruptly to a short base or sessile, the basal ones soon deciduous; involucral bracts acute, not striate.

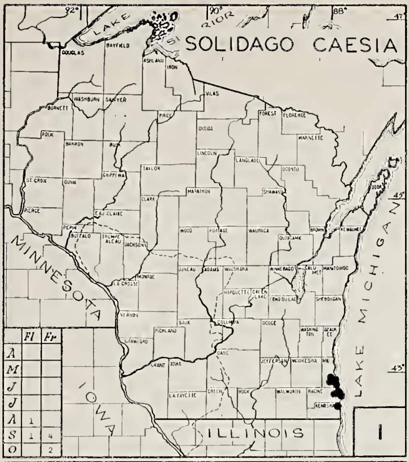
Y. Leaves 1-nerved or sometimes faintly 3-nerved, but without any additional nerves, 2–5 mm (rarely 6 mm) wide and 4–9 cm long, with conspicuous, dark and viscid punctation; heads slenderly cylindric (becoming slenderly turbinate on pressing), tending to be evidently pedicellate; involucres 4.5–6.5 mm high; not common; south of the Tension Zone ________________ __________________________20. *S. gymnospermoides.*

YY. Leaves evidently 3-nerved, the larger ones ordinarily with 1 or 2 additional pairs of fainter lateral nerves, 2–12 mm wide and 4–13 cm long, with less conspicuous punctation; heads slenderly campanulate to turbinate, chiefly sessile or subsessile in small glomerules; throughout Wisconsin __________21. *S. graminifolia.*

1. Solidago caesia L. Wreath or Blue-stemmed Goldenrod. Map 1.

A slender glabrous plant 3-10 dm tall from a stout caudex or short rhizome; stem greenish or purplish, terete, glaucous, mostly simple or sometimes branching; *leaves narrowly lanceolate to lance-elliptic,* 4–12 cm long and 1–3.5 cm wide, serrate, pinnately veined, narrowed to a sessile or very short-petiolate base, acuminate at apex, glabrous or only slightly pubescent above and along the midrib beneath; basal and lowermost cauline ones deciduous at flowering time; *inflorescence a series of axillary clusters, all but the uppermost exceeded by subtending leaves;* involucre glabrous, 3–5 mm high, the bracts obtuse or rounded; rays 3–5; achenes hairy.

An Eastern Deciduous Forest species, restricted in Wisconsin to Milwaukee, Racine and Kenosha counties, where it reaches its western limit. Locally abundant in Milwaukee County, in Grant Park, near South Milwaukee, at the edge of a Sugar Maple-Beech woods above the ravine; and at the edge of and along a path in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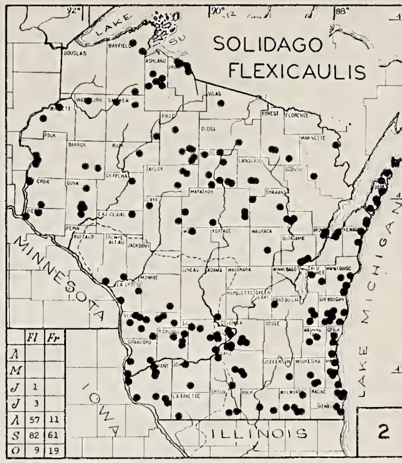
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O 9 19
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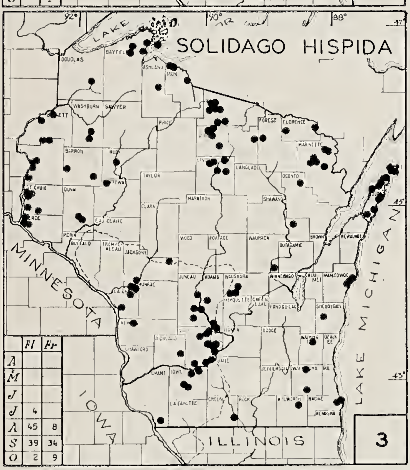
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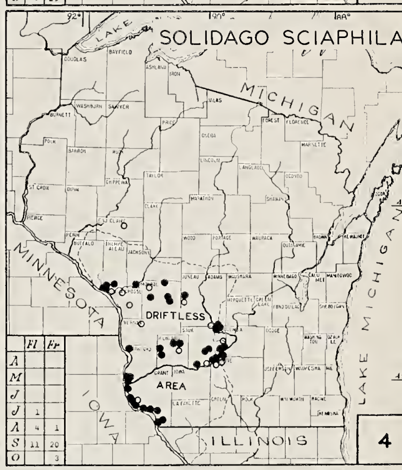
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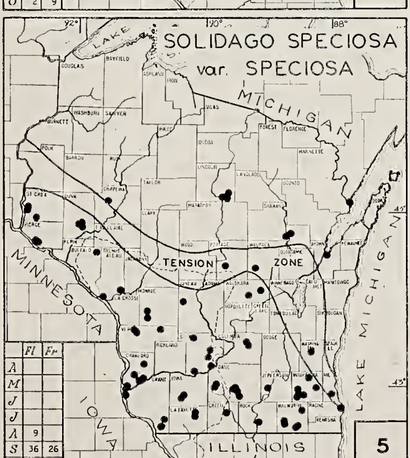
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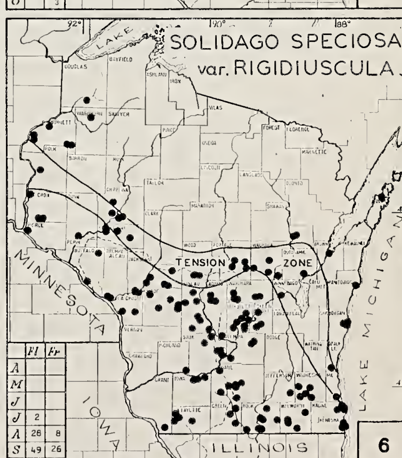
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var. RIGIDIUSCULA
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A 28 8
S 49 26
O 3 17
6

a Sugar Maple-Beech woods (Cudahy Woods) at the junction of W. College Ave. and S. Howell Ave. Flowering from late August to late September; fruiting into October.

2. SOLIDAGO FLEXICAULIS L. Flexuous-stemmed or Zigzag Goldenrod. Map 2.

Plant 2–10 dm high; stem mostly simple, slender, flexuous (zigzag), erect, striate-angled, and glabrous below the inflorescence; *leaves ovate to elliptic, 7–15 cm long, 3–10 cm wide, abruptly narrowed to a short winged petiole, acuminate at the tip, sharply serrate to nearly dentate,* hirsute beneath at least on the midrib and main veins, glabrous or sparsely pubescent above, the basal and lower cauline slightly smaller than the middle ones and usually deciduous by flowering time; upper cauline and bracteal leaves narrower and less toothed or entire, subtending the *clusters of heads;* involucre 4–6 mm high, bracts obtuse; rays 3–4; achenes short-hairy.

Throughout Wisconsin rather common in dry to mesic Oak, Sugar Maple, Basswood, Beech and Aspen woods, sometimes in mixed conifer-hardwood forests, and rare in low woods and edges of bogs. Collections are sparse in the central sand area and in the counties bordering Lake Superior. Flowering from (late July) early August to mid-September (early October); fruiting from late August to mid-October.

3. SOLIDAGO HISPIDA Muhl. var. HISPIDA. Hairy Goldenrod Map 3.

Plant with a stout branched caudex, 1–10 dm tall; stem erect, *hirsute throughout; leaves broadly oblanceolate to narrowly obovate,* 3–20 cm long, 1–5 cm wide at or near the base of plant, acute to nearly rounded at the tip, crenate or serrate, petioled, more or less pubescent, progressively reduced upward and becoming lance-elliptic to oblong, sessile or nearly so, and obscurely toothed to entire; *inflorescence a narrow, erect, terminal panicle,* the heads not secund; involucre 4–6 mm high; bracts obtuse or rounded, the tips slightly greenish; rays 7–14, deep yellow; achenes glabrous when mature.[1]

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[1] A very similar eastern species, *Solidago bicolor* L., has been listed as occurring in Wisconsin (Fernald, 1950; Gleason, 1952). The following Wisconsin specimens were annotated by Cronquist as *S. bicolor:* Polk Co.: St. Croix Falls, September, 1851, *E. P. Sheldon* (MIN); Osceola, September, 1852, *E. P. Sheldon* (MIN). Door Co.: Ellison Bay, August 11, 1918, *Milton T. Greenman* (MIN). Milwaukee Co.: Milwaukee, *E. J. Hasse* (NY). This species differs from *S. hispida* chiefly in having whitish or cream-colored rays. Because the rays of *S. hispida* tend to fade and those of *S. bicolor* become yellowish after some years in the herbarium, it is difficult to distinguish the two species. According to Cronquist (personal communication) another difference is the color of the involucre, that of *S. bicolor* being distinctly paler and, doubtless it was on this basis the above specimens were identified. There have been no recent collections of *S. bicolor* in Wisconsin and, during four years of field work, I was not able to find this species in this area.

Locally abundant on dry to moist sandy or rocky soils in open White Pine-Red Pine or mixed conifer-hardwood woods, chiefly in the northern part of the state, extending southward to Iowa and Kenosha counties on sand or gravelly wooded hillsides, sandstone cliffs, outcrops and slopes. In the Driftless Area it frequently occurs in areas adjacent to *S. sciaphila.* In these localities *S. hispida* usually occupies the more mesic wooded sandy areas while *S. sciaphila* prefers the more open cliff (drier?) sites. Flowering from (late July) early August to October, and fruiting from August to October.

Var. *arnoglossa* Fern., distinguished by its smaller size and scanty pubescence, has been listed from northern Michigan by Fernald (1950) and Gleason (1952), and northeast Minnesota by Fernald (1950) and Rosendahl and Cronquist (1945). To date only var. *hispida* has been collected in Wisconsin.

4. SOIIDAGO SCIAPHILA Steele Cliff Goldenrod Map 4.

Plant about 4–10 dm tall, with a caudex, *glabrous throughout except for sparse pubescence in the inflorescence;* basal and lower cauline leaves broadly oblanceolate to elliptic-ovate, 3–15 (–22) cm long and 1–5 (–8) cm wide, *crenate to serrate,* acute, tapering to the petioles, the upper cauline progressively reduced, becoming oblanceolate to elliptic, sessile or nearly so, and obscurely serrate to entire; inflorescence a narrow terminal panicle; involucre about 4–6 mm high, bracts obtuse, entire; rays 5–8; *achenes with short stiff hairs,* clearly visible with a hand lens even when immature.

This species, one of Wisconsin's few endemics (?), is apparently confined almost entirely to the Wisconsin Driftless Area where it occurs in open or lightly wooded sandstone and limestone cliffs, outcroppings and slopes, and rarely in open Black Oak or Jack Pine woods at the base of cliffs. Fernald (1950) extended the general range of this species to include western Ontario, Michigan and Minnesota, perhaps due to possible confusion of this species with glabrous northern variants of *S. hispida.* Flowering from (late July) mid-August to late September; fruiting from late August through mid-October.

Some individual specimens were observed with sparse pubescence in the upper portions of the stems below the inflorescences, and some of these also are sparsely pubescent on the undersides of the leaves. These individuals are plotted as open circles on Map 4. Since *S. hispida,* a similar but more pubescent species often occurs nearby on the more wooded slopes, these plants may possibly represent hybrids between *S. sciaphila* and *S. hispida.*

5. SOLIDAGO SPECIOSA Nutt. Showy Goldenrod. Maps 5, 6, 7.

A slender to stocky or sometimes stout plant with a thick caudex, 3–12 dm tall, glabrous or slightly scabrous (except slightly pubescent in the inflorescence); *leaves firm,* obovate to lanceolate or broadly elliptic, decreasing in size upwards and sessile or nearly so, the lower 6–13 (–20) cm long, 1.5–6 (–7) cm wide, abruptly short petiolate, *entire or slightly toothed,* the lateral veins not prominent; *inflorescence a terminal narrowly pyramidal to thyrsiform panicle,* the heads not secund, the branches stiffly ascending or sometimes slightly spreading; involucre 3–6 mm high; bracts obtuse or rounded, yellowish; rays 6–8; *achenes glabrous.*

KEY TO VARIETIES

A. Tall robust plants, 6–12 dm high; middle and lower cauline leaves 2–5 cm wide; basal leaves 4–6 (–7) cm wide -- 5a. *S. speciosa* var. *speciosa.*

AA. Plants 3–8 dm high; middle and lower cauline leaves 1–3 cm wide (mostly less than 2 cm wide); basal leaves 1.5–3.5 cm wide.

B. Cauline leaves numerous, usually 18–40; inflorescence dense with ascending branches -- 5b. *S. speciosa* var. *rigidiuscula.*

BB. Cauline leaves relatively few, 3–20; inflorescence tending to become somewhat open paniculate -- 5c. *S. speciosa* var. *jejunifolia.*

5a. SOLIDAGO SPECIOSA Nutt. var. SPECIOSA. Map 5.

Chiefly in western and southwestern Wisconsin south of the Tension Zone, in remnant mesic prairies (Curtis, 1955), open sandy fields, roadsides, open sandstone bluffs, steep roadbanks, neglected cemeteries, and sometimes in open Black Oak or Jack Pine woods, spreading northward and eastward along sandy roadsides and railroad rights-of-way. Flowering mid-August through September; fruiting from early September to mid-October.

According to Cronquist (Gleason, 1952), this variety occupies that portion of the species-range which was originally forested, while the next, var. *rigidiuscula,* is mostly in the Great Plains area and slightly eastward. In Wisconsin the ranges of both varieties extend only slightly beyond the prairie areas.

5b. SOLIDAGO SPECIOSA Nutt. var. RIGIDIUSCULA Rydb. Map 6.
Solidago speciosa Nutt. var. *angustata* T. & G.

Locally common south of the Tension Zone in prairie remnants and on sandy soils along roadsides, in open fields, ridges, outcroppings, river terraces and open Black Oak and Jack Pine woods, more common than var. *speciosa* and, with a similar range in the state, but occurring farther eastward, chiefly along sandy roadsides, railroad rights-of-way, and on sandy beaches and dunes along the shores of Lake Michigan. Flowering (late July) early August to early October; fruiting from mid-August to late October.

5c. SOLIDAGO SPECIOSA Nutt. var. JEJUNIFOLIA (Steele) Cron. Map 7.

Solidago jejunifolia Steele.
Solidago castrensis Steele, Contr. U. S. Natl. Herb. 16:223. 1913.

[Type: Juneau County, Camp Douglas, Sept. 9, 1890, *E. A. Mearns 96* (US No. 670444).]

There are a number of specimens in the University of Wisconsin Herbarium which fit the description of this variety. These appear to be mostly depauperate slender plants (cf. Cronquist, 1947, pp. 77–78).

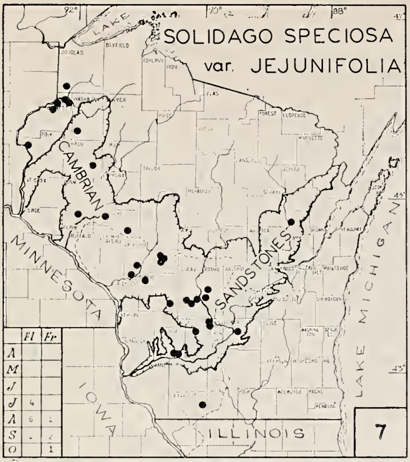
Northwestern and central Wisconsin following the area of outcropping Cambrian sandstone, in sandy soils along roadsides, river terraces, in Bur Oak and Black Oak openings, and in open Jack Pine stands. Flowering from (mid-) late July to late August (early September); fruiting from late August into October.

6. SOLIDAGO SPATHULATA DC. var. GILLMANI (Gray) Cron. Gillman's Goldenrod. Map 8.

Solidago racemosa Greene var. *Gillmani* (Gray) Fern.

Plants 1–9 dm tall from a short branched caudex, essentially glabrous except for slight pubescence in the inflorescence and sometimes along the stem; *basal and lower cauline leaves narrowly oblanceolate to narrowly obovate,* 3–20 cm long and 0.4–4 cm wide, serrate or crenate serrate to subentire, acute, ciliate margined, cauline leaves progressively reduced upward; inflorescence a terminal raceme, the heads not secund, on *pedicels 5–15 mm long;* involucre 3–9 mm high, somewhat glutinous, the bracts obtuse to acute; rays 7–9; achenes short-hairy.

This variety is an eastern representative of the wide-ranging (eastern U. S., southern Canada to the Pacific northwest) *S. spath-*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SANDSTONES
MINNESOTA
IOWA
ILLINOIS
LAKE MICHIGAN
Fl Fr
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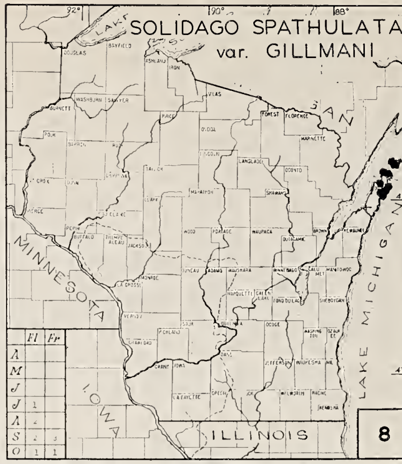
A 6
O 1
7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var. GILLMANI
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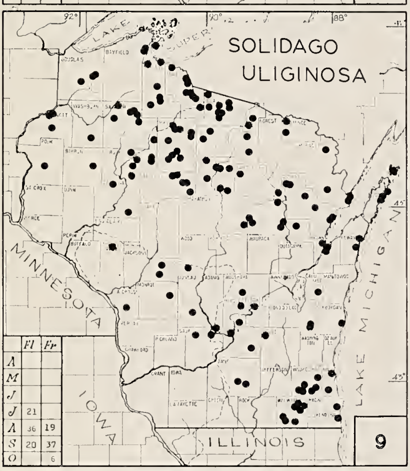
ILLINOIS
LAKE MICHIGAN
Fl Fr
J 1
O 1 1
8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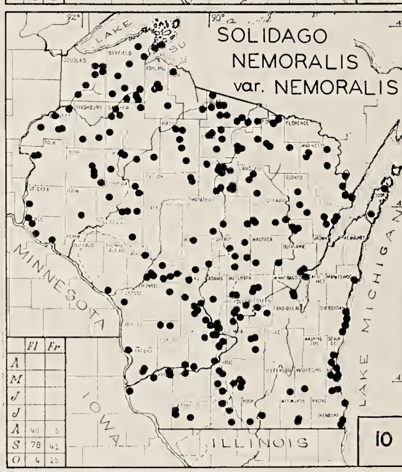
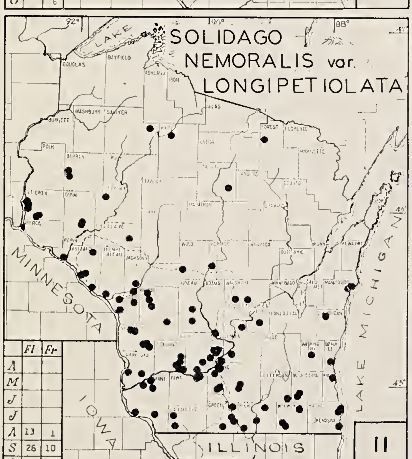
ULIGINOSA
MINNESOTA
IOWA
ILLINOIS
LAKE MICHIGAN
Fl Fr
J 21
A 36 19
S 20 37
O 6
9


SOLIDAGO
NEMORALIS
var. NEMORALIS
MINNESOTA
IOWA
ILLINOIS
LAKE MICHIGAN
Fl Fr
A 48 5
S 78 41
O 4 15
10


SOLIDAGO
NEMORALIS var.
LONGIPETIOLATA
MINNESOTA
IOWA
ILLINOIS
LAKE MICHIGAN
Fl Fr
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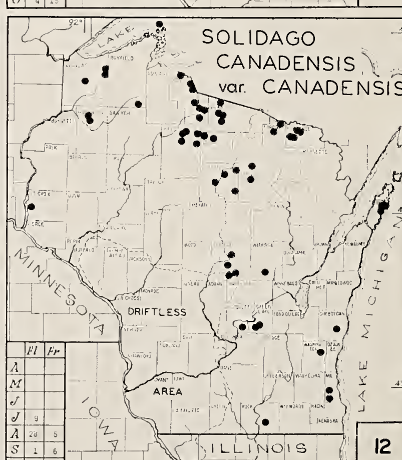
S 26 10
O 1 2
11


SOLIDAGO
CANADENSIS
var. CANADENSIS
DRIFTLESS
AREA
MINNESOTA
IOWA
ILLINOIS
LAKE MICHIGAN
Fl Fr
J 9
A 28 5
S 1 6
O 3
12

ulata. In Wisconsin it is infrequent on open sand dunes, ridges and sandy beaches along Lake Michigan. All our specimens are from Door County, there associated with such strand species as *Calamovilfa longifolia, Artemisia caudata, Elymus canadensis, Calamagrostis inexpansa, Potentilla anserina, Rudbeckia hirta, Agropyron psammophilum (A. dasystachyum* sensu Fassett) and *Salix* sp. Since this plant also has been collected in the Indiana Dunes area, its present limited distribution in the state may be due to the widespread and often needless habitat destruction along the Lake Michigan shore. Flowering (late July) early August to October; fruiting mid-September into October.

This plant represents one of an aggregate of entities which have been variously described as *S. racemosa* Greene, *S. Gillmani* Steele and *S. Randii* Porter. In a recent work, Cronquist (Gleason, 1952) considers all these varieties of *S. spathulata,* a treatment followed here.[2]

7. SOLIDAGO ULIGINOSA Nutt. var. ULIGINOSA. Swamp Goldenrod. Map 9.

An essentially glabrous plant, except sometimes puberulent in the inflorescence, from a rather long caudex; stem 0.4–15 dm tall; basal and lower cauline leaves persistent, varying from narrowly oblanceolate to ovate lanceolate or elliptic, from nearly entire to serrate, tips acute, *tapering to long petioles with more or less sheathing bases,* blade and petiole 6–30 cm long and 1–6 cm wide; upper leaves progressively reduced and becoming entire and sessile; inflorescence terminal, thyrsiform, the short branches varying from straight to slightly recurved, the heads from non-secund to slightly secund; involucre 3–6 mm high, the inner bracts rounded to obtuse, the outer ones often acute; rays 1–8; *achenes glabrous or nearly so.*

A variable species, but only var. *uliginosa* appears to occur in our area.

Fairly abundant in northern Wisconsin in moist sandy roadsides, ditches, wet to mesic sedge meadows, fens, edges of bogs and open marshy areas, less frequently at the edges of conifer-hardwood forests and Sugar Maple woods, southward in central and eastern Wisconsin, chiefly in black muck soils of marshy areas, edges of bogs and moist lake banks. A number of plants were observed in the low prairie area of southeastern Kenosha County in

[2] *Solidago spathulata* var. *racemosa* (Greene) Cron. *(S. racemosa* Greene) and *Solidago spathulata* var. *Randii* (Porter) Cron. *(S. Randii* (Porter) Britt.) are also listed as occurring in Wisconsin by both Gleason (1952) and Fernald (1950), presumably based on the few Wisconsin specimens in the Gray and New York Botanical Garden Herbaria. These specimens all appear to be var. *Gillmani.*

association with *S. Riddellii, S. ohioensis* and *Aster ptarmicoides.* Flowering (late July) early August to September; fruiting from mid-August to mid-October.

Solidago Purshii Porter, as described by Fernald (1950), but not listed by Cronquist (Gleason, 1952), has similar morphological features and a range that includes Wisconsin. The chief morphological differences between these entities is that *S. uliginosa* tends to have secund heads while those of *S. Purshii* are non-secund. Recently, Beaudry and Chabot (1959) further distinguished between these plants on the basis of chromosome numbers. *S. uliginosa* is a tetraploid ($2n = 36$), while *S. Purshii* is diploid ($2n = 18$). The Wisconsin specimens, including those in the Gray Herbarium, appear to have the tendency for secund heads and, therefore, all are considered as *S. uliginosa.*

8. SOLIDAGO NEMORALIS Ait. Field Goldenrod; Old-field Goldenrod. Maps 10, 11.

Small plants from a caudex; stems 1–12 dm tall, *densely pubescent* with loosely spreading hairs; *leaves oblanceolate to spatulate-ovate or sometimes lance-linear,* the basal and lower cauline ones 5–25 cm long and 0.5–2.5 cm wide, long-petioled, crenate, crenate-serrate to entire, densely pubescent, often with axillary tufts; inflorescence a terminal panicle, sometimes elongate, narrow and only *nodding at the tip,* sometimes with spreading recurved branches and heads secund; involucre 3–6 mm high, the bracts acute to obtuse; rays 5–9; achenes more or less pubescent.

KEY TO VARIETIES

A. Involucre 3–4 mm high; achenes with short ascending or spreading hairs; lower cauline leaves mostly 3–6 times as long as wide; basal leaves broadly oblanceolate to spatulate-obovate ------------------8a. *S. nemoralis* var. *nemoralis.*

AA. Involucre 4–6 mm high; achenes silky with relatively long appressed pubescence; lower cauline leaves 7–10 times as long as wide; basal leaves mostly narrowly oblanceolate to lance-linear -----------------8b. *S. nemoralis* var. *longipetiolata.*

8a. SOLIDAGO NEMORALIS Ait. var. NEMORALIS. Map 10.

Common throughout Wisconsin, on dry, sandy, clayey and sterile soils in open fields, pastures, along roadbanks, on prairies, railroad embankments, edges of oak woods, and in Jack Pine and Black Oak barrens. Flowering from early August to early October; fruiting late August to mid-October.

8b. SOLIDAGO NEMORALIS Ait. var. LONGIPETIOLATA (Mack. & Bush) Palmer and Stey. Map 11.

Solidago nemoralis Ait. var. *decemflora* (DC.) Fern.

Habitats are similar to those of var. *nemoralis,* though more common in southwestern Wisconsin. Flowering from mid-August through late September (October); fruiting from early September into October.

Beaudry and Chabot (1959) have determined that var. *nemoralis* is a diploid ($2n = 18$) and var. *longipetiolata* is a tetraploid ($2n = 36$). On this evidence as well as the differences in morphology and geographic distribution, those workers recommend that the latter variety be given specific status as *S. decemflora* DC.

There are no references in the literature to hybridization between these two varieties. A population analysis of a limited number of Wisconsin specimens is shown in Fig. 1. Most of the individuals of each variety can be distinguished by the height of the involucre and the type of achene pubescence. The relationship of length and width of the lower leaves is quite variable and is a less reliable taxonomic character. A few individuals appear to be intermediate with long involucres and short, appressed pubescence or sericeus achenes and short involucres, and suggest that some intergradation occurs between these two entities. It is also possible to interpret these results as indicating that some genetic barrier exists and that specific status for each variety might be considered. Since the morphological differences are not great, chiefly quantitative in degree of achene pubescence and size of involucre, it seems best for the present to retain both entities as varieties.

9. SOLIDAGO MOLLIS Bartl.

A rigidly erect plant, canescent throughout; stems 1–6 dm tall, solitary or loosely clustered, from a creeping rhizome, sometimes glabrate near the base; cauline leaves elliptic or oval to obovate, sessile or nearly so, triple-nerved, lower ones 3–10 cm long and 8–40 mm wide, gradually reduced upwards; basal leaves wanting; inflorescence terminal, dense, paniculate or compactly thyrsoid, the lower branches more or less recurved, and heads secund; involucre 3.5–6.5 mm high, with rounded to acute yellowish chartaceous bracts; rays 6–9; achenes with short hairs.

A western species accidentally introduced into Wisconsin but probably not established, the only record consisting of the following flowerless specimen: Washington Co.: Soo Line R. R., se of Slinger (center of N ¼ Sec. 28, T10N, R19E), July 6, 1940, *Shinners 2135* (WIS). It is reported to flower in late July to September, and fruits from August to October.

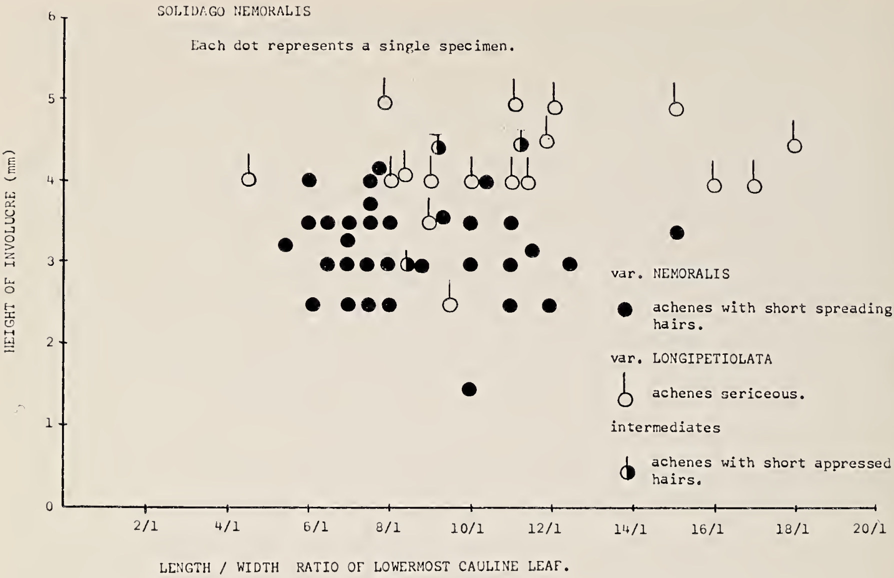


FIGURE 1.

10. SOLIDAGO CANADENSIS L. Canada Goldenrod. Maps 12, 13, 14

Plant with creeping rhizome and with solitary or clustered stems, 3–15 dm tall, pubescent at least above the middle; *leaves lanceolate to lance-elliptic, long acuminate, tapering to a sessile base,* the larger 5–13 cm long and 0.5–1.8 cm wide, *mostly sharply serrate* and only slightly reduced upward, *triple-nerved,* glabrous to scabrous above, *puberulent at least on the midrib and main veins beneath* or over the entire surface, the basal and lower cauline leaves reduced or soon deciduous. Inflorescence a terminal broad pyramidal panicle with conspicuous recurved branches, and secund heads; involucre 2–5 mm high, the bracts thin and slender, acute or acuminate, yellowish, without conspicuous green tips; rays mostly 10–17; achenes short-hairy. An extremely variable and widely distributed species.

KEY TO VARIETIES

A. Involucres 2–3 mm high; widespread species.

B. Leaves glabrous or merely scabrous above, slightly pilose along the midrib and main veins beneath; stems more or less puberulent above the middle, glabrous below ________________________________10a. *S. canadensis* var. *canadensis.*

BB. Leaves scabrous puberulent above, densely puberulent beneath; stems densely puberulent throughout, or glabrate only near the base__10b. *S. canadensis* var. *gilvocanescens.*

AA. Involucres 3–5 mm high; northern Wisconsin ____________ __________________________10c. *S. canadensis* var. *salebrosa.*

10a. SOLIDAGO CANADENSIS L. var. CANADENSIS. Map 12.

Occasional along roadsides, open fields, slopes, edges of marshes and swamps, along fencerows, and edges of and in open woods, chiefly in northern and eastern Wisconsin. Not as common as the next variety. Flowering (late July) early August to early September; fruiting August to October.

10b. S. CANADENSIS L. var. GILVOCANESCENS Rydb.[3] Map 13.

The common phase of the species, occurring abundantly in open fields, prairies, sandy beaches, along railroad rights-of-way, roadsides, slopes, dry to moist ditches, edges of bogs, marshes and woods, and occasionally in open deciduous woods and in Jack Pine and Black Oak Barrens. Flowering (mid-) late July to mid- (late) September; fruiting late August into October.

10c. SOLIDAGO CANADENSIS L. var. SALEBROSA (Piper) M. E. Jones.[3] Map 14.

Solidago lepida DC. var. *fallax* Fern.
Solidago lepida DC. var. *elongata* (Nutt.) Fern.

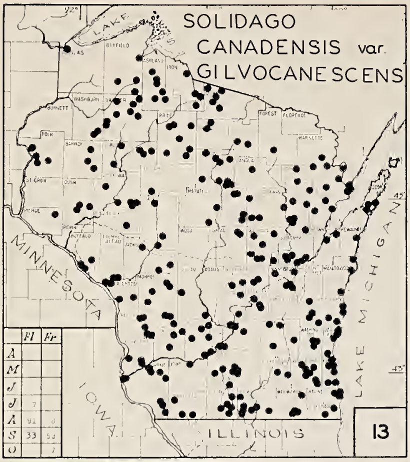
A boreal plant which has been collected in only a few northern counties. It prefers open habitats along roadsides, sandy shores, moist to dry fields and edges of deciduous and coniferous woods. Flowering (late July) August to mid-September; fruiting late August to October.

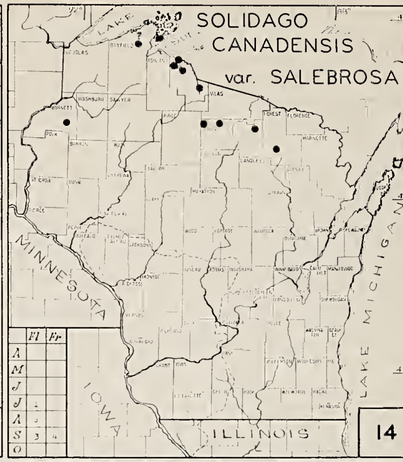
The taxonomic status of this plant is not clearly established as evidenced by the different designations of Cronquist (1952) and Fernald (1950). The first worker described this plant as *S. elongata* Nutt. but in the appendix of the same reference reduced it to the varietal status under *S. canadensis.* Fernald considered it as *S. lepida* DC. and divided it into four varieties, two of which apparently occur in Wisconsin. In the latter treatment, the specimens collected in the state seem to fit more closely the description of var. *elongata* (Nutt.) Fern. than var. *fallax* Fern. The nomenclatorial version of Cronquist (1952) is used only because this reference is being followed in this report.

11. SOLIDAGO ALTISSIMA L. Tall Goldenrod. Map 15.

Solidago canadensis L. var. *scabra* (Muhl.) T. & G.

A tall robust plant with long rhizomes; stems 8–20 dm high, *grayish with spreading puberulence,* at least above the middle;


SOLIDAGO
CANADENSIS var.
GILVOCANESCENS
MINNESOTA
IOWA
ILLINOIS
LAKE MICHIGAN
Fl Fr
A
M
J
J 7
A 91 8
S 33 53
O 1
13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var. SALEBROSA
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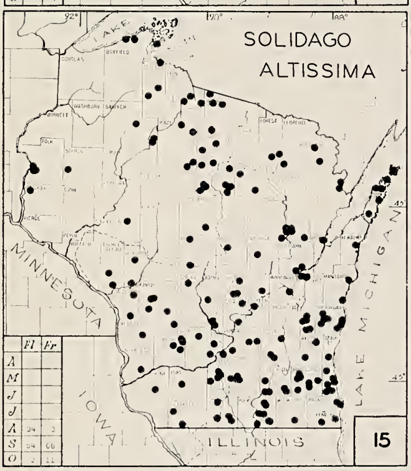
A 1
S 3 4
O
14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LAKE MICHIGAN
Fl Fr
A
M
J
J
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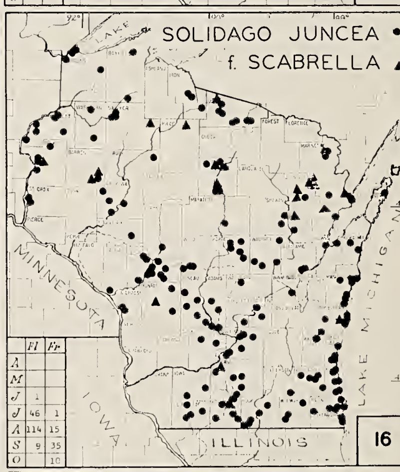
S 54 66
O 2 11
15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f. SCABRELLA ▲
MINNESOTA
IOWA
ILLINOIS
LAKE MICHIGAN
Fl Fr
A
M
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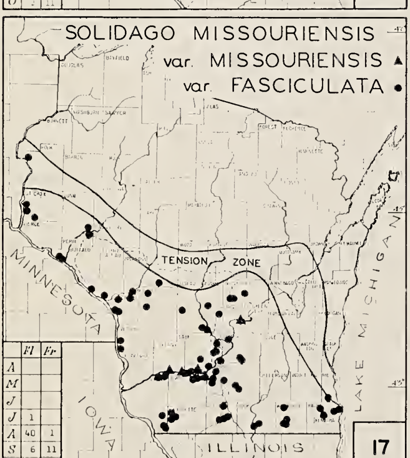
A 114 15
S 9 35
O 10
16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var. MISSOURIENSIS ▲
var. FASCICULATA •
TENSION ZONE
MINNESOTA
IOWA
ILLINOIS
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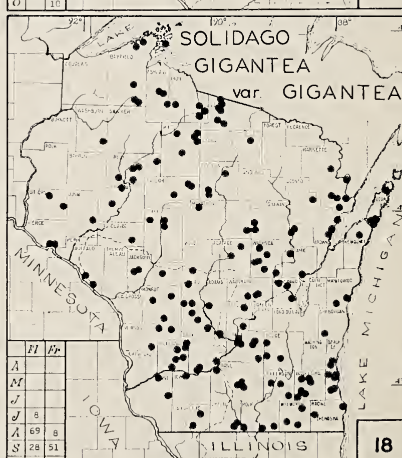
Fl Fr
A
M
J
J 1
A 40 1
S 6 11
O 2
17


SOLIDAGO
GIGANTEA
var. GIGANTEA
MINNESOTA
IOWA
ILLINOIS
LAKE MICHIGAN
Fl Fr
A
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J
J 8
A 69 8
S 28 51
O 3 14
18

leaves lanceolate to lance-elliptic, acuminate at apex, tapering to a sessile base, middle ones 5–15 cm long and 0.7–2.2 cm wide, *triple-nerved, cinerous with spreading puberulence beneath, scabrous above;* lower cauline and basal leaves soon deciduous, the upper gradually reduced upwards, few toothed to nearly entire; inflorescence a terminal pyramidal panicle with many recurved branches and secund heads; involucre 3–5 mm high; bracts yellowish, inner ones sharply acute to broadly rounded, outer ones acute; rays 9–15; achenes short-hairy.

Widespread throughout, but more common in southern Wisconsin, most frequently in open moist to dry fallow fields, prairies, dry open roadsides, steep sloping banks, railroad embankments, brushy roadsides, fencerows, open sandy areas, and along edges or, rarely, in open deciduous woods and Jack Pine-Black Oak Barrens. Flowering (early) mid-August to late September (early October); fruiting late August through October (early November).

This species is similar in general appearance to *S. canadensis* var. *gilvocanescens,* which blooms about two or more weeks earlier, and extremes of either are often difficult to distinguish in our area. Cronquist[3] (1952) considers this plant as *S. canadensis* var. *scabra* (Muhl.) T. & G. On the basis of quantitative measurements the two entities usually can be separated. In *S. altissima,* the involucres are 3–5 mm high, and the middle cauline leaves are sparsely pubescent (scabrous) on the upper surface and more or less densely puberulent or pilose beneath. The involucre in *S. canadensis* var. *gilvocanescens* is usually 2–3 mm high and the upper and lower surfaces of the cauline leaves are more or less uniformly puberulent. Recently, Beaudry and Chabot (1957) determined that *S. canadensis,* and presumably *S. canadensis* var. *gilvocanescens,* is diploid ($2n = 18$), while *S. altissima* is hexaploid ($2n = 54$). They also noted that *S. altissima* blooms about a month later, at least in Quebec, than *S. canadensis.* Similar differences in flowering dates occur in Wisconsin (see flowering data on Maps 12, 13 and 15). On this evidence it seems more desirable to consider this plant as a distinct species.

12. SOLIDAGO JUNCEA Ait. Early Goldenrod. Map 16.

An essentially glabrous plant, except for scabrous or ciliate leaf margins and sometimes sparingly hirtellous on lower surfaces of leaves and branches of the panicle; stems solitary or few, from a caudex, 3–12 dm tall; *basal leaves on caudex, oblanceolate to narrowly oval, acuminate, tapering to the long petiole,* serrate, *persistent,* 10–15 cm long and 1.5–8 cm wide, *not conspicuously 3-nerved;*

[3] See Cronquist (Gleason, 1952, 3:546).

cauline leaves remote, decreasing in size upwards, becoming lance-elliptic, less toothed and sessile; *inflorescence a pyramidal or somewhat rhomboidal panicle* with recurved branches and secund heads; involucre glabrous, 3–5 mm high; bracts acute or obtuse, firm, pale green or straw-colored; rays 7–12; achenes pubescent.

Plants with more or less hirsute upper and lower leaf surfaces and panicle branches have been designated as forma *scabrella* (T. & G.) Fern. Specimens of this form are indicated by triangles on Map 16.

Common throughout Wisconsin, especially abundant in sandy or loamy open fallow fields, along railroad embankments and weedy fencerows, less common in mesic to wet-mesic prairies and fields, along brushy roadsides, on steep roadbanks, and rarely at the edges of open deciduous woods. The sparsity of plants in the north central and west central counties is probably due to limited collecting. The paucity of plants in the southwestern counties, however, was confirmed on the several trips into this region. The agricultural practice of clearing fencerows, the absence of fallow fields, as well as the frequent clearing by cutting and burning along roadsides and railroad rights-of-way may be contributing factors to this rarity. Flowering late June to early (mid-) September; fruiting from late July into October.

13. SOLIDAGO MISSOURIENSIS Nutt. Missouri Goldenrod Map 17.

A glabrous plant 3–10 dm high from a creeping rhizome; *leaves oblanceolate, mostly triple-nerved, rather firm, sharply acute to acuminate, tapering to a sessile or inconspicuous petiole,* glabrous except for scabrous margins, the lower 0.3–2 cm wide, serrate, only slightly reduced upwards and becoming lance-elliptic to linear and entire; inflorescence a pyramidal panicle; *branches glabrous,* more or less recurved, the heads secund; involucre glabrous, 3–5 mm high; bracts firm, blunt or acute; rays 7–12; achenes sparsely pubescent.

KEY TO VARIETIES

A. Plants 1–8 dm tall; panicles 2–12 cm broad, with ascending branches bearing scarcely or only slightly recurving one-sided racemes; achenes strigose-pilose or hirsute 1.3–2.2 mm long; basal leaves often present at flowering time ---------------------------------13a. *S. missouriensis* var. *missouriensis.*

AA. Plants mostly taller, up to 1 m high; panicles up to 20 cm wide, usually with arched recurving branches; achenes glabrous or short-hispid, 1–1.3 mm long. Basal leaves usually wanting at flowering time. ---13b. *S. missouriensis* var. *fasciculata.*

13a. SOLIDAGO MISSOURIENSIS Nutt. var. MISSOURIENSIS.
Map 17, triangles.

The western phase of the species, collected in few south central and southwestern counties, in dry sandy prairies, along open sandy roadsides and on sandy river terraces. This variety is less common than the next and appears to prefer drier habitats. Flowering August to September; fruiting from September to October.

13b. SOLIDAGO MISSOURIENSIS Nutt. var. FASCICULATA Holz.
Map 17, dots.

The widespread variety in our area, occurring chiefly in the southwestern half of the state. It is present, but not abundantly, in dry to mesic prairies on gentle slopes, river terraces, along roadsides and along railroad rights-of-way, sometimes in sandy prairies, on or adjacent to blow-out dunes, and on steep hillsides. This variety as well as var. *missouriensis* appears to be restricted to the prairie areas of Wisconsin south of the Tension Zone. Flowering from (late July) early August into September; fruiting from mid-August into October.

14. SOLIDAGO GIGANTEA Ait. Late Goldenrod Maps 18, 19, 20.

A tall plant from a creeping rhizome; stems stout, often 5–25 dm tall, *glabrous below the inflorescence, sometimes glaucous;* leaves numerous, *lanceolate to narrowly lance-linear, acuminate, tapering to a sessile or nearly so base,* more or less sharply serrate chiefly above the middle, *triple-nerved and relatively uniform in shape throughout* and only slightly reduced in size upward, the lower ones soon deciduous; larger leaves 6–18 cm long and 1.5–3.5 cm wide, *glabrous or scabrous above, glabrous or sparsely pubescent on the main veins beneath;* inflorescence a terminal pyramidal panicle with recurved pilose branches and heads secund; involucre 2.5–4 mm high; bracts blunt to acute, slightly green-tipped; rays 10–17; achenes short-hairy.

KEY TO VARIETIES

A. Cauline leaves 1–2.5 cm wide, the middle ones mostly more than five times as long as wide, serrate; lower panicle branches 3–15 cm long, commonly less than 10 cm long.
B. Leaves with midrib and main veins pilose beneath ---- ------------------------14a. *S. gigantea* var. *gigantea.*
BB. Leaves glabrous beneath ---14b. *S. gigantea* var. *serotina.*
AA. Cauline leaves 2–4 cm wide, the middle mostly less than five times as long as wide, coarsely serrate; lower panicle branches 5–25 cm long, commonly more than 10 cm long ----------- --------------------------14c. *S. gigantea* var. *Pitcheri.*

14a. SOLIDAGO GIGANTEA Ait. var. GIGANTEA. Map 18.

Common throughout Wisconsin in open moist fallow fields, fens, marshes, roadside ditches, along banks of lakes and streams, at the edges of bogs and moist sandy beaches, less common in dry to mesic prairies, open fields, along railroad embankments and brushy roadsides, in the latter habitats it is often associated with *S. canadensis* and *S. altissima.* Individuals with sparse pubescence in the upper portions of the stems, just below the inflorescences, may represent hybrids with these species. Flowering late July to September, and fruiting August to October.

14b. SOLIDAGO GIGANTEA Ait. var. SEROTINA (Kuntze) Cron. Map 19.

Solidago gigantea Ait. var. *leiophylla* Fern.

Similar habitats, distribution, and flowering and fruiting dates as var. *gigantea.*

Beaudry and Chabot (1959) noted that two cytodemes exist within both varieties of *S. gigantea,* one diploid ($2n = 18$) and the other a tetraploid ($2n = 36$), but made no recommendations concerning any special taxonomic treatment.

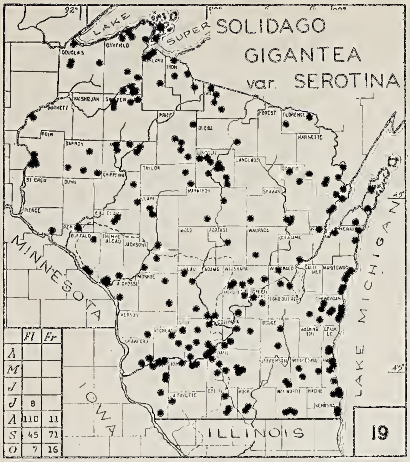
14c. SOLIDAGO GIGANTEA Ait. var. PITCHERI (Nutt.) Shinners. Map 20.

According to Shinners (1953) this variety is found in the low prairies of Iowa, Illinois, southern Wisconsin and Minnesota. The few specimens with broad leaves and broad panicles, which seem to fit the description of this taxon(see Map 20), do not appear to be restricted to the prairie areas of the state. Furthermore, it is possible that these plants may represent either robust plants of the two common varieties, or their tetraploid races.

Because of the limited number of specimens, no significant ecological or geographic trends can be determined for this variety in Wisconsin. Flowering and fruiting dates are probably similar to those of the other varieties.

15. SOLIDAGO PATULA Muhl. Roughleaved Goldenrod; Spreading Goldenrod. Map 21.

A smooth plant from a caudex, 5–20 dm high; stems glabrous below the inflorescence, more or less 4-angled; *leaves glabrous on lower surface, harshly scabrous on upper surface,* the basal and lower cauline leaves persistent, elliptic, elliptic-ovate or elliptic-obovate, acute to acuminate, serrate, 8–30 cm long and 4–10 cm wide, somewhat abruptly narrowed to a broad petiole; middle and upper cauline leaves much smaller, becoming sessile and somewhat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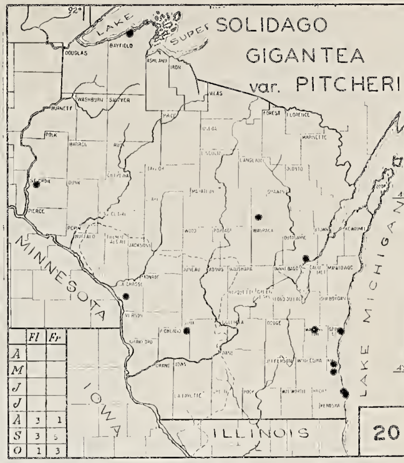
A 110 11
S 45 71
O 7 16
19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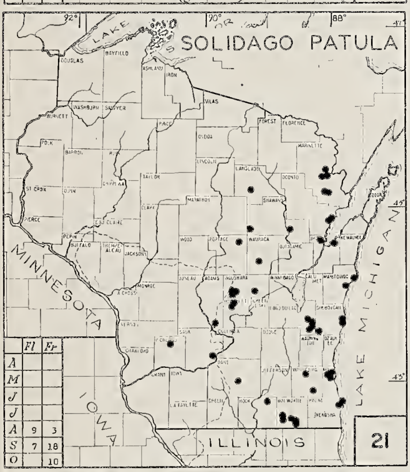
S 3 5
O 1 3
20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MINNESOTA
IOWA
ILLINOIS
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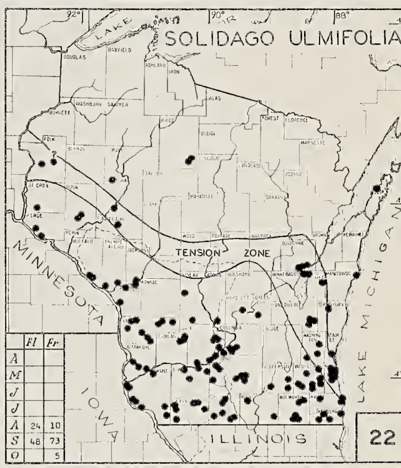
A 9 3
S 7 18
O 10
21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TENSION ZONE
MINNESOTA
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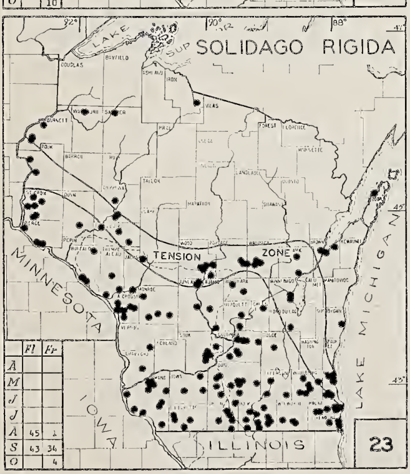
A 24 10
S 48 73
O 5
22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ILLINOIS
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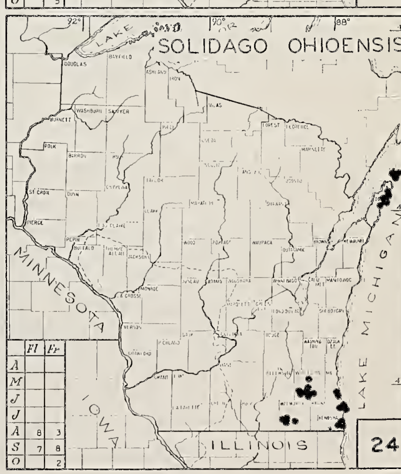
S 43 34
O 4
23


SOLIDAGO OHIOENSIS
MINNESOTA
IOWA
ILLINOIS
LAKE MICHIGAN
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A
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A 8 3
S 7 8
O 2
24

more lanceolate, more or less toothed; inflorescence a stiff terminal panicle, generally with *wide-spreading recurved branches,* but narrower and more elongate in smaller plants; heads secund; involucre about 3–4.5 mm high, the bracts greenish, acute to obtuse or rounded, ciliolate; rays 5–10; achenes sparsely pubescent.

An occasional plant in low conifer-deciduous woods, edges of bogs, on shrubby boggy stream and lake banks (Shrub-Carr community of Curtis, 1959), and in sedge meadows, rarer in low deciduous woods, roadside ditches, chiefly in eastern Wisconsin, but absent from Door County and northeastern counties, where it appears restricted to areas underlain by calcareous rocks. Flowering mid-August through September; fruiting late August to mid-October.

16. SOLIDAGO ULMIFOLIA Muhl. Elm-leaved Goldenrod. Map 22.

A slender stemmed plant from a caudex, 4–12 dm tall, glabrous or nearly so below the inflorescence, leaves thin, sharply and *coarsely serrate, elliptic to elliptic ovate,* larger ones 6–12 cm long and 1–5.5 cm wide, the lower usually deciduous by flowering time, acute or acuminate, abruptly narrowed to a short petiole or nearly sessile, glabrous to somewhat hirsute above, *loosely long-pilose beneath, especially on the veins;* inflorescence a terminal panicle with a *few long divergent or arched-recurving branches,* the heads secund; involucre 2.5–4.5 mm high, the bracts slender, acute to obtuse, yellowish; rays about 3–6; achenes minutely pubescent.

A species associated chiefly with the Mesic Southern Deciduous Forest Community (Curtis, 1959), most common at the edges of Sugar Maple-Basswood woods, Oak woods, and sometimes Birch-Aspen woods, frequently along brushy roadsides, wooded gravelly hills and sandy outcroppings, and occasionally on steep, dripping wet, sandstone cliffs and brushy rock outcrops in the Driftless Area. Flowering late July to early October; fruiting late August to October.

17. SOLIDAGO RIGIDA L. Rigid or Stiff Goldenrod. Map 23.

A coarse plant with a stout caudex; stem 3–15 dm tall; herbage grayish-pubescent; *leaves firm,* entire to slightly crenate, the basal and lower cauline persistent, elliptic-oblong, broadly lanceolate to broadly ovate, acute, 6–30 cm long and 2–10 cm wide, with equally long blades and petioles on the lower, the middle and upper cauline leaves reduced in size and sessile or nearly so; *inflorescence a large terminal corymb; heads large* with involucres 5–9 mm high; bracts firm, broadly rounded, glabrous or puberulent, conspicuously striate; rays 7–14; achenes 10–15 nerved, glabrous.

Widespread in dry to mesic prairies (Curtis, 1955), sandy roadsides, open sandy fields, south-facing slopes, and along fencerows throughout the southern half of the state, sometimes weedy in overgrazed pastures, spreading beyond the limits of the prairie areas into north and east Wisconsin, on sandy soils along roadsides, railroad rights-of-way and occasionally on sandy lake shores. Flowering from early August to late September; fruiting from early September into October.

18. SOLIDAGO OHIOENSIS Riddell. Ohio Goldenrod Map 24.

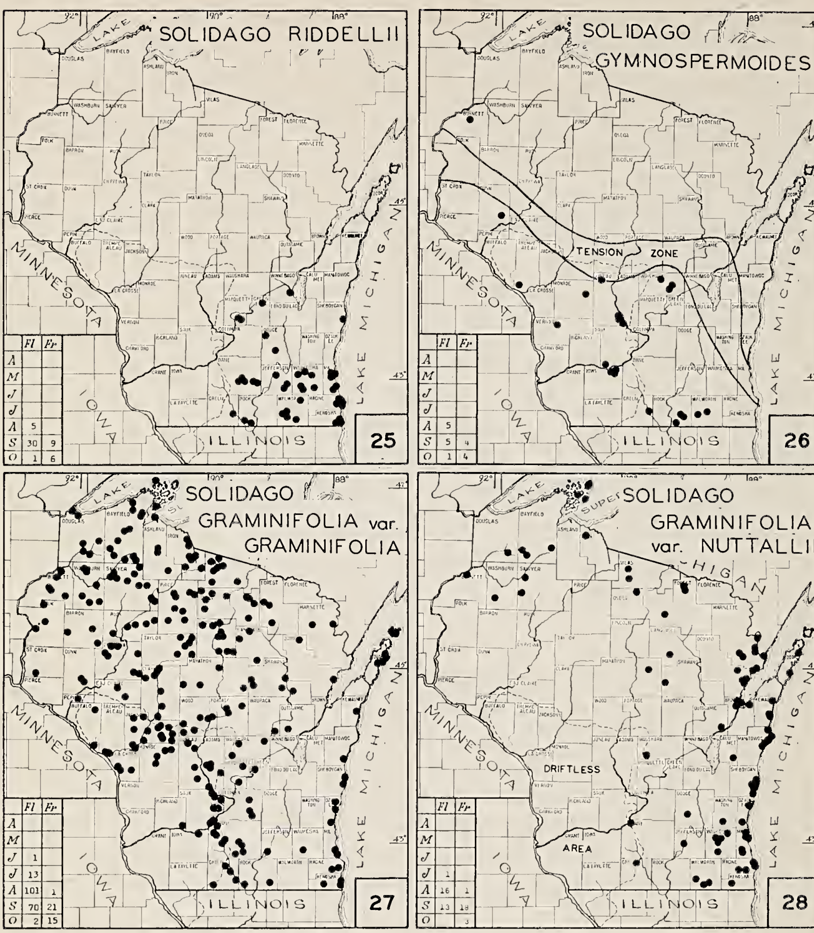
A slender glabrous plant from a branched caudex; stem 4–9 dm tall; *basal and lower cauline leaves persistent, long petioled, narrowly oblanceolate to spatulate,* the blade 7–22 cm long and 1–4 cm wide, *obtuse at tip,* entire or slightly toothed, the middle and upper cauline leaves few, progressively reduced upward and becoming short-petioled or sessile; inflorescence terminal, *corymbiform;* heads numerous; involucre 4–6 mm high; bracts obtuse or rounded, more or less striate; rays short, about 6–8; achenes glabrous, 3–5 angled.

Rather rare in wet alkaline meadows, low prairies, especially those underlain by calcareous substrate, and fens (Curtis, 1959), in southeastern Wisconsin, and in moist to dry depressions between old beach ridges with such species as *Juniperus horizontalis, Calopogon pulchellus, Gentiana procera* and *Solidago spathulata* var. *Gillmani* in Door County; the absence of specimens in the intervening area may be the result of habitat destruction. Flowering from mid-August to late September; fruiting late August to October.

19. SOLIDAGO RIDDELLII Frank. Riddell's Goldenrod. Map 25.

A glabrous plant from a caudex, sometimes with a creeping rhizome; stem stout, commonly 4–10 dm tall, with slight pubescence in the inflorescence; *middle and upper cauline leaves linear-lanceolate, often longitudinally folded, acute, sometimes with recurved tips, long tapering into a keeled, clasping or sheathing base,* lower and basal leaves tapering into a long keeled petiole, the lower ones 3–5 dm long, 1–2 cm wide; inflorescence terminal, corymbiform, the heads crowned; involucre 5–6 mm high; bracts glabrous, obtuse to rounded, more or less striate; rays small, 7–9; achenes glabrous or nearly so, 5–7 nerved.

Occasional in alkaline sedge meadows, wet prairies, edges of marshes, and rarely in moist roadside ditches, in the southeastern



quarter of the state. Flowering from early August to late September; fruiting September to October.

This species sometimes occurs with *S. ohioensis* and *Aster ptarmicoides* (Nees) T. & G. and hybridization among them has been suspected. Cronquist (Gleason, 1952, 3:460) mentions a report of a natural hybrid between *Aster ptarmicoides* and an unknown species of *Solidago*. He further suggests that the true affinities of this aster are with *Solidago* rather than with *Aster*.

Dr. Jean-Paul Bernard, in a personal communication, reported that in population samples of these species, including specimens from a wet prairie in Kenosha County, he observed certain intergrading characters. Among the Wisconsin plants he noted hybrids between *S. Riddellii* and *S. ohioensis,* and *S. Riddellii* and *Aster ptarmicoides.*[4]

20. SOLIDAGO GYMNOSPERMOIDES (Green) Fern. Map 26.

A glabrous plant, 3–10 dm tall, from a creeping rhizome; stem branched at or below the middle; leaves linear, attenuate, entire, with scabrous margins, mostly 4–9 cm long and 1.5–5 mm wide, *with dark and viscid punctation, lateral veins obscure to faintly 3-nerved,* the basal and lower cauline deciduous during flowering time, others not significantly reduced upwards; inflorescence a terminal corymb, open to compact, the heads sometimes sessile in small glomerules, but *more commonly somewhat pedunculate, slenderly cylindric;* involucre 4.5–6.5 mm high, narrow, viscid; bracts obtuse to acute; rays 10–14; achenes hairy.

A western species which reaches its eastward limit in western and central Wisconsin on dry sandy soils in open fields, along fencerows and at the edges of Jack Pine-Black Oak woods. Flowering August to September, and fruiting September to October.[5]

21. SOLIDAGO GRAMINIFOLIA (L.) Salisb. Grass-leaved Goldenrod. Maps 27, 28.

Plant from a branching rhizome; stems 3–12 dm tall, glabrous to hirtellous; leaves linear to linear-lanceolate or linear-elliptic, acuminate to nearly acute in some varieties, sessile, sparsely or moderately punctate, 4–13 cm long and 2–12 mm wide, the basal and lower cauline soon deciduous, others not much reduced upwards, *evidently 3–5 nerved,* glabrous or hirtellous beneath; inflorescence a terminal corymb; *heads sessile or nearly sessile in small glomerules, campanulate to broadly obconic;* involucre 2.5–5 mm high, more or less viscid; bracts obtuse or rounded; rays small, 15–25; achenes with short hairs.

KEY TO VARIETIES

A. Stem, branches and branchlets of the inflorescence essentially glabrous; leaves glabrous except for scabrous margins and occasionally scabrous along the main veins beneath ____________________________ 21a. *S. graminifolia var. graminifolia.*

[4] Two plants which appear to be hybrids between *Solidago Riddellii* and *Aster ptarmicoides* were collected in a wet prairie area about two miles south of the city of Kenosha on September 22, 1963. One of these is deposited as a voucher specimen in the herbarium of the University of Wisconsin–Milwaukee (UWM) and the other has been transplanted to this campus for further study.

[5] *Solidago remota,* a plant of open sandy areas along the southern shores of Lake Michigan and Lake Erie, is listed by both Gleason (1952) and Fernald (1950) as extending to Wisconsin. However, no voucher specimens exist in any of the herbaria examined. Dr. Shinners, in a verbal communication, mentioned that a specimen had been collected in a sandy beach area along Lake Michigan in Kenosha County, but this specimen could not be located.

AA. Stems sometimes, branches and branchlets of the inflorescence evidently pubescent; leaves more or less pubescent ------------------------------------ 21b. *S. graminifolia* var. *Nuttallii.*

21a. SOLIDAGO GRAMINIFOLIA (L.) Salisb. var. GRAMINIFOLIA. Map 27.

Common throughout Wisconsin along open sandy or clayey roadsides, fencerows, in remnant mesic to moist prairies, moist to dry fallow fields, railroad rights-of-way and sedge meadows, occasionally in alkaline marshes, and edges of bogs, moist Maple-Basswood woods and Hemlock-Yellow Birch-Maple woods. Specimens are sparse in the area from Brown County to Walworth County and in the southwestern counties. Because considerable portions of these areas are underlain by dolomitic bedrock or glacial drift containing dolomite material, the lack of plants here may be correlated with soil alkalinity. Flowering (late July) early August into October; fruiting from late August into October.

21b. SOLIDAGO GRAMINIFOLIA (L.) Salisb. var. NUTTALLII (Greene) Fern. Map 28.

Generally distributed in eastern and northern Wisconsin in sandy open fields, along railroad rights-of-way, moist to dry open sandy roadsides, moist fencerows, mesic to moist prairie remnants, and sometimes at the edges of marshes, low woods and, rarely, bogs, in open deciduous woods or at the edges of Maple-Basswood, White Pine and Aspen woods. Flowering and fruiting as in var. *graminifolia* .

In addition to the varieties listed here, the following are excluded: Fernald (1950) lists a var. *media* (Greene) Harris, which is described as being glabrous except for scabrous lines; the leaves linear-lanceolate, long attenuate, with only two lateral nerves and with fewer flowered heads. Some narrow-leaved glabrous plants which fit this description were observed from central and southwestern Wisconsin. Rosendahl and Cronquist (1945) observed similar plants in Minnesota, and suggested they represent intergrades between *S. graminifolia* and *S. gymnospermoides.* Since these narrow-leaved plants were observed in the area of Wisconsin where the ranges of these two species overlap, this explanation has considerable merit.

Var. *major* (Michx.) Fern., the boreal phase of *S. graminifolia,* is distinguished by having broadly lanceolate leaves, mostly 7–10 times as long as wide, and with acute tips. Specimens of this variety have been collected in northern Michigan and northern Minnesota. Although no specimens have been collected in Wisconsin, they should be looked for in the northernmost counties.

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