Transactions of the Wisconsin Academy of Sciences, Arts and Letters. volume LXV 1977

Madison, Wis.: Wisconsin Academy of Sciences, Arts and Letters, 1977

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TRANSACTIONS OF THE WISCONSIN ACADEMY OF SCIENCES, ARTS AND LETTERS

LXV—1977

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ELIZABETH McCOY

TRANSACTIONS OF THE WISCONSIN ACADEMY

Established 1870

Volume LXV 1977

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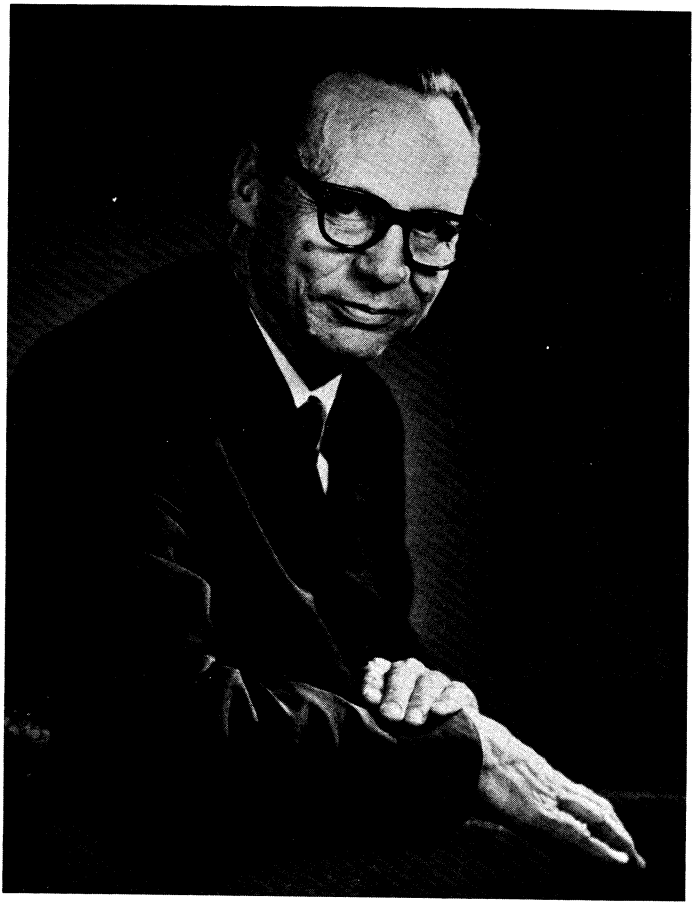

ROBERT E. GARD

55th President 1977

WISCONSIN ACADEMY OF SCIENCES,

ARTS AND LETTERS

OF ELMS AND THE ACADEMY

Robert E. Gard
Presidential Address
May 7, 1977
Wausau, Wisconsin

I am eternally searching for symbols of a permanence in life; of firm values that do not change, of faith and belief that is unshakable.

It is growing harder and harder to find such symbols. Occasionally I think I meet a man or woman who exemplifies what I mean, but the symbolic, traditional objects and institutions with their attendant securities, seem to be harder to find, or to recognize.

To me the Academy is one such symbol. It was founded by persons of idealism, and has stood more than one hundred years, a symbol of aspiration, of high hopes for mankind.

To me the Academy speaks of the magnification of man, of a vast humanism that encompasses all time, all knowledge, all hope that man might express the best of himself, not the worst. To me, the Academy is this kind of an Island.

But the eras do change, and our traditional symbols do slip away. I reverently hope that the Academy will remain, and that its ideals will prevail.

Let us expand a bit on what I mean by changing or disappearing symbols. The elm trees that once shaded America are excellent examples.

Near the front door at our home in Madison, we had one of the largest elms in the area. My wife purchased the house and property because of that great tree. Often she said, "If that tree ever goes, I go, too."

We had the wonderful tree for 20 years; then, though we struggled to save it with many scientific treatments, it withered and died. My lady wept when the men came to cut it down.

Something soon happened to our environment. A ground cover died the next summer; ivy began to cover the front of our house. The whole front looked different, inadequate. But she didn't go; she stayed, and we planted another tree: a Gingko. She said it would probably last for 500 years. I didn't want another tree. I felt the change. As a writer, the loss of the tree desensitized me for a while, but that's when I began to ponder about the death of elms across the breadth of the land.

The great elms are gone—victims of rampant dutch elm disease. The streets the elms once adorned are blank, empty. The feeling of grace, of an almost ageless tradition ended with the disappearance of their tall arch. With their passing, an atmosphere has vanished; the whole air of permanence, of a corridor through time, has passed. We have had a corresponding generation of turmoil and unrest.

When I was a lad, I heard of the arch of the elms of New England; and I was told how Kansas pioneers, many who came from the East, first planted elms in the town square and lined the new streets with the sturdy trees, almost before they built houses. The stability of America itself somehow was symbolized by the elms.

Lately I visited my old hometown in Kansas. Once there were tall elms in the courthouse park and green wooden benches placed beneath them. At one side stood an old horse watering trough. But when I visited last summer, the trees were all gone—so was the trough; so, indeed, was the old red-brick courthouse. A low structure of yellow brick, entirely unshaded, sat uneasily in the middle of the park.

I cannot believe that the death of the elms has had no effect upon us as a people. The tradition of a leisurely college life, enhanced by the presence of great trees above a quadrangle, or along a student walkway, appears to have departed. Perhaps students are more restless than they were a generation ago. Could it be that great trees that spoke of quietness, a timeless tradition, a deep feeling of place, had their effect upon the young?

There is a bleakness now in the atmosphere of colleges. Two or three generations hence, when the new trees have grown, the atmosphere may return. But what in the meantime? Colleges are not necessarily known for the beauty and uniformity of their architecture. Without the trees, the buildings sometimes look stark, and their windows empty and lonely. I have noticed also, as the trees have disappeared, that the traditions of the colleges themselves have grown less important—indeed, the traditions seem often forgotten. I recently found the senior class calumet—the peace pipe smoked in friendship by each senior class at the University of Wisconsin since, I believe, 1887, in a dark closet, entirely forgotten. The famed "little red wagon," so important to athletic teams of the university, has disappeared. Nobody knows where. It was the wagon that students drew with ropes; hauling the victorious teams from railroad station to campus.

And the tradition of great professors of magnificent bearing and influence . . . where are they? In a time of great elms the great professors flourished. Bennie Snow (Academy member), noted professor of physics, who received a "skyrocket" before each class; "Wild Bill" Kiekhoffer (Academy member), great economics professor with a deep love of students; Carl Russell Fish (Academy member), historian and lecturer par excellence who was literally followed by groups of students wherever he walked under the elms . . . these great professors have vanished with the trees. With them, of course, have gone the cherished stories . . . Bennie Snow, for example, one day walking down a sidewalk on State Street. He was walking with one foot in the gutter, one on the walk. An inquisitive student, noticing this curious performance, asked the professor whether something was the matter. "Why," said Bennie, "I believe one leg feels somewhat shorter than the other."

Ah, for the great trees again!

I have many older friends these days, especially since I myself have qualified for the golden years. Once the elderly sat peacefully beneath the elms. Tales told there carried on the oral tradition of generations. A bench now, set on a bare corner or in a treeless park, seems forlorn, though it may be occupied by two or three old cronies. Their daily meeting, the passing talk, seems to lack the benediction of the elms and often my older friends comment on the feeling of loneliness and uneasiness.

"Elm shade," one said, "was once the essence of friendship. Most of our elms are gone in this town. We moved in from the farm, my wife and I, to be under the elms . . . that's what my wife said. She liked this town because of the trees. She said the elm was a woman's tree, a woman's friend. This town will never be the same to us since the elms have gone. It's harder now to make new friends."

Our national values, our national character, may be affected by the loss of the trees. There are many, many reasons why our whole system of ethical and moral behavior is changing. The elms certainly are not to blame; yet the changes have occurred simultaneously with the death of these trees. The elms have always symbolized home and its values; the lure and pull of a homestead, of waiting friends and parents when one returns. Once, the trees planted at the doorstep to commemorate family events furnished shade and comfort in times of joy and grief. Now the trunks, dead and gray, stand sometimes in the yard beside the door. Or there is simply a blank space—or a stump remains where grandfather planted the elm sapling when the first baby died in the fall of 1861 . . .

We are certainly a nation which has developed its character through the associations of family life. Family life relied on the elms. The effect of their going may be subconscious upon us; but a phase of American life—the serene elm phase—probably will not come again.

Let us hope that the death of the elm trees does not point toward the demise of the ideals of the Academy.

Let us hope that we may preserve and nourish the Academy. It may be more precious than we realize. But institutions and organizations are subject to the winds of chance. Recognition of values and planning for the winds of change are the only answer. I plan to work on that, and trust that we all will.

SOIL EROSION IN THE LAKE STATES DRIFTLESS AREA — A HISTORICAL PERSPECTIVE

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ABSTRACT

The paper briefly describes the geological, settlement, and agricultural history of Wisconsin's unglaciated or "Driftless Area". Gullying of forested ridge sides and river terraces was especially severe during the 1920s and 1930s when the University of Wisconsin, U. S. Department of Agriculture, and the U.S. Forest Service began surveys of the erosion problem. Erosion has been less in recent years. Many gullies have healed naturally; the change from horse plowing to tractor plowing has resulted in less cultivation of steep slopes and less erosion. Ridgetops are used more for pastures and hay fields than for annual grain crops.

INTRODUCTION

Geologists know it as the "Driftless Area," local residents, as the "Coulee Region": "driftless" from the lack of glacial deposits (drift); "coulee" because of the steep-sided, narrow valleys. But no matter what one chooses to call it, the ridge-and-valley country of southwestern Wisconsin and adjoining States is an unusual land. Four times the great, continental glaciers pushed their icy fingers down over the upper Mississippi valley region. Some reached far down toward the tip of Illinois, and into Iowa. But for reasons still not clearly understood, southwestern Wisconsin and adjacent parts of Minnesota, Iowa, and Illinois were bypassed each time by the great, grinding mass of ice and rocks.

So, unlike the country that surrounds it, the land here was neither scoured, leveled, nor filled. Indeed, of all the many ways that nature uses to shape the face of the land, only erosion has been at work here.

In the Beginning

It began with nature's relentless wearing down of primeval mountains into primeval waters. It was then that the sandstones and limestones that we see exposed today were laid down. As the land emerged from the ancient sea a new cycle of erosion began, and the land forms of today's Driftless Area—the flattopped ridges, the slopes rising steeply from narrow valley floors, the rocky crags—began to take shape (Fig. 1).

Although it was never touched by the ice sheets, much of the area was nevertheless affected by the glacial advances. Erosion, this time by wind, was again the agent. As the rivers that spewed from the retreating glaciers finally subsided, they left in their wake huge deposits of rock flour, of silt, and sand. And as this material dried out it began to blow. We do not know how long this went on, but by the time it had stopped, a 100-mile-wide strip of country along the Mississippi River was blanketed with a layer of fine silt. In places it was as much as 20 feet thick, and it covered most of today's Driftless Area.

Thus, time and erosion shaped the face of the land. Later trees came to hold it in place—grasses too, because this region was the boundary between forest and prairie.

No wonder that early explorers who paddled up the Mississippi to view the bluffs and the steep hill country beyond the river were awed by what they saw. "The scenery combines every element of beauty and grandeur," wrote one. "The sunlit prairie with its soft

FIGURE 1. Driftless Area landscape as seen from ridgetop. The forest is oak-hickory and associated species.

swell . . . the somber depth of primeval forests . . . cliffs rising hundreds of feet . . . streams clear as crystal."

But this was 150 years ago. The natural advantages of the region brought on rapid settlement, primarily by Norwegian immigrants, who had found a new world counterpart to the old country. The sunlit prairie and the primeval forest began to give way to the plow and to the axe and the grubbing tool. Farmsteads and fields of grain began to dot the landscape; and a new cycle of erosion was not far off.

The Plowman's Folly

The settlers soon found that the deep, wind-laid blanket of silt was an excellent soil. The flattopped ridges, remnants of the ancient ocean bottom, were easily cleared and the rock-free soil was easily plowed. Unfortunately, for both the settler and for posterity, the amount of flat land was somewhat limited because much of the ocean bottom had been worn down into steep slopes following the period of geologic emergence. So a lot of steep land was cleared for agriculture, too. After all, the soil was just as fertile; and the settlers had been used to farming steep land back in the old country. Forests were left only on slopes too steep to plow.

The soil was very productive, but also very erosive. The wind-laid silt was free of rocks and relatively low in clay, the fine material that binds soil particles together. So soil erosion was inevitable. Forest remnants became the dumping ground for runoff water from overlying fields. Gullies slashed through the wooded slopes, disgorging rocks and rubble and silt onto valley floors and into flooding streams. "Civilization" had arrived in the Driftless Area.

Just when man-caused erosion actually began, we do not know, but it was probably about the mid-1800s, soon after the land was settled. At first wheat was the primary crop, but after 20 to 30 soil-depleting years, wheat farming gave way to dairying. Soil fertility probably declined rapidly under the annual wheat cropping system, and the new cycle of erosion must have started in this era. That a problem existed at least as early as the 1880s was shown by an immigrant German farmer, August Kramer, who began strip cropping on his farm near La Crosse, Wisconsin, about 1885 (Zeasman and Hembre 1963). One of the earliest published references to erosion in the area came from Professor F. H. King (1895) of the University of Wisconsin, in a textbook published 10 years after Kramer's practice began. Speaking of the Driftless Area, he wrote:

> "The hills, no longer protected by the forest foliage, no longer bound by the forest roots, are gullied and channeled in all directions. Storm by storm and year by year the old fields are invaded by gullies, gorges, ravines, and gulches, ever increasing in width and depth until whole hillsides are carved away . . ."

It appears that King was describing the forest land gully, caused by runoff from overlying fields. Other forms of erosion were probably going on at the same time: sheet and rill erosion on sloping fields; gully erosion on sandy river-terrace flatlands; and wind erosion on sand plain areas. Forty years later, Aldo Leopold also described (1935) the gullying of forest land:

> "Every rain pours off the ridges as from a roof. The ravines of the grazed slopes are the gutters. In their pastured condition they cannot resist the abrasion of the silt-laden torrents. Great gashing gullies are torn out of the hillside. Each gully dumps its load of hillside rocks upon the fields of the creek bottom, and its muddy waters into the already swollen streams".

Although Leopold was writing about just one small watershed (Coon Creek), the forest land gully was, and still is a common blight throughout the coulee region. Such gullies are found in practically every wooded slope that lies below farmland (Figs. 2 and 3). How extensive they were in the 1930s was shown by a systematic survey in 1935-1936 (Fig. 4).

Less common, but even more spectacular, than the erosion on the loess-covered hills were the gullies on level river terraces of sandy, alluvial soil. Here acres of productive farmland were sometimes destroyed by gullying during a single storm (Fig. 5). The gully in Fig. 5 advanced 1,000 feet during one storm in 1922, according to the owner:

> "This storm caught George Vollmer in the back field. On his way home the team had to swim the new gully with the wagon floating where the field was only minutes earlier.
>
> "The debris pile at the outlet of the gully had buried highway No. 37 repeatedly. A survey in 1929 revealed that this cone was about 14 feet thick near the road crossing and averaged over 6 feet over a 40-acre area. Much of the finer soil material had gone down the river" (Zeasman and Hembre 1963).

The largest of these river terrace gullies—one of many along the Buffalo River in southwestern Wisconsin—decimated a 50-acre

FIGURE 2. Beginning of a forest land gully. Photo was taken in 1936.

FIGURE 3. Part of extensive gully system below open land on Coulee Experimental Forest, La Crosse County, Wisconsin. Note man holding rod (lower left).

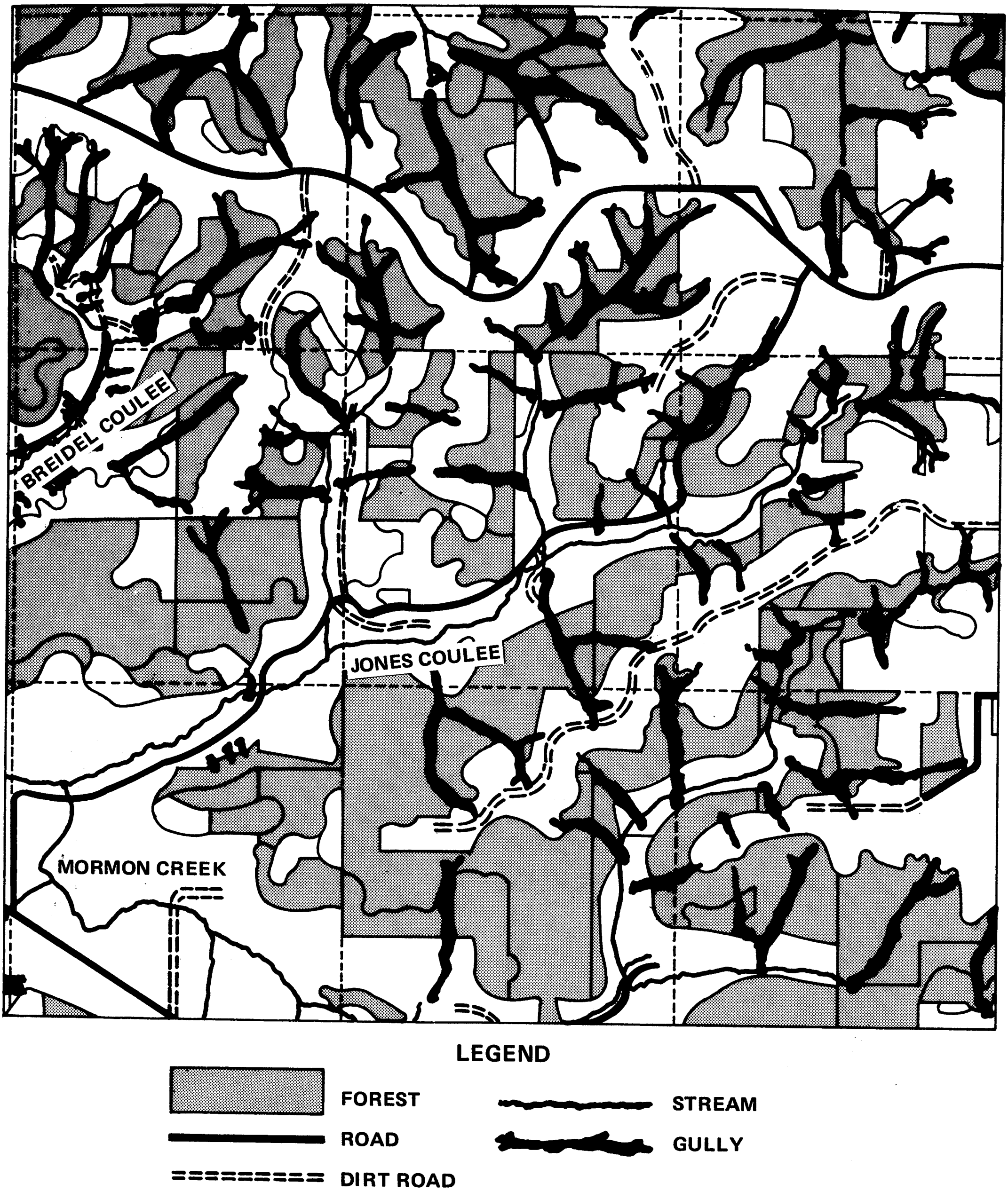

FIGURE 4. Land use and gully survey of part of a township in La Crosse County, 1935.

area, and ranged from 30 to more than 50 feet deep. Its beginning dated back to at least 1914. A 1929 survey of the Buffalo River area showed 170 gullies with a total length of 18 miles, a total area of 138 acres, and a total volume of 3,247,000 cubic yards in a 75 square-mile area (Bates and Zeasman 1930). Much of the eroded soil washed into the Buffalo River, and subsequently into the Mississippi.

The soil loss and sediment gain from sheet and rill erosion were inestimable. Soil surveys did indicate their magnitude, however. For example, Muckenhirn and Zeasman reported about 1940 that more than 60% of the cropland in southwestern Wisconsin had lost at least one plow depth of soil. This probably reflects water erosion of loessal silt loam soils on sloping fields for the most part. However, wind erosion also took its toll on flat fields of the sand plain area, as shown in a photo taken in 1960 (Fig. 6). A road nearby was protected from drifting sand by a snow fence.

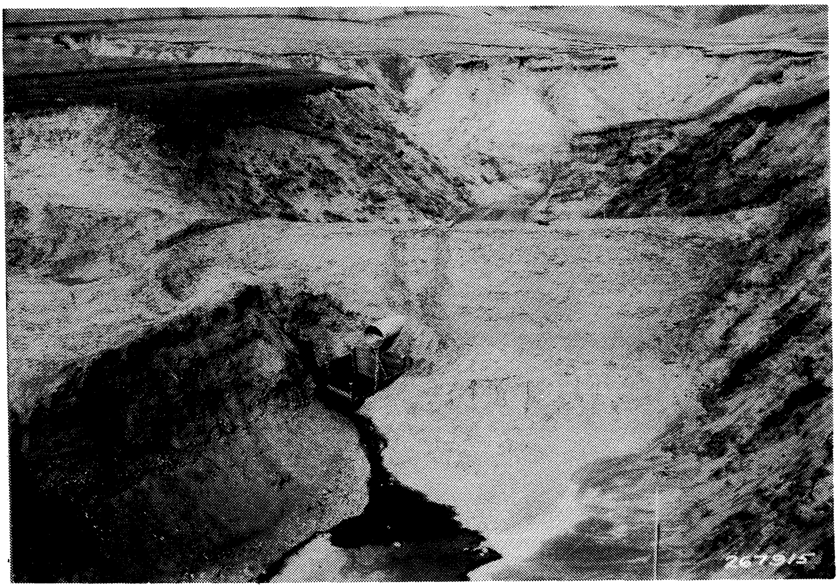

FIGURE 5. River terrace gully showing drop inlet dam, 1932. Except for growth of vegetation, the area looked much the same in 1958.

Early Control Efforts

Except for a few innovators like August Kramer, nothing much was done about the erosion problem until the early 1920s. The U.S.

Soil Conservation Service did not yet exist, and most landowners had nowhere to turn for help. Then in 1922, O. R. Zeasman, a University of Wisconsin extension specialist in land drainage, was assigned the job of "stopping ditches." Perhaps it was a sign of the times that Zeasman was originally moved into the erosion control field not to save farms or rivers, but to reduce highway maintenance costs in Buffalo County (Zeasman and Hembre 1963).

One of his early efforts was to stake out diversion terraces, the first in the fall of 1922. Later, he began building drop inlet gully control dams; the first large one was started on the Vollmer farm (Fig. 5) in 1928. In 1932 he laid out a diversion terrace there that successfully diverted the water away from the gullies. I visited the farm in 1958 and was told by Mr. Vollmer that construction of the terrace had taken care of the problem; water no longer ran through the gully.

In the meantime, the USDA Forest Service was called upon to help in a "Cooperative Study of Soil Erosion Problems in Wisconsin." The cooperative agreement between the Lake States Forest Experiment Station and the Wisconsin College of Agriculture was signed June 4, 1929.

A lot happened in the early 1930s. Research at the Upper Mississippi Valley Soil Conservation Experiment Station, a cooperative project between the U.S. Department of Agriculture and the Wisconsin College of Agriculture, began at La Crosse in 1931. A year later, watershed management research by the Lake States Forest Experiment Station (USDA Forest Service) also began there. The Nation's first watershed improvement project was begun in Coon Creek watershed in 1933, the same year that the Forest Service proposed public acquisition of some 1.4 million acres in the bluff lands area as an erosion control purchase unit (nothing came of this). The Soil Erosion Service was created as an emergency agency in the Department of Interior in 1933, and was transferred to the Department of Agriculture as a permanent agency in 1935. The Civilian Conservation Corps (CCC) was born, and many camps were engaged in erosion control work in the Driftless Area during 1933-34. Constructing gully control structures was a major activity: some 900 were built.

Other efforts in the 1920s and 1930s included construction of various kinds of check dams to protect railroads and highways from mud-rock flows (Fig. 7). These structures were largely ineffective because they attempted to cure the symptom rather than the disease. Some were filled after one storm. Nevertheless, large sums were spent in this futile effort.

FIGURE 6. Wind erosion on sand plain in north La Crosse County, 1960.

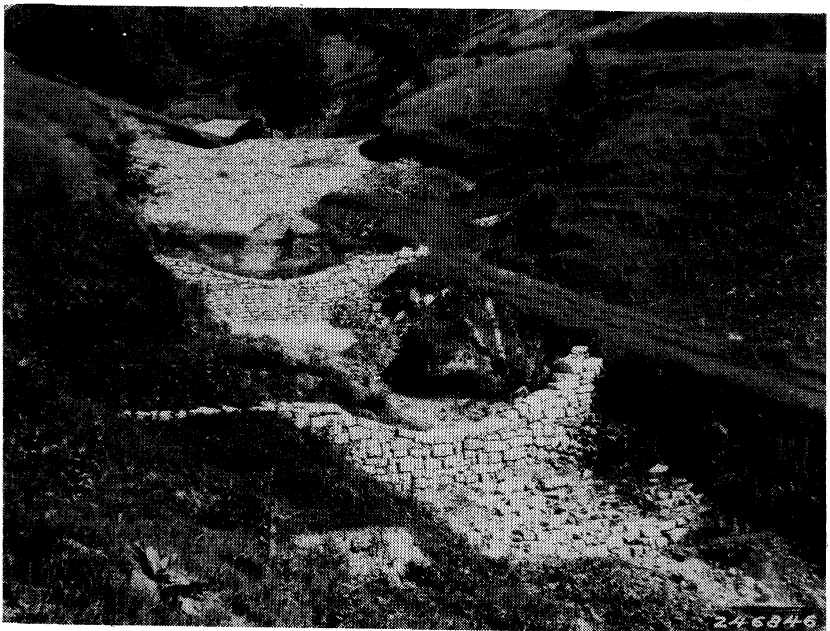

FIGURE 7. Check dams built by Chicago, Burlington, and Quincy railroad in the 1920s to protect tracks near Genoa, Wisconsin.

The Situation Today

Although yesterday's gullies still scar the land (there is no reasonable solution to large holes in the ground), most have at least stopped growing. This is largely the result of natural causes. The first big storms probably washed out most of the soil and rock fill. As the gullies enlarged, the erosion potential diminished. Even if the most destructive storms were repeated on the same area today, the potential for further erosion would not be there because some channels have long since been worn down to bedrock. However, the gullies have not entirely healed. Some still discharge rocks and rubble during high runoff storms.

Gradual changes in land use over the years have also speeded the healing process. With the change from annual grain cropping to dairying, some cropland went into permanent pasture. When the tractor replaced the horse, more was saved because tractors cannot safely negotiate steep slopes. As gullies ate into upland fields the plow line had to retreat upslope, and old fields soon became new forests of aspen, birch, and elm. Narrower ridges also went out of crop production eventually to revert to forest. And, of course, the increase in conservation farming over the years has also helped. With all of these changes, less water now flows from upland fields onto forested slopes.

Even so, new gullies can still form, given the proper combination of conditions. But now the triggering mechanism is more likely to be a bulldozer than a plow; and the site, a hillside subdivision instead of a farm field. However, all may not yet be right down on the farm. Steep land is still cultivated; so eroding fields and flash floods are still more than just a memory of bygone days. The Corps of Engineers is currently seeking support for two separate flood control projects in the area. And consider, for example, this quote from a recent newspaper story (Breitbach 1975):

> "If a final epitaph were to be written for 1974, it could best be summed up in one word . . . 'failure.' Failure to protect the land from soil erosion saw the most severe soil losses in the past 25 years."

One man's opinion? Perhaps. But coulee streams still run muddy with every rain. So the current cycle has not yet run its course. Nor is it likely to—as long as those who work the land continue to ignore the demands of an uncompromising nature.

BIBLIOGRAPHY

Bates, C. G., and O. R. Zeasman. 1930. Soil erosion—a local and national problem. Univ. Wis. Res. Bull. 99, 100 pp., illus.

Breitbach, Dave. Article in Waukon Republican Standard, Conserv. Suppl., March 25, 1975.

King, F. H. 1895. *The Soil Its Nature, Relations, and Fundamental Principles of Management.* L. H. Bailey, ed. 303 pp., Macmillian and Co., New York.

Leopold, Aldo. Coon Valley, an adventure in cooperative conservation. Am. For. 41:205-208. 1935.

Muckenhirn, R. J., and O. R. Zeasman. [n.d. circa 1940] Soil erosion survey of Wisconsin. Wis. Univ. Spec. Bull., 24 pp., illus.

Zeasman, O. R., and I. O. Hembre. 1963. A brief history of soil erosion control in Wisconsin. State Soil and Water Conserv. Comm. In Cooperation with Univ. of Wis. Ext. Serv., Coll. Agr., Madison, Wis.

WISCONSIN'S FIRST UNIVERSITY SCHOOL OF THE ARTS

THE UNIVERSITY OF WISCONSIN—MILWAUKEE SCHOOL OF FINE ARTS: ITS FIRST TWELVE YEARS

Adolph A. Suppan
University Wisconsin—Milwaukee

In December 1962, the University of Wisconsin Regents established the state's first university school of the arts, at The University of Wisconsin-Milwaukee. This is an account of the creation of that School, its academic innovations, and its first twelve years of development.

It will be evident from what follows that a potent stimulus toward the possibility of such a school came when the University began its artist-in-residence program during the 1960 summer session.[1] On campus were poet John Ciardi, abstract-expressionist painter Jack Tworkov, composer Alvin Etler, the Fine Arts Quartet, the New York Woodwind Quintet, and pianist Frank Glazer. The program (subsequently given the inclusive title of "Summer Arts Festival") was unique, at that time, in several respects. The artists came not for a one-day visit, but to teach courses, lecture or perform, and hold conversations with students, faculty, and public. In round-table discussions between visiting artists and the faculty, the arts were examined in relation to one another under such topics as: "The Artist and the Critic," "Government Subsidy for the Arts," "The Artist and the Public: A Communications Gap?," and "The Artist in the University." At concert "previews" and lecture-demonstrations, Mozart and Beethoven, as well as Bartok and Schönberg, were explained and discussed. A spirit of aesthetic excitement prevailed for many weeks, as the audiences realized that the arts together had more impact than the arts individually.

The success of this, and the 1961 summer program relating the arts in teaching and performance, soon posed an obvious question for the University. Why should the arts come together only during the summer session?

Early in 1962, Chancellor J. Martin Klotsche created the Ad Hoc UWM *Committee to Consider the Future of The Arts.* The Committee, representing a broad range of the arts and art related administrators. included Professors Lester E. Fuhrmann

(Theatre), Frank M. Himmelmann (Education), Frederick I. Olson (Extension), Milton H. Rusch (Music), Robert Schellin (Art), and Adolph A. Suppan, Chairman (Director, Summer Session).

This committee wrote a document which, for those years, displayed significant foresight relating to the situation of the arts in most of the nation's universities. The essential recommendations were:

PROPOSAL FOR A UNIFIED FINE ARTS PROGRAM AT UWM

OBJECTIVES

1. To provide a continous and effective relationship between UWM departments related to the fine arts area
2. To enable these departments to coordinate their resources; to encourage generally in the university a recognition of the value of the disciplines inherent in the arts; and to intensify departmental offerings in the fine arts to both the students and the community
3. To make it possible for students to major in a fine arts curriculum which cuts across departmental boundries; permits students to see the arts in their natural relationship to one another; and allows concentration upon such areas as aesthetics, arts history, cultural development, and art in society
4. To permit within the professional training of each student majoring in the arts a maximum intensity of study and experience in his area
5. To centralize lines of communication between the total university arts program and civic organizations working in the arts
6. To coordinate programs in the arts (music, theatre, the dance, and the visual arts) so that each year a calender of arts activities can be printed in advance, providing the community with a total awareness of the varied activities and wide range of the arts in UWM.

RECOMMENDATIONS

1. The university should establish a separate division of fine arts with an administrative head directly responsible to the Provost [now Chancellor]. This division would include the departments of art, art history, theatre, music, and the dance. The present budgets of these departments (or what are now areas within departments, such as theatre and dance) would be incorporated into the total budget of the division.
2. The fine arts unit would include among its primary functions the objectives given above, and would implement them as soon as is possible.

The recommendations, approved by Chancellor Klotsche and the relevant departments and deans, were submitted to the University of Wisconsin administration in Madison. Action on the document came in the fall of 1962 when the new president of the University, Fred Harvey Harrington, also approved it and relayed it to the University Regents. In December 1962, the Regents created a School of Fine Arts for The University of Wisconsin-Milwaukee and appointed Adolph A. Suppan as its first dean.[2]

Intense planning by faculty and administration began; only eight months remained before the new School was to open. The deans and faculties involved had to consider the mechanics of bringing existing departments and new academic areas together. Dean Joseph G. Baier of the College of Letters and Science played an important role in effecting a smooth transition for Music (already a department) and Theatre Arts (three faculty members in the Speech Department). At the School of Education, the Art Department (like Music, already possessed of an excellent reputation in the state) was also involved in the move. The existing dance courses were offered by the Department of Women's Physical Education; that department preferred to retain the one faculty member involved and, therefore, an entirely new dance faculty had to be appointed.

A Faculty Planning Committee was formed to design a general curriculum for the new School—admission details, course requirements, and revised departmental programs. The Committee's recommendations were resourceful and innovative. Besides the four departmental programs—Art, Dance, Music, and Theatre Arts[3]—a fifth unique program was added: Inter-Arts. A student choosing to become a generalist in the arts could get a degree by working in any three of the four departments; e.g. 24-credit with "mini-majors" in Music, Theatre Arts, and Dance. This degree could form a background for fields such as arts administration, arts history, concert hall management, or arts journalism.

A second feature of the proposed new curriculum was a requirement that every student, no matter which of the five new majors he or she chose, should take two year-long survey courses: *Arts and Mankind* in the freshman year and *The Arts: Theory and Criticism* in the senior year. These wide-ranging courses, taught by a team of instructors from the entire arts faculty, would, in the first year of the students' academic experience, acclimate them to art disciplines other than their own and, in the fourth year, give them an overall view of critical principles and practices relating to all the arts, and thus broaden their aesthetic approaches. These classes would, we hoped, liberate the students from the too-concentrated, conventional arts major. As far as we knew, such courses were not offered in any other institution.

The Committee also was aware of current criticism that many private conservatory programs in music, art, theatre or dance neglected the students' liberal arts education. The new curriculum required 30 credits in the humanities and sciences, without sacrificing an adequate credit load in the major discipline.

In summary, the Committee proposed an arts education of rigorous professional competence, yet eschewed over-specialization by creating a balance with general education and an introduction to the other arts.

The labors of the Committee (its members always in consultation with colleagues in their various departments) were rewarded when, on March 28, 1963, the arts faculty approved the new curriculum. On April 11, the all-University faculty gave a unanimous go-ahead to the new School. Similar approval of the new curriculum by the University administration and Regents quickly followed. In a few months, the first university college of the arts in Wisconsin was ready to face its next challenge: its reception by students and the public.

First-semester registration, in September 1963, exceeded predictions. Enrollment in arts majors increased from 1,011 to 1,248—23 percent overall. Class registration rose from 6,798 to 7,579—12 percent, compared with an all University increase of 9 percent.

During that first year and the next, these developments in the academic progress of the School took place:

(1) Recognition of the Music Department by the two leading national accreditation systems: the National Association of Schools of Music and the National Council for Teacher Accreditation. These were significant not only for their stamp of approval for an already reputable department, but because there had been some faculty concern that the department might lose stature by joining an arts school with a new curriculum.

(2) The appointment of the internationally-famous Fine Arts Quartet to full-time faculty status with tenure. There were some resident quartets in other universities but, to our knowledge, none had ever been given tenure as a group. The acknowledged excellence of the Quartet also signalled to the community the standard of quality the new School would strive for in its appointments.

(3) New graduate programs in Art and Music: three Master of Music degrees (Applied Music, Conducting, Music History and Literature); a Master of Fine Arts degree, offered parallel to the existing degrees of Master of Science in Art, and Master of Science in Art Education.

(4) A four-year curriculum and an Education major in Theatre Arts.
(5) A four-year professional major program in the new Department of Dance.
(6) Revision of the Art Department's undergraduate program, with eight professional areas of specialization.

During subsequent years (1965-67) enrollment increase continued, exceeding all-University averages; the full-time faculty had now increased from 44 to 70. And, because of the burgeoning student population, a desperate need for additional classroom and office space developed. Only the Music Department was adequately housed; it had acquired, a few years before the formation of the School of Fine Arts, an efficient new building with an excellent recital hall.The Art Department was still in cramped quarters at the north end of old Mitchell Hall's third floor; dance and theatre classes were also scheduled in that building; music, theatre, and dance performances took place in Mitchell's "auditorium," originally designed for lectures and debates. It had a cramped stage which served only minimally for theatre purposes; also rows of uncomfortable, joined, wooden seats were movable, to make room for campus dances. The new School, with its many students, was suffering one of the most ancient of institutional diseases—lack of space.

In the fall of 1966, Chancellor Klotsche announced the welcome news that the Regents had approved a new Fine Arts Center for the University. A Faculty Planning Committee was immediately appointed to advise the state architects and engineers on the three-building complex (to adjoin the existent Music Building). We wanted a plan that would include classrooms, offices, studios, galleries, student recreation space, and a multi-purpose theatre. Though we wanted a center that would offer adequate performance and exhibition space, we hoped it could also be an appropriate environment for the artist/teachers and their students.

As indicated before, the School had a two-fold academic purpose: to provide professional and general training in the arts, and at the same time to alert students to the inter-relationship of the arts. We therefore asked the architects to design a quadrangle which would coordinate the arts in a spatial, as well as academic, continuum. They accomplished this with an inter-flow between the units, using covered walks and adjoining courtyards; provision was also made for a number of arts activities in each of the buildings.

A specific example of how this "inter-flow" principle was considered for every aspect of the Center can be seen in the Planning

Committee's objection to the architects' orginal plan for the galleries, which were to be in a squat, one-story structure, separated from the other buildings. We complained that this made them merely another museum, isolated from the ebb and flow of people on the campus. We suggested that the galleries be situated on the second floor of the Theatre Building (its first-floor lobby was also a concourse) where students, in the daytime, and the public, attending evening events, would be attracted to the painting, sculpture, and crafts exhibitions. The architects not only agreed, but put floor-to-ceiling gallery windows in the upper well of the theatre lobby. Day and night, many of the structures and colors of artworks could be seen from below—a continuing display of ongoing attractions in the visual arts.

A distinctive feature of the theatre itself was its flexibility in regard to both thrust- and proscenium-staging. Normally the theatre, with thrust-stage, would seat 550 people. Sharp-rise seating around three sides of the stage would make it possible for every member of the audience—even those sitting in the eleventh and last row—to have a clear and close view of the performances. Experts were also consulted to provide a variety of different acoustical situations to suit whatever would be staged. The theatre would not be limited to plays, but would be used for orchestral and choral concerts, recitals, lecture-demonstrations, and dance concerts as well. Hydraulic-electric devices would make it possible to lower the entire thrust-stage so that it disappeared, transforming the theatre into a 600-seat proscenium-type interior. Portions of the floor could also be lowered to form an orchestra pit for musical comedies and certain types of dance performances. Other features of the Theatre Building included a lower-level rehearsal room with a stage of the exact measurements of the thrust-stage, dance studios, and numerous shops for scenery, costuming, and stage design.

The Art Building had studios and classrooms adapted for every art activity: ceramics, sculpture, graphic arts, painting, photography, film, design, weaving. Between the Art Building and the Theatre was a sculpture court which served as both an outdoor working area (there was direct access to it from the interior studios) and an exhibition space.

Although the 300-seat Recital Hall was conceived mainly for chamber music, it also was flexible in its uses; and the Lecture-auditorium would serve equally well for film showings, theatre workshop productions, and lectures.

In the 1960s (the Fine Arts Center was completed in 1968), some cultural historians had complained that, although support for the arts was increasing, much of this manifested itself in a national "edifice complex"—that more money was being poured into hundreds of arts halls and centers than into badly-needed support for artists and arts organizations themselves. Our Fine Arts Center defied such a trend. More than a cluster of performance and exhibition spaces, it provided learning and studio space for 900 Fine Arts majors and 75 faculty members, and was a locus for over 150 arts events annually. It offered, because of its many resources, the widest possible range in the arts: from the classic to the contemporary, from the traditional to the experimental and the challenging. The arts could flourish here, free from the restraints and limitations of box-office commercialism. In addition, with opening of this Center, metropolitan Milwaukee had its first multi-purpose performing arts building complex.

The Center, of course, also became the home of the Summer Arts Festival, which had continued and expanded each year. The selection process for the artists-in-residence began during the academic year, when faculty committees, departmental chairpersons, and administrators wrote letters, made phone calls, and conducted interviews. The artists were chosen not only for their reputation, but for their ability to be articulate and interested teachers.

Thus, when summer arrived, students, faculty and the community were offered the rich experiences of seeing, hearing, and meeting great creative personalities from the arts world beyond the campus. There was stimulation and controversy, and sometimes even shock, in observing and talking with such gifted people as composers Leon Kirchner and Milton Babbitt; painters Carl Holty and Lester Johnson; poets James Dickey and Kenneth Rexroth; dancers Ruth Currier and Lucas Hoving; musicans Sylvia Marlowe and Leon Fleisher; and theatre directors Alan Schneider and Gene Frankel. These—and many others—gave all of us fresh, invigorating ideas about the arts. Altogether, up to 1974, more than 60 artists-in-residence came to the campus.

The Arts Festival also included chamber music, modern dance, ballet, theatre, painting/sculpture/crafts exhibitions and experimental film series. There were concerts by a Festival Orchestra including the members of the Fine Arts Quartet, the New York Woodwind Quintet (and later our own Woodwind Arts Quintet), musicians from the Milwaukee Symphony Orchestra (and its predecessors), music faculty, and selected students. Among the conductors were Thor Johnson, Robert Whitney and Leonard Sorkin.

As a logical extension of the successful summer program, artists-in-residence were now appointed during the academic year as well. The four Fine Arts departments (and in the case of poets, the English Department cooperating) invited artists to teach, perform, lecture and conduct workshops.

Enrollments, as well as programs, continued to grow; and, as student involvement in university policies increased nationally, the School sought more student advice in academic decisions. In 1968, a Student Advisory Committee to the Dean was formed; members (representing their organizations in the various departments) were recommended by departmental chairpersons. The Committee met every two months; problems, issues, and proposals were frankly (and, if requested, confidentially) discussed; and if so directed by the students recommendations were relayed to the departments. The departments also created means by which students could communicate their opinions directly.

With the new quadrangle of buildings, an energetic faculty, and a steadily increasing enrollment, the School had become not only a respected academic unit, but a magnetic force for the arts in the Milwaukee area. *The Milwaukee Sentinel* described it as a "haven of the arts," but our goals went beyond that. In the 1960s the University of Wisconsin-Milwaukee was one of the pioneering urban institutions of its kind in the nation. We of the School of Fine Arts felt we had a mission, a major commitment to our city. We therefore began to offer both cooperation and initiative to the urban sector, wherever requested or needed. Major projects developed by us,[4] always in consultation and participation with citizen groups, were:

The People's Theatre

Formed in 1968 by G. L. Wallace, who had been appointed Inner City Arts Consultant to the Dean, this was the city's first black repertory group. Despite very limited resources, the company quickly won the respect of the community and has enjoyed critical and public approval.

The University Ballet

This, the city's first continuing ballet ensemble, was organized in 1966 with the participation of faculty and students in the Departments of

Dance, Music, and Theatre Arts. The latter two departments contributed their resources for staging, design, and a good orchestra.

The Milwaukee Ballet Company

In the fall of 1969 we were asked if the School would co-sponsor an attempt to found a repertory ballet for Milwaukee. A few months later, in response to invitations sent out by the School, a group of about 50 ballet enthusiasts met on campus to organize support for such a group. The School provided rehearsal and performance space for a number of years; the organization also got advice and participation from the faculty and students of the Dance Department.

Symphony-on-Campus

For many years the Milwaukee Symphony was invited annually to be "in residence" for a week on campus. Daily rehearsals in the Fine Arts Theatre were open to students and public; many thereby had their first opportunity to attend a symphony rehearsal. The orchestra included faculty composers' works in either "reading sessions" or in concert; and the visit would culminate in a free evening program.

The Community Theatre Institute

The Theatre Arts Department, hoping for a closer relationship with many community theatres in the area, inaugurated an informal community theatre organization which later evolved into what is now a similar state group.

The Preparatory Arts Division

With the realization that in the arts, especially in dance, training must begin before college age, University Extension Arts, in cooperation with the School of Fine Arts, began offering pre-college and children's classes in dance, theatre, and visual arts. This program has continued to enroll hundreds of students annually.

Downtown Concerts

Co-sponsored with the First Wisconsin National Bank, the Fine Arts Quartet, Woodwind Arts Quintet, and other artist/faculty from the Music Department gave a series of concerts in Vogel Hall (Performing Arts Center) every spring.

Art Exhibitions

The Department of Art, which got its first full-time gallery director in 1963, mounted literally hundreds of exhibitions in the years 1963-74. National invitational exhibitions included Paintings, and Sculpture, '64; the "10/10" Invitational Photography Exhibition; National Crafts

Exhibition; National Print Exhibition; and "Mice that Roar," National Political Cartoon Exhibition. Also, the department's own faculty and student exhibitions have made the Fine Arts Galleries a continuous showcase of significant and exciting traditional and contemporary art every month of the year.

Inner City Film Workshop

This workshop provided a range of activities and experiences for economically disadvantaged inner-city youth through the medium of photography. The age range was from 10-18. The younger people worked with art and animated films, and the older youth dealt with live-action films and still photography.

The above programs, mentioned to illustrate the School's outreach in the urban community, constituted only some of the projects developed by the departments.

In theatre, at least five classical and contemporary plays received major productions annually; the small studio theatre was used for student and experimental plays. The University Players won national honors from the American College Theatre Festival for a production staged in Washington D. C. at Kennedy Center.

In music, in addition to the traditional band, symphony orchestra, and choral concerts, numerous faculty and student recitals and operas were presented; baroque and contemporary ensembles were developed. A "Composers' Showcase" series with works by music faculty and students was instituted.

In dance, faculty and student concerts were presented each semester; and companies of international fame—those of Jose Limon, Erick Hawkins, and others—were brought to the campus for from one to three weeks, for teaching, workshops, and performance.

By the time the School celebrated its tenth birthday (1973), it had demonstrated in many ways the advantages of combining the arts under one academic roof. The North Central Association of Colleges and Universities described it as follows:

> Perhaps this is the most impressive example of how the UWM has been able to achieve high quality by concentrating its resources. Unlike its parent campus the Milwaukee campus has been able to bring together all creative performers in the arts into one School housed in a single complex, the Fine Arts Center . . . Clearly, from all respects, this is one of the most distinguished and successful efforts of the University!

In enrollment (majors), the School was now among the first 10 of 100 or more similar schools in the nation. Some of its faculty had achieved international recognition.

The short history of the School also showed that such an academic structure could nurture a climate of creativity. New student plays were continually being produced; original faculty and student choreography was being presented. Of the 147 exhibitors in the 1971 Wisconsin Designer-Craftsmen Exhibition, 47 were faculty, students, or former students of our Art Department. They received 10 of the 22 awards of the exhibition. Three faculty composers won national recognition; their works and their students' works were performed on campus by faculty and student ensembles.

Although some problems remained, such as the prevalent (and national) disproportion in salaries between artist-faculty and other university faculty, and the need for additional classroom and performance space, solutions were gradually being found. The auditorium of Engelman Hall, although being renovated for the School of Architecture, was equipped for some stage and concert presentations. And, in the spring of 1974, planning was begun for an extensive renovation of Mitchell Hall, with large areas assigned to the School. In May of that year, the University Faculty Senate approved plans for a needed fifth department—Film Arts. And a new Master of Performing Arts degree was proposed and approved by our faculty and the University administration, for the next biennium.

In character with the history of the State of Wisconsin itself, a history distingushed by innovation and progress in both social and educational areas, the School of Fine Arts at UWM continued in its pioneering directions. It demonstrated pragmatically the advantages of an "alliance" between the arts; that, indeed, such cooperation was a logical development in a century where art forms had become more related than ever before. It also demonstrated that a school of the arts can greatly strengthen the arts in a metropolitan area. It can use its human and technical resources to reveal the value and profundity of the old, and at the same time the excitement and necessity of the new.

Finally, if any single word describes the spirit of this School, it is "interflow." From the earliest manifestation of cooperation between departments and visiting summer artists, through the subsequent formation and development of the School, there was an interflow of goodwill and mutual effort between administration and faculty, faculty and students, creators and performers. The physical proximity, the common curriculum, the innovative programs made this interflow natural, continual and rewarding for all.

NOTATIONS

1. Artists-in-residence had come to the campus as early as 1955 for the *Summer Evenings of Music* series; however, they obviously represented only one art form.

2. Subsequently, similar schools of the arts have been formed at UW-Whitewater, UW-Stevens Point, and UW-Superior of the University of Wisconsin System. 3. The Art History Department elected not to join the new School.

4. The *People's Theatre, Preparatory Arts Division*, and the *Inner City Film Workshop* were implemented with the invaluable cooperation and assistance of the University Extension Arts, which also inaugurated many workshops with the Department of Music.

NEW DEAL WORK PROJECTS AT THE MILWAUKEE PUBLIC LIBRARY

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"Give a man a dole and you save his body and destroy his spirit; give him a job and pay him an assured wage and you save both the body and the spirit."[1] This statement by Harry Hopkins reflects the philosophy of the New Deal, its creator Franklin D. Roosevelt and like-minded social thinkers such as Homer Folks. Thus, an important purpose of the many work-relief bureaus was to "substitute work for relief"[2] so as to restore feelings of self-esteem to the unemployed.

Some authorities would contend that the unprecedented intervention of the Federal government caused a revolution in the State-Federal relationships, not to mention waste and inefficiency, which is summed up in the word "boondoggling." The New Deal did effect a revolution in the nature of the government and there was undoubtedly a great deal of waste and inefficiency. But to emphasize only these negative aspects would seriously distort the picture. In seeking to save the capitalistic system from collapse, the New Deal made unstinted efforts to salvage human resources.

Many people today are familiar with the New Deal's accomplishments through an awareness of its physical outcroppings—the dams, airports and parks that dot America's landscape. But the New Deal also played a sizeable role in fostering cultural and scholarly programs which became known as "white collar" jobs because they provided work to such unemployed professionals as musicians, artists, and clerks. This article will discuss the origins, nature and results of the "white collar" enterprises of the Civilian Works Authority (C.W.A.), the Federal Emergency Relief Administration (F.E.R.A.) and the Works Projects Administration (W.P.A.) which were administered through the Milwaukee Public Library.

From 1933 until 1942, the Milwaukee Public Library and the New Deal were closely linked. Many New Deal programs were of marginal significance, making no lasting impact on the Library and contributing nothing of consequence to the cultural heritage of the community. Among these was the National Industrial Recovery Act or the N.R.A., as its administration came to be called. The

N.R.A. was an attempt at industrial self-regulation coupled with a Federal works program. But as it affected the Library, N.R.A. activity was confined to the regulation of hours in the bindery and adherence to certain purchasing policies and guidelines.[3] By themselves these agreements were unimportant. Yet, in another respect, they signalled a readiness on the part of the Library to enter cooperative undertakings with the Federal government.

Of greater consequence were the varied programs of the C.W.A. and the F.E.R.A. They ranged from the mundane though necessary repair and painting of branch and main libraries to artistic and bibliographic projects such as the reorganization of the card catalog and the restoration of books. These latter projects involved the recopying of 287,500 cards and their redistribution throughout the catalog, and the repair of 17,840 books. These C.W.A. undertakings gave employment to forty-eight persons including six librarians and forty-two clerk typists.[4] Unfortunately, the task was never completed, possibly due to a shortage of funds but more likely because the expenditure of money on library programs *per se* was not yet encouraged.[5] "Blue collar" maintenance work received higher priority. Nonetheless, the work that was completed was considered an important contribution.[6] Moreover, the catalog reorganization was significant in that it represented a departure from the typical roof repair projects which had characterized so many C.W.A. library activities.[7] A valuable precedent was thus created for the more expansive white collar programs of the F.E.R.A. and later the W.P.A.

One such white collar undertaking was an F.E.R.A. music project. The plan entailed the copying and duplication of "good music" in manuscript form. (Fig. 1). In all, 755 selections were completed on master sheets and 67,256 sheets were dittoed.[8] Selection was made on the basis of demand and also on the advice of recognized musicians in the city, among them Herman Smith, supervisor of music in the Milwaukee Public Schools, and Milton Rusch of the Milwaukee State Teachers College.[9] In addition to employing twenty to thirty jobless musicians, the plan enabled the Library's Art and Music Room to meet a borrower demand beyond the capacity of normal library appropriations.[10] The project resulted in what was described as a "splendid collection" that was made available to the general public and also to small churches for use on Palm Sunday and Easter Sunday. It was thought that if the work were continued, it would, in the words of library director Mathew S. Dudgeon, "eventuate in the Milwaukee Library having

FIGURE 1. Music copying under W.E.R.A. Project 40-F5-460.

the finest collection of good music in any library in the country."[11] While a "strict constructionist" might ponder the constitutionality of these displays of government "aid" to religious bodies, none could question the pragmatism of the undertaking. It helped the Library to meet a public need; it put unemployed musicians back to work; and it was the first successful attempt at employing the white collar worker within the Library.

Many C.W.A. and F.E.R.A. projects were haphazardly planned, inadequately funded, or faced with bureaucratic impediments. This was particularly true of the C.W.A. and applied not only to the reorganization of the card catalog, and to book repairs but to "blue collar" programs as well.[12] The Library also attempted to use F.E.R.A. funds to finish repair jobs which had not been completed by the C.W.A.[13] One can surmise that the C.W.A., in providing relief, had embarked upon a murky area in Federal-local relationships, undefined and unprecedented. Consequently, programs such as the catalog reorganization were eliminated because of uncertainties as to whether Federal funds could be used solely for library-related work. Moreover, the C.W.A. was a short term effort of only five months. The above limitations were not peculiar to the Milwaukee Public Library but were characteristic of most C.W.A. and F.E.R.A. programs throughout the country. Hiring restrictions, for example, limited library work almost exclusively to "blue collar" projects.[14]

On the other hand, both the C.W.A. and the F.E.R.A. allowed the Library to satisfy patron demands which would have been impossible with the Library's restricted financial resources. It is interesting to note that such library projects did not constitute "made work", as even the maintenance jobs were long overdue, or, like the catalog reorganization, had been planned years in advance. They did not constitute "boondoggling" as that word is generally understood.

The W.P.A., the third New Deal bureaucracy to operate within the Library, was the most successful in terms of duration, lasting contributions and sheer variety of programs. Undoubtedly much of the W.P.A. success in the Milwaukee Public Library can be attributed to the fact that both local and Federal officials learned a great deal from their past mistakes.[15] There was not the same pell-mell rush to put people to work as was typical of other works programs. Rather, the W.P.A. possessed what one writer has called a "unity of purpose" and a "continuity of operation"[16] which lent a characteristic stability to all of its undertakings.

Initially, W.P.A. programs were characterized by the stock-in-trade manual labor projects. But they were important. Consider, for example, the repair of books. During 1935-1936 alone 422,841 books were renovated[17] and tens of thousands more in the years following. (Fig. 2). In fact, the enormity of the book binding project was such that Dudgeon noted that he knew of no bindery prepared to do that amount of work.[18] In any case, the limited city budget which had already reduced Library expenditures by twenty-five per cent simply would not allow for sending books out for repair.[19] The binding project takes on an added significance, when it is considered that thousands of volumes were in "desperately bad condition" and some collections near collapse.[20] To prevent deterioration, W.P.A. workers shellacked and varnished the covers of all new books and reinforced their bindings, thereby doubling the books' durability. Similar procedures were applied to older books. Without this conservation policy, the library might have experienced a net loss of over 100,000 volumes.[21] Richard Krug, who succeeded Dudgeon in 1941, fully appreciated the W.P.A.'s contribution when he wrote to a W.P.A. supervisor, "I cannot emphasize too strongly the importance of the W.P.A. menders and

FIGURE 2. Book mending under Project 7787.

book repairers to the library," further noting that the the institution could not have assumed such a burden by itself.[22] The total Federal contribution to the project came to $877,475, which was really a small price considering what was gained.[23]

As the W.P.A. gained momentum, it branched out into areas which suggested imagination and special concern for the needs of artists, businessmen, and scholars. White collar work became dominant and questions of whether money could be used for library work *per se* were no longer raised. Included were bibliographic and indexing undertakings of major proportions: the indexing of the federal censuses for 1860 and 1870, a Union List of Serials, and the *Milwaukee Sentinel* Newspaper Index.

The census indices were important for several reasons: They could be used to establish eligibility for citizenship and for pensions. They were also of historical value at the State Historical Society of Wisconsin. Undoubtedly, they aided many genealogists doing research in family history. Hitherto it had been difficult and time consuming, if not impossible, to locate the name of a forebear because names were entered in the order in which the census taker visited the homes. But the 70,000 index cards which the project created were alphabetically arranged with a citation to the volume and page where the name could be found.[24] Almost forty years after its creation, the census indices located in the Local History Room of the Milwaukee Public Library remain an important research tool, both for the amateur genealogist and especially for the Milwaukee County Genealogical Society.

Unquestionably the most significant W.P.A. venture in the Milwaukee Public Library was the *Milwaukee Sentinel* Newspaper Index, jointly sponsored by the Library, the Milwaukee State Teachers College, and the Milwaukee County Board of Supervisors. It was hoped that the Index would "supply an unbroken chain of information from the earliest days to the present day."[25] *The Milwaukee Sentinel* was chosen both because it was the earliest newspaper in circulation and because it provided the best continuity and had the largest number of issues available.

Newspaper indexing was a common W.P.A. library project throughout the United States. The Cleveland Public Library had its *Annals of Cleveland.* But the *Sentinel* Index was unique in that all information about a person or subject appeared under one entry and thus saved the researcher the bother of having to consult a number of volumes, as in the *Annals.* Like the *Annals,* the *Sentinel* Index was never completed. Only the years 1837-1879 were finished. The library was left holding over 750,000 cards, 70,000 feet of microfilm, and several thousand unfinished entries.[26] Although incomplete, the Index stands at the pinnacle of W.P.A. achievements. It remains today as a major aid for the historian, the student and the genealogist doing research on Milwaukee and Wisconsin.[27]

The Union List of Periodicals was the last link in the triad of bibliographic projects. The plan was a cooperative undertaking of the Municipal Reference Library in City Hall, the Milwaukee Public Library, and the Milwaukee chapter of the Special Libraries Association. The Reference Room of the Milwaukee Public Library played an important role in assembling and coordinating the list. The purpose of the Union List was to increase bibliographic access to expensive business magazines, proceedings, and other periodicals which were owned by several business libraries in the city and by the Milwaukee Public Library. This could be done by compiling a list of libraries that held certain titles. It was felt that the List would have the dual advantage of pooling resources but allow the libraries to retain their own identities. The outcome of the project, a 250 page book which gave the libraries access to 5,000 reference sources, was indeed a marked improvement from the previous average of 44 magazines in each library.[28] Aside from its obvious value of broadening the base of what were frequently very specialized publications, the Union List demonstrated the innovative ways in which the W.P.A. and its co-sponsors were able to respond to the needs of Milwaukee's businesses and industrial economy.

A second major division of white collar work consisted of a variety of art and music programs, from the preparation of music scores to live performances. The library's role rested upon its willingness to be sole sponsor as well as to cooperate with other agencies. For example, W.P.A. bands gave live performances at the Library.[29] The significance of these concerts should not be overlooked as they undoubtedly served to relieve some mental anxieties, furthered social contacts and perhaps helped people temporarily to forget their economic plights.

Copying of music was another program carried out by the Federal Music Project. The plan was essentially a continuation of the W.E.R.A. project noted earlier but far more extensive in that it attempted to raise the cultural level of the community. For example, it provided for the teaching of music to under-privileged groups and for lectures, forums and panel discussions on "music as an art and as a social agency".[30] The copying itself was a success both locally and nationally. Worked out by the Library's capable director, M. S. Dudgeon, it employed up to sixty eight musicians who copied scores on which the copyrights had expired. Some of the scores were rare and old compositions lent to the library by local musicians who had extensive musical libraries.[31] Exact figures as to how many pieces were copied, vary and were admittedly difficult to tabulate. But one report noted that from 322 selections there were made 5,999 masters and 42,386 dittos.[32] The scores were kept in the library and lent to the public on the same basis as library books. From 1939-1941, over 2900 selections were circulated.[33] That the music attained the highest standards of excellence is evidenced by the fact that Bach's Chorales were used by the Music Educators National Conference and the State Teachers Convention.[34] Moreover, the project attracted attention from other parts of the Midwest. Librarians came from Ohio, Michigan and Indiana to observe what was being done in the Library.[35]

The music copying project was important because of the quality of the work, the people it employed, and the cultural heritage it created for the Library. Almost thirty years after its completion, Richard Krug could still affirm that the W.P.A. orchestration copying project was "a valuable part of the library's music collection."[36]

Library exhibits on practical how-to-do-it skills such as etchings, woodcuts, lithography, and air brush art were yet other facets of W.P.A. "art" work.[37] These exhibits were important because they furnished employment and because they indicated a reluctance to give narrow interpretations to the idea of art. Once again, the pragmatic and innovative character of the New Deal carried the day.

W.P.A., like many New Deal recovery and reform agencies, fell victim to World War II. Yet it is interesting to note the degree to which the onset of war shaped the character of some later W.P.A. programs. As war clouds hovered over Europe, America's munition plants began to tool up as the "arsenal of democracy." F.D.R.'s image as "Dr. New Deal" was replaced with "Dr. Win-the-War." Similarly, the W.P.A. played important roles in national defense both in the construction of war material and in serving as an information source, once America entered the conflict. Playing a part in the latter capacity was the War Information Center of the Milwaukee Public Library.

The War Information Center was established by the Library in conjunction with the W.P.A. to deal with a variety of war-related questions which "cut across the normal divisions of library work."[38] Its functions were threefold: to supply information about the war's progress on both home and fighting fronts; to keep records of Milwaukee's part in the war effort; and to cooperate with the Victory Book Campaign.[39]

These activities were influenced by the trends of the war. In the initial stages of the conflict, the thrust of the Center was toward civilian defense. Thus, it maintained lists of air raid wardens in Milwaukee County, indexed a twelve volume set of Milwaukeeans who had served in World War I, clipped newspapers for information related to the city's war efforts, and maintained index cards on Milwaukee County men and women in the service.[40] As more and more Americans faced the prospects of induction, as the public wanted to know about areas in which their countrymen were fighting, or the names of important allied and axis military personnel, the center's work gravitated toward the military aspects.[41]

When one views the multitude of tasks to which the War Information Center addressed itself, it is easy to understand the disappointment that followed the closing of the Center, a victim of the W.P.A.'s dissolution in 1942. The quality of its contributions is the more surprising in that it was staffed by fourteen people with little or no library experience.[42] So successful was the Center that it received national recognition from the National War Office of Civilian Defense and the American Library Association for its community activities.[43] The Board of Trustees made a concerted effort to save the Center by operating it under Library auspices because of its informational services and because it was the only department in the county that kept a systematic record of Milwaukee's role in the war.[44] But these efforts came to nothing. Support within the Board of Estimates was lukewarm at best.[45]

With the closing of the Center, the work of the New Deal in the Library came to an end. Its overall accomplishments were important both then and now. Its services permitted the Library to fulfill some normal obligations to the public which had been curtailed by depression budgets, and some of the projects, notably the *Sentinel* Index, went far beyond the normal expectations of library service. Some of the W.P.A. work survives to this day. The Local History Room has thousands of war related photographs left from the War Information Center; the census indices are a continuing boon to genealogical workers; and one could scarcely imagine not using the *Sentinel* Index for research on Milwaukee and State history prior to 1879.

Surprisingly, all of these achievements were carried out with an absence of serious friction. There were no fights over "turf," as it were, between W.P.A. and library personnel. Rather the relationship was one of "unusual cooperation."[46] Perhaps this harmony can be attributed to the leadership provided by the city librarians, Matthew Dudgeon and Richard Krug. Both men had excellent administrative backgrounds which created a "can-do" atmosphere.[47] Interestingly enough, both had law degrees and no formal training in librarianship. One should also consider that the caliber of W.P.A. workers assigned to library projects was uniformly high. The depression had created a desperate employment situation which encouraged in many a desire for work and productivity. This positive outlook toward the W.P.A. projects was shared by Milwaukeeans in general. As one former W.P.A. supervisor has commented, "people wanted to work."[48]

It is also worth noting that library participation in the New Deal was comprehensive in scope and not limited to one small or traditional aspect of library operations. This is best illustrated by pointing to some of the projects which never materialized. Among them were plans for a separate Sports Room; a Collection of Foreign Language Publications which would have operated like a union list;

and especially, a Circulation Survey Project which would have attempted to determine precisely how many people used the library and when.[49] No evidence remains as to why these plans were never carried out. Yet they strongly indicate that everything within the library from circulation to technical operations was thoroughly appraised so as to improve services to all clients.

The increasing contributions of the C.W.A., F.E.R.A. and the W.P.A. to the Library take on a final significance, when one compares Federal expenditures for white collar projects in the Library with those in other city institutions. In 1935, the Library ranked eighth out of seventeen agencies, receiving but 0.35% of Federal appropriations. By 1942, it ranked second out of eleven, receiving 6.31%.[50] This sharp increase reflects the diversification and expansion of white collar work and usefulness which allowed the W.P.A. to prosper even after the war had started. By way of comparison, the W.P.A. in the Cleveland Public Library was moribund by 1940.

One could conclude by saying that the white collar thrust of the New Deal was momentous because of its utility, the quality of its work, or because of its legacies to the community. But Harry Hopkins captured the true flavor and humanity of its intent in his frequently quoted statement that the unemployed white collar workers got hungry, and they too had to eat.[51]

NOTATIONS

[1]Quoted in William W. Breme, "Along the American Way": The New Deal's Work Relief Programs for the Unemployed, Jour. Amer. Hist. 62, 637, 1975.

[2]William Leuchtenberg, *Franklin D. Roosevelt and the New Deal* New York, p. 124, 1963.

[3]M. S. Dudgeon, Secretary of the Board of Trustees and library director to Joseph W. Nicholson, City of Milwaukee purchasing agent, Sept. 16, 1933; "Minutes of the Board of Trustees," Dec. 12, 1933; "Memo for Consideration of the Board," Oct. 10, 1935; Frank T. Boesel, Milwaukee N.R.A. Compliance Board, to M.S. Dudgeon, April 3, 1934. All citations in *Proceedings of the Board of Trustees.* Hereafter cited as *Proceedings.*

[4]"Memo for Consideration of the Board," Dec. 12, 1933; Dudgeon to R.E. Stoelting, Commissioner of Public Works and city member of the Local Civil Works Board, Dec. 2, 1933, *Proceedings.* Unidentified typescript, "Final Completion Report for C.W.A. Project #151, Dec. 8, 1933.

[5]"Minutes of the Board of Trustees," Dec. 12, 1933, *Proceedings.*

[6]"Memo for Consideration of the Board," Apr. 10, 1934, *Proceedings.*

[7]Dudgeon to Stoelting, Dec. 2, 1933, *Proceedings.*

[8]Typescript, "Progress Report," W.E.R.A. Project 40-F5-460. Copying

and Reproducing Music. Hereafter cited as W.E.R.A. Project 40-F5-460.

[9]Clipping, *Milwaukee Leader*, Feb. 2, 1934, W.E.R.A. Project 40-F5-460.

[10]"Memo for Consideration of the Board," Jan. 8, 1935, *Proceedings.*

[11]"Memo for Consideration of the Board," Dec. 12, 1933; "Minutes of the Board of Trustees," May 14, 1935; "Memo for Consideration of the Board," Mar. 12, 1935. *Proceedings;* clipping, *Milwaukee Leader*, Feb. 2, 1934; W.E.R.A. Project 40-F5-460. The music project operated under the aegis of the Wisconsin Emergency Relief Administration (W.E.R.A.), which distributed federal funds. See William P. Raney, *Wisconsin, A Story of Progress*, New York, p. 495-497, 1940.

[12]Both of these projects were revised under the F.E.R.A. See typescript, "Cataloging, Filing, Book Rehabilitation," July 17, 1935. Project 40-F7-150. Records and Catalog.

[13]"Memo for Consideration of the Board," May 8, 1934, *Proceedings.*

[14]See Edward Barrett Stanford, *Library Extension under the W.P.A., An Appraisal of an Experiment in Federal Aid*, University of Chicago Press, 1944 p. 24, 31.

[15]Interview: Harry Janicki, former supervisor of W.P.A. projects, June 23, 1976, Brown Deer, Wisconsin.

[16]Stanford, op. cit., p. 2.

[17]"Summary of Situation," Mar. 8, 1937, *Proceedings.*

[18]Dudgeon to C.J. McGrane, Project Engineer, Jan. 26, 1939. Project 447. Rehabilitation of Books.

[19]Roy Charmock, District Director to Don Teter, W.P.A. Supervisor, Sept. 23, 1935, *Ibid;* typescript, "Supplementary Information and Operating Schedule Sponsor No. 229" Project 7787. Book Binding and Repair.

[20]"Summary of Situation," Mar. 8, 1937. *Proceedings.*

[21]*Ibid.*

[22]Krug to Harriet Clinton, W.P.A. Supervisor, July 14, 1941, W.P.A. Mending Project.

[23]"W.P.A. Mending Project Copy" W.P. A. Mending Project. The project was not limited to book repair but also included the preparation of bibliographies, the cataloging of unclassified library materials and several other tasks. See Project 7787. Book Binding and Repair.

[24]"A brief summary of library activities for 1937," Mar. 8, 1938, *Proceedings.*

[25]*Ibid; Milwaukee Newspaper Index Project* (Manual) September, 1941.

[26]Daniel F. Ring, "The Cleveland Public Library and the W.P.A.: A Study in Creative Partnership," Ohio Hist. 84: (Summer, 1975) 160; *Minutes of the Board of Estimates*, Oct. 29, 1942, p. 420-421; "Minutes of the Board of Trustees," Oct. 13, 1942, *Proceedings; Milwaukee Newspaper Index Project.*

[27]Clipping, *Milwaukee Sentinel*, Dec. 18, 1963, Milwaukee Sentinel Index File. In 1969 Dr. Herbert Rice began the awesome task of "editing, combining, alphabetizing, and interalphabetizing" the items for the years 1880-1890. For further information see his "The Milwaukee Sentinel Index," *Milwaukee Reader and Calendar of Local Events*, 30, Apr. 24, 1972.

[28]*Union List of Periodicals* (Manual) preface, Mar. 20, 1939.

[29]William V. Arvold, State Supervisor, W.P.A. Music Project, To Krug, Apr. 23, 1941, W.P.A. Music Copying Project.

[30]Teter to Dudgeon, Oct. 9, 1939. Project 10032. Music State Wide.

[31]*Milwaukee Journal*, Aug. 25, 1935; Dudgeon to Teter, Nov. 13, 1938. W.P.A. Music Copying Project.

[32]"Final Report W.P.A. Program — City of Milwaukee," Oct. 1, 1942. Project 2211. Copying and reproducing music scores to be kept in Public Library.

[33]"Art Department," *Department Reports*, 1941.

[34]"Art and Music Department," *Progress Reports*, 1942.

[35]*Milwaukee Journal*, Aug. 25, 1935.

[36]Clipping, *Milwaukee Journal*, Feb. 11, 1975. Milwaukee Public Library Clipping Collection. *The Catalog of Musical Selections in Milwaukee Public Library Reproduced under the Federal Music Project*, (1937) is itself a superb guide and well worth looking at.

[37]"Art and Music Department," *Progress Reports*, 1942.

[38]"Memo for Consideration of the Board," Dec. 8, 1942, *Proceedings;* A.L. Wapp, Superintendent, W.P.A. to Krug, Aug. 5, 1941. War Information Center.

[39]"Memo for Consideration of the Board," Dec. 8, 1942. *Proceedings;* "Sponsors Request for Project Authorization and Sponsors Agreement," War Information Center; "Memo for Consideration of the Board," Jan. 13, 1942, *Proceedings.* The Victory Book Campaign was an effort on the part of the Red Cross, the U.S.O. and the American Library Association to acquire books for servicemen.

[40]"War Information Center," *Progress Reports*, 1942.

[41]Unidentified newspaper clipping, May 25, 1942, Milwaukee Public Library Clipping Collection.

[42]"War Information Center," *Progress Reports*, 1942.

[43]Krug to Wapp, Apr. 13, 1942. Project 1005. Library-State-Wide.

[44]Unidentified newspaper clipping, Dec. 9, 1942, Milwaukee Public Library Clipping Collection; "Memo for Consideration of the Board," Dec. 8, 1942, *Proceedings.*

[45]*Minutes of the Board of Estimates*, Dec. 9, 1942.

[46]Dr. Herbert Rice, former supervisor of *Sentinel* Index, communication to author, May 30, 1976.

[47]Interview, Harry Janicki, June 23, 1976; Interview, Kenneth Haagensen, former Project Director, Milwaukee, Wisconsin, June 25, 1976; telephone interview, Harry Friedman, former projects technical advisor for *Sentinel* Index, June 11, 1976. Dudgeon had served in various capacities as a lawyer, legislator and district attorney before becoming director in 1920. Krug had been Municipal Reference Librarian 1930-1939 and assistant city librarian from 1939-1941.

[48]Interview, Harry Janicki, June 23, 1976.

[49]See folders "W.P.A. Sports Room," "W.P.A. Circulation Survey Project" and "W.P.A. Miscellaneous" in Local History Room, Milwaukee Public Library.

[50]City *of Milwaukee W.P.A. Work Accomplished and Money Expended, 1935-36, 1942-43.* In 1935, white collar work in the city bureaus ranked in the following order: School Board, Public Museum, City Comptroller,

Health Department, Tax Assessor, Fire Department, Vocational School, Public Library, City Treasurer, Building Inspector, Real Estate Division, Harbor Commission, Land Commission, City Clerk, Municipal Reference Library, City Attorney, Layton Art Gallery. In 1942, the order was Land Commission, Public Library, Civilian Defense, Health Department, Public Museum, School Board, City Comptroller, Municipal Reference Library, Building Inspector, City Treasurer, Tax Enforcement.

[51]Cited in Frank Freidel, American Historians: a Bicentennial Appraisal, Jour. Amer. Hist. 63 (June, 1976), p. 7.

LANDFORM DISTRIBUTION AND GENESIS IN THE LANGLADE AND GREEN BAY GLACIAL LOBES, NORTH-CENTRAL WISCONSIN

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ABSTRACT

Landforms in the Langlade Lobe have a distribution characteristic of many glacial lobes in the midwest. In the nothern part of the Green Bay Lobe, landform distribution is more complex, with several recessional moraines and extensive areas blanketed with outwash and ice-contact stratified drift. Three landform zones are recognized: 1) an end moraine zone made up of five ridge types based on orientation, lithology, and form; 2) an intermediate zone of ground moraine, eskers, and kames (not present in the Green Bay Lobe); and 3) a zone of erosional drumlins.

The Langlade Lobe advanced twice from the highlands of the Upper Peninsula of Michigan obliquely down the regional bedrock slope. The Green Bay Lobe repeatedly advanced up the regional bedrock slope out of the Green Bay lowland. The differences in landform distribution and development between the two lobes is due primarily to contrasting bedrock slopes of the glacier bed and secondarily to the pattern of advances and retreats of each lobe.

INTRODUCTION

Numerous authors have noted a similarity in the distribution of glacial landforms in areas formerly covered by the lobes of continental ice sheets (Flint, 1971). The fact that this classic distribution is so common despite differences in the scale, thermal regime, and bed lithology of the glaciers involved suggests that the distribution of landforms in glacial landscapes is determined primarily by 1) the glaciological conditions which prevailed at or near the maximum of a glacial advance, and 2) the location of the landforms with respect to the center of the ice sheet or lobe (Sugden and John, 1976). However, not all glacial landscapes exhibit this classic distribution due to a number of other locally important factors (Clayton and Moran, 1974). We will discuss the importance of two of these factors — regional bedrock slope and glacial history — in determining landform distribution in the Langlade and Green Bay glacial lobes in north-central Wisconsin.

Because only one major recessional moraine exists, and in most areas is adjacent to the terminal moraine, the landforms of the Langlade Lobe conform to the classic distribution of landforms within a lobe. The landform distribution in the northern part of the Green Bay Lobe is more complex, with several recessional moraines and extensive areas blanketed with outwash and ice-contact stratified drift. We will discuss the landforms of both lobes in terms of zones similar to those proposed by Clayton and Moran (1974), Sugden and John (1976), and earlier workers, in which sets of landforms exist in an orderly fashion. We feel that the degree of development of these zones can be explained primarily by the differences in the pre-Woodfordian topography of the areas over which these lobes advanced. As Thwaites (1943) noted, the ice from the Green Bay Lobe advanced up the regional slope out of the Green Bay Lowland. The ice of the Langlade Lobe, after crossing the highlands of the Upper Peninsula of Michigan, advanced obliquely down the regional slope. Other factors, such as differences in the length of time the ice was in an equilibrium position, the thermal regime of the base, or bed lithology, which might have influenced landform distribution and development are difficult to distinguish from the overriding influence of topography.

We have previously discussed the till lithologies and glacial chronology in north-central Wisconsin in detail in Mickelson, Nelson, and Stewart (1974) and Nelson (1973). During Woodfordian (late Wisconsin) time, ice advanced into north-central Wisconsin from the southeast (Green Bay Lobe), the northeast (Langlade Lobe), and the north and northwest (Wisconsin Valley Lobe) (Fig. 1). Prominent terminal moraines were built by each lobe and the existence of these moraines has been recognized since the work of Chamberlin (1883.). The lobes were named by Weidman (1907) who assumed the ice advances in each lobe were simultaneous. Subsequent reconnaissance mapping by Thwaites (1943), who named all of the moraines mentioned in this study except the Harrison Moraine, outlined the basic distribution of drift in the Langlade and Green Bay Lobes. Thwaites argued that the deposition of the terminal moraines in the three lobes was contemporaneous and that ice masses of the Langlade Lobe and Green Bay Lobe were in contact with each other during retreat. From our recent work we can demonstrate that these moraines are

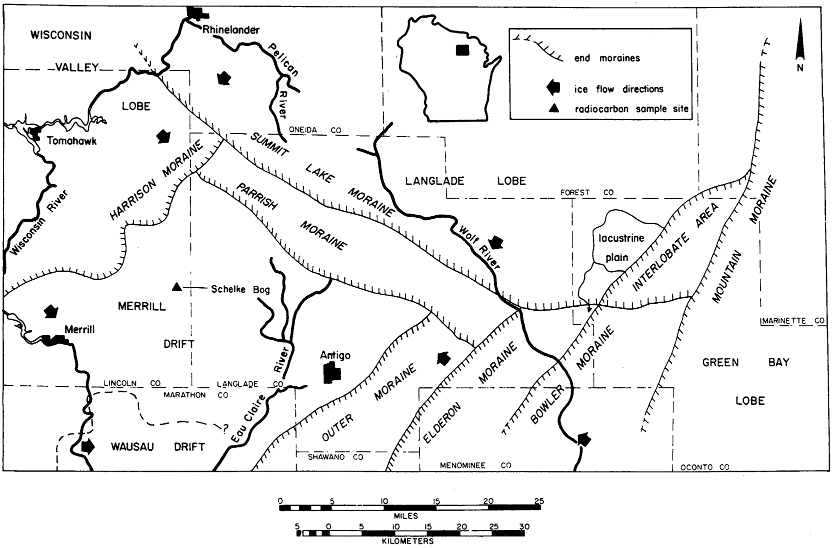

FIGURE 1. Location map of north-central Wisconsin showing ice flow directions, major moraines, drift boundaries, and other physiographic features. The Merrill and Wausau Drifts and Schelke Bog Site which pre-date the late Wisconsin moraines are discussed in Stewart & Mickelson (1976).

not really time equivalents, although all of the events described took place during Woodfordian time (about 12,500-20,000 years ago).

THE LANDFORM ZONES

End Moraine Zone

Our end moraine zone is much like the wastage zone of Sugden and John (1976) and the marginal suite of Clayton and Moran (1974), consisting mainly of till ridges oriented parallel to the former ice margin with some ice disintegration features along the inner edge of the zone.

Four genetically different lithologies make up the sediments of the end moraine zone — lodgement till, ablation till, ice-contact stratified drift, and outwash. Differences between ice-contact stratified drift and outwash are due chiefly to deposition behind and in front of the ice margin respectively (Price, 1973). Although more detailed till classifications have been proposed (Boulton, 1968; 1970) we prefer the two-fold lodgement-ablation classification used by Flint (1971) and Dreimanis and Vagners (1971) because of difficulty in distinguishing till deposited by meltout and flow processes particularly in coarse-grained tills.

Lodgement tills in north-central Wisconsin can be distinguished from ablation tills on the basis of stratigraphic position, thickness, color, grain size variability, and pebble fabric orientation (Nelson, 1973). Lodgement till in the end moraine zone of the Langlade Lobe is typically 1-7m thick with red-brown (2.5YR4/6 to 5YR4/4) colors, massive to platy structure, approximately 6% clay, and strong pebble fabrics perpendicular to the larger end moraines. The overlying ablation till is light brown (7.5YR6/3) in color, massive to semistratified and very friable, and has no preferred pebble orientation, at least from outcrop to outcrop. Grain size distribution in the latter averages 73% sand, 26% silt, and 1% clay, but is highly variable, as is the thickness (0-4m).

In the Langlade Lobe the end moraine extends from the distal edge of the Parrish Moraine to the proximal edge of the Summit Lake Moraine, and averages 12 km in width (Fig. 2). Due to the

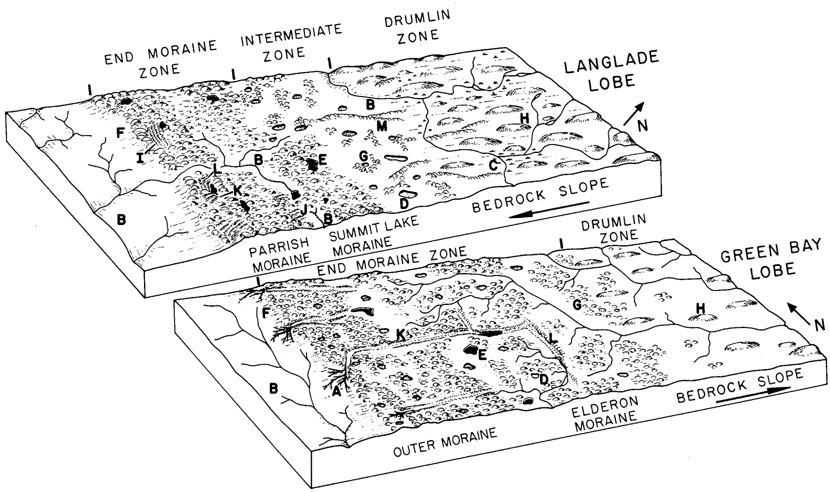

FIGURE 2. Physiographic diagrams of general landform distribution in the Langlade and Green Bay Lobes. The diagrams are not to scale, but are diagrammatic illustration of the landform zones and features (referenced by capital letters) found in each lobe.

A. Outwash fan
B. Outwash plain
C. Marsh Deposit
D. Kettle-hole (dry)
E. Kettle-hole lake
F. Outwash apron on moraine front
G. Kames
H. Drumlin
I. Ridges of till parallel to ice front (Type 1)
J. Ridges of till perpendicular to ice front (Type 2)
K. Ridges of sand and gravel perpendicular to ice front (Type 3)
L. Ridges of sand and gravel parallel to ice front (Type 4)
M. Esker

many recessional moraines and extensive outwash deposits, the end moraine zone of the Green Bay Lobe is wider (16 km), extending from the distal edge of the Outer Moraine to the drumlin zone, with no distinguishable intermediate zone of low ground moraine composed of till and ice-contact stratified drift, as in the Langlade Lobe.

The complex and widely distributed ridges which make up most features in the end moraine zones of each lobe can be divided into five types (Fig. 2): ridges composed dominantly of lodgement till and oriented parallel to the ice margin (Type 1), those made up of lodgement till and oriented perpendicular to the ice margin (Type 2), those made up of ablation till and stratified drift and oriented perpendicular to the ice margin (Type 3), those made up of ablation till and stratified drift and oriented parallel to the ice margin (Type 4), and those without particular orientation (Type 5).

Type 1 Ridges

Type 1 till ridges, oriented parallel to the former ice margin, average 1.2 km in length, 300 m in width, and 20 m in height in the Outer Moraine and are up to 1.5 km long, 400 m wide, and 30 m high in the Parrish Moraine (Fig. 3). Although they are lower and less continuous, these ridges are also present within the recessional moraines throughout the Green Bay Lobe. The higher relief in the Parrish and Summit Lake Moraines results in more exposures in these ridges, some of which contain lodgement till with pebble fabrics (Nelson, 1973) consistent with expected ice flow directions overlain by up to several meters of ablation till. The origin of these ridges, however, is uncertain. They may be due to increased deposition where till was sheared up along concentrations of shear planes near the ice margin, followed by meltout deposition of ablation till.

The smaller ridges containing lodgement till may have been formed in part by ice shove or stacking of till near the margin. Exposures are poor, however, and evidence for this is lacking. Another possibility is that most basal till deposition was taking place in a very narrow zone near the ice margin and that the ridges represent brief pauses in retreat of ice margin position or pulses in the rate of till deposition in time.

Type 2 Ridges

Although far less common than other ridge types in the Parrish and Summit Lake Moraines, Type 2 ridges, perpendicular to the ice

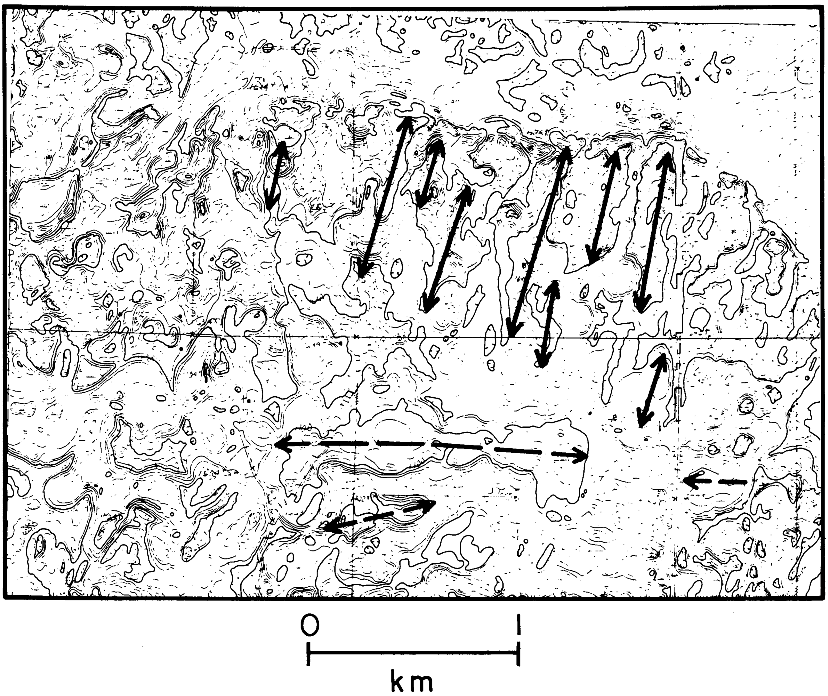

FIGURE 3. Lodgement till ridges oriented parallel to ice flow (solid arrows) and perpendicular to ice flow (dashed arrows) in the Parrish Moraine of the Langlade Lobe north of the town of Antigo (Fig. 1). North is at top of map (from USGS Elcho S. E. Quadrangle).

margin, occur in parts of the proximal side of the Parrish Moraine. Here parallel ridges of lodgement till (some with a 1 m veneer of ablation till) are about 10 m high and 100-150 m apart (Figs. 2 and 3). They begin abruptly at the proximal edge of the moraine and extend nearly to the crest. Mechanical analyses, till color, and a till fabric measurement indicate that these ridges are composed of basal till and represent large grooves on the till surface. No evidence was found for features of this type in the Green Bay Lobe, although similar ridges in this lobe could have been buried by later outwash.

Type 3 Ridges

Type 3 features are ice disintegration ridges as defined by Gravenor and Kupsch (1959). Most of those perpendicular to the former ice margin are probably ice channel fillings formed both above and beneath the ice. The largest ridges (700 m long, 200 m wide, and 10 m high) are found in the Langlade Lobe, primarily near the crest of the moraines and on their distal sides (Fig. 2). No flow direction studies have been done, but these ridges were probably deposited by water flowing toward the outer margin of the ice or by slumping of washed materials into longitudinal (splaying) crevasses.

Several much larger features found only in the Green Bay Lobe, are channels which have ice disintegration ridges 20 m high lining their sides, are up to 12 km long and 0.5 km wide and appear to be ice-contact drainageways which were meltwater outlets while the Green Bay Lobe was at the Outer Moraine (Figs. 2 and 4). The channels are the result of either subglacial drainage similar to the tunnel valleys of the Superior Lobe in Minnesota discussed by Wright (1973) or large englacial or supraglacial streams flowing

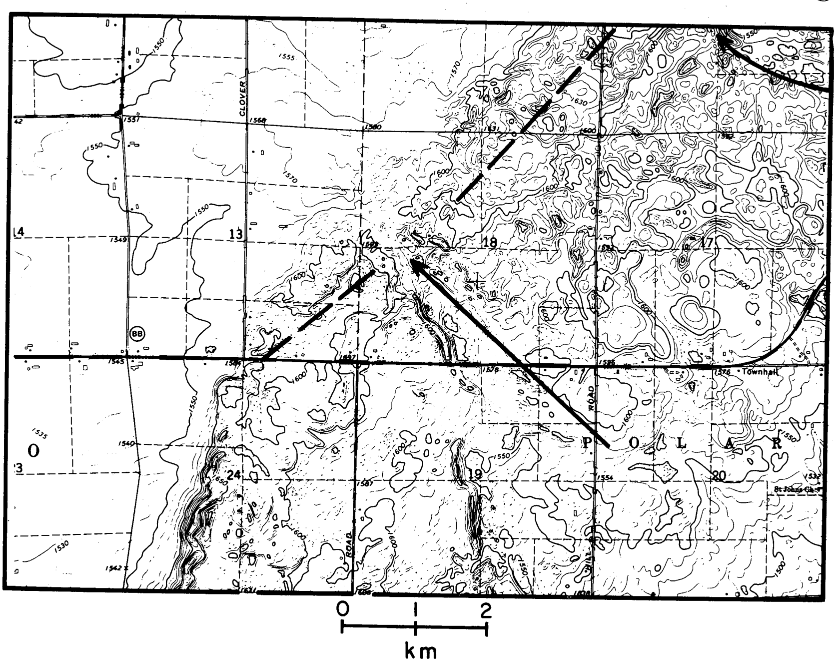

FIGURE 4. Two examples of large ice-contact drainageways (solid arrows) through the Outer Moraine (dashed line) of the Green Bay Lobe about 8 km northeast of the town of Antigo (Fig. 1). The drainageways were the primary outlets for meltwater while the ice was at the position of the Outer Moraine. North is at top of map (from USGS Antigo S. E. Quadrangle, 1976).

out of or off the ice. The hydrostatic head needed to develop channels flowing up the regional slope may have been supplied by a northwest sloping ice surface profile. Ice flowing to the northwest from the center of the lobe in Green Bay would have provided such a

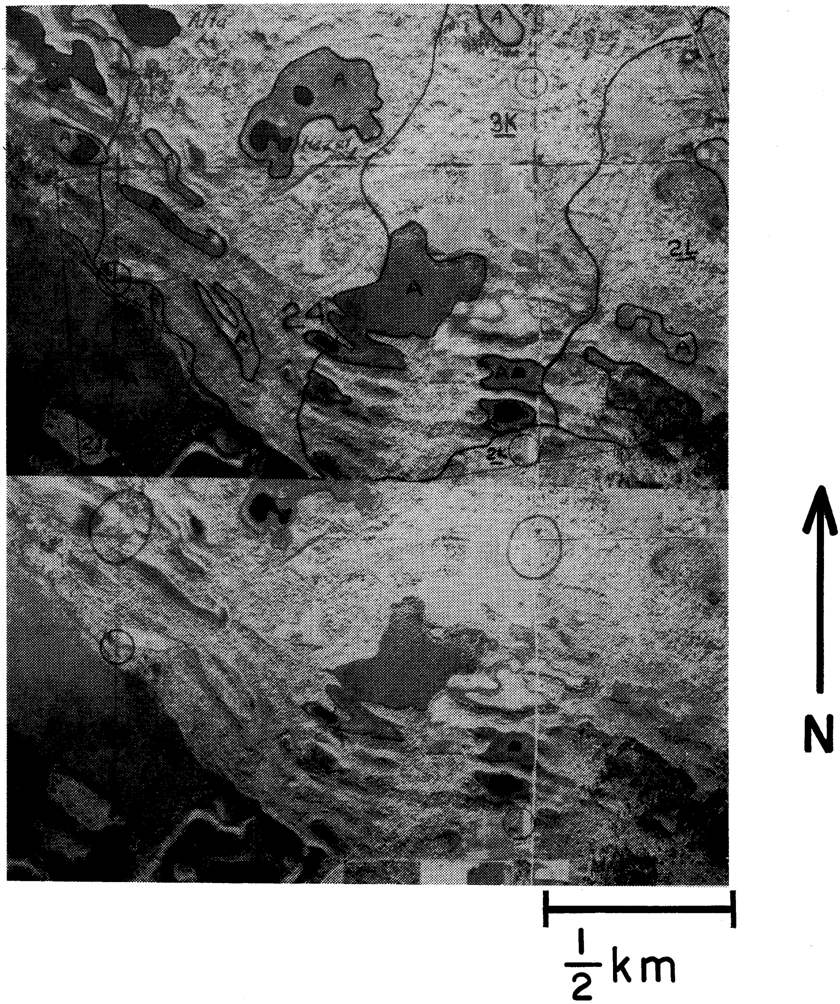

FIGURE 5. Air photo stereopair (photo no. BHW-5-44, 45, 1936) in the western part of the Parrish Moraine (NE 1/4, S24, T33N, R10E) showing parallel ridges of sand and gravel which are probably small coalescing outwash fans built synchronously along an ice margin. Symbols on the upper photo refer to an earlier soils mapping sheet.

gradient. That deposition of material was predominantly on or in ice can be seen by the collapsed nature of the deposits.

Type 4 Ridges

Ice disintegration ridges generally parallel to the ice margin occur discontinuously in the Parrish Moraine along its distal edge. South of Summit Lake the largest ridges are 4 km long and reach a height of 17 m. Five roughly parallel ridges occur *en echelon* in this part of the moraine (Figs. 2 and 5). Exposures in these features show inclined planar-bedded sand and gravel suggesting that the ridges are small coalescing outwash fans built synchronously along an ice margin.

In the Green Bay Lobe the smaller scale features of this type are not prominent, but thick, widespread sheets of outwash found in some areas of the Green Bay Lobe might have been spread over thin stagnant ice, thus hiding the evidence for disintegration ridges forming during deglaciation. In fact, the extensive pitted outwash in the Green Bay Lobe is probably analogous to these ridges in the Langlade Lobe. However, along the proximal edge of and within the Elderon Moraine (Fig. 1), large channels up to 5 km long and 0.5 km wide and oriented parallel with the moraine have been eroded in the drift (Fig. 2). Also noted by Thwaites (1943), these probably were developed along an ice margin between the higher areas of recessional moraine as the ice stagnated during retreat. No analogous channels have been identified in the Langlade Lobe.

Type 5 Deposits

The end moraine zones of both the Langlade and Green Bay Lobes also contain numerous smaller ice-contact forms (Type 5 deposits) such as ice-contact rings, kames, kettles, and moraine lake plateaus like those which have been described from other areas of ice stagnation (Parizek, 1969). The size of these features suggests that a debris layer several meters thick must have covered some areas of the ice near the terminus. Exposures in these deposits contain large blocks of slumped sediment, flow structures, blocks of till within stratified bodies of sand and gravel, and irregular thicknesses of ablation till due to topographic inversion during disintegration of the ice masses. The density and relief of these features in the Green Bay Lobe is less than in the Langlade Lobe due to partial burial by extensive, pitted outwash deposits. The moraine lakes which built the small circular plaeaus in the Parrish Moraine were of the "uncoalesced ice-walled" type proposed by Clayton and Cherry (1967) and were formed over a short period in a relatively unstable stagnant ice environment. Several small circular elevated plains found in the Outer Moraine south of Antigo may also have a moraine lake origin.

Outwash

Additional depositional contrasts are evident in the outwash areas in front of the end moraine zones of each lobe. A wedge-shaped apron of outwash was deposited along the Parrish Moraine of the Langlade Lobe, while the ice stood at the moraine. Exposures up to 15 m deep near the moraine contain coarse, bouldery outwash which gradually thins to the south. The gently rolling topography with a southerly bedrock slope enabled streams from the Langlade Lobe to spread this outwash over a wide area as far south as Antigo (Figs. 1 and 2).

The outwash in front of the Outer Moraine of the Green Bay Lobe is also quite extensive in the Antigo flats area, although the apron is not as thick and continuous near the moraine. The latest drainage from the ice carried water southward along the moraine front into the present Eau Claire River drainage south of Antigo. Drainage from the Parrish Moraine probably also contributed to the cutting of channels across the flats. The large ice-contact drainageways described under Type 3 ridges may have provided much of the outwash on the Antigo flats. Each of the drainageways deposited an outwash fan where it breaches the Outer Moraine (Figs. 2 and 4), suggesting that while the Green Bay Lobe stood at the Outer Moraine, large streams flowing from under or within the ice were depositing outwash over the Antigo plain. As the ice retreated from the moraine, the relief of the moraine and the southeast bedrock slope insured that later outwash was deposited within and between the later recessional moraines.

Intermediate Zone of Ground Moraine

The intermediate zone of ground moraine (Fig. 2), from 0 to 8 km wide, is present only in the Langlade Lobe where it consists of low, rolling ground moraine of thin till and ice-contact stratified drift with eskers up to 10 km long and numerous kames. These features were partially buried by outwash along the distal side of the

Summit Lake Moraine. Little ablation debris is present on the lodgement till in this zone. Sugden and John (1976) attribute the lack of ablation till in this zone of an ice sheet to the small amount of material carried into englacial positions because of reduced compressive flow away from the margin of the ice. Alternatively, if retreat was rapid in comparison with that of the ice margin as it stood at the terminal moraine, little ablation till would be deposited in this zone even from debris-rich ice. The advance of ice in the Green Bay Lobe to the Elderon and Bowler Moraines (Fig. 1) may have destroyed this zone if it existed during the formation of the Outer Moraine and many features may be covered with later outwash.

Zone of Drumlins

Numerous drumlins (in the sense of elongate hills) with a southwest orientation are present in the Langlade Lobe north and northeast of the intermediate and end moraine zones about 16 km behind the terminal moraine (Fig. 2). Dimensions average 600-1200 m by 100-300 m, but some drumlins are up to 2.5 km long. Although many drumlins are partially buried, heights reach 30 m above the surrounding outwash.

The internal characteristics of the majority of the Langlade Lobe drumlins were not examined, but cuts through and cores of about ten of them show outwash, flat-bedded where it can be seen, of the Green Bay Lobe. In one gravel pit in southern Forest County about 10 m of gravel is underlain by at least 18 m of sand. The gravel in the core of the drumlins is capped with 2-5 m of Langlade Lobe till. At the east edge of this pit a discontinuous line of boulders marks the till-gravel contact.

The thinness of the till, and the gravel-core character of these drumlins require that they be erosional rather than depositional. This type of drumlin has been described by many authors including Gravenor (1953), Aronow (1959), Flint (1971), Muller (1974), and Whittecar and Mickelson (1977), and that literature will not be reviewed here. From a hypothetical reconstruction of the ice surface profile of the Langlade Lobe, we suggest that these drumlins formed under wet-based ice approximately 1000 m thick (Nelson and Mickelson, 1974). Numerous reasons for the differential erosion of this type of drumlin have been suggested, but none have been demonstrated.

Only a few drumlins are found in the Green Bay Lobe in this region. They are less elongate and less symmetrical than the drumlins in the Langlade Lobe, but they begin at about the same distance behind the terminal moraine (16 km, Fig. 2). Widths are approximately 200-400 m, a few being more than 1 km long and 20 m high.

THE GLACIAL SEQUENCE AND LANDFORM DEVELOPMENT

We have shown that the Green Bay Lobe differs from lobes with a typical landform distribution such as the Langlade Lobe in having all zones dominated by extensive outwash and ice-contact stratified drift, having very large subglacial or englacial drainage channels extending through the end moraine zone, and lacking an intermediate ground moraine zone or extensive drumlin zone. From a general model of glacial advance and retreat similar to that proposed by Clayton and Moran (1974), these differences in landform development and distribution between two lobes could be attributed to the differing topography over which each lobe advanced. However, the present landform distribution is the product of several alternating advances and retreats of the ice of each lobe during Woodfordian times. The following chronology attempts to show how these differences in landform distribution developed during the sequence of glacial events in north-central Wisconsin. Because no radiocarbon dates directly associated with the moraines are available, relative ages were determined by cross-cutting moraine relationships (Mickelson, Nelson, and Stewart, 1974).

The earliest recorded advance during Woodfordian time is that of the Green Bay Lobe to the Outer Moraine. During this advance out of the Green Bay basin into north-central Wisconsin from the southeast, the ice must have overriden much of its own outwash and earlier drift deposits before reaching its terminal position. While the ice was at the Outer Moraine, lodgement and ablation till were deposited in the marginal zone forming ridge Types 1 and 2, and outwash was spread over a large area of the Antigo outwash plain by the ice-contact drainageways described under Type 3 ridges. The drumlins found 16 km southeast of the moraine were probably also developed while the ice was in this position. Stagnation within the moraine and retreat to the recessional Elderon Morainic System followed, producing small Types 3 and 5 ridges in the Outer Moraine.

Some time after the formation of the Outer Moraine and the deposition of the large outwash plain near Antigo, the Langlade Lobe advanced to its terminal position, building the Parrish Moraine. This advance also overrode older deposits and its own outwash before depositing a thick lodgement till in the marginal zone. However, unlike the Green Bay Lobe, the ice advanced down a gentle regional bedrock slope in an area of relatively shallow drift. While the ice was at the moraine, Types 1 and 2 ridges were formed extensively beneath the ice, and drift within the ice was carried to the surface in the marginal area of compressive flow. This mantle of super-glacial till then filled longitudinal crevasses and other openings in the ice, forming ridge Types 4 and 5. The drumlins in the area northeast of the terminal moraine were differentially eroded from previously deposited till and underlying Green Bay Lobe outwash at this time.

While the ice was at its terminal position an outwash apron was built along the north edge of the Antigo outwash plain and several branches of the Eau Claire River carried non-dolomitic Langlade Lobe outwash across the dolomitic outwash of the Green Bay Lobe. Although dead ice buried by debris may have been present in the Outer Moraine when the Parrish Moraine was built, the main ice mass of the Green Bay Lobe had retreated at least back to the Elderon Morainic System. Outwash flowing from this ice margin was trapped behind the Outer Moraine without reaching the Antigo plain and the channels parallel to the margin described under Type 4 ridges may have been eroded at this time.

Ice remained in the Parrish Moraine until after retreat of the Green Bay Lobe ice from the Elderon Morainic System. That the two ice lobes were joined during the building of the outer Elderon Moraine can be seen by the change in orientation of morainal features in the area of contact between the two lobes. Here, parallel Type 4 ridges of ice contact drift from both lobes are found in the moraine. From the composition (intermixed dolomite contents) and northeast orientation of the ridges, we suggest that they were built by debris brought into the ice by shear planes due to compressional flow in both lobes, and then let down as partially washed ice-contact debris.

Ice, probably debris covered, remained in the Parrish Moraine and in the interlobate part of the Elderon Moraine after the retreat of Green Bay Lobe ice. Outwash streams carried gravel with a low

(< 5%) dolomite content (suggesting a Langlade Lobe source) southeastward to the outer Bowler Moraine of the Green Bay Lobe.

After the formation of the Parrish and Elderon Moraines, both lobes retreated an unknown distance, depositing superglacial drift on locally grooved lodgement till, covering it in many places. As the ice masses separated from the margin, meltout deposits (Type 3 ridges and Type 5) were formed and Type 4 ridges developed along some areas of the retreating ice margin. Little outwash is present between the Parrish and Summit Lake Moraines, although outwash valleys carried water across the Antigo outwash plain in the Eau Claire River and into the Wolf River to the south and east. Extensive dolomitic (up to 30%) outwash, much of it pitted, was deposited behind the Elderon Moraine by the Green Bay Lobe ice as it retreated down slope, burying many features.

The ice of the Langlade Lobe readvanced to, or remained at, the Summit Lake Moraine while ice in the Green Bay Lobe retreated down slope beyond the outer Bowler Moraine. Marginal processes of till deposition in the recessional moraines resulted in the same types of landforms that were produced in the terminal moraines, but on a smaller scale.

Large amounts of outwash from the Langlade Lobe were deposited along the Wolf River, and as an outwash apron extending from at least 13 km east of Antigo to the front of the Bowler Moraine. At the reentrant between the two moraines, an area of kettled interlobate deposits formed which contained stagnant ice for some time after the retreat of both lobes from these moraines.

As the margin of the Langlade Lobe retreated from the Summit Lake Moraine into the zone of ground moraine, eskers and kames were deposited over a thin lodgement till. The ice margin then retreated over the drumlins, depositing a thin lodgement till over the shaped gravels. Outwash streams such as the Wolf and Pelican Rivers buried much of this zone with outwash. As the ice margin continued to retreat up slope, thin lodgement and ablation till were deposited on the eroded bedrock and drift surface north of the drumlins. No other recessional moraines of the Langlade Lobe were formed between the Summit Lake Moraine and the very small, discontinuous Laona Moraine (Thwaites, 1943) 40 km to the north.

As the ice of the Green Bay Lobe retreated from the Bowler Moraine, small, discontinuous recessional moraines, mainly composed of ice-contact sand and gravel, were built at least as far southeast as the Mountain Moraine. Also during this time an outwash plain was spread from the ice in the interlobate area onto Green Bay Lobe drift between the Bowler and Mountain Moraines.

After an unknown interval following the retreat of the Green Bay Lobe ice from the Bowler Moraine, ice advanced to the Mountain Moraine. There is no evidence that ice was present during this advance in areas previously covered by ice, even in the interlobate area, and the position of the Langlade Lobe margin at this time is unknown.

CONCLUSIONS

While the location and size of landform zones within a glacial lobe are probably most dependent on the scale and thermal regime of the ice lobe, the differences in landform distribution and character between the Langlade and Green Bay Lobes is due primarily to the differing slopes of the glacier bed and secondarily to the pattern of advances and retreats of each lobe. A bedrock and older drift surface sloping opposite to the direction of ice flow in the Green Bay Lobe prevented meltwater from rapidly draining away from the ice margin which allowed ice-contact features to be extensively dissected by glaciofluvial streams and partially buried by outwash. The large meltwater channels eroded in the drift of the Green Bay Lobe both perpendicular and parallel to the end moraines are also the result of large amounts of meltwater with extensive contemporaneous outwash deposition. The repetitive advance and retreat history with relatively long-lasting stagnant ice in the moraines of the Green Bay Lobe accentuated the dissection and reworking of ice-contact sediments and deposition of outwash by providing more episodes of meltwater production over a longer period of time than in the Langlade Lobe. The much better drainage of the latter with a single short-lived readvance to the Summit Lake Moraine prevented the glacial features formed during the building of the Parrish Moraine from being greatly modified by glaciofluvial processes, thus preserving the classic zonal landform distribution in the Langlade Lobe.

ACKNOWLEDGEMENTS

Funds for this research were provided in part by the Wisconsin Alumni Research Foundation administered by the Graduate School of the University of Wisconsin-Madison. We thank N. P. Lasca and D. S. Cherkauer for critically reviewing the manuscript.

REFERENCES CITED

Aronow, S. 1959. Drumlins and related streamline features in the Warwick-Tokio area, North Dakota. Amer. Jour. Sci., 257: 191-203.

Boulton, G. S. 1968. Flow tills and related deposits on some Vestspitzbergen glaciers. Jour. Glaciology, 9: 213-229.

____________ 1970. On the deposition of subglacial and melt-out tills at the margins of certain Svalbard glaciers. Jour. Glaciology, 9: 231-245.

Chamberlin, T. C. 1883. *Geology of Wisconsin.* Geol. Nat. Hist. Survey, v. 1, 300 pp.

Clayton, L., and J. A. Cherry. 1967. Pleistocene superglacial and ice-walled lakes of west-central North America, *in* Clayton and Freers, *eds., Glacial Geology of the Missouri Coteau:* North Dakota Geol. Survey, Misc. Ser. 30, p. 47-52.

____________, and S. R. Moran. 1974. A glacial process-form model, *in* Coates, D. R., *ed., Glacial Geomorphology,* 5th Annual Geomorphology Symposium: Pub. Geomorphology, State Univ. New York, Binghamton, p. 89-120.

Dreimanis, A., and U. J. Vagners, 1971. Bimodal distribution of rock and mineral fragments in basal tills, *in*, Goldthwait, R. P., *et al., eds., Till, a Symposium*: Ohio State Univ. Press, Columbus, p. 237-250.

Flint, R. F. 1971, *Glacial and Quaternary Geology.* John Wiley and Sons, New York 892 pp.

Gravenor, C. P. 1953, The origin of drumlins. Amer. Jour. Sci. 251: 674-681.

____________, and W. O. Kupsch, 1959. Ice disintegration features in western Canada. Jour. Geol. 67: 48-64.

Mickelson, D. M., A. R. Nelson, and M. T. Stewart, 1974. Glacial events in north-central Wisconsin, *in* Knox, J. C., and D. M. Mickelson, *eds., Late Quaternary Environments of Wisconsin:* Amer. Quaternary Assoc. Third Biennial Meeting, p. 163-181.

Muller, E. H. 1974. Origin of drumlins, *in* Coates, D. R., *ed. Glacial Geomorphology,* 5th Annual Geomorphology Symposium: Pub. Geomorphology, State Univ. New York, Binghamton, p. 187-204.

Nelson, A. R. 1973, Age relationships of the Wisconsin Valley and Langlade glacial lobes of north-central Wisconsin: M.S. thesis, Univ. Wisconsin, Madison, unpub., 130 pp.

____________, and D. M. Mickelson, 1974. Landforms of the Langlade Lobe, north-central Wisconsin: *Late Quaternary Environments of Wisconsin, eds.* J. C. Knox and D. M. Mickelson; American Quat. Assoc. Third Biennial Meeting, Univ. Wisconsin-Madison, July 28-August 2, 1974, p. 187-195.

Parizek, R. R. 1969, Glacial ice-contact rings and ridges: Geol. Soc. Amer., Special Paper 123, p. 49-102.

Price, R. J. 1973. *Glacial and Fluvioglacial Landforms:* Oliver and Boyd, Edinburgh, 242 pp.

Stewart, M. T., and D. M. Mickelson. 1976. Clay mineralogy and relative age of tills in north-central Wisconsin. Jour. Sed. Pet. 46: 200-205.

Sugden, D. E., and B. S. John. 1976. *Glaciers* and *Landscape: A Geomorphological Approach.* John Wiley and Sons, New York, 376 pp.

Thwaites, F. T. 1943. The Pleistocene of part of northeastern Wisconsin. Geol. Soc. Amer. Bull. 54, p. 87-144.

Weidman, S., 1907. The geology of north-central Wisconsin. Wis. Geol. Survey Bull. 16, 697 pp.

Whittecar, G. R., and D. M. Mickelson. 1977. Sequence of till deposition and erosion in drumlins. Boreas 6: 213-218.

Wright, H. E., Jr. 1973. Tunnel valleys, glacial surges, and subglacial hydrology of the Superior Lobe, Minnesota. Geol. Soc. Amer., Memoir 136, p. 251-276.

CAMBRIAN CONGLOMERATE EXPOSURE IN NORTHWESTERN WISCONSIN: A NEW INTERPRETATION

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ABSTRACT

A large exposure of conglomerate previously assigned a Late Precambrian age is re-interpreted as basal Cambrian. Nearby Precambrian quartzite exposures provided the quartzite pebbles in the conglomerate. Deposition of the conglomerate apparently occurred in shallow waters near more resistant quartzite islands as the Cambrian sea transgressed on to the Wisconsin Arch.

INTRODUCTION

An exposure of quartzite pebble conglomerate in northern Wisconsin may represent the northernmost exposure of Cambrian deposits in Wisconsin. The exposure lies near the northern end of the River Falls Syncline, where a tongue of Cambrian sedimentary rocks extends northward onto the Precambrian rocks of the Wisconsin Arch (Fig. 1). The Precambrian rocks of the area consist of the Late Precambrian Keweenawan series of lava flows and red beds, a Pre-Keweenawan Late Precambrian quartzite unit named the Barron Formation, and an undifferentiated group of Early and Middle Precambrian igneous and metamorphic rocks.

Because of the presence of widespread thick glacial deposits, outcroppings are not common in the area. The exposures examined in this project are the only known exposures in a 144 square mile area of four townships. Information about the bedrock geology of the area comes from well logs and geophysical data. These reports indicate that Cambrian sandstone underlies most of the area.

FIELD RELATIONSHIPS AND PETROLOGY

The exposures examined lie in Sections 1 and 12, T39N, R11W, Washburn County, Wisconsin (Fig. 2). The exposures were previously described during a mineral survey by the Wisconsin Geological and Natural History Survey (Hotchkiss, 1915), and assigned a Precambrian age. This interpretation called for two

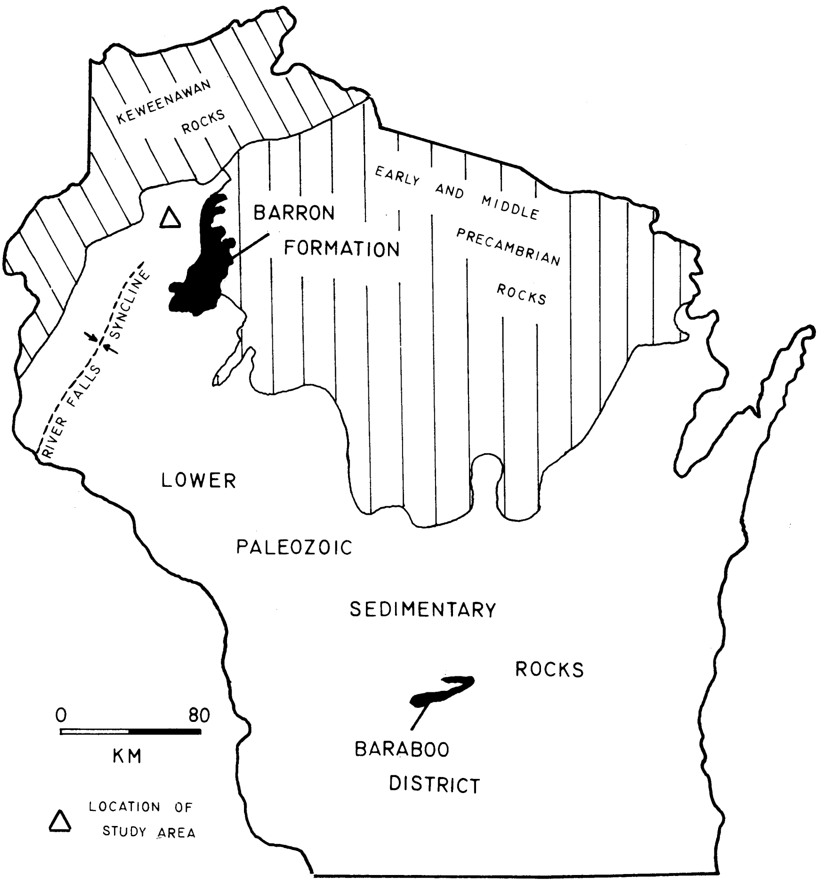

FIGURE 1. Generalized geologic map of Wisconsin.

episodes of quartzite deposition during the Late Precambrian: 1) Deposition of the Barron Formation, which was weathered to produce the quartzite clasts in the conglomerate, and 2) The later deposition of the conglomerate. Regional evidence for two periods of quartzite deposition during the Late Precambrian does not appear to exist. A more reasonable interpretation appears to be that the clasts in the conglomerate were derived from the nearby Late Precambrian Barron Formation, and that the conglomerate represents basal Cambrian deposition. A similar interpretation has been made for a quartzite breccia 30 miles to the south near Canton, Wisconsin (Hotchkiss, 1915).

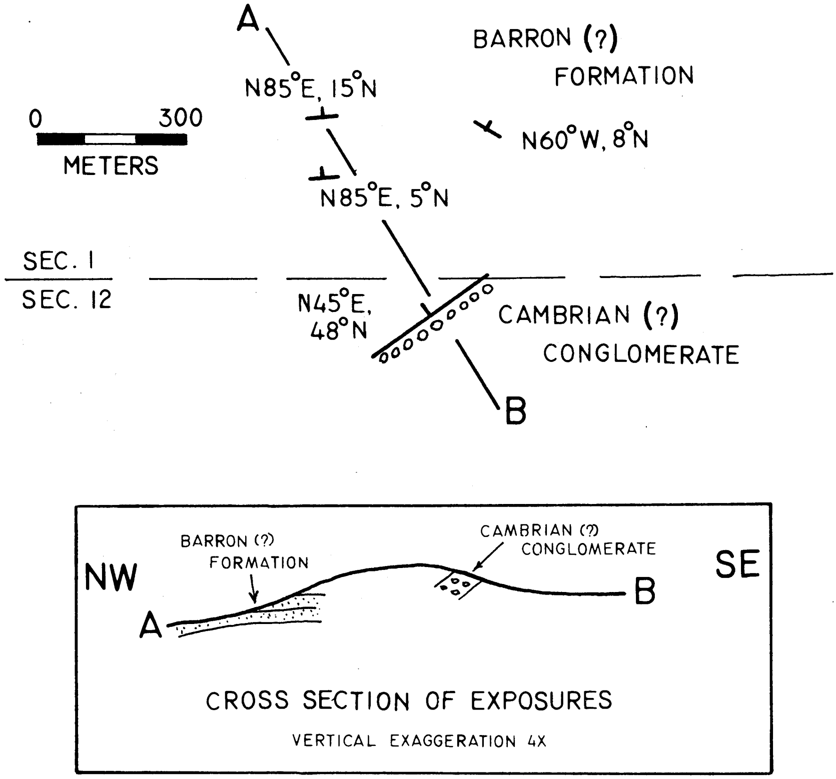

FIGURE 2. Map of exposures in Sections 1 and 12, T39N, R11W, Washburn County, Wisconsin.

The exposures examined in this investigation lie on a prominent hill which overlooks MacKay Valley. At the base of the north side of the hill, a series of quartzite ledges are exposed with an attitude of N85°E, 15°N. Near the top of the north side of the hill, several ledges with an attitude of N85°E, 5°N are exposed. On the northeast side of the hill, a quartzite ledge with an attitude of N60°W, 8°N is exposed. All of these exposures consist of well cemented pink to light red quartzite, which breaks across the individual well-sorted, well-rounded grains. Modal analyses of thin sections (Table 1) indicate an orthoquartzite composition for the exposure. The exposed ledges indicate a thickness of at least 35 m for the quartzite.

On the southeast side of the hill, an exposure of 16 m of conglomerate with an attitude of N45°E, 48°N is present. This conglomerate consists of very well rounded pebbles of light pink quartzite and vein quartz in a yellow sandstone matrix. The pebbles

TABLE 1. MODAL ANALYSES OF QUARTZITE, NORTH SIDE OF HILL.

Sample No.	Location	Polycrystalline Quartz	Monocrystalline Quartz	Felsic Volcanic Fragments	Chert	Feldspar	Granulated Quartz*	Silica Cement	Hematite Cement	Pore Space
MV-1	Hill base, N	1	81	-	x	-	-	16	-	2
MV-2	Hill base, N	16	56	1	-	-	6	15	3	3
MV-3	Hill base, N	5	79	-	-	-	4	18	-	2
MV-4	Hill top, N	2	76	x	x	-	-	17	1	3
MV-5	Hill top, N	7	70	x	x	x	4	13	1	4
MV-6	Hill base, NE	9	74	-	-	-	1	12	-	4
	AVERAGE	7	73	x	x	x	2	15	x	3

*Granulated quartz formed by crushing of silica overgrowths and cement during folding. Figures are %, x = < 1%.

have a maximum diameter of 20 cm, with average of about 4 cm. A pebble count indicates that the conglomerate is composed of 81% quartzite clasts, 1% quartz clasts, and 18% sandstone matrix. The pebbles are in contact with each other, and form a solid framework. The conglomerate is poorly bedded, and the clasts do not exhibit preferred orientation. Both the clasts and the matrix have been fractured by a later event. Modal analyses of thin sections of the clasts (Table 2) indicate an orthoquartzite composition, and compare very closely to the quartzite exposures on the north side of the hill. Both the pebbles and the quartzite exposures on the north side of the hill are similar in composition (Table 3) to the Late Precambrian Barron Formation which is exposed in the area. It appears that the quartzite exposures on the north side of the hill are Barron Formation, and that the pebbles in the conglomerate on the

TABLE 2. MODAL ANALYSES OF PEBBLES FROM CONGLOMERATE, SOUTHEAST SIDE OF HILL.

Sample No.	Location	Polycrystalline Quartz	Monocrystalline Quartz	Felsic Volcanic Fragments	Chert	Granulated Quartz*	Silica Cement	Pore Space
P-1	Conglomerate exposure, SE of hill	6	76	1	-	-	16	1
P-2	Conglomerate exposure, SE of hill	13	73	x	x	-	10	3
PM-1	Conglomerate exposure, SE of hill	6	75	2	-	2	13	2
PM-2	Conglomerate exposure, SE of hill	2	79	-	-	1	16	2
PM-3	Conglomerate exposure, SE of hill	7	73	2	x	-	14	3
PM-4	Conglomerate exposure, SE of hill	7	73	2	-	1	15	2
PM-5	Conglomerate exposure, SE of hill	10	69	2	-	1	17	1
	AVERAGE	7	74	1	x	x	15	2

*Granulated quartz formed by crushing of silica overgrowths and cement during folding. Figures are %, x = < 1%.

southeast side of the hill were derived from this formation.

The matrix of the conglomerate differs from the clasts in several ways. The matrix consists of moderately rounded, coarse grained sandstone, whereas the clasts are composed of medium grained, well-rounded, well-sorted quartzite. The matrix ranges from yellow to buff in color, whereas the quartzite clasts are pink to light red. Modal analyses of thin sections (Table 4) indicate several other differences between the conglomerate matrix and the quartzite

TABLE 3. MODAL ANALYSES OF BARRON FORMATION, NORTHWESTERN WISCONSIN.

Sample No.	Location	Polycrystalline Quartz	Monocrystalline Quartz	Felsic Volcanic Fragments	Chert	Silica Cement	Pore Space
BR-1	Sec. 13, T38N, R9W, Sawyer Co., Wis.	4	79	2	-	15	x
BB-1	Sec. 12, T38N, R9W, Sawyer Co., Wis.	8	73	x	-	18	x
B-1	Sec. 12, T38N, R9W, Sawyer Co., Wis.	12	76	-	-	12	-
BB-3	Sec. 21, T38N, R8W, Sawyer Co., Wis.	14	71	-	-	14	x
B-3	Sec. 21, T38N, R8W, Sawyer Co., Wis.	15	71	x	-	14	-
BB-8	Sec. 1, T37N, R9W, Sawyer Co., Wis.	14	70	3	-	13	x
B-8	Sec. 1, T37N, R9W, Sawyer Co., Wis.	12	76	x	x	11	-
	BARRON AVERAGE	11	74	x	x	14	x

Figures are %, x = < 1%.

clasts. The matrix is not as well cemented as the quartzite, and contains an average of 12% pore space. Also, minor amounts of quartzite fragments are present in the matrix.

These data and field relationships are the basis for this new interpretation of these exposures. Because the attitude and composition of the exposures on the north side of the hill are all similar, these exposures are interpreted as being portions of the same formation or unit. The similarity between this unit and the

TABLE 4. MODAL ANALYSES OF CAMBRIAN (?) CONGLOMERATE MATRIX, SECTIONS 1 AND 12, T39N, R11W, WASHBURN COUNTY, WISCONSIN.

Sample No.	Location	Polycrystalline Quartz	Monocrystalline Quartz	Quartzite Fragments	Felsic Volcanic Fragments	Feldspar	Granulated Quartz*	Silica Cement	Hematite Cement	Pore Space
M-2	SE side of hill	14	59	1	-	-	-	14	-	12
M-4	SE side of hill	6	69	-	1	x	3	11	x	10
M-5	SE side of hill	8	65	1	-	-	-	15	-	11
M-2b	SE side of hill	5	67	2	1	-	3	10	-	12
M-4b	SE side of hill	3	67	1	1	-	6	9	-	13
M-5b	SE side of hill	7	64	-	1	-	1	13	-	14
	AVERAGE	8	65	x	x	x	2	12	x	12

*Granulated quartz formed by crushing of silica overgrowths and cement during folding. Figures are %, x = < 1%.

nearby Barron Formation strongly suggests that this quartzite unit is correlative with the Barron Formation. The nearly identical composition of this quartzite unit and the clasts in the conglomerate on the southeast side of the hill also strongly suggests that the clasts were derived from this quartzite, of presumably Late Precambrian age. The significant difference in attitude between the conglomerate and the quartzite indicates that a tectonic episode apparently occurred during the time interval between deposition of these two units. The age of the conglomerate then must post-date the deposition of the quartzite and the later folding, and is therefore interpreted as being Cambrian.

CAMBRIAN SEDIMENTATION AND PALEOGEOGRAPHY

Because of the lack of fossils and indicative sedimentary features, only general inferences about the Cambrian sedimentation and paleogeography may be made. The rather large clast size in the conglomerate indicates the existence of a nearby source area, probably a high hill of resistant Barron Formation. Such resistant hills would have projected above the Late Cambrian sea as it transgressed onto the Wisconsin Arch. These islands would have shed quartzite debris into the surrounding sea, in a manner similar to that described by Dott (1974) near islands in the Cambrian sea of the Baraboo District, Wisconsin. The solid framework of the clasts in the conglomerate indicates the presence of rather high velocity currents during deposition. These currents swept away the sand and finer grained sediment, leaving behind the solid framework of cobbles and pebbles. Sand later filtered in between the clasts. The environment necessary to produce such a sequence of events would exist in the turbulent nearshore waters of a group of islands, particularly within the tropical latitudes which existed in Wisconsin during Cambrian time (Dott, 1974).

It is very difficult to determine the exact correlation of the conglomerate unit with the well exposed Cambrian strata of the Upper Mississippi Valley 80 km to the south (Twenhofel et al., 1935). Because of similar difficulties, Dalziel and Dott (1970) designated a conglomerate facies around the islands which existed in the Baraboo District during the Cambrian, and made no attempt to precisely correlate the Baraboo conglomerate deposits with the more widespread Cambrian strata of the Upper Mississippi Valley. It seems most probable that the conglomerate exposures of the MacKay Valley area are a high energy, nearshore facies of the shallow water marine Dresbach Formation, which thins northward from the Upper Mississippi Valley as it passes over the Wisconsin Arch (Hamblin, 1961).

The lack of Cambrian exposures in the northern end of the River Falls Syncline makes it difficult to accurately reconstruct Cambrian paleogeography. The varying Precambrian rock types of the region were no doubt expressed topographically, with the more resistant rocks such as the Barron Formation forming hills. As the Late Cambrian sea transgressed onto the Wisconsin Arch, the low areas were inundated, and the hills became islands. The resulting shallow water deposition left a thin widespread blanket of sandstone and conglomerate over the region.

ACKNOWLEDGMENTS

The writer gratefully acknowledges the assistance of Anita Gerb Mattis during this project. Richard Olsson and Martha Hamil made helpful suggestions during preparation of the manuscript. The Department of Geology, Rutgers University, provided laboratory facilities.

BIBLIOGRAPHY

Dalziel, I.W.D., and R. H., Dott, Jr. 1970, Geology of the Baraboo District, Wisconsin, Wis. Geol. Nat. Hist. Sur., Inform. Circ. 14, 164 pp.

Dott, R. H., Jr. 1974, Cambrian tropical storm waves in Wisconsin. Geology, 2: 243-246.

Hamblin, W. K. 1961, Paleogeographic evolution of the Lake Superior region from Late Keweenawan to Late Cambrian time, Geol. Soc. Amer. Bull., 72: 18 pp.

Hotchkiss, W. O., 1915, Mineral Land Classification: Ashland, Bayfield, Washburn, Sawyer, Price, Oneida, Forest, Rusk, Barron, and Chippewa Counties, Wisconsin. Wis. Geol. Nat. Hist. Sur., Bull. 44, Econ. Series 19, 378 pp.

Twenhofel, W. H., G. O. Raasch, and F. T. Thwaites. 1935. Cambrian Strata of Wisconsin, Geol. Soc. Amer., Bull. 46, 1687-1744.

DEWEY AND NIETZSCHE: THEIR INSTRUMENTALISM COMPARED

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Careful comparative scholarship has shown clearly that John Dewey's instrumentalism is not a peculiarly unique formal articulation of the realistic and democratic temper of the American people. Students of the "internal" history of ideas, i.e. those who examine the "relationship between what some men write or say and what other men write or say,"[1] have noted similarities between Dewey's experimentalism and Hume's empirical analysis, Kant's phenomena (but not the noumena), Hegel's phenomenology, the social orientation of the Utilitarians, the positivism of Comte and Haeckel, and Bergson's emphasis on activity.[2] Dewey himself recognized and expounded upon the logical connections between his brand of pragmatism and the separate thought of several European philosophers.[3] Although many comparative studies have discouraged the parochial misprizoning of instrumentalism, further work needs to be done. No account of experimentalism's European resemblances can be complete without the recognition of similarities with the thought of Friedrich Nietzsche. The purpose of this paper is to demonstrate likeness of thought in three areas: attitude toward metaphysics, concepts of truth, and ideas on the nature of value. My hope is that such a demonstration will enlarge the conceptual Euro-American background against which instrumentalism must be understood.

John Dewey's claim that ideas are instruments of action and that their usefulness determines their truth had profound implications for his view toward metaphysics. He agreed with Arthur Lovejoy that metaphysical constructions have been the dominant concern of intellectual mankind throughout history[4] but found this pursuit to be rooted in man's deep sense of insecurity. Man, long before the Heideggerian *angst* became fashionable, had found himself confronted with a dark, uncertain world infused with peril and mystery. Such a cosmos demanded appeasement but the available manipulative arts were often futile. Tools were often inadequate and the senses never fully reliable. In reaction to his natural condition, early man compensated with myth, ritual, and most importantly, protometaphysics. This latter device would contribute an *a priori* order and rationale to the fanciful belief systems and practices of mankind. As Dewey tells it, "Exaltation of pure intellect and its activity above practical affairs is fundamentally connected with the quest for a certainty which shall be absolute and unshakeable."[5] Significantly, then, these beliefs and practices attempted to deal with the vicissitudes of secular life by celebrating the transtemporal perfections of another life.

Construction of such a perfect world provided early humans with access to a secure arena of action (Dewey might say "non-action"). Correlative to this construction was the establishment of special techniques which would allow knowing that was sure, universal, and revelatory; such knowledge was quite different from the fumbling way of the senses used by artisan and eoscientist who were involved in a world of mere fact, imperfection, and uncertainty.[6] The methods of attaining to this genuine reality, then, were extraordinary and purificatory. Dewey finds evidence of such catharizing methodology in early Greek philosophy:

> If one looks at the foundations of the philosophies of Plato and Aristotle as an anthropologist looks at his material, that is, as cultural subject-matter, it is clear that these philosophies were systematizations in rational form of the content of Greek religious and artistic beliefs. The systematization involved a purification. Logic provided the patterns to which ultimately real objects had to conform, while physical science was possible in the degree in which the natural world, even in its mutabilities, exhibited exemplification of ultimate immutable rational objects. Thus, along with the elimination of myths and grosser superstitions, there were set up the ideals of science and a life of reason. Ends which could justify themselves to reason were to take the place of custom as the guide of conduct. These two ideals form a permanent contribution to western civilization.
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> But . . . they brought with them the . . . notion, which has ruled philosophy ever since the time of the Greeks, that the office of knowledge is to uncover the antecedently real, rather than, as is the case with our practical judgments, to gain the kind of understanding which is necessary to deal with problems as they arise.[7]

Hence, for our instrumentalist, metaphysical systems are a response to a complex of culturally conditioned experiences. The search for reliable knowledge must rest elsewhere.

Though it was clear to Dewey that metaphysics could be "reduced" to the perennial quest for certainty, he realized that instrumentalism must still deal in its own way with questions traditionally addressed by the former "official philosophy." The questions about what is most important in life and what is most real could be "explained" by his antimetaphysical reduction but not answered *per se*. Dewey, assuming that humans live in and adjust to their social and physical environment experientially, felt that most metaphysical questions could be "answered" by distinguishing between events and objects. These two terms are the key to his characteristic experimentalist approach to pseudo-problems long agonized over by "first philosophy."

Dewey distinguishes between "events" (or "existences") and meanings. An event is "ongoing" and its nature is revealed in experience "as the immediately felt qualities of things."[9] Thus events are the ingredients of ordinary experience. (Dewey felt that science also conceptualizes in terms of events.) An object is defined as an event with meaning. We are asked to consider tables, the Milky Way, chairs, dogs, electrons, and to appreciate them as examples of "objects." Dewey would have us further appreciate that every event may have numerous explicit meanings with differing consequences for action. The best example he himself elucidates is that of paper.

> Thus an existence identified as 'paper,' because the meaning uppermost at the moment is 'something to be written upon,' has as many other explicit meanings as it has important consequences recognized in the various connective interactions into which it enters. Since possibilities of conjunction are endless, and since the consequences of any of them may at some time be significant, its potential meanings are endless. It signifies something to start a fire with; something like snow; made of wood-pulp; manufactured for profit; property in the legal sense; a definite combination illustrative of certain principles of chemical science; an article the invention of which has made a tremendous difference in human history; and so on indefinitely . . . We are saying in effect that its existence is not exhausted in its being paper.[10]

In experimentalism, then we are introduced to a tool that can powerfully respond to the traditive metaphysical conundrums. Perhaps one example of such a response will suffice. Beginning with Plato, philosophers of various intellectual persuasions have attempted to reason with the concept of essence. But for John Dewey, these philosophers (including some Existentialists with whom he has important points in common) have been pursuing a chimera. "Essence," we are told, "is but a pronounced instance of meaning; to be partial, and to assign a meaning to a thing as the meaning is but to evince human subjection to bias."[11] Hence, there is no reason why the traditive explanation of essence as one, immutable, and constitutive of a thing should exhaust the various meanings the word may have. The traditive claim for legitimacy only reflects the interest that the definer happens to have in the concept. Dewey concludes as follows:

> Since the consequences which are liked have an emphatic quality, it is not surprising that many consequences, even though recognized to be inevitable, are regarded as if they were accidental and alien. Thus the very essence of a thing is identified with those consummatory consequences which the thing has when conditions are felicitous.[12]

Thus this pragmatist argues that we are in error when we repose in ideas and concepts; all ideas and meanings are instruments for dealing with concrete problems. If this be deemed a delitescent metaphysic, it is at the least an unusually "open" and flexible one.

Nietzsche was never as systematic or methodical as Dewey. Often his ideas on metaphysics are inconsistent, although we know that he, like Dewey, was hostile to such traditional notions as substance, cause, effect, and Being. The difficulty for the scholar wishing to analyze Nietzsche's own brand of antimetaphysics is due in part to his peculiar *modus operandi*. Unlike Dewey, he never fights thoroughly or scientifically but rather assumes the role of intellectual warrior using clubs and sledge-hammers to impress the truth upon his readers.[13] Despite these differences in style, however, both men were very similar in their anthropological and psychological analysis of metaphysics.

Nietzsche, like Dewey, felt strongly that the entire metaphysical enterprise results from a maladjustment to a changing environment. "First philosophy" develops when, in the pursuit of security, man avoids the world of Becoming for an absolute world of Being. Man seeks the "true world," a world where there can be no suffering. Nietzsche believes that the unique psychological mind of the average human propends toward happiness. This happiness, as most men see it, can be achieved only in the realm of Being since change and happiness exclude each other.[14] Pain is a leading inspiration for these fanciful conclusions: at bottom they are wishes that such a world might exist because of the hatred men feel toward a world full of suffering. As with Dewey, Nietzsche takes Plato to task for indulging the "metaphysical need."

> An artist cannot endure reality; he turns away or back from it: his earnest opinion is that the worth of a thing consists in that nebulous residue of it which one derives from colour, form, sound, and thought; he believes that the more subtle, attenuated, and volatile a thing or a man becomes, *the more valuable he becomes: the less real,* the greater the worth. This is Platonism: but Plato was guilty of yet further audacity in the matter of turning tables — he measured the degree of reality according to the degree of value and said: The more there is of 'idea' the more there is of Being . . . . At bottom, Plato, like the artist he was, placed appearance before Being! and therefore lies and fiction before truth! unreality before actuality![15]

Thus, metaphysics is a sign of "ill health" or at the least a pernicious weakness in the human psyche. As such, it may be designated as the "science which treats of the fundamental errors of mankind but treats of them as if they were fundamental truths."[16] Clearly Dewey and Nietzsche are in agreement here.

Both philosophers also claimed that metaphysical structures were too often caused by linguistic traps that tend to rigidify concepts. Dewey, for example, criticized thinkers for allowing the concepts of "essence," "universals," "appearance," and "reality" to become static entities each endowed with but one meaning. Nietzsche also excoriated the rigid use of such concepts as "true," "apparent," and "reality."[17] Finally, both men felt that the solutions to many of the old metaphysical puzzles would be forthcoming if the philosopher accepted man as *active* and not passively receptive. For both men, thinking and perceiving are acts of interpretation in which our desires, memories, and passions do affect the object that we perceive or contemplate.

Although many thinkers today, particularly the sociologist of knowledge, take for granted that men's subjective interests and expectations influence their perception, Nietzsche was one of the first to use such information to attack the petrified concepts of metaphysics. Like Dewey, he argued that once we have achieved a conceptual framework, we tend to persist in interpreting our experiences statically even though circumstances inevitably change. This sort of "laziness" increases when the conceptual framework is given a linguistic formula. When this occurs, the concept becomes a closed "self-evident" structure that all experience of the world is required to fit.[18]

To obviate the problems posed by such a conceptology, Nietzsche would have us remember that meaning (like life) is fluid and can take almost illimitable forms. The "interested" subjective thinker should become aware of the intellectual *cul-de-sac* he prepares for himself when he employs ossified thoughts. For example, Nietzsche panned Kant's stringent bifurcation between a "thing-in-itself" and mere appearance. This stiff ontological schism was absurd because of the reasons indicated below.

> A 'thing-in-itself' is just as absurd as a 'sense-in-itself,' a 'meaning-in-itself.' There is no such thing as a 'fact-in-itself,' for a meaning must always be given to it before it can become a fact.
>
> The answer to the question, 'What is that?' is a process of *fixing a meaning* from a different standpoint. The 'essence,' the essential factor, is something which is only seen as a whole in perspective, and which presupposes a basis which is multifarious. Fundamentally the question is 'What is that for me?' (for us, for everything that lives, etc., etc.).
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> . . . In short: the essence of a thing is really only an *opinion* concerning that 'thing' or, better still; *'it is worth'* is actually what is meant by *'it is'* or by 'that is.'[19]

For Nietzsche, then, the putative independently existing object that rigid concepts attempt to mirror is an enduring myth perpetuated by linguistics and human psychology. An uninterpreted "original" is never available to an ideally objective mind;[20] there are only the various "meanings" that an existent can have at different times and for different individuals. For both Dewey and Nietzsche, cognition of metaphysical absolutes must of necessity be a subjective on-going process.

Further similarities of thought are evinced in their theories of truth, although the correspondences are not exact ones. In general, both men argued against the validity of objective truth and argued for the beneficial nature of subjective truth, consciously arrived at. As might be expected, much of what they say about truth follows from their analysis of "first philosophy."

John Dewey's attack on "inexpugnable" objective truth took the form of criticizing two widely held theories. One of these theories avers that there is little distinction between truth and reality. In other words, this Platonic concept claims that truth already exists (as does reality) whether one comes upon it or not. Attendant to this belief is the notion that there is but one truth for everyone at any given time. Dewey answers this by pointing out the obvious empirical refutation that various people do not attain to the same truths. Another difficulty with this former hoary argument is that it finds the subject matter of truth to be reality at large, "a metaphysical heaven to be mimeographed at many removes upon a badly constructed mental carbon copy which yields at best only fragmentary, blurred, and erroneous copies."[21] The only proper object of truth is and must be that relationship of organism and environment in which functioning is most amply and effectively attained.[22] Truth can not be monistic as the Platonist asserts.

The second attack on "objective" verity is against another major defense: the correspondence theory of truth. This is the idea that truth is a duplicate or copy of an independent reality. Dewey admits the innate plausibility of this account because it does distinguish between truth and reality. Since such a distinction is made, the correspondence theory does include statements men make about the world. As such, it involves meaning or discourse and refers to ideas and their validity. However, Dewey complains, the claim that veracity equals a one-to-one relation with objective existents opens up the old (and still unsolved) Descartean problem of dualism.[23] The correspondence theory can not explain how mind, world, and body interact to produce knowledge and "truth." He further argues that even if this theory could explain the ontological abyss between facts and ideas, we would still not know *why* the mind should make a copy of the world at all.[24] Hence, Dewey finds two venerable supports for objective truth to be unconvincing. Not content to merely analyze, he has synthesized a positive, subjective approach to truth.

Such an approach he calls the instrumental or consequence theory. Dewey states that truth or falseness is a property of ideas. This property is chiefly one of predictions of what consequences will follow if any given plan of action, communicated by an idea, is carried out. All ideas are hypotheses continually being verified or disverified in the light of predictable results. The particular consequences or results are those in terms of which a problem has arisen.[25] Pretend, for example, that you hear a noise in the street. The meaning suggested to you is that a street-car has caused the sound. To test the idea you walk to the window and through observation organize into a unity elements of existence and meaning which previously were disconnected. In this way your idea is rendered true; that which was a proposal or hypothesis is no longer a mere educated speculation. Apart from your forming and considering some interpretation, the category of truth has neither meaning nor existence. Your idea, in other words, had to be acted upon to become a truth.[26] As Dewey concludes about his "non-objective" theory,

> Truth . . . is a just name for an experienced relation among the things of experience: that sort of relation in which intents are retrospectively viewed from the standpoint of the fulfillment which they secure through their own natural operation or incitement. Thus the experimental theory explains directly and simply the absolutistic tendency to translate concrete true things into the general relationship, Truth, and then to hypostatize this abstraction into identity with real being, Truth *per se* and *in se*, of which all transistory things and events—that is, all experienced realities—are only shadowy futile approximations.[27]

In conclusion, truth belongs to humans actively engaged in a changing world. Verity, as Dewey sees it, is a satisfactory response to a problem originating in the world. Because truths are not monolithic or fixed in a rigid matrix forever, they can be transformed by the subjective, interested thinker who must consciously and continuously strive to cope with his environment. Since there is no final and absolute truth, there can be no further test of veracity other than its ability to work and to organize facts.[28] Objective truth, moreover, must be recognized as yet another symptom of man's quixotism and quest for security; subjective truth must be recognized as successful and dynamic "interpretations" proposed tentatively by adaptive and creative individuals.

Nietzsche would appear to agree fully with the above conclusions of Dewey. He, too, devastated pretensions to objective truth by revealing the psychology on which they are based and the thin reasoning which disguises them. He too relativized truth to a context of person, world, and problem. And he too, though less carefully and systematically, posited a subjective brand of truth to replace impossible, surreal objectivity. Nietzsche is perhaps most effective in analyzing the psychological bases of cognition and truth.

Even the greatest philosophers, we are told, think that they can achieve *the* Truth through elaborate reasoning. But the theories of men like Spinoza, Wolff, Descartes, and Plato are only fatuous efforts to justify the beliefs they hold on instinctive or pre-reflective grounds. Behind even the purest logic, there are subjective prejudices and physiological demands.[29] Far from being disinterested and objective, Nietzsche sees the intellect as the instrument of something nonintellectual;

> The unconscious disguising of physiological requirements under the cloak of the objective, the ideal, the purely spiritual, is carried on

> to an alarming extent, and I have often enough asked myself, whether on the whole, philosophy hitherto has not generally been merely an interpretation of the body, and a *misunderstanding of the body.*[30]

The concept of transcendent and final truth must, then, be an illusion.

In addition, Nietzsche uses an epistemological argument to attack any claims that "objective" truth can be supported by a strictly empirical outlook. His argument is that we have the kinds of sensations and perceptions we do because of their "utility." The product of our senses reflects our values, and the senses are pragmatic just as our conceptual abilities are. He denies, furthermore, that our sensations and perceptions are uninfluenced by the concepts and prejudgments which we all hold; our conceptual life mandates, in large part, our sensory life.[31] Hence, in contraposition to empiricists such as Locke, the senses cannot absolutely and objectively verify the concepts we may hold as the senses are pre-influenced by beliefs and values. Nietzsche tells us that "faith is the primal beginning even in every sense impression."[32] Consequently, the quest for the Platonic realist version of truth as static and independent of humans may not rest on our conceptual or empirical abilities. No "truth" about the "world of appearances" or phenomena can be any more than a perspectival interpretation.

Finally, Nietzsche shares Dewey's odium for the Kantian noumenon or absolute "thing-in-itself" (or "Truth-in-itself") which so many thinkers for centuries had pursued. Nietzsche in his writings not only denies that our knowledge could transcend the limitations of the senses, but also writes that the very concept of noumenon which we seek to know is an *ignis fatuus.* First, he offers the now familiar psychological explanation (and reduction) of the origin of the notion: the realm of absolute reality was concocted by weak intellects who do not dare to live and adjust in a changing world. The quest for the fictional transcendent and inaccessible noumenon serves as an escape mechanism for such weak spirits.[33] Secondly, he finds the Kantian belief in noumenon useless and superfluous and therefore refuted.[34] Although many reasons are given for the contradictory character of an objective realm of truth, Nietzsche's greatest complaint is that it makes no difference for our quotidian engaged life. With Dewey, he believes that nothing possesses a constitution in itself apart from active interpretation and subjectivity. As Nietzsche understands it,

> Every centre of energy has its point of view of the whole of the remainder of the world—that is to say, its perfectly definite valuation, its mode of action, its mode of resistance. The 'world of appearance' is thus reduced to a specific kind of action on the world proceeding from a centre.
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> But there is no other kind of action: and the 'world' is only a word for the collective play of these actions. *Reality* consists precisely in this particular action and reaction of every isolated factor against the whole.[35]

Consequently, there can be no truth apart from the subjective engaged thinker.

Although denying the possibility of inaccessible verity, Nietzsche proposed that a subjective truth could yet be very instrumental to the man who has the courage to live with perspectivism. Interpretative truths, the only ones we are really capable of, can still give us practical guidance in life. Subjective truth is or can be a useful tool. It can observe how elements in the world affect us, noting their actual benevolence or malevolence, and can draw up from this very personal angle of vision a picture or scheme of the world. With the aid of ideas we can make our way through life's mazes with more confidence because we can handle the empirical world more easily.[36] Those ideas which have life-preserving consequences should be labeled as "truths", while ideas which decrease our chances of coping with the environment should be abandoned as "lies." Truth is human and only individuals who possess it give it importance. With Dewey, Nietzsche concludes that this importance lies in our confrontation with a problematic world. For both men, there is no shame in the fact that we do not have entry into the fictive mansion of static and transcendent verity. Alethiology belongs only and fully to mankind.

The last general area of substantive agreement lies in their axiology. Although their ideas do not correspond exactly in this field of inquiry or any other, we can discern important similarities. Dewey and Nietzsche tended to understand value and experience as inextricably mixed; for both discovered that value cannot exist independently of nature. Lastly, they thought that what was valuable was a practical and not a metaphysical problem. "Solutions" for traditional axiological questions rested in an empirical methodology and were always considered tentative by our two philosophers.

John Dewey's discussions of value parallel his writings on *philosophia prima;* he characteristically saw most of the traditional questions about values as mere pseudo-problems. According to this pragmatist, too many philosophers have agonized over the "status" of value or about the rank of values in some transempirical hierarchy. That these false problems seemed real to metaphysicians was because of the ancient search for certainty and security. The conatus to build a "realm of values" which would contain especially sublime goods caused the nettling split between this world of shadows and the "real" world of sempiternal worth. With this division the philosopher has a new problem with which to deal: what is the relationship between such different domains? Is the transcendent domain that of ultimate Being from which the life we know is but an unfortunate fall? Or is the world of "real" value a mere subjective creation of minds desperate to order their world, as William of Ockham averred?[37] The metaphysicians who select the first alternative usually spend the rest of their intellectualizing on determining the special and fixed order of values in the transcendent realm; their concern for actual choice in mundane life is neglected. Other scholars choose the second alternative, thus rendering values completely subjective and therefore unable to provide a criterion for successful choice among current options. Both choices are meaningless because the problem is arbitrary.[38] Characteristically, Dewey's approach to axiology was empirical and antimetaphysical.

What then is a proper approach to axiology? Dewey's theory is, as might now be anticipated, existential in that he emphasizes the concrete context in which value judgments proceed. Humans are continually faced with situations in which lie conflicts and they are forced to decide which course of action should be pursued. The fundamental question of an involved individual is not what is the "eternal good" that he should emulate but rather what should he do? Typically, value is rendered dynamic and experiential.

To elucidate the *process* of valuation Dewey distinguishes two meanings of "to value." First, like Ralph Barton Perry, Dewey says we value something when we take an interest in it; to value in this manner signifies an immediate experience. However, such a rendition of value is incomplete as a prizing in itself does not specify any course of action; it provides no means of determining what the consequences of pursuing it will be. Therefore, Dewey advances an additional and vital meaning for value.[39] The alternate meaning of "to value" means to judge or to evaluate. Clearly, it is a *process* ending in a value judgment. It is an endless proceeding just as change in our environment is perpetual.[40]

Dewey suggests that this process of valuation is similar in many ways to scientific judgment.[41] Valuation arises when there is conflict within the course of experience and we must attempt to understand the nature of the conflict, suggest various alternative actions, and judge the consequences of each. As in science the existential results of a given course of an action can verify or disprove a given value judgment. Also, as in science, the leading principles used in a given valuation are derived from past experience.[42] Hence, valuation proceeds during conflicts of our immediate values and of what we directly prize. It is a reflective process in which we must decide what we should desire. In making a value judgment we ascribe worth to something rather than merely describe a hierarchy of values.[43] To repeat, "value" for Dewey is a dynamic idea.

Significantly, Dewey argued that values are not greatly different from other facts in the world. There are initial enjoyings just as there are initial impressions of physical objects. Insofar as and only as long as the initial enjoyings are enjoyed, they are good. Naturally experience may come to show some initial enjoyments as deceptive just as it may find some immediate sense experiences deceptive. Just as initial sense data that survive the subsequent empirical testing become "facts" so immediate enjoyments that survive the same test become values.[44]

Finally, Dewey's axiology includes the notion that values are as unstable as clouds; we can never be sure that what we value as good will continue to be desirable. Good things vanish not only with alterations in the environment but with changes in ourselves.[45] Be that as it may, knowledge that a particular object or experience is good—that is, it has survived the best available examinations—will have to be sufficient. Such knowledge will be a reasonable rule for directing behavior. In any case, it is far more usable and trustworthy than depending on revelation or waiting for the philosopher-king to re-enter the reechy cave. The rational, courageous man, Dewey reminds us, will face up to the lack of absolute merit and will strive to improve criteria for choice. In a world of becoming, any other approach would be fatal.

> Since it is relative to the intersection in existence of hazard and rule, of contingency and order, faith in a wholesale and final triumph is fantastic. But some procedure has to be tried; for life itself is a sequence of trials. Carelessness and routine, Olympian aloofness, secluded contemplation are themselves choices. To claim that intelligence is a better method than its alternatives, authority,

> imitation, caprice and ignorance, prejudice and passion, is hardly an excessive claim. These procedures have been tried and have worked their will. The result is not such as to make it clear that the method of intelligence, the use of science in criticizing and recreating the casual goods of nature into intentional and conclusive goods of art, the union of knowledge and values in production, is not worth trying.[46]

Perhaps this implies an ability only found in the strangest kind of individual, but Dewey believed it an ability that any reasonable man could possess.

The idea that values are by and for men appealed also to the mind of Nietzsche. He states often that there is no absolute, self-existent, supreme standard of valuation distinct from volition.[47] Not surprisingly he attacks any belief concerning independent, objective merit as yet another sign of mediocrity and bestial fear in the face of relentless change. Men, as is the consuetude, gladly accept the proposition that values have an independent origin and sustenance.[48] In addition to this familiar posture, he also asserts that the only world which exists for the individual is the empirical one. For the reason discussed above there can be no Kantian thing-in-itself or in this case value-in-itself. For example, Christian theology is wrong most egregiously because it demands complete acceptance of an empyrean realm of objective value. As Nietzsche puts it,

> In Christianity neither morality nor religion has even a single point of contact with reality. Nothing but imaginary *causes* . . . nothing but imaginary *effects* . . . intercourse between imaginary *beings* . . . an imaginary natural science . . . an imaginary psychology.
>
> This *world of pure fiction* is vastly inferior to the world of dreams insofar as the latter mirrors reality, whereas the former falsifies, devalues, and negates reality. Once the concept of 'nature' had been invented as the opposite of 'God,' 'natural' had to become a synonym of 'reprehensible': this whole world of fiction is rooted in hatred of the natural . . . it is the expression of a profound vexation at the sight of reality.[49]

No values can exist outside of the phenomenal world and man's active confrontation with it.

Another major reason why Nietzsche refused to grant values an individual ontological status is his much discussed theory of psychology and morals. He deflated the claims of absolute value systems by arguing that such systems are actually based on human psychological propensities and should be adjudged as artificial self-justifying superstructures (Nietzsche sounds more like Pareto than

Dewey here). The desire for something is the primal ground that "independent" ethical systems cover, consciously or otherwise.[50] Nietzsche says that he can account for the differences in valuational constructions whereas seekers after absolute and fixed systems can not. He tells us that there are as many moralities or values as there are human psychological desires because all moralities are tied to them. In his book, *Human, All to Human* he gives numerous examples of values which are tied to human needs; these needs have, in effect, "chosen" a moral rationalization in order to realize a goal. In one such example he informs the reader that the quality of pity we are given to admire is not disinterested:

> All those who are not sufficiently masters of themselves and do not know morality as a self-control and self-conquest continuously exercised in things great and small, unconsciously come to glorify the good, compassionate, benevolent impulses of that instinctive morality which has no head, but seems merely to consist of a heart and helpful hands. It is to their interest even to cast suspicion upon a morality of reason and to set up the other as the sole morality.[51]

In another example, Nietzsche exposes one instance of philanthropy as also related to ulterior motives:

> Why beggars still live—If all alms were given only out of compassion, the whole tribe of beggars would long since have died of starvation . . . The greatest of almsgivers is cowardice.[52]

Hence, all morality is subjective and interlocked inextricably with secular experiences. Nietzsche, it should be noted, did not deplore this fact as such because he claims that apart from the involved subject, no value could exist. With Dewey, he deplores those who would not have the intellectual integrity to face the ultimate connection between value and experience. For both men, valuation becomes most meaningful when employed consciously by individuals engaged in an active confrontation with a changing world.

Like Dewey, Nietzsche advanced a reconstruction of a sounder ethic which would be based on subjectivity. The function of anyone courageous enough to face existential connection between psychological inclinations and value is to create or to will a value system which corresponds to the needs of the subject. The most fundamental instinct which requires realization is the "will to power" or the desire of the subject to control his personal and external world. This presupposition, roughly similar to Dewey's belief that humans seek to form a propitious environment for their actions, provides the substructure for any realistic value. If Nietzsche is correct, we can call an event or an experience "valuable" only if it aids us in preserving and furthering our life and our ability to successfully manipulate the world.[53] No ethics can subsist independently of individuals in posssession (or possessed) of a subjective consciousness which above all includes a drive of "power" striving for self-realization. Hence values are always to be judged by their relations to active subjects.

Furthermore, Nietzsche agrees that values are transient and a continual challenge to a person. He too feels that an ethic is dynamic and process oriented. An engaged subject must repeatedly experiment with values in order to increase his ability to "build" a world in a favorable image, i.e. to facilitate the realization of personal strength and power.[54] Those goods which are *instrumental* in furthering one's capacity to realize personal goals in the world should be retained until better goods are discovered through experimentation. Significantly, there is no ethical repose here. As the world alters, so must our means to achieving our goals. It is indeed even possible that the interpretation of our instinctive needs and their attendant values will be transmogrified in the future. The rational and practical thinker will accept this possibility and yet affirm the existence of a meaningful ethical system. Such an individual would have

> the means of *enduring* it: the transvaluation of all values. Pleasure no longer to be found in certainty, but in uncertainty; no longer 'cause and effect,' but continual creativeness; . . . no longer the modest expression 'it is *only* subjective' but 'it is all our work! let us be proud of it.'[55]

Thus for Nietzsche, as for Dewey, the best valuations we can have are grounded in humanity. However, far from being an excuse for an aporetic nihilism, this fact can be a beginning for a new and more efficacious concept of value.

The conclusion to this comparative study should not imply that Dewey and Nietzsche possessed identical thoughts, attitudes, or styles of expression. In regard to the three areas of interest discussed above, the major difference between the two men was attitudinal. They particularly differed in their emotional response toward and expression of the over-arching discovery that life is insecure. Nietzsche's style of expression was, characteristically, metaphysical, eristic, and idiosyncratic. His emotional reaction was typically (particularly as seen in his later writings) as semi-hysterical affirmation of life and meaning despite its horror and objective purposelessness. Paroxysmally he urges us to bite the snake of nihilism that crawls into our throats, while we wax complacent in our fictional metaphysical explanations.[56] In contradistinction, Dewey's communication of the ground of metaphysics was calm, scholarly, and exact. Since he did not feel an abyss within himself he was not personally involved with the threat of insecurity. As was his wont, he viewed man's commerce with insecurity as a physician might.[57] Perhaps he also felt that the "cure" for insecurity (i.e. the use of instrumentalism to effect proximate solutions) was not overly difficult; no overman would be necessary to implement a realistic axiology or alethiology. In any case, no desperate ophiophagous measures need be taken to create a solid niche for mankind.

Be this as it may, the discovery of important generic correspondences of substantial thought in Dewey, an American, and Nietzsche, a German, forces us to broaden the view we take of formal instrumentalism. The similarities in their ideas on the nature of metaphysics, truth, and value are no less remarkable for their developing independently of one another. Indeed, their ideational correspondences provide an eloquent instance of congruence in Hesperian thought. Nietzsche's ideas should, then, be added to the conceptual Euro-American community in which the Experimentalism of Dewey grew and prospered. The intellectual historian, in a continuing effort to obtain full understanding of the possible novelty of "Dewey's theory," should not then ignore the reality of shared beliefs between two of the Occident's finest thinkers.

NOTATIONS

[1]John Higham, Intellectual History and its Neighbors, Jour. Hist. Ideas, 15: 3 (June, 1954), 341.

[2]W. T. Jones, *A History of Western Philosophy: Kant to Wittgenstein and Sartre*. (New York: Harcourt, Brace, and World, Inc., 1969). p. 281.

[3]John Dewey, "From Absolutism to Experimentalism," In *Contemporary American Philosophers*, George P. Adams and William P. Montague (Eds.), Vol. 2. (New York: Macmillan Co., 1930), pp. 13-27.

[4]Arthur O. Lovejoy, *The Great Chain of Being* (Cambridge: Harvard University Press, 1936), p. 26.

[5]John Dewey, *The Quest for Certainty* (New York: Minton, Balch and Company, 1929), p. 3.

[6]George Geiger, *John Dewey in Perspective* (New York: Oxford University Press, 1958), p. 11.

[7]John Dewey, *The Quest for Certainty* (New York: Minton, Balch and Company, 1929), pp.16-17.

[8]John Dewey, *How We Think* (New York: D. C. Heath and Company, 1909), pp. 12-13.

[9]John Dewey, *Experience and Nature* (New York: W. W. Norton and Company, Inc., 1925), pp. iv-v.

[10]*Ibid.*, pp. 318-320.

[11]*Ibid.*, pp.182-183.

[12]*Ibid.*, p. 183.

[13]M. A. Mugge, *Friedrich Nietzsche: His Life and Work* (London: T. Fisher Unwin, 1908), p.814.

[14]Friedrich Nietzsche, *The Will to Power*, translated by Anthony Ludovici (New York: Russell and Russell, Inc., 1964), p.88.

[15]*Ibid.*, pp. 74-75.

[16]Friedrich Nietzsche, *Human, All-Too Human*, translated by Helen Zimmern (New York: Russell and Russell, Inc., 1964), p. 33.

[17]Friedrich Nietzsche, "Twilight of the Idols." In *The Portable Nietzsche*, edited by W. Kaufman (New York: Viking Press, 1954), p. 484.

[18]Friedrich Nietzsche, "On Truth and Lie in an Extra-Moral Sense." In *The Portable Nietzsche*, edited by W. Kaufman (New York: Viking Press, 1954), p. 46.

[19]Friedrich Nietzsche, *The Will to Power*, translated by Anthony M. Ludovici (New York: Russell and Russell, Inc., 1964), pp. 64-65.

[20]Friedrich Nietzsche, *The Genealogy of Morals*, translated by Horace Samuel (New York: Russell and Russell, Inc., 1964), p. 152.

[21]John Dewey, "Truth and Reality." In *The Philosophy of John Dewey*, edited by Joseph Ratner (New York: Henry Holt and Company, 1928), pp. 188-189.

[22]*Ibid.*, p. 190.

[23]John Dewey, "The Correspondence Theory of Truth is Inadequate." In *The Philosophy of John Dewey*, edited by Joseph Ratner (New York: Henry Holt and Company, 1928), p. 192.

[24]George Geiger, *John Dewey in Perspective* (New York: Oxford University Press, 1958), p. 72.

[25]*Ibid.*, p. 73.

[26]John Dewey, "The Instrumental Theory of Truth," In *The Philosophy of John Dewey*, edited by Joseph Ratner (New York: Henry Holt and Company, 1928), pp. 199-200.

[27]John Dewey, "The Experience of Knowing." In *The Philosophy of John Dewey*, Volume I, edited by John McDermott (New York: G. P. Putnam's Sons, 1973), p.192.

[28]Morton White, *The Origin of Dewey's Instrumentalism* (New York: Octagon Books, 1964), p. 82.

[29]M. A. Mugge, *Friedrich Nietzsche: His Life and Work* (London: T. Fisher Unwin, 1908), p. 214.

[30]Friedrich Nietzshe, *The Joyful Wisdom,* translated by Thomas Common (New York: Russell and Russell, Inc., 1964), p. 5.

[31]John T. Wilcox, *Truth and Value in Nietzsche: A Study of His Metaethics and Epistemology* (Ann Arbor: The University of Michigan Press, 1974), p. 149.

[32]Friedrich Nietzsche, *The Will to Power,* translated by Anthony M. Ludovici (New York: Russell and Russell, Inc., 1964), p. 25.

[33]Friedrich Nietzsche, "The Antichrist." In *The Portable Nietzsche,* edited by Walter Kaufmann (New York: The Viking Press, 1954), pp. 576-577.

[34]Friedrich Nietzsche, "Twilight of the Gods." In *"The Portable Nietzsche,* edited by Walter Kaufmann (New York: The Viking Press, 1954), p. 485.

[35]Friedrich Nietzsche, *The Will to Power,* translated by Anthony M. Ludovici (New York: Russell and Russell, Inc., 1964), p. 71.

[36]William M. Salter, *Nietzsche the Thinker: A Study* (New York: Frederick Ungar Publishing Co., 1968), p. 52.

[37]John Dewey, *Experience and Nature* (New York: W. W. Norton and Company, 1925), p. 394.

[38]*Ibid.*, p. 395.

[39]James Gouinlock, *John Dewey's Philosophy of Value* (New York: Humanities Press, 1972), p.128.

[40]John Dewey, The Objects of Valuation, Jour. Philos. 15, 1918, p. 257.

[41]John Dewey, *The Quest for Certainty* (New York: Minton, Balch and Company, 1929), pp.258-259.

[42]John Dewey, *On Experience, Nature, and Freedom,* edited by Richard J. Bernstein (New York: The Bobbs-Merrill Company, Inc., 1960), p. xxxiv.

[43]*Ibid.*, p. xxxv.

[44]W. T. Jones, *A History of Western Philosophy: Kant to Wittgenstein and Sartre* (New York: Harcourt, Brace and World, Inc., 1969), p. 305.

[45]John Dewey, *Experience and Nature* (New York: W. W. Norton and Company, Inc., 1925), p. 399.

[46]*Ibid.*, p. 437.

[47]M. A. Mugge, *Friedrich Nietzsche: His Life and Work* (London: T. Fisher Unwin, 1908), p. 306.

[48]Friedrich Nietzsche, "The Antichrist." In *The Portable Nietzsche,* edited by Walter Kaufmann (New York: The Viking Press), p. 611.

[49]*Ibid.*, pp. 581-582.

[50]Friedrich Nietzsche, *Human, All Too Human,* translated by Paul Cohn (New York: Russell and Russell, Inc., 1964), pp. 226-227.

[51]*Ibid.*, p. 222.

[52]*Ibid.*, p. 317.

[53]John Wilcox, *Truth and Value in Nietzsche* (Ann Arbor: University of

Michigan Press, 1974), p. 198.

[54]Friedrich Nietzsche, *Beyond Good and Evil*, translated by M. Cowan (Chicago: Henry Regnery Co., 1955), pp. 100-101.

[55]Friedrich Nietzsche, *The Will to Power*, translated by Anthony Ludovici (New York: Russell and Russell, Inc., 1964), p. 424.

[56]Friedrich Nietzsche, "Thus Spoke Zarathustra." In *The Portable Nietzsche*, edited by Walter Kaufmann (New York: The Viking Press, 1954), p. 271.

[57]W. T. Jones, *A History of Western Philosophy: Kant to Wittgenstein and Sartre* (New York: Harcourt, Brace and World, Inc., 1969), p. 291.

THERMAL PLUMES ALONG THE WISCONSIN SHORE OF LAKE MICHIGAN

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ABSTRACT

The surface temperature characteristics of the thermal plumes associated with Wisconsin power plants on Lake Michigan were measured by an aircraft mounted, thermal line scanner. Approximately 100 images of each of the heated water discharges were acquired and calibrated during a two year project. A pictorial representation of more than 300 of these thermal images are included in the report. The use of these images by the Wisconsin Department of Natural Resources for regulatory purposes is discussed. Recommendations for future operational remote sensing of thermal discharges are made.

INTRODUCTION

Over the past decade, a good deal of both scientific and political controversy has centered on the use of water taken from the Great Lakes to cool large condensers associated with steam-electric power plants. Great Lakes water is abundant, and the cooling process relatively inexpensive. However, the water is warmed from 10F to 40F before being returned to the lake. This warmed water forms a "thermal plume:" a body of water distinguishable from the surrounding, natural lake water by reason of its increased temperature.

Thermal plumes may harm the ecosystem in the nearshore area. Fish behavior is changed noticeably by the plume.[1, 2, 3] Benthic life, including fish eggs, cannot escape the higher temperatures. While such effects can be loosely estimated from laboratory and theoretical studies, field measurements must form the basis of any meaningful assessments of environmental impact at a particular location. Since the amount of warm water in a thermal plume must be a key parameter in measuring and understanding the plume's effect, the plume size and shape should be determined as part of the measurement program. Because the surface area of the plume is often larger than the deeper warm water area, aerial remote-sensing techniques, combined with a few suitable temperature measurements taken in the water, can be used in both monitoring and assessing the effects of thermal plumes.[4]

The thermal plumes associated with five large power plants along the Wisconsin shore of Lake Michigan and one power plant in Green Bay were studied. The description is designed to give an overview of water-surface temperatures in the vicinity of these power plants, together with a feeling for the average sizes and shapes of the plumes and their variations with important environmental parameters. The more technical supporting data are referenced where this is appropriate.

BACKGROUND

Studies of thermal plumes on Lake Michigan before 1972 were mainly performed by the Argonne National Laboratory, and by various university groups interested in particular aspects of the plumes. In 1972, the Wisconsin Department of Natural Resources (DNR) issued a directive requiring that all important aspects of the thermal plumes associated with heat discharges greater than 500 x 10^6 Btus per hour* be studied intensively over all seasons of the year.[5] The results of these studies were to be used by DNR to guide the establishment of "mixing zones" within which the thermal water-quality standards set forth in the Wisconsin Administrative Code (section NR 102) would *not* apply.

Three power companies were affected by this directive:

Wisconsin Electric Power Company (WEPC), Wisconsin Public Service Corporation (WPSC), and Wisconsin Power and Light (WPL).

The power plants exceeding the heat-discharge minimum are:

Oak Creek (1670 MW**; WEPC)
Point Beach (1048 MW; WEPC)
Kewaunee (540 MW; WPSC, WPL)
Edgewater (477 MW; WPL)
Pulliam (393 MW, WPSC)
Lakeside (311 MW, WEPC)

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*A Btu is a British Thermal Unit: The heat required to raise the temperature of one pound of water 1F.

**Peak electrical generating capacity in megawatts (MW).

The locations of these plants are shown in Fig. 1. The Kewaunee plant came on line quite recently, and plume studies at that plant are not very extensive.

One outcome of the DNR directive was a grant from the three power companies to the University of Wisconsin Institute for Environmental Studies, under which the university was to conduct an extended series of aerial remote sensing missions to measure the surface characteristics of the above-mentioned thermal plumes. One hundred "thermal scans" (see below) were to be taken of each plume, over a study period of at least one year.

Each thermal scan provides a picture of the surface character of a thermal plume at an instant in time. A large number of these scans provides a "plume climatology," which shows how each thermal plume usually looks and how it changes with variations in both load and weather conditions.

The resources to conduct this program came from a number of groups:

i. The DNR provided the aircraft and flight crew, and much of the funding for data analysis.

ii. The three power companies provided much of the remote

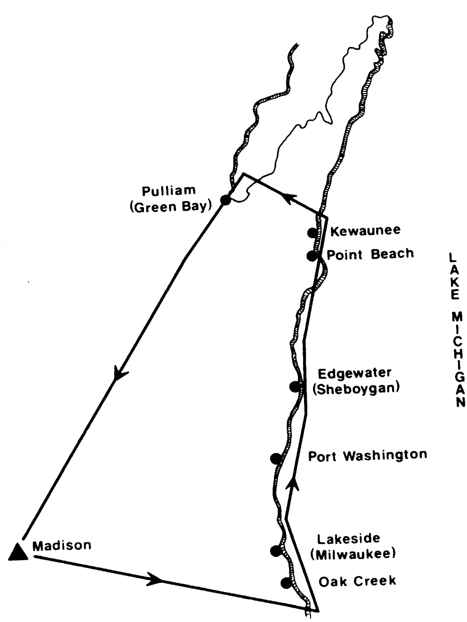

FIGURE 1. Route flown for routine thermal plume monitoring.

sensing equipment, partial maintenance funding for the aircraft, and surface temperature measurements during the thermal scanning missions.

iii. The University provided experienced equipment operators and the data recording equipment, and performed the data analysis. Much of the support for this work came indirectly from NASA, NSF (RANN), the Sea Grant Program, and the University of Wisconsin-Madison Graduate School.

As the scanning missions were being performed, consulting firms and other groups were sampling both the subsurface temperatures associated with the thermal plumes, and the effect of these elevated temperatures on lake biota. Similar work, but along more scientific lines, was carried out by Argonne National Laboratories, and by various University groups under the Sea Grant Program and the Office of Water Resources Research.

THERMAL SCANNING: A Brief Introduction

All bodies radiate energy. Broadly speaking, this energy varies with body temperature, and with the molecular character of the body (its "emissivity"). Water is relatively cool (compared to the sun, for example). Because of this, the radiated energy is almost entirely in wavelengths long compared to those that the eye can detect. Because of absorption, the energy radiated into the atmosphere from a body of water comes only from the water surface. Water has an emissivity which is always very close to one, so that the radiated energy is proportional to the temperature of the water surface.

Certain devices react to this long-wave radiation. For example, a detector made of mercury, cadmium, and telluride which is kept extremely cold will generate a voltage roughly proportional to the amount of long-wave energy falling on it. Thus, it generates an electrical signal which is proportional to surface-water temperatures.

The detector is mounted in an aircraft, and used in conjunction with a set of mirrors which collect the radiation emitted from a spot on the water surface and focus it on the detector. (Fig. 3) The mirrors rotate so that the spot sweeps out a path perpendicular to the direction of flight. The assemblage, together with the associated motors, electronics, and a detector cooling system is a thermal scanner. (Fig. 2)

The signal from the detector is recorded on magnetic tape, which can be played back later through a special film-maker to give a TV-like picture or "thermal scan" of the temperature of the water surface. It is important to remember that light and dark tones in such a "thermal image" correspond only to *water surface temperature.* The shore usually appears much different than the water surface because of a large difference in emissivity. Throughout this paper, light tones on the thermal image denote warm surface water, and dark tones cool surface water. The maximum water-temperature difference is usually about 20F.

Because of atmospheric effects and problems associated with radiative devices within the scanner used to obtain reference temperatures, thermal images can only rarely be interpreted to

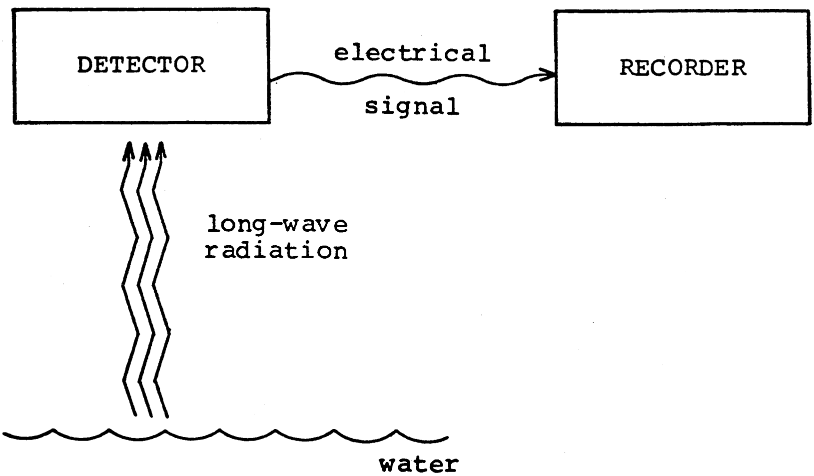

FIGURE 2. Block Diagram of a Thermal Scanner

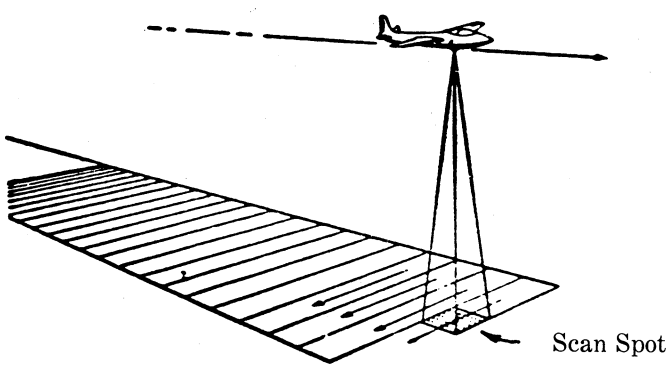

FIGURE 3. Airborne Thermal Scanning

give actual water-surface temperatures unless at least two different water temperatures are measured by more direct methods (eg, with a standard thermometer). With these, the entire image can be calibrated so that the temperature at any point on the water surface is known. Similarly, one should know the important physical parameters governing the character of the thermal plume, in order to rationally interpret the thermal image. The plant load, the pumping rate of cooling water, surface wind, waves, and nearshore lake currents are usually the most important factors. Measurements such as those described above are often called "ground truth." A more complete description of the ground truth used to calibrate a thermal image is given by Scarpace et al.[4]

THE OPERATION

(a) *The Scanning Flights*

The flight path normally used to monitor the Lake Michigan thermal plumes is shown in Fig. 1. The flight lines were always straight in the vicinity of the power plants. They were usually positioned so that from 10% to 20% of the thermal image was of the shore; thus the image could be easily scaled during data analysis. The flying height was generally chosen to maximize thermal detail, while still including the entire plume in the thermal image, and was almost always between 2,000 feet and 5,000 feet above the lake. Scanning was done only near the power plants unless interesting thermal structure such as lake upwelling was noticed at other locations.

The flight line shown in Fig. 1 takes about 2.5 hours to complete. Occasionally, two scans of each plume were obtained by returning southward along the lake shore instead of returning directly to Madison. This altered flight line took about 3.5 hr. Before a flight was begun weather conditions had to be suitable over all the power plants. Occasionally conditions worsened during a flight, forcing part of the flight to be cancelled.

(b) *On Site Measurements*

Shortly before takeoff each power company was notified of the expected flyover time at each plant. The companies relayed this information to the individual plants, and ground truth data were usually taken within a half hour of the actual flyover. This information generally included two water-surface temperatures, pumping rate and estimates of wind and surface waves at the site.

The type of temperature measurements at each plant varied according to the degree of involvement in the project and the nature of the power plant intake and discharge. Details for each plant are given in Fig. 4.

Oak Creek: Bucket* temperatures taken at points A and B provided the necessary scanner calibration points. Point A is near one of the subsurface discharges and point B is near the cooling water intake. At times the temperatures in these areas were not uniform over one scan spot size. This non-uniformity was typical of shore based efforts; the problem could only be alleviated by measuring offshore temperatures from a boat. The submerged discharges add to the problem.

Lakeside: Bucket temperatures were taken in the south discharge channel at point G and at point H. At times the temperature at point H was not uniform over one scan spot size. The water in the surface discharge canal was well mixed and gave good results.

Edgewater: Recorded thermocouple data provided the thermal scanner calibration temperatures at Edgewater. One subsurface intake and two surface discharge temperatures were monitored. Unit 3 and 4 discharge temperatures were recorded at the discharge and at the condenser for each unit. Unit 1 and 2 discharge temperatures were recorded at the condenser for each unit. Occasionally, the discharge temperature for units 3 and 4 disagreed by several degrees F from the weighted average of the individual condenser temperatures. WPL personnel indicated that this was due to recirculating some discharge water through the intake to prevent freezing. Since units 1 and 2 were not used for recirculation it was assumed that the averaged condenser discharge temperatures represented the surface discharge temperature at point Y. The temperature monitored at point Z (Units 3 and 4) was used for that discharge. The weighted average from units 3 and 4 was used only when data were not available at point Z. The weighted average was not used when the possibility of recirculation existed. Where possible the two calibration points were taken at points Z and Y with the intake, X, as a check.

Point Beach: Near the time of flyover power plant personnel, using the bucket technique, measured the temperature at points J

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*See Page 96 for calibration.

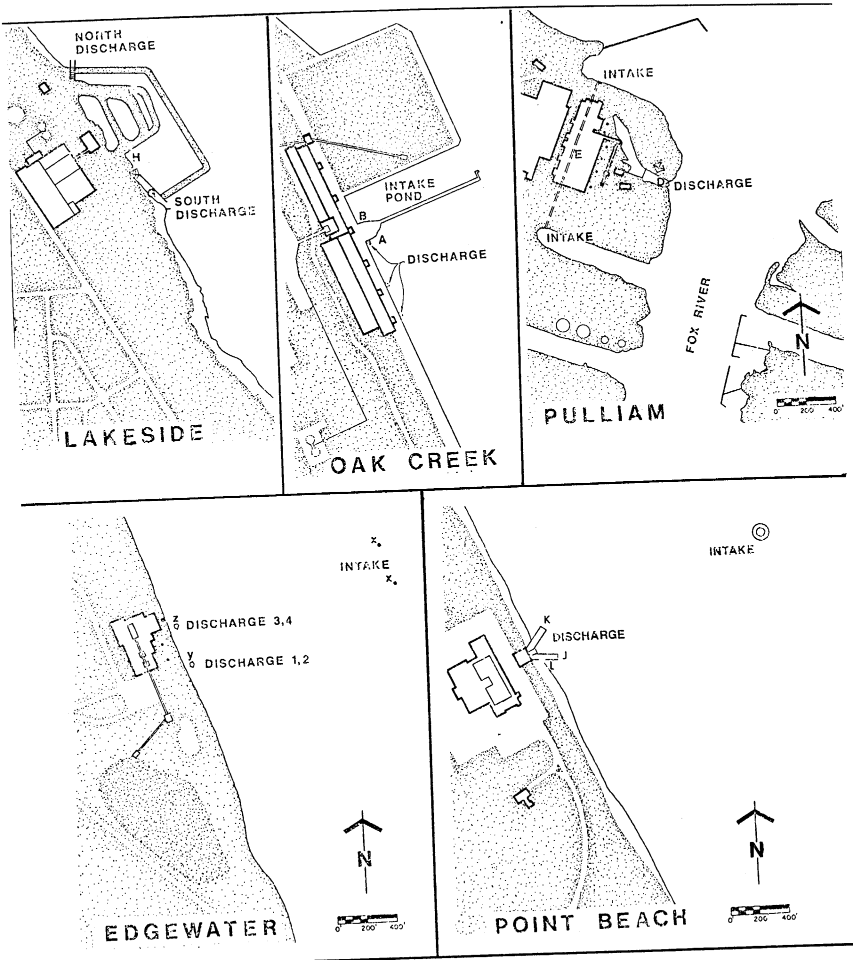


FIGURE 4. Schematics of the power plants.

and L (Fig.4). Usually these two temperatures were sufficient for scanner calibration. When unit 1 (point J) was down, the south discharge temperature differed little from the temperature at L. For these occurrences the recorded discharge temperature for unit 2 (point K) was used as the high temperature calibration point. Tests on unit 1 indicated negligible temperature drop from the recorded discharge temperature and the bucket temperature at point J. Thus point K is shown at the end of the unit 2 outfall. Usually the temperature at point L was uniform over at least one scan spot size. This seems fortuitous; frequently one must go offshore in a boat to find a large enough area of uniform temperature for scanner calibration.

Pulliam: Thermal scanner calibration temperatures were measured by recording thermocouples at points E (intake) and D (discharge). The highest temperature seen by the scanner in the discharge canal was taken as representative of the thermocouple temperature. The temperature at point E is a weighted average of the temperatures at the north and south water intakes. The average depends on the units operating and their relative location to each intake. According to power plant personnel, the amount of water drawn through each intake cannot be readily determined. Therefore, analysis of Pulliam scanner data was necessarily limited to those occasions when the north and south intake temperatures were approximately equal. The temperature change from the surface water near the intake to point E is also unknown.

(c) *Equipment*

Only limited descriptions of the equipment used are given below. More detailed descriptions can be found in the manufacturers' technical specifications. All equipment in the aircraft was checked out in operation before each flight. The aircraft used to obtain the thermal images in this report is the *Wisconsin Department of Natural Resources DC-3*. The DC-3 is relatively large compared to most aircraft used for thermal scanning, and can fly quite slowly. A well tuned area navigation system together with a downward-looking TV viewer which can be monitored by the pilot allowed us to set up and easily reproduce an optimum flight line over each thermal plume. It would be extremely difficult to find an aircraft more suitable to the scanning operation.

Two thermal scanners were used in this work. A prototype *Texas Instruments RS-300* scanner was used in the initial stages, but was replaced by a more accurate *Texas Instruments RS-18A* scanner in late May, 1973. This latter scanner is electronically roll stabilized, and is thus much lighter. Its mercury-cadmium telluride detector is cooled by liquid nitrogen, and is sensitive to radiation in the 8-14 micron waveband.

The signal from the scanner was displayed, recorded, and reconstructed for analysis using the four devices shown schematically in Fig. 5.

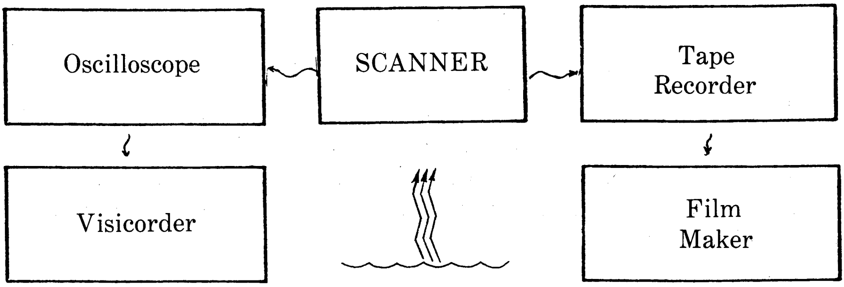


FIGURE 5. Data Acquisition and Display

(a) *Oscilloscope:* Tektronix 5B10N
This displayed the voltage trace resulting from one sweep of the scan spot across the water surface. It allowed the scanner operator to monitor the signal from the detector both before and after being recorded, and to check the aircraft flight line.

(b) *Tape Recorder:* Sangamo Saber III (FM)
The Saber III is a wideband group II FM instrument. It has a frequency response of DC to 250 kiloherz at a record speed of 60 inches per second. The signal to noise ratio at this speed is 33 decibels. The raw data are recorded in an analog made on this instrument in the aircraft. The tape recorder is then returned to the laboratory and used with the analog tapes to produce film imagery and digital computer compatible tapes.

(c) *Visicorder:* Honeywell 1856 fiber-optics cathode-ray tube visicorder oscillograph. This was used with nonpermanent light-sensitive visicorder paper to produce a crude thermal image a few seconds after the aircraft passed over a plume, with which to insure proper coverage of each plume. This imagery was not used for data analysis.
The visicorder was also used to make thermal imagery on film from the data on magnetic tape. The quality of this imagery, however, was below that obtained with the film-maker discussed below.

(d) *Film-maker:* Texas Instruments RFR-70
This instrument makes thermal imagery on standard 70 mm photographic film from a magnetic tape. The result is a negative from which photographic prints can be made. The imagery is corrected for the inherent tangential distortion of the scanner. All imagery in this paper was made with the RFR-70.

(e) *Computers:*
The analog imagery was converted to digital form on a PDP-11 computer. The digital tapes were then interactively processed on a PEP 801 remote terminal connected with the UW-MSN Univac 1110 computer.[6]

DATA ANALYSIS

Calibrating the Thermal Imagery

The quality of the thermal scanner data is limited mainly by the quality of the ground-truth temperatures. We must first relate the scanner output voltage, converted to digital values, to the water-surface temperature. Experimental tests and radiation theory have shown that, for the temperature range in which we are working, the scanner output voltage V is very closely related to the absolute water temperature T (in degrees Kelvin) by the equation:

$$V = A + B T^4$$

Here, A and B are constants, which are ascertained from the two ground-truth temperatures.[4] This equation is accurate to within 0.1F if the two ground-truth temperatures span the water-surface temperatures range. A cooling-water outfall temperature and an ambient (i.e., outside the plume) lake temperature usually meet this criterion. Also, the parcel of water used as a ground-truth "point" should be isothermal over an area somewhat greater than that of the scan spot, due to the response time of the scanner electronics. This is an area of about 400 square feet at a flying height of 2,000 feet. Finally, the water temperatures should be measured at the water surface, or at least near the surface, and in well mixed water.

Two temperature-measuring techniques were used in our program. One was to use the intake and outfall temperatures recorded routinely by the power plant, usually with thermocouples. However, these temperatures are often unsatisfactory because they are taken well beneath the water surface, and can differ by several degrees from those sensed by the scanner. A more reliable technique involved taking two "bucket" temperatures near the time of flyover. At two designated locations, a tethered bucket was lowered, filled with "surface" water, and retrieved. The temperature of this water was measured with a standard thermometer. Three problems were associated with this shore-based technique: the isothermal area near shore was sometimes smaller in size than the scan spot; the bucket temperatures on occasion did not span the full water-surface temperature range; the water was on occasion not well mixed, so that a surface skin may have been present.

The size of the isothermal area was checked during analysis by looking at digital values adjacent to the selected calibration value. For 90% of the plumes analyzed the calibration points were isothermal to within 0.3F. The bucket temperature for analyzed data spanned a temperature range adequate to insure negligible error; for those instances where this was not true the data could not be analyzed. The hot calibration temperature was usually measured in the plume discharge, a well mixed area. The skin effect could, however, affect the cold calibration temperature. Comparisons of in situ temperature mapping from a boat, and airborne thermal scanning under a variety of environmental conditions indicated good agreement with one exception (Point Beach, June 6, 1973).[7] It was felt that the surface skin effect contributed to the differences in this exception. Of all the plumes analyzed less than 5% exhibited the unusual characteristics of the June 6, 1973 scan. Errors as large as 1F or 2F could be present in those analyses. Some ground truth data were obtained from consulting firms working for the power companies. However, attempts to coordinate measurement efforts with these firms were largely unsuccessful, so that overlapping data are sparse. At Point Beach, several plume-measuring efforts were coordinated with the Argonne National Laboratory.[7]

Finding the Size of the Thermal Plumes

The scanner output voltage recorded on tape in the aircraft was converted to digital values in the laboratory on a PDP-11 computer together with an analog-to-digital converter. The digital tapes were then analyzed interactively with a graphics display terminal to connect the operator with the University of Wisconsin-Madison Univac 1110 computer.[6] The terminal displayed a digital representation of the thermal image. The operator used this image to select ground truth locations and isolate the digital values associated with the plume and ambient lake water from extraneous heat sources. The digital scanner voltage values were then converted to water surface temperatures by the above equation, and areas enclosed within various isotherms calculated. A schematic example is shown in Fig. 6. One should recall that the normal definition of a mixing zone is equivalent to the area contained with the 3F (above ambient) isotherm.[8]

Assigning an area to the digital values requires knowledge of the aircraft groundspeed and its flying height. To obtain greater accuracy the tangential distortion-corrected film image of the scan was scaled with aerial photographs and power plant scale drawings as references. Corrected aircraft speeds and altitudes were then calculated. Slight variations in speed and altitude during the scan were not corrected. Together these variations could introduce as much as 7% error in the calculated areas. This occurred only on very turbulent days; for most of the scans the error was much less.

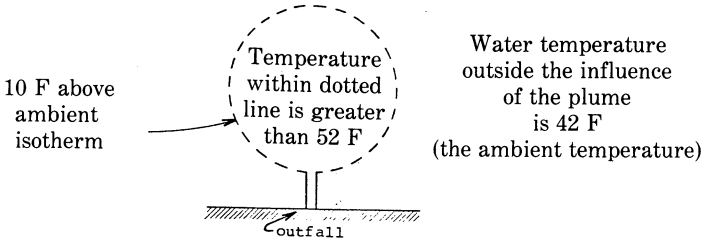


FIGURE 6. Schematic of Thermal Plume Isotherm

RESULTS

A photographic print was made of each RFR-70 thermal image, with careful quality control to enhance the thermal plume. The prints for each power plant were arranged as a mosaic and photographically reduced. For each of these pages of thermal images a corresponding page with pertinent information was made. The typewritten pages are arranged so that the data pertaining to each thermal image are in the corresponding frame. These pairs of typewritten/thermal image pages are Figs. 8 through 16. To further save space the data are presented without units. After a brief perusal of Fig. 7, an example with units included, the reader will find this "mosaic tabulation" easy to comprehend.In some cases not all the environmental and/or plant data were available. Dashes are used in these instances. No areas are listed where the surface calibration temperatures are missing. The metric system was not used because DNR requested surface areas in square feet enclosed within the 3F, 6F and 10F isotherms (the pertinent regulations are

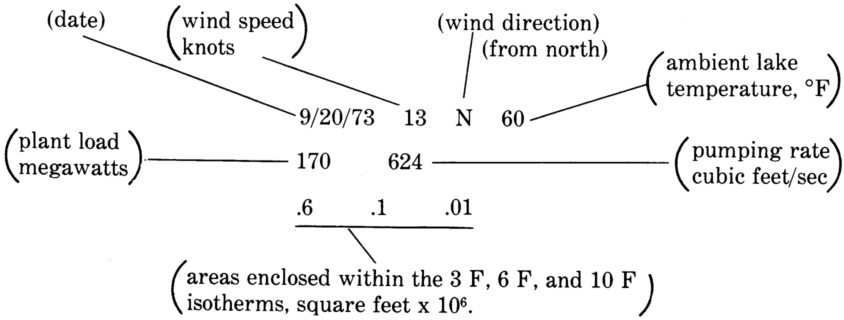


FIGURE 7. Interpretation of Data Presentation Legend.

written in degrees F). It would be possible of course to list areas in square meters enclosed within the 1.67C, 3.33C, and 5.55C isotherms. However, in view of the fact that the state regulations regarding mixing zones are formulated in English units the authors have decided to avoid confusion in one realm, at the risk of creating it in another.

Error Summary

Error sources stemming from temperature calibration and scaling of the imagery have been discussed. The maximum expected error in either case is less than 10% for the plumes analyzed. For most of the plumes the errors should be considerably less. Temperature and scale calculations both contribute to the error in the final result, the area enclosed within isotherms. Assessing the contribution due to scale errors is straightforward; assessing that due to temperature is more complex. Area uncertainties due to errors in temperature are modulated by the temperature gradient. That is, where the slope of the area vs. temperature curve is the steepest, the effect of temperature errors will be the greatest. The wide variability in the structure of thermal plumes demands each plume be evaluated individually. In general, however, we feel a conservative estimate of the error bounds on the results presented here is 10 ± %.

CONCLUSIONS AND RECOMMENDATIONS

It is impossible to conclude this report without a brief set of recommendations based on the misgivings, frustrations, and hindsight associated with two years of work. The authors offer the recommendations below in the hope that they may be incorporated as part of a cost-effective, regional remote sensing program serving the needs of the State of Wisconsin.

Ground Truth The weakest link in the process of generating high quality thermal contour maps from raw thermal scanner data is the measurement of water surface temperatures required for calibration. Although the authors were not satisfied with the ground truth effort described above, it would be difficult to (inexpensively) improve upon it on an operational basis. Two techniques of improving future ground truth are worth investigating. These are:

1. Developing specially painted, large, heated panels of known emissivity. These panels would be strategically placed near

the plume and frequently thermally calibrated. For routine work, they would only need to be uncovered prior to flyover and their temperature monitored.

2. Changing the scanner wavelength sensitivity from a range of 8 to 14 microns to one of 10 to 11.5 microns. Atmospheric effects are considerably reduced in the latter range.[9] It may then be feasible to calibrate the scanner in the laboratory, and

9/20/73 13 N 60 170 624 .6 .1 .01	1/30/74 16 SW -- -------- ------------	10/17/73 10 W 53 190 716 3.4 .9 .2	11/5/73 15 W 49 66 251 .3 .2 .1

2/9/73 13 W 34 220 919 .8 .2 .01	2/12/73 13 SE 33 240 949 2.8 1.7 .3	10/5/73 10 WSW 60 24 0 9.8 2.2 .2

2/21/73 16 NW 34 210 830 1/4 .8 .2	10/18/73 11 NW 52 34 362 .3 .01 .01	1/30/73 7 WSW 33 201 978 1.2 .8 .1

2/20/74 5 SW 34 220 234 .3 .2 .1	3/27/74 9 SE 37 188 633 .4 .04 .01	3/13/74 --- --- 175 596 -----------	2/22/73 13 W 34 235 950 1.8 .6 .3

3/21/74 15 WSW 36 226 716 2.1 .7 .01	2/5/73 14 NE 35 160 949 2.1 .8 .3	3/12/74 17 NNE 35 148 512 1.4 .4 .1	2/18/74 13 SSW 33 185 605 .5 .3 .2

2/18/74 11 S 35 58 399 .1 .02 .01	4/11/73 13 WSW 37 220 978 2.0 .4 .1	4/12/73 9 N 39 240 918 1.9 1.2 .3	5/30/74 10 NNE 49 160 1496 4.9 1.2 .1

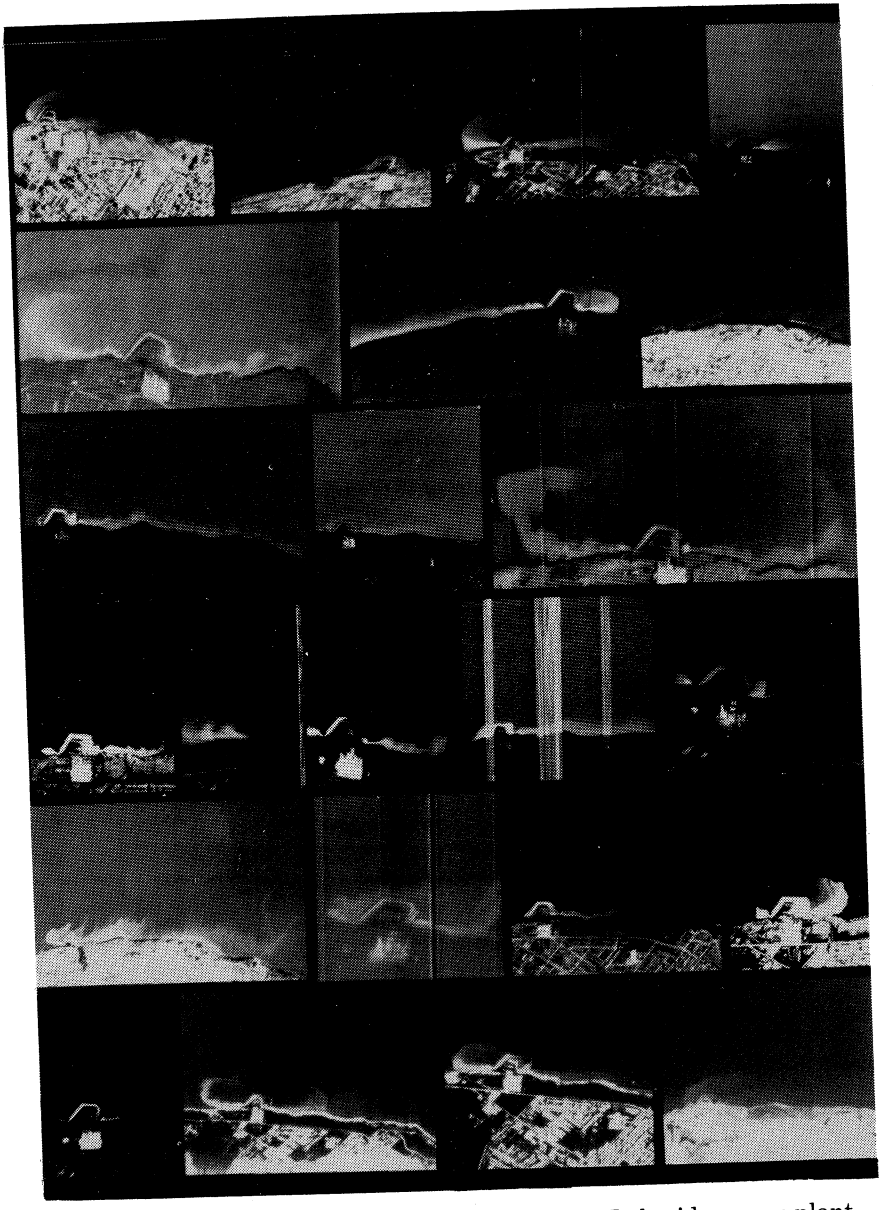
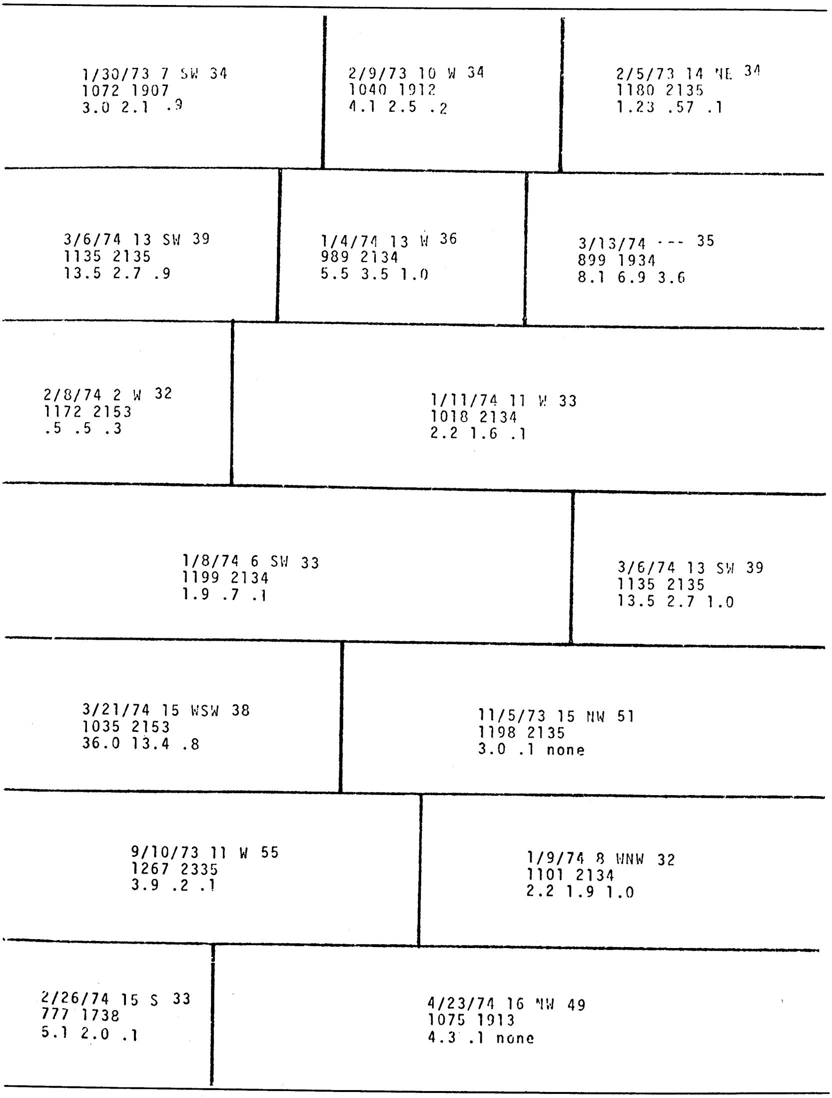


FIGURE 8. Thermal images and data for the Lakeside power plant.

neglect atmospheric effects altogether. The effects of the surface skin are not well understood.[10] Field experiments under various environmental conditions would be useful to ascertain under what conditions serious discrepancies occur between scanner-derived surface water temperatures and the actual near-surface water temperatures.



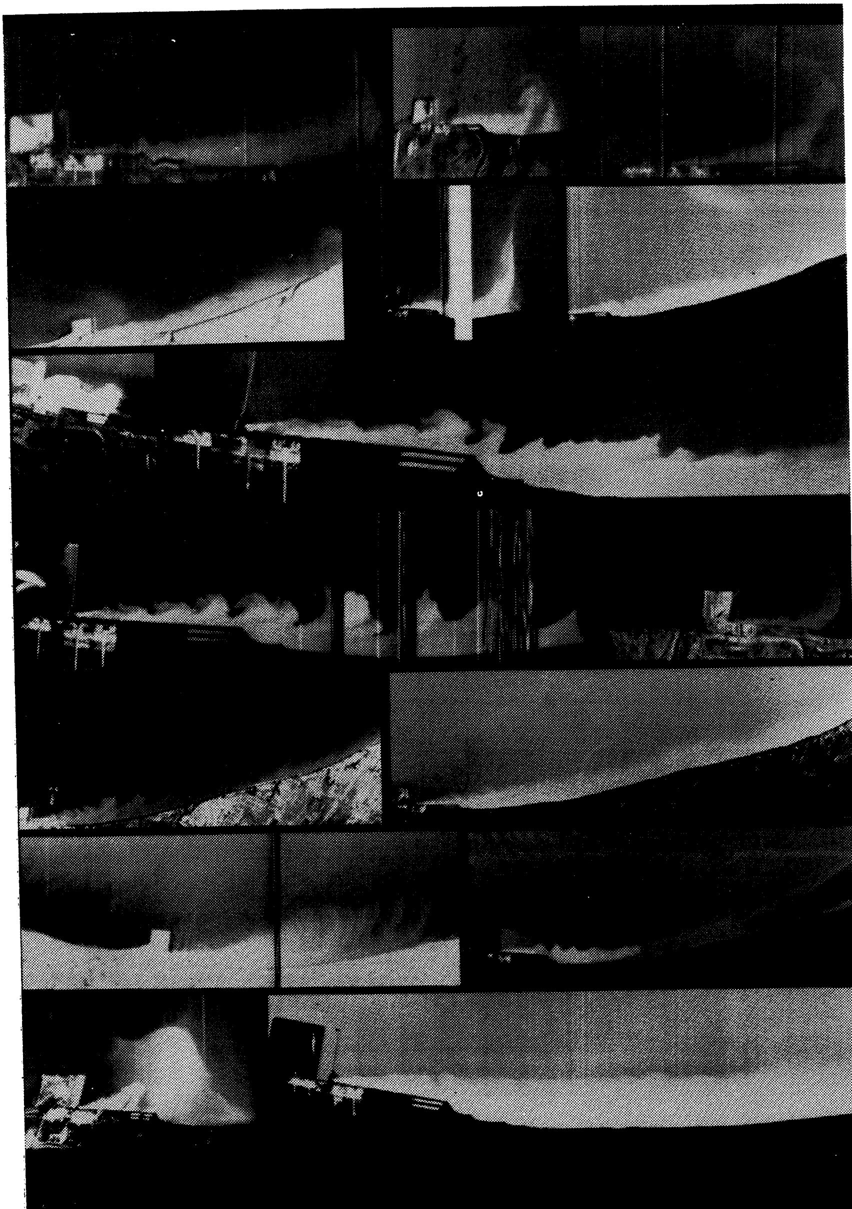


FIGURE 9. Thermal images for the Oak Creek power plant.

Routine Monitoring Routine thermal monitoring of thermal plumes is recommended. Public interest in all aspects of power generation has understandably increased with the dramatic increase in the number of power plants. Aerial remote sensing of thermal discharges is an inexpensive way to insure compliance with

7/11/73 8 NE 54 I: 19 120 II: 392 354 11.0 6.7 2.9	9/4/73 15 SSE 51 I: 45 120 II: 386 355 5.0 1.0 .2	10/5/73 10 SSE 58 I: 38 475 II: 387 475 5.4 1.7 .6	5/31/73 12 N 50 I: 42 120 II: 391 354 4.9 1.8 .6
5/30/73 10 NNE 50 I: 42 120 II. 372 354 3.7 1.1 .6	7/3/73 10 S 53 I: off II: 394 354 1.3 .3 .1	4/17/73 26 S42 I: 44 120 II: 394 354 9.5 3.9 .4	
5/15/74 12 SSE 44 I: 9 II: 364] 364 13.6 1.7 .5	9/10/73 12 WSW 48 I: 23 120 II: 394 354	6/14/73 12 S 51 I: 44 120 II: 389 354 3.4 .3 .03	
6/7/73 20 SW 49 I: 40 120 II: 382 355 2.0 .7 .1	6/15/73 15 SSE 48 I: 44 120 II: 391 227 6.8 2.3 .6	6/6/73 3 E 50 I: 41 120 II: 391 227 14.8 5.7 1.2	9/7/73 10 E --- I: 25 60 II: 390 354 -------------
7/10/73 10 NE 44 I: 45 120 II: 388 354 5.4 2.8 .5	5/24/73 5 SE 52 I: 46 120 II: 43 100 5.3 2.3 .01	6/12/74 18 W 50 I: 0 II: 390] 304 1.7 .6 .2	7/3/74 20 S 53 I: 29 II: 335] 314 5.4 1.6 .6
5/11/73 15 WNW 50 I: 46 120 II: 57 100 .4 .1 .01	9/14/73 8 SSE 55 I: 45 120 II: 391 354 22.5 14.3 1.6		
7/10/73 8 NNE 44 I: 27 120 II: 416 354 2.4 .3 .2	6/26/73 13 WSW 50 I: 24 60 II: 392 354 1.3 .7 .2	5/9/74 10 NE 47 I: 22 II: 279] 287 2.2 .7 .2	10/10/73 12 S 58 I: 29 II: 382] 414 4.4 1.2 .6

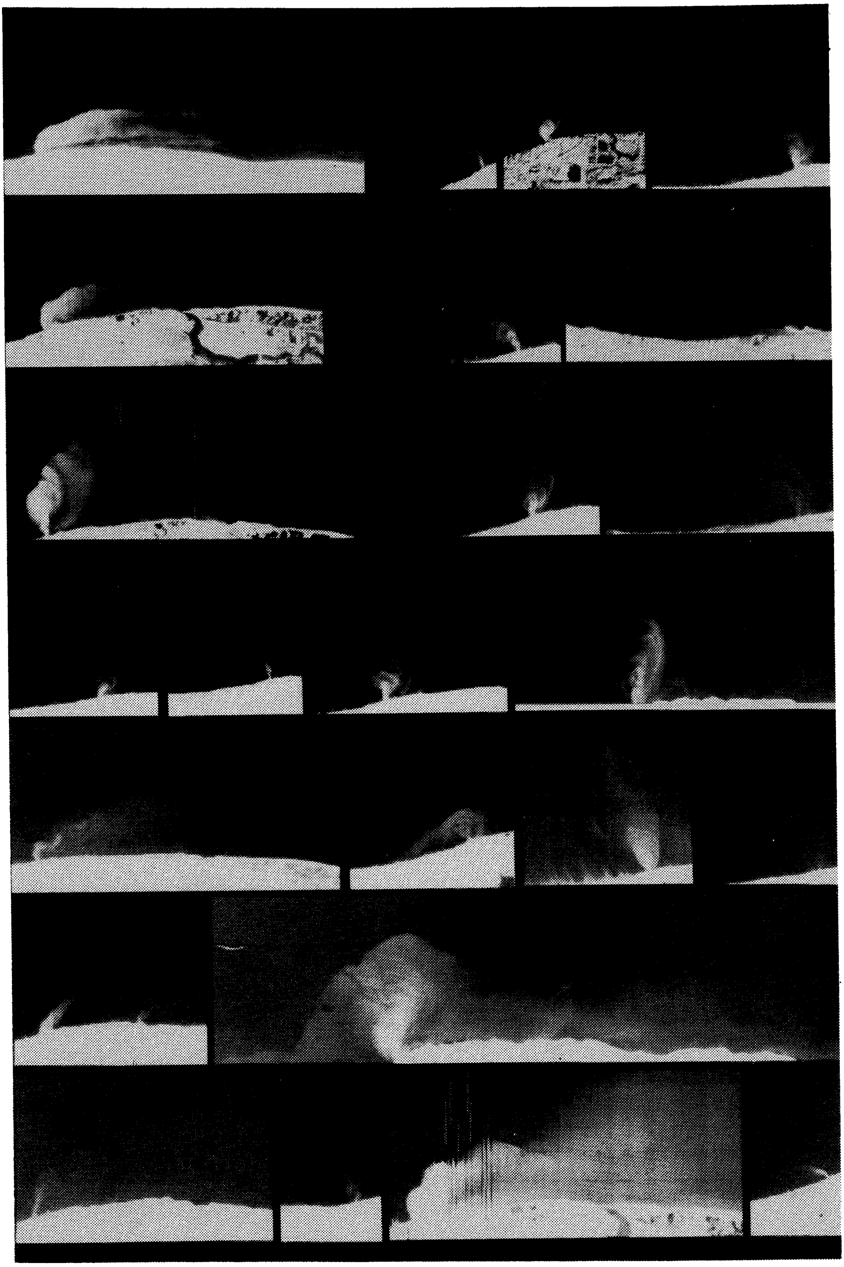


FIGURE 10. Thermal images for the Edgewater power plant.

regulations, and keep the public informed of the extent of thermal discharges into Lake Michigan. New power plants should be monitored frequently initially, to extend what has been reported herein. Routine monitoring would also be useful as a guide and a complement to other thermal plume sampling programs.

5/31/73 10 SW 51
I: 480 858
II: 450 858
13.2 2.1 .2

6/27/73 11 SSW 50
I: 500 858
II: 479 858
3.3 .5 .1

7/3/73 SW 51
I: 970 858
II: 970 858
4.0 .9 .2

6/12/74 16 W 50
I: 366 486
II: 490 871
2.9 1.0 .2

7/10/73 10 NNE 54
I: 500 858
II: 500 858
11.1 2.8 .3

7/17/74 16 S 55
I: 500 858
II: 500 858
5.2 .3 .1

9/7/73 9 SSE 48
I: 495 858
II: 500 858
16.9 3.3 .6

9/10/73 9 WSW 49
I: 459 858
II: 495 858
21.7 5.7 1.0

6/14/73 9 SSW 50
I: 500 858
II: 495 858
5.9 2.0 .3

6/15/73 12 SSW 47
I: 500 858
II: 480 858
18.2 .8 .1

5/11/73 12 NW 49
I: 365 858
II: 480 858
5.3 .7 .04

5/21/74 9 SSE 49
II: 495 884
4.6 .8 .2

6/7/73 14 SW 49
I: 487 858
II: 500 858
8.8 2.0 .2

6/26/73 calm 51
I: 970 858
II: 970 858
2.1 .5 .1

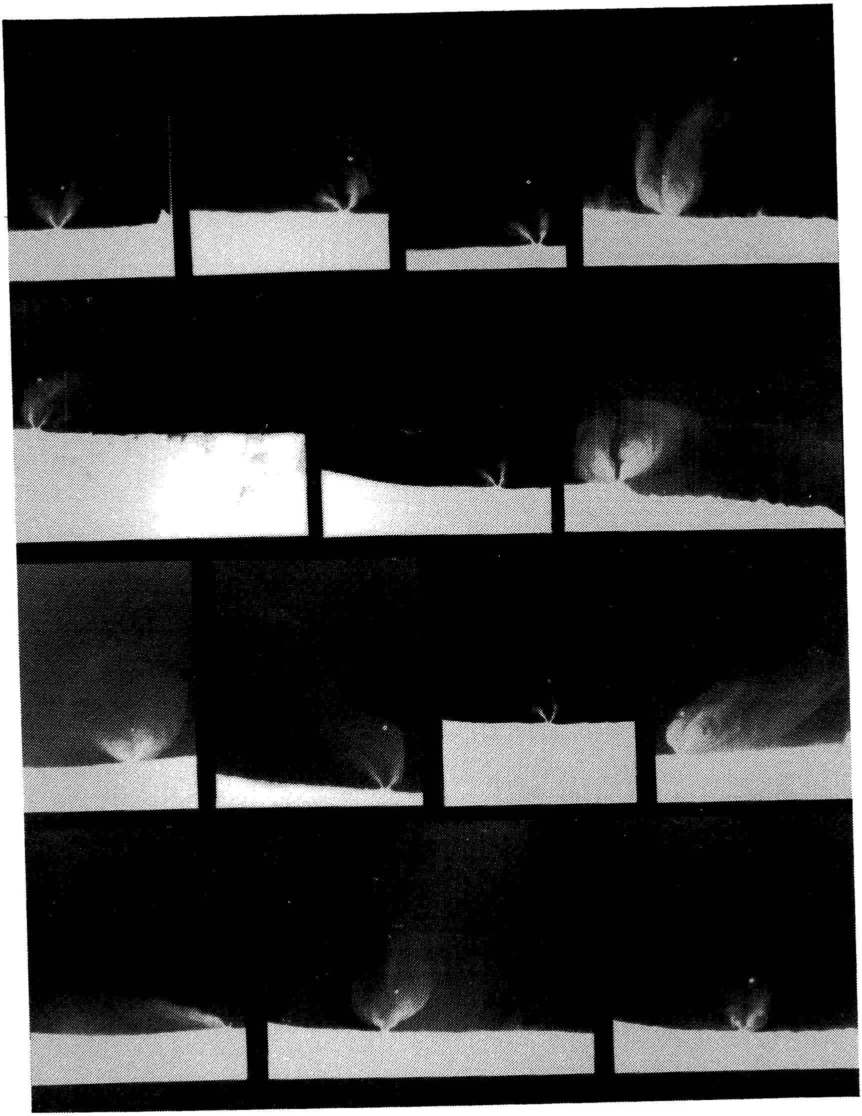


FIGURE 11. Thermal images for the Point Beach power plant. (A)

Round-the-Lake Monitoring If routine monitoring is deemed necessary, it would be foolish not to monitor an entire region, or at least all of Lake Michigan. Aerial remote sensing has proven to be quite cost-effective for monitoring the Wisconsin portion of Lake Michigan; the cost-effectiveness would certainly increase if all of Lake Michigan were included.

10/12/73 12 SW 50 I. 474 858 II. 508 858 61.8 4.5 .8	9/14/73 2 NE 62 I: 390 858 II: 505 858 32.4 10.8 1.0	9/12/73 4 WNW 58 I: 500 858 II: 500 858 29.3 9.9 1.5	11/19/73 9 NNE 42 I: 470 486 II: 500 871 11.9 5.3 3.2

10/1/73 8 NE 60 I. 480 858 II: 500 858 65.4 12.6 1.5	9/14/73 2 NE 61 I: 390 858 II: 505 858 41.9 14.5 .3	9/14/71 ----- ------------- ------------- -------------	10/10/73 13 S 56 I: 480 858 II: 507 858 3.7 1.8 .3

10/5/73 10 W 60 I: 480 858 II: 505 858 39.8 7.2 1.0	3/7/74 19 NE 36 I: 475 490 II: 500 490 18.4 13.8 6.3	4/17/73 26 SE 39 I: 371 858 II: 467 858 10.7 4.0 .4

9/20/73 9 N 57 I: 500 858 II: 500 858 5.6 1.6 .8	4/5/73 8 SE 37 371 884 4.4 1.2 .2	3/23/73 9 SE 40 I: 375 490 II: 450 490 11.7 4.7 1.0	5/30/74 10 NNE 47 II: 495 884 18.5 6.0 1.2

5/30/73 7 NE 50 I: 480 858 II: 480 858 34.7 24.9 3.5	4/9/72 ------- -------------- -------------- --------------	4/12/73 11 N 38 373 884 3.7 1.4 .1

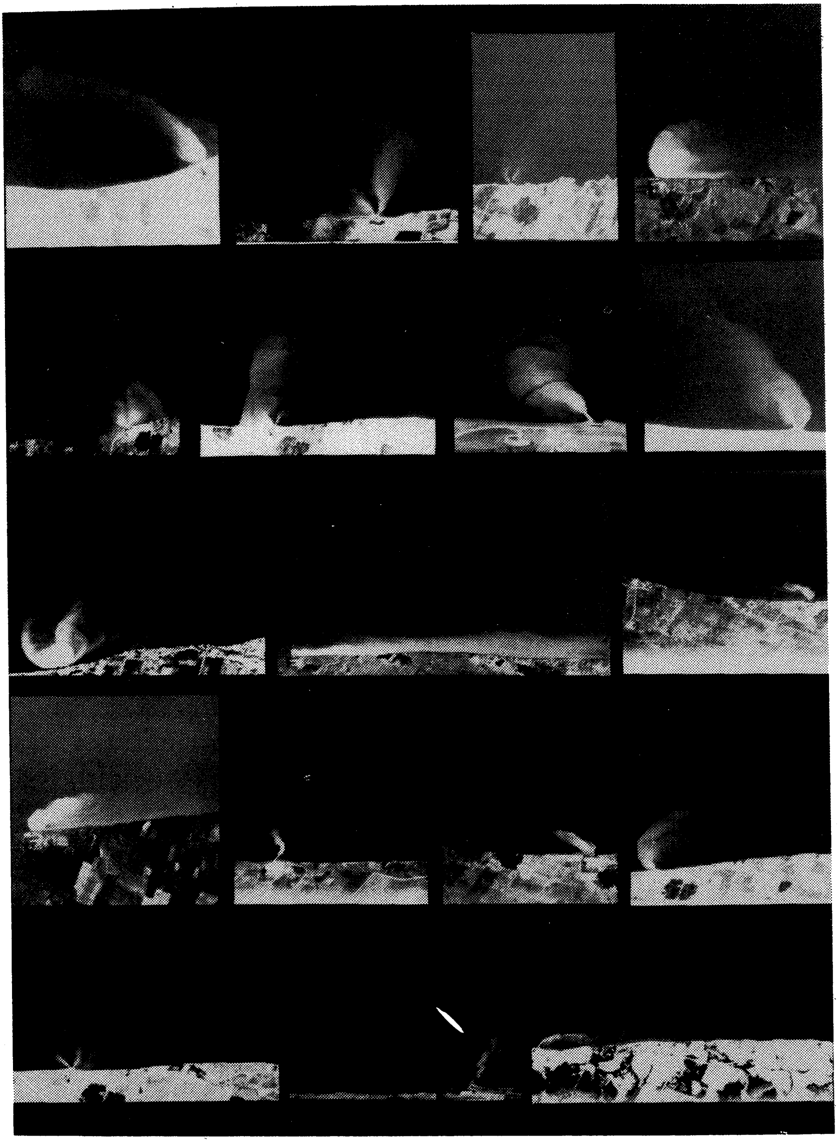


FIGURE 12. Thermal images for the Point Beach power plant. (B)

9/15/71 ------- --------------- ---------------	4/11/72 ------ -------------- --------------

4/15/72 ---- -- --------------- ---------------	7/11/73 -------- ---------------- ----------------

5/9/74 3 NNE -- II: 490 884 ---------------	4/6/72 ------ ------------- -------------

4/11/72 ------ -------------- --------------	4/11/72 ----- ------------- -------------

4/12/72 ----- ------------- -------------	5/15/74 9 NW 44 II: 488 884 10.5 1.5 .3	Sept. 1971 ------------ ------------

4/9/72 ----- ------------ ------------	5/15/74 13 NW 43 II: 500 884 3.3 1.0 .1	4/12/72 ----- ------------- -------------

4/15/72 ----- ------------- -------------	4/23/74 NW 44 I: 0 II: 485 884 8.2 .6 .2

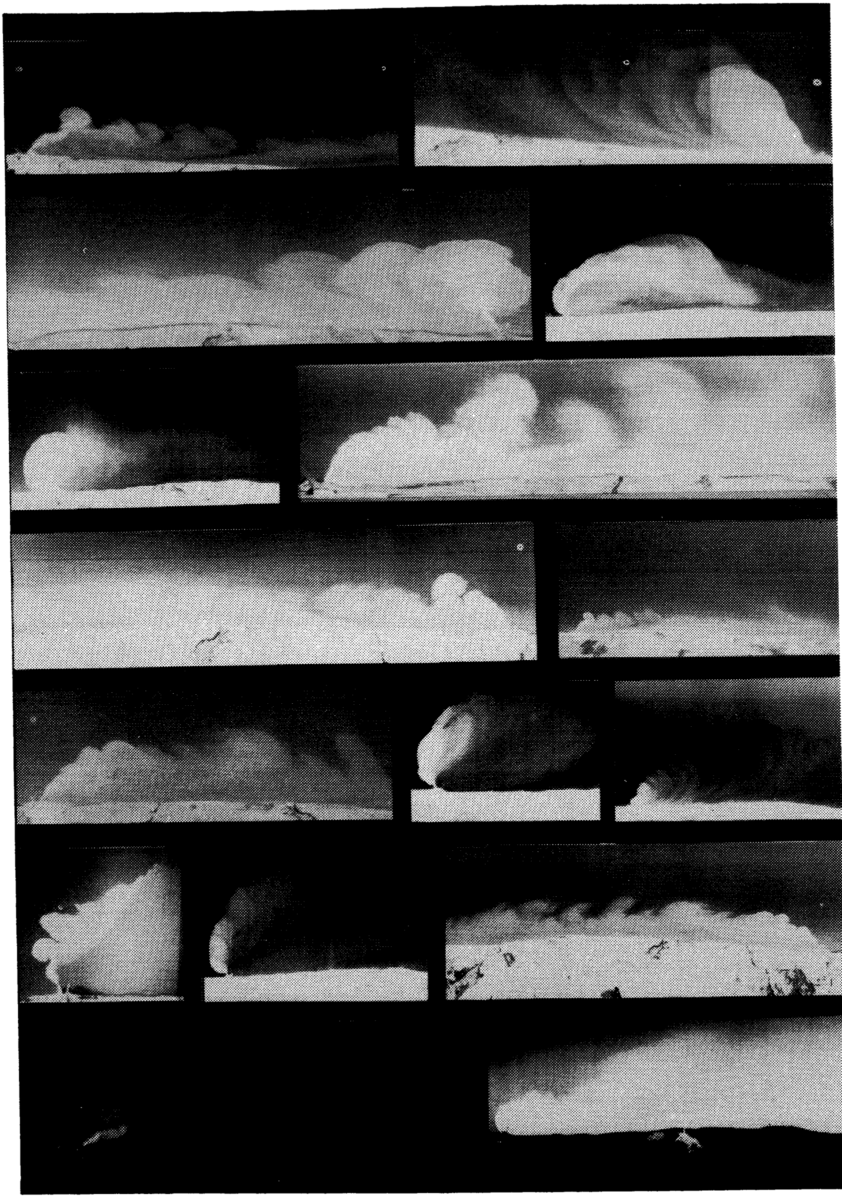


FIGURE 13. Thermal images for the Point Beach power plant. (C)

4/17/73 10 SSW 42
227 457
1.0 .2 .1

2/19/74 5 NW 34
247 428
.2 .1 .02

2/21/73 5 NW 33
283 400
.4 .1 .03

2/18/74 1 SW 32
233 371
.7 .1 .04

1/4/74 4 SW 33
322 364
.3 .3 .05

1/11/74 4 N 32
317 422
.5 .4 .2

3/27/73 7 SE 37
248 363
2.0 .8 .4

2/20/74 8 SW 32
220 371
.3 .04 .02

2/18/74 2 S 33
245 428
.4 .4 .2

4/11/73 5 SW 37
260 377
1.1 .1 .1

2/12/73 7 SE 33
222 518
.7 .1 .02

2/22/73 7 W 34
277 400
2.5 .6 .1

10/5/73 3 W 64
270 451
1.8 1.0 .1

10/12/73 10 SSW 68
249 451
.3 .1 .03

2/27/74 6 S 33
247 330
.4 .1 .05

4/5/73 8 SW 41
257 410
1.4 .7 .3

3/12/74 36
248 382
.01 0 0

2/26/74 3 S 35
239 359
.5 .1 .02

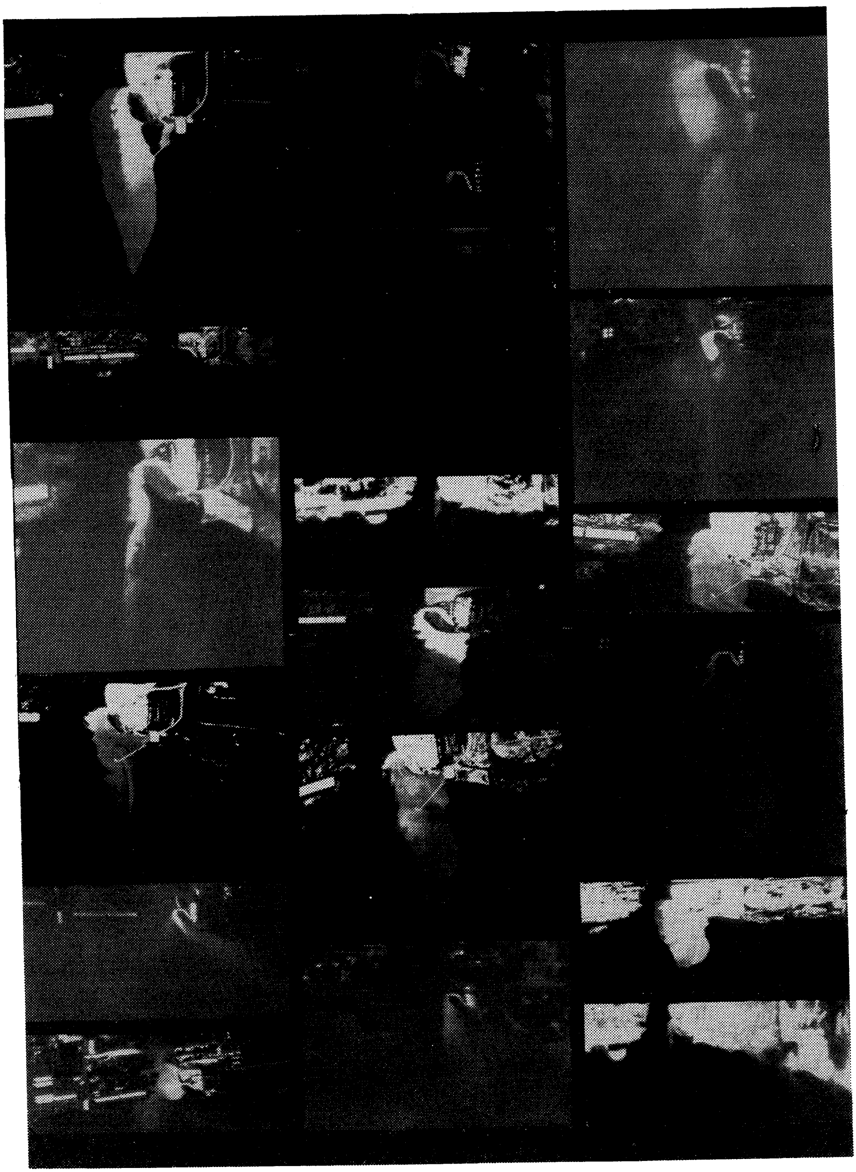


FIGURE 14. Thermal images for the Pulliam power plant. (A)

9/7/73 -- 70
290 603
.5 .1 .01

11/19/73 7 NE 42
331 385
4.6 1.3 .8

3/6/74 6 SW 36
246 382
3.4 .4 .2

4/23/74 9 N 44
360 593
.2 .1 .02

9/20/73 2 NE 58
282 451
.9 .5 .1

2/5/73 6 E 34
350 466
2.0 .2 .01

2/8/74 2 SW 33
275 415
.4 .2 .04

9/4/73 8 SSW 68
286 744
.5 .4 .2

9/14/73 5 SW --
322 744

3/7/74 9 NE 34
234 382
.3 .1 .03

9/12/73 4 NW 62
290 796
7.4 3.1 1.2

2/9/73 4 W --
356 466

6/12/74 --- 62
261 414

1/30/73 4 E 32
313 388
.7 .2 .02

3/13/74 2 E 36
245 382
.6 .04 .01

9/10/73 3 SW --
281 796

10/17/73 4 SW --
347 536

1/30/74 6 SE 33
359 471
1.6 .2 .02

7/10/73 3 NE 72
323 874
3.2 .8 .2

7/11/73 3 ESE 72
333 874
5.8 2.1 .1

FIGURE 15. Thermal images for the Pulliam power plant. (B)

6/15/73 4 SW 72
336 833
.8 .4 .02

3/23/73 7 SE 37
251 372
.4 .1 .03

6/14/73 3 SW --
328 833

5/30/74 --- 61
267 403
1.6 .4 .04

5/15/74 6 W 52
254 453
.4 .1 .02

5/31/73 5 SW 59
348 594
.6 .3 .1

5/21/74 --- 56
265 431
1.3 .5 .1

6/7/73 8 SW --
351 743
1.1 .5 .1

6/6/73 4 W 70
343 833
1.1 .6 .1

5/15/74 5 SW 50
244 453
.7 .4 .02

3/28/73 2 SE 34
258 363
1.3 .7 .3

5/11/73 11 W 54
347 652
.3 .2 .1

10/1/73 4 NE 66
283 373
.6 .2 .1

10/10/73 6 S 63
306 396
1.3 .7 .3

7/17/74 --- 76
284 848
.9 .1 .03

7/3/73 5 SSW 71
308 774
.8 .3 .03

9/14/73 4 SW 70
327 744
.3 .1 .02

5/30/73 7 S 52
341 594
.6 .3 .3

7/3/74 --- 72
360 932
.2 .1 .02

FIGURE 16. Thermal images for the Pulliam power plant. (C)

Thermal Standards The thermal standards for power-plant thermal plumes should be written operationally, as a compromise between "end-of-pipe" standards and biological-effect standards. That is, standards should be based on information that *can* be obtained with a reasonable effort. Standard remote-sensing monitoring procedures should be developed, which would include standardized, routine, ground-truth measuring techniques. The control of raw data through the entire processing procedure should also be standardized to insure that legal integrity is maintained. Every attempt should be made to avoid arbitariness by continuing intensive biological effect programs at a few representative plants, rather than studying all plants on relatively limited bases.

ACKNOWLEDGEMENTS

In any study as extensive as this many people besides the principal authors are necessary for completion of the project. It would be difficult to list everyone who contributed his time and talents. The authors are especially grateful for the invaluable assistance and cooperation of the DNR flight crew, specifically, K. Beghin, L. Sypchalla, J. Palmer, G. Olson, and T. Sheafor. This project would never "have gotten off" the ground without the superb administrative, technical, and advisory help offered by these men. In addition the quality of the scanner data is due in large part to excellent piloting of the DC-3 as well as the superior suitability of this aircraft for research purposes.

The authors also wish to thank university personnel, Dr. L. Fisher whose expertise in interactive computer programming was a critical and essential aspect for the success of this project, and F. Townsend, L. Jaeger, W. Reindl, G. Howard and C. Fricke who assisted in the preparation of this report. The authors are grateful for the support and cooperation of all agencies and utilities involved whose names are mentioned in the text.

BIBLIOGRAPHY

1. Neill, W. H., and J. J. Magnuson. 1974. Distributional ecology and behavioral thermoregulation of fishes in relation to heated effluent from a power plant at Lake Monona, Wisconsin; Trans. Amer. Fish. Soc. 103: 663-710.

2. Robinson, J. P. 1973. Migratory Movements of Adult Coho Salmon, *Onconorhynchus Kisutch,* in Lake Michigan as revealed by Ultrasonic Telemetry Methods: I. General Movements. II. Behavior Near the Point Beach Nuclear Power Plant Thermal Plume. M.S. Thesis; Zoology, Univ. Wisconsin—Madison.

3. Stuntz, W. E. 1973. Distribution of Fishes near Point Beach Power Plant, Lake Michigan; MS Thesis, Zoology, Univ. Wisconsin—Madison.

4. Scarpace, F. L., R. P. Madding, and T. G. Green III; 1975. Scanning Thermal Plumes; Photogram. Engr. and Remote Sensing 41: Oct., 1975.

5. Wisconsin Department of Natural Resources Administrative Code NR102.04: "Lake Michigan Thermal Standards;" Register, Jan. 1972.

6. Madding, R. P., and L. T. Fisher. 1976. Interactive Analysis of Thermal Imagery. Proc. Amer. Soc. Photogramm; 42nd Annual Meeting; Feb., 1976.

7. Madding, R. P., J. V. Tokar, and G. J. Marmer. 1974. A Comparison of Aerial Infrared and In Situ Thermal Plume Measurement Techniques. Proc. Environ. Effects Cooling Systems at Nuclear Power Plants; IAEA Symposium; Oslo, Norway; Aug. 1974.

8. Wisconsin Department of Natural Resources Proposed Adminstrative Code NR102.05; "Lake Michigan and Lake Superior Thermal Standards", approved by DNR Board, Nov. 21, 1974.

9. Razumovskii, I. T. 1972. Effect of the Atmosphere on the Accuracy of Measuring Sea-Surface Temperature by Aircraft-Borne Radiometers. Radiatsionnye Issledovaniya v Atmosphere (Atmospheric Radiation Studies), 1972. Translation available from U.S. Department of Commerce, Natl. Tech. Inform. Ser., Springfield, Va. 22151.

10. Ewing, G., and E. D. McAlister, On the thermal boundary layer of the ocean; *Science;* 131; 174.

CHANGES IN SUBMERGED MACROPHYTES IN GREEN LAKE, WISCONSIN, FROM 1921 TO 1971

Mary Jane Bumby
Green Lake, Wisconsin

ABSTRACT

In 1921, H. W. Rickett studied the macrophytes in this lake and his data are the basis for a 50 year comparison. The 1971 and 1921 data at the 30 selected stations showed that, overall, total biomass decreased. Five species increased in biomass while eight species decreased; four species of *Potamogeton* were not found in the 1971 quadrats, but all except one have been identified as still present elsewhere in the lake. *Myriophyllum spicatum, Vallisneria americana* and *Potamogeton crispus* have the largest increases, while *Chara* sp. had the largest decrease of more than 600 gm/m^2. The largest total biomass decrease occurred at the deepest area in the littoral zone 3 (3-10 m) with zone 2 (1-3 m) and zone 1 (0-1 m) also decreasing in that order. The sharp differences in biomass between the high and low stations selected from Rickett's report have diminished; all the previous high stations have declined in biomass and the low stations display no specific pattern of change. One high and one low station within the deepest zone located where effluents entered the lake, were devoid of vegetation in 1971. Over the 50 year span, the total percentage of dry weights of the comparable plant species showed an insignificant increase, but some individuals had significant variations.

No *Cladophora* problem existed in Green Lake during Rickett's observations, but, in 1971, the biomass of the filamentous algae, mainly *Cladophora* sp., formed a serious nuisance in the littoral zone and proved to be the most important autotroph by weight in zone 1 and third in both zones 2 and 3. Blue-green algae in the phytoplanktonic community in 1971 were *Microcystis aeruginosa, Anabaena flos-aquae, Aphanazomenon flos-aquae* and *Gloeotrichia echinulata.*

It appears that the littoral plant community in Green Lake has diminished in the past 50 years, especially in the deepest zone, although macrophytes of foreign origin, *Vallisneria americana* and filamentous algae are increasing in importance.

INTRODUCTION

Green Lake, located in Green Lake County (Lat. 42° 48′ N, Long. 89° 00′ W), has a narrowly oval outline oriented northeast to southwest with a length of 11.9 km and a maximum width of 3.2 km (Fig. 1). This lake, which is the deepest inland lake (72.7 m) in the

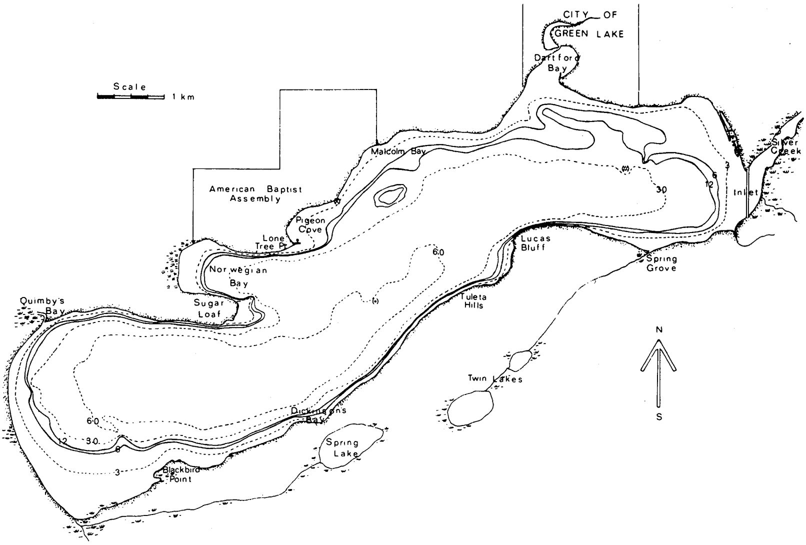


FIGURE 1. Hydrographic map of Green Lake adapted from Marsh and Chandler (1898) showing depth in meters and geographic features mentioned in text. Plankton samples were collected at Pier Station (X), Buoy Sation (#) and Deep Station (*). Some physical data were also obtained from the latter site (Bumby 1972).

state (Juday 1914), was formed by glacial action when the Green Bay lobe of the Wisconsin Stage of glaciation modified the preglacial valley formed earlier by stream erosion. The ice moved through this valley in the direction of the lake's long axis and deepened the basin which is underlain by easily worn Potsdam sandstone. Glacial drift closed the smaller tributary valleys and impounded the water into the present lake basin by depositing a moraine at the west end of the ancient valley. The water thereafter drained through a new outlet, the present day Puchyan River, which flows northeasterly to join the Fox River, finally draining into Lake Michigan.

Pietenpol (1918) noted that Green Lake is not "marsh stained". Silver Creek is the largest stream entering the lake; additional water comes from springs, either directly, or via five small streams on the SW and SE shores and one stream enters the head of Norwegian Bay, through land owned by the American Baptist Assembly (ABA). The hydrographic map of Green Lake (Fig. 1) shows the low areas which Rickett (1924) described as "extensive swamps and marshes" at the Silver Creek and other stream inlets. Other marshy areas are evident in the vicinity of Quimby's Bay and at the head of Norwegian Bay which Rickett described as a "muddy bog". The shoreline is diverse with low sandy beaches at the ends of the lake, wooded slopes of varying steepness, and perpendicular cliffs of Potsdam sandstone at Lucas Bluff, W of Lone Tree Point, S of Sugar Loaf and E of Dickenson's Bay. An unauthorized dam which raised the level of the lake 5 ft. (1.5 m) was built by the Victor Lawsons at one of the mills along the outlet; the date is unknown but probably was before the first hydrographic map (Marsh and Chandler, 1898) because the depth of the lake was reported by them as 72.2 m. Perhaps then, this change of water level, which affected the entire shoreline of the lake, occurred 23 years before Rickett's study of the macrophytes in the pristine water of Green Lake.

Presently, "Big Green", as it is often called, is, and has been for some years, heavily used for recreation during all seasons of the year. It is beautifully set within a densely wooded margin which is surrounded by a large watershed area of 27,618.8 ha (Marter and Cheetham 1971). This basin can be divided into 1,537.8 ha in roads and farmsteads, 991.1 ha in urban areas (two cities) and 1, 256.6 ha in public land; the remaining 86.3% (23,832.5 ha) is mostly in agricultural use. Because of its attractive setting, large size, depth and proximity to populated areas, there are many houses of all sizes along this lake's 43.9 km of shoreline. Fortunately, extensive parts of the shore have not been subdivided. The City of Green Lake is located on the NE edge of the lake near the outlet. The Wisconsin Department of Natural Resources is authorized to determine the maximum and minimum levels of the lake but the actual control of the level is in the hands of the City of Green Lake, since it owns the dam.

Sewer lines are located within the City of Green Lake (1,033 in 1970) but the lake is not affected because the partially treated sewage is discharged into the outlet. Plans are underway to improve this plant. In 1971, treated sewage effluents did enter the lake from the ABA treatment plant, which discharges into Norwegian Bay (Fig. 1) at station 13 (Fig. 2), and also from the City of Ripon (grown from 3,929 population in 1920 to 7,053 in 1970) through its

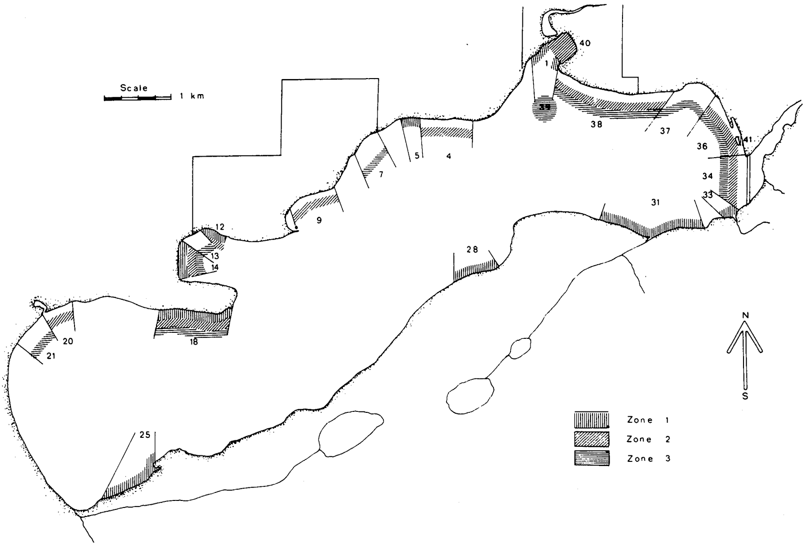


FIGURE 2. Outline map of Green Lake showing the location of the stations sampled in 1971. Depth zones at these stations are Zone 1 (0-1m), Zone 2 (1-3 m) and Zone 3 (3-10 m). Station numbers are those of Rickett (1924).

discharge into Silver Creek which enters near station 34 (Fig. 1 and 2). Septic systems are used in all other areas around the lake, regardless of steepness of slope, soil type, and height of land above the water table. Almost all of the previously described low-lying areas of the lake's shoreline have been affected by channels dredged for boat docks and by the dredge spoils used as land fill for real estate development. Perhaps because of these circumstances of population growth, large watershed area, sewage disposal methods and the change of the low-lying land from its natural state, many symptoms of deteriorating water quality have appeared in Green Lake in recent years. Colored oblique aerial photographs give evidence of some of these conditions (Bumby 1972). These photographs show opaque, discolored water entering the lake through the Silver Creek inlet which carries both Ripon's sewage effluent and runoff from a low-lying real estate development, and also at the opening of Quimby's Bay (which has been deepened and enlarged through dredging for real estate development). The obvious mixing of seston in the water in the littoral zone by heavy motorboat traffic is visible in another photo. But, the real evidence of increasing eutrophication of the lake is found in the plants including *Cladophora* sp. and other filamentous algae now growing abundantly attached to rocks and macrophytes to 1.5 m depth in spring and early summer; two introduced species, *Potamogeton crispus* and *Myriophyllum spicatum*, very prominent in the submerged community; the decreased biomass of submerged macrophytes; and the various blue-green algae floating on or near the surface of the water in summer.

In the six years since the summer of 1971 several changes have occurred. The *Potamogeton* species which were reported in 1921 but not collected in 1971, have been identified (except for one) along with previously unreported species in Green Lake. Concern for water quality has risen over the effect of the body wastes of the Canada geese which linger at Green Lake until late freeze-up date in mid-January. This problem has been aggravated by the new DNR policies enacted to make Horicon Marsh inhospitable to the migrating geese. But perhaps recent changes to liberalize hunting regulations will help. The three collective sewage systems in the watershed area have made improvements. The ABA put into operation a primary facility with an absorption pond for land disposal of effluent to avoid discharge into Norwegian Bay. The Green Lake City sewage system has been extended to some lakeshore residents and a hotel, and is now planning the necessary enlargement and modernization of its sewage plant. The City of Ripon has in almost full operation its new modern activated sludge, tertiary treatment system which will significantly change Silver Creek and its environs. Fifteen Ripon College students completed studies of the physical, chemical and biological parameters from June 1972 to August 1974 paid by the federal government and by the Green Lake Association. This latter organization of interested volunteers pursues many issues and problems concerning the lake. The Green Lake Sanitary District (established in 1964) is financing a study which will produce a feasibility report on control of the input of nutrients into the lake. The conversion of the sanitary district into a lake district is an important issue before the Green Lake County Board. Mechanical harvesting of nuisance weeds had been studied and considered too expensive but some owners have sprayed herbicides on the aquatic weeds and algae. This approach is not inexpensive either and may have more detrimental effects than now known, besides causing toxic reactions in unknowing swimmers who enter these areas too soon after spraying. The problems of the changes in water quality of Green Lake are profoundly interwoven with human activity.

METHODS

The sampling method used in this study was based as nearly as possible on Rickett's method so that data from the two studies could be validly compared. Rickett (1924) chose 41 stations of which 38 were determined by shore characteristics and the three others were marshy bays. At each station, aquatic plants were taken from three depth zones: zone 1 (0-1 m), zone 2 (1-3 m), and zone 3 (3-10 m or where plants cease to grow) and collections were taken in the shallow zone first. A square frame of thin, heavy metal, 50 x 50 x 7 cm, was used to delineate a 0.25 m^2 area of the bottom, and all large algae and macrophytes (including roots) within the frame were collected.

Actually, the pattern Rickett used for the collection of samples is not clear. He stated that multiple samples were taken at stations in zones 1 and 2, whereas, because the plants in zone 3 were more homogeneous where bottom type and slope were similar, one collection was often applied to several of these similar stations in that zone. The number of 0.25 m^2 samples collected averaged less than three per station for all depth zones. Whatever the pattern of sample collection used by Rickett, the weights were computed in g per m^2 for each species at the stations; see Tables 3, 4 and 5 of Rickett (1924). I used the totals of these 1921 wet weights in choosing the stations to be studied in 1971. No dates of collection of samples were furnished in the 1921 study.

For this 1971 study, ten of Rickett's 41 stations were selected in each zone (depth) to include the five highest and the five lowest in wet weight total values. Because of these criteria, it can be noted in Fig. 2 that the ten stations compared over the 50 years for zone 1 are not necessarily the same stations used for zones 2 or 3. The pattern for the collection of the samples consisted of the following: in both zones 1 and 2, samples were taken at three different anchorages randomly located within the limits of each station, whereas in zone 3, one sample was randomly collected at each station. Wet weights were tabulated, averaged (for zones 1 and 2) and then computed into g/m^2 for all species collected within each of the 10 stations at each of the three zones. Thus, data of 1971 and 1921 can be satisfactorily compared for the majority of the species; the problems involving the species will be revealed below.

The 1971 collections in zone 1 were completed July 7-9; all 30 samples were taken within 0.5-1.0 m depth, average 0.8 m. In zone 2, the 30 samples were collected between 1.4-2.6 m, average 2.1 m and were taken from July 16-30. The 10 samples in zone 3 were collected on August 7-8 in depths ranging from 3.7-5.2 m, average 4.4 m. Sometimes a clear line was observed at about 4.6 m beyond which little or nothing grew on the bottom; Rickett reported no plants after 8 m.

Labeled plastic bags separated each sample collected within a quadrat and kept the plants fresh. Collected material was examined and sorted the same day by placing the contents into a large, white enamel pan filled with water. As much of the filamentous algae as practicable was separated from the *Chara* sp. and other macrophytes. After sorting and identifying the species of macrophytes and filamentous algae (under 20 to 140x magnification), they were wrapped in absorbent, dry cloths to remove the excess water, then unwrapped and weighed with a Dial-O-Gram scale accurate to 0.1 g. The weighed samples were separately placed in labeled paper bags and dried at 70 C for 4-6 days. Rickett estimated dry weights from the wet weights with a factor for wet:dry for each species.

Data for biomass of the filamentous algae over the 50 year period are not comparable because in 1921 algal biomass was not determined for each quadrat. Rickett wrote of the lack of *Cladophora* sp. in Green Lake, contrasting this with the serious algal problems in Lake Mendota at that time. He reported that in Green Lake *Cladophora* sp. grew only as a fringe on a few of the rocks at the edge of the water or a few inches below the surface in some areas. Estimations of the biomass of the very few large patches of *Cladophora* sp. then growing in Green Lake in zone 1 were obtained with a different technique from the collection of plants in quadrats; the perimeter of a patch was estimated by Rickett after rowing a boat around it and, from the wet and dry weights directly obtained from the algae collected in one of these patches, the biomass of the other patches was approximated. Therefore, it was not possible to satisfactorily compare these different areas and weight measurements for *Cladophora* over this 50 year interval.

The total biomass collected in 1971 at each station and zone is presented in two ways in this report; the biomass is given both with and without the weights of the filamentous algae, mainly *Cladophora* sp. Without the algae, the values are the basis for comparison with Rickett's data, while the inclusion of the algae gives a clearer portrayal of the plant community in Green Lake during the growing season of 1971.

In 1971, the samples in zone 1 and 2 were taken by a diver using snorkel, face mask and flippers. A SCUBA diver collected the plants in zone 3, using a pressure sensor to determine the exact depth at which the samples were taken. A "diver with a helmet" was used by Rickett in the deepest zone.

Rickett wrote of the lumping of rare species with similar macrophyte species because his study was a quantitive one. Certainly, it is unfortunate that no voucher specimens from his study could be located because verification of their identifications would help answer several questions. Voucher specimens from the 1971 study are deposited in the University of Wisconsin-Milwaukee herbarium. The nomenclature for various plant species is that of Fassett (1960) as revised by Ogden (except for the species of *Myriophyllum* and *Ranunculus);* algae were identified according to Smith (1920), and the revised edition of Ward and Whipple (Edmondson 1963) was used for the zooplankton.

RESULTS

The biomass of the individual species of submerged macrophytes in 1921 and 1971 are discussed in sequence from the largest over-all increase in wet weight to the largest decrease, followed by comment on those plants which seemingly disappeared. References are made to minor aquatic plants, to attached filamentous algae (according to biomass), to plankton (according to presence), and to some physical data.

This report gives the macrophytes found in Green Lake in 1971 and also in 1921, the macrophytes reported only in 1921, and the macrophytes not found in 1971 but identified later from 1971 to 1974; 6 taxa of macrophytes are noted which either were not present in 1921 or were possibly missidentified at that time. The basic data for these comparisons of changes in biomass and species are tabulated in the thesis (Bumby 1972) in Appendices A, B and C and are summarized in its Tables 3, 4 and 5. Each species collected in 1971 is compared to the 1921 data according to their biomass (total g/30 m^2 for total zones or total g/10 m^2 for any one zone) numerically and in percentage (Bumby 1972), and here graphically (Figs. 3, 4, 5, and 6).

The biomass of the algae is often indicated in the above data for each macrophyte species at the zones as it is also for the changes in the selected stations in each zone (Figs. 7A, 7B, 8A, 8B, 9A, 9B).

BIOMASS CHANGES IN SUBMERGED MACROPHYTES

Increases

The following taxa increased in wet weight biomass over the 50 year period in the selected stations. Approximations of biomass compared are in total g/30 m^2 with or without the inclusion of the filamentous algal biomass. As the result of this study, the most abundant species and the one with the largest increase in biomass is *Myriophyllum spicatum* L. The species identified as *M. verticillatum* L. var. *pectinatum* Wallbr. by Rickett is no longer present in the lake in any of the stations checked in 1971 (where it had been abundant in 1921). Its place has been completely taken over by the Eurasian invader, *M. spicatum*, with more than one-third increase in biomass (Fig. 3). As mentioned before, no voucher specimens from the 1921 study have been located so the specimens concerned cannot be verified. Thus, it is possible that the species of the 1921 study may have been either incorrectly identified or may have changed from a minor species (the same or a different minor species) to a dominant one in the plant community today. In my thesis, I designated this taxon as *M. exalbescens* Fernald, but it was identified from voucher specimens as *M. spicatum* in November 1972 by F. M. Uhler of the Patuxent Wildlife Research Center, Laurel, Maryland.

Myriophyllum spicatum is the most important plant in Green Lake today and this is not unusual for a hard water lake of 163 to 183 ppm $CaCO_3$ (Hasler 1967). Over the 50 year period, total wet weight of the *Myriophyllum* taxon increased by 2,232 g. Its 1971 total wet weight of 8,265 g represented 46% (56% dry weight) of the total biomass in this comparative study (Bumby 1972). In 1921, Rickett reported *M. verticillatum* L. var. *pectinatum* Wallbr. present in Green Lake with a total wet weight of 6,033 g which was only 11.6% (10% dry weight) of the total biomass at the selected stations. Flowers and fruits were found on floating *Myriophyllum* on July 2, 1971 and, in September, more flowers and fruits were seen on both floating and rooted plants in a sheltered area. During the summer and fall of 1972 and 1973, no fertile plants were observed, but 1974 produced profuse growths of fertile plants.

The species showing the second largest increase in biomass is *Vallisneria americana* Michx. whose wet weight was 1,785 g in 1971 in contrast to 214 g in 1921. In 1971, this wet weight was about 10% of the total biomass whereas 50 years ago, it was only 0.4%.

Rickett listed *V. spiralis* L. as being present in Green Lake, but this seems to be an error in identification; Fassett (1960) comments that the latter species is European and the only species recorded in North America is *V. americana*. Also, only *V. americana* has been

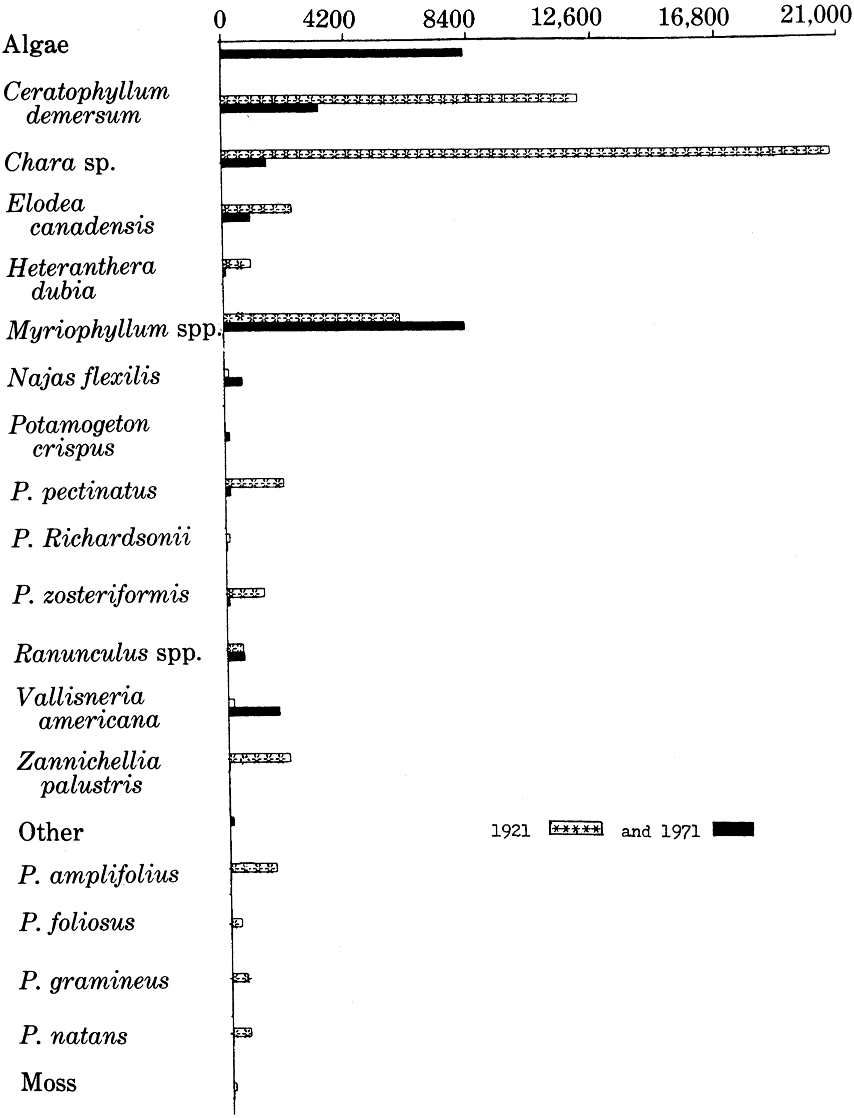


FIGURE 3. The total changes in wet weight biomass g/30m² of each species collected in the three zones in 1921 and 1971.

reported by Nichols and Mori (1971), Modlin (1970) and Belonger (1969) whereas Rickett (1922) reported that it had the greatest biomass in Lake Mendota in 1920.

Third in the series of those macrophytes showing increases is *Najas flexilis* (Willd.) Rostk. and Schmidt, one of the three taxa in Green Lake with true hydrophily. It increased in wet weight from 186 g (0.4% of total biomass) to 647 g in 1971 (3.6% of total biomass).

Ranking fourth in weight among taxa with increasing total biomass was an early summer macrophyte which was not reported in the 1921 study. *Potamogeton crispus* L. has a total wet weight of 180.4 g which was 1% of the total biomass in this study. Since it disintegrates in early summer, its weight is probably undervalued. The appearance of *P. crispus*, an important European invader, may be of particular significance in judging the quality of lake waters because it often appears in polluted water (Fassett 1960) and in waters which have been enriched with city wastes (McCombie and Wile 1971). On the other hand, Sculthorpe (1967) includes *P. crispus* with the "almost truly cosmopolitan" submerged hydrophytes which become easily established in the areas where native plants are not well adapted. Its turion is the most highly specialized of all the aquatic plants and these winter buds were often seen floating in Green Lake during this study and have become increasingly evident in the summers since 1971. Fertile plants were not noticed until 1974, when they were profuse. Since its introduction from Europe, it has spread to the West Coast (Ogden 1943), and Moyle (1945) reported this species in Minnesota about 1910; perhaps this plant was in the lake in 1921 and was lumped in with another *Potamogeton* species. Unfortunately, this taxon will probably become extremely important in the plant community because of its abundant vegetative reproduction.

Comparison of weights of *Ranunculus longirostris* Godron [= *R. circinatus* Sibth. (Fassett 1960)] with weights of the *Ranunculus* sp. reported in 1921, indicated the least gain in biomass, only 19 g. The 1921 *Ranunculus* sp. with 553 g wet weight, was 1.1% of the biomass; the 1971 species, with 572 g wet weight, was 3.2% of the biomass. On July 2, 1971, flowering specimens of the former species were identified in the floral key of Muenscher (1944). Rickett had reported the presence of *R. aquatilis* L. var. *capillaceus* D.C. (now called *R. trichophyllus* Chaix., according to Fassett, 1960). The species Rickett found was not collected in the present study. However, both of these species have been reported in water bodies in this area by Belonger (1969), Modlin (1970) and Nichols and Mori

(1971) who cite *R. longirostris*, while *R. trichophyllus*, reported by Rickett, was listed by Lind and Cottam (1969). Interestingly, Hotchkiss (1967) considers *R. aquatilis* and *R. longirostris* as the "same". As in the *Myriophyllum* situation, a complete replacement by another species of the same genus over the 50 year period may have occurred or there may have been an error in identification, which cannot be resolved because no herbarium specimens of the earlier collection are available.

Decreases

The following taxa showed declines in wet weight biomass at the 30 stations compared in 1921 and 1971. Often an increase in percentage of the total biomass in 1971 will be evident which reflects the decline in total biomass of that year, especially for those species in the lower range of decreases. See Fig. 3.

Potamogeton Richardsonii (Benn.) Rybd. changed from 119 g in 1921 to 53 g in 1971. This taxon had the least decline in wet weight biomass, although it constituted only 0.2% of the total biomass 50 years ago and 0.3% in 1971. This minor increase may reflect the different total biomass values in these studies.

Second in the group of species with decreases is *Heteranthera dubia* (Jacq.) MacM. which declined a total of 867 g and changed from 1.8% of the 1921 total biomass to 0.5% in 1971.

Potamogeton zosteriformis Fernald decreased 1,234 g in wet weight and changed from 2.5% of the total biomass in 1921 to only 0.4% in 1971. Perhaps indicative of its low status in eutrophic lakes is its relative frequency of 0.12% in University Bay (Lind and Cottam 1969) and 0.4% in Lake Wingra (Nichols and Mori 1971).

Elodea canadensis (Michx.) Planchon [= *Anacharis canadensis* (Michx.) Planchon] changed from 2,380 g wet weight in 1921 when it was 4.6% of the total biomass, to 952 g of wet weight and 5.3% of the total biomass at the present time. McCombie and Wile (1971) found that *Elodea* sp. was either absent or abundant, but always associated with abundant *Chara* sp., in the clearer impoundments with specific conductivities between 224 and 330 micromhos/cm^2 at 18 C. Because *Chara* sp. also declined in the 1971 study (see below), this study seems to support their observations of a relationship between these two taxa.

Potamogeton pectinatus L. diminished 1,858 g in wet weight since 1921. Its biomass changed from 4% of the total biomass in 1921 to 1% of the total biomass in 1971. The date of collection is important as this is a late-maturing plant (Belonger 1969). Fertile plants were common every year 1971-74 in Green Lake. Sculthorpe (1967) wrote that *P. pectinatus* may grow in very polluted areas and is among the "silt-loving species". This seems contradictory in this study, since silted and polluted conditions are a recent occurrence in this lake; perhaps this plant is responding to other physical or chemical environmental factors.

Zannichellia palustris L., one of the few macrophytes with true hydrophily, was identified by its seeds on frail, otherwise barren stems, collected in July and early August 1971. The biomass of this early-summer plant would have been greater, if its leaves had been present at the time of collections. During the time of the study, this plant showed a decrease of 2,072 g in wet weight with a change from 2,083 g in 1921 (4% of the total biomass) to 11.4 g (0.06% of the total biomass) in 1971. It was not reported by Modlin (1970), Belonger (1969), Nichols and Mori (1971), Livingston and Bentley (1964) or McCombie and Wile (1971). Lind and Cottam (1969) reported it in University Bay in Lake Mendota with a relative frequency of 0.03% and noted that it had not been reported previously in that area. It is a very small plant which matures in early June and could be easily overlooked if broken into small pieces.

Ceratophyllum demersum L., another common plant with submerged hydrophilous flowers, diminished 8,834 g in wet weight from 12,190 g (23% of the total biomass) in 1921 to 3,356 g (19% of the total biomass) in 1971.

Chara sp. showed the most dramatic decline from its peak biomass 19,194 g (40% wet and 54% dry of the total biomass) in 1921 to 1,553 g (9% wet and 13% dry of the total biomass) in 1971. In 1971, *Nitella* sp. was observed in Green Lake in very small quantities and was not separated from *Chara* sp. Rickett reported the abundance of *Chara* sp. in Green Lake; he found that it grew " . . . almost everywhere . . . sometimes mixed with other plants, often forming great masses in which no other form can get a foothold." He contrasted its abundance in Green Lake with its paucity in Lake Mendota which he had studied the summer before. The difference he attributed to Lake Mendota's muddier bottom and its warmer, more turbid water. Recent documentation of the abundance of *Chara* sp. has been reported by Modlin (1970) and Belonger (1969) and the tolerance of it for wide ranges of $CaCO_3$ (4.2-118 ppm) can be found in the work of Livingston and Bentley (1964). However, environmental situations exist where no *Chara* sp. can be found, as in Lake Wingra (Nichols and Mori 1971), and where it is the taxon with the lowest relative frequency of 0.01%, as in University Bay in Lake Mendota (Lind and Cottam 1969). Thus, *Chara* sp., although still present in Lake Mendota, is very limited (at least in University Bay). It has declined in Green Lake, according to this study, from about 50% to 10% of the total biomass over these 50 years and yet it is still very successful in other lakes mentioned above. Can there be chemical and/or physical parameters causing these two opposite trends? Perhaps the increased erosion of the rich farmland in the watershed area is changing Green Lake's bottom and its water clarity to be more like Lake Mendota's of 1920.

Aquatic Plants Reported in 1921 But Not Collected in 1971

Four species of *Potamogeton* which occurred in Green Lake in 1921 were not found in the 1971 quadrat samples: *P. amplifolius* Teckerm., *P. foliosus* Raf., *P. gramineus* L. and *P. natans* L. However, *P. natans* and *P. gramineus* were found in other areas of the lake during the 1971 study. *P. amplifolius* and *P. foliosus* were not collected in quadrats nor observed elsewhere in the lake in 1971. In Rickett's study, these four species collectively represented a small percentage (6.4%) of the total biomass. Further investigation during 1972 through 1974 led to the verification of the presence of *P. amplifolius, P. nodosus* Poir., and *P. friessi* Rupr. The narrow-leaved *Potamogeton* species (which resembles *P. foliosus)* was determined by R. R. Haynes. No flowers were observed in 1971, but, except for *P. natans,* fertile plants were found during succeeding summers.

In 1921, *P. amplifolius* was relatively abundant at 3% of the total biomass. Besides its apparent absence in 1971 in Green Lake, it also was not reported in Lake Wingra (Nichols and Mori 1971) or University Bay of Lake Mendota, although it had been a common species in 1922 (Lind and Cottam 1969). Documentation of its abundance in other areas are given by Modlin (1970) and Belonger (1969). In 19 impoundments in Ontario, this aquatic plant was found only in the least fertile impoundment with the lowest conductivity and with Secchi disc reading of 2.2 m (McCombie and Wile 1971). Presently in Green Lake, it does grow in beds between stations 28 and 25 (Fig. 2).

Although present in Green Lake in 1971, *P. gramineus* was not recorded in any of the quadrats; its special floating leaves and flowers were not observed in 1971 nor during the years since. This species comprised 1.1% of the total biomass in 1921.

P. natans made up 1.2% of the total biomass in 1921. Although seen in the lake in 1971, it was not collected in any of the quadrats. No flowers were seen in the years since, but its floating leaves have been observed.

P. foliosus had a wet weight of 363 g or 0.7% of the biomass in the collections of 1921. In 1971, this species was not found in the quadrats nor through casual sampling in the years since but a similar plant *(P. friessi)* was verified in 1972 and 1973.

Minor Aquatic Plants

Several aquatics such as a moss and species of *Lemna* were observed in 1971 but not in sufficient quantities for adequate comparisons (Table 3 of Bumby 1972).

In 1921, these plants comprised 0.4% of the total biomass. Rickett stated that a diver could sink up to his knees into beds of the moss *Drepanocladus* sp., quite abundant in zones 2 and 3. Only one of the selected stations sampled in 1971 had mosses in 1921; thus, these plants occur but in sparse distribution.

Lemna minor L. and *L. trisulca* L. were found in the lake, the latter only in very small numbers in Dartford Bay quadrats (station 40) where this tiny flowering plant was entangled with algae and macrophytes growing on the bottom.

Neither the aquatic moss nor *Lemna* sp. was present in sufficient numbers to be compared with Rickett's results or listed except as minute amounts or traces (X) in the figures and tables (Bumby 1972).

The Algae

Attached algae collected in Green Lake in 1921 and collected in 1971 were: *Cladophora* sp., *Nostoc* sp., *Rhizoclonium* sp., *Rivularia* sp., *Spirogyra* sp., *Tolypothrix* sp., *Ulothrix* sp., *Zygnema* sp. *Vaucheria tuberosa (?) was not collected in 1971.*

Although this study is mainly concerned with macrophytes, some observations of the algae were made in 1971 because they are significant in interpreting the changes in biomass in Green Lake. Massive nuisance blooms of *Cladophora* sp. have appeared in Green Lake in recent years; these growths often extend from the waterline down to a depth of 1.5 m in rocky areas. No *Cladophora* problem existed in 1921 and Rickett used a different technique for estimation of the algal biomass. Rickett noted that sometimes

Oedogonium sp. replaced *Cladophora* sp. in the muddier stations and *Spirogyra* sp. also grew on the plants and rocks.

In 1971, most of the algae were of the filamentous type and only a cursory microscope examination of each sample collected in a quadrat was made to identify the conspicuous genera. The weights of the algae which were collected in the quadrats in each zone are on record in Table 3 (Bumby 1972) and the weights at each station are in Appendices A, B and C (Bumby 1972); weights of non-filamentous algae (as *Rivularia* sp. and *Nostoc* sp.) are not included, unless found attached to the macrophytic plants in all zones, and not separated from these plants when they were weighed.

Algae listed above were attached either to the macrophytes or to the rocks under shallow water. In zone 1, 24 of the 60 samples contained filamentous algae; in zone 2, 33 of the 60 samples; while in zone 3, only 2 out of 10 samples (actually 2 in 8, as two samples were devoid of plants) contained weighable quantities of filamentous algae. Their occurrence in zone 1 (from the highest to the lowest frequency) are *Cladophora* sp., *Rhizoclonium* sp., and *Spirogyra* sp., whereas in zone 2, *Cladophora* sp. was most abundant followed by *Rhizoclonium* sp., *Zygnema* sp., *Rivularia* sp. and *Tolypothrix* sp. In zone 3, *Rhizoclonium* sp. and *Rivularia* sp. were present but sparse.

In recent years, a massive floating bloom of *Spirogyra* sp. has been an unsightly covering of the lake along the shore but only on calm days in the very early spring. *Vaucheria tuberosa (?)* was listed at one station in 1921, but was not observed in the present study. The attached filamentous algae were extremely important among the autotrophs in Green Lake in 1971 and will be discussed further with the macrophytic biomass changes within the zones and stations.

CHANGES IN THE PERCENTAGE OF WATER TO DRY CONTENT FOR EACH SPECIES

The dry weight comparison for each species found in 1921 and 1971 are listed in Table 1 as percentages of wet weights. Eight of the 12 macrophytes with comparable data were almost at the same level of water content in both studies. For that reason I have used wet weights in most of these comparisons but dry weights are shown in the graphs (Figs. 7, 8 and 9) and data are in the thesis (Bumby 1972). Comparing dry weights of the taxa eliminates the weight variability accumulated because of the differences in both water adhering to the outside of freshly sampled plants (due to the

TABLE 1. PERCENTAGE DRY WEIGHT IN EACH SPECIES FOR ALL ZONES IN 1921 AND 1971

Species Found in 1921 & 1971	% Dry Wt. 1921	% Dry Wt. 1971
Algae		18.22
Ceratophyllum demersum	7.02	8.50
Chara sp.	15.08	20.12
Elodea canadensis	4.4	13.07
Heteranthera dubia	10.56	9.28
Myriophyllum spicatum		16.44
M. verticillatum var. *pectinatum*	9.63	
Najas flexilis	9.93	10.05
Potamogeton crispus		7.97
P. pectinatus	12.21	12.50
P. Richardsonii	14.64	19.35
P. zosteriformis	12.41	14.10
Ranunculus longirostris		13.35
R. aquatilis var. *Capillaceus*	11.69	
Vallisneria americana	7.71	6.49
Zannichellia palustris	6.96	7.10
Other		14.35
P. amplifolius	11.9	
P. foliosus	10.55	
P. gramineus	11.5	
P. natans	11.43	
Moss	19.49	
Lemna Sp.		5.71
With Algae:		15.06 ± 4.65 S. D.
Without Algae	11.19	13.58 ± 4.52 S. D.

differences in leaf forms, etc.) and in the water content within the structurally different cells of the plants (Sculthorpe 1967).

Every species in each sample collected in 1971 was weighed both wet and dry. In contrast, Rickett dried about 12 samples of a species, averaged the dry weights as a percentage of the wet weights and then used these averages for estimating dry weights of these samples. The macrophytes in 1921 had an average dry weight percentage of 11.2; the 1971 average dry weight was 13.6% ± 4.52% S.D. The minor differences in the 1971 and 1921 dry weights may be due to an increase in epiphytic algae and other organisms clinging to the macrophytes, to an increase in the settling out of particulate matter from the water, to an increase in the accuracy of the equipment and to the differences in the technique for determining dry weights in the two studies. The latter does not permit a comparison of the significance of the changes in dry weights because there is no way of estimating the within-sample variance of Rickett's data.

Although no great change in the total percentage of dry weight of the aquatic plants in Green Lake occurred over this 50 year period, some significant variations appeared among the individual species. *Elodea canadensis* indicates a three fold increase over the 1921 percentage dry weight; however, its 1921 percentage of 4.4 seems unusually low. What may be two *Myriophyllum* species (as identified in 1921 vs. 1971) have a substantial difference almost twice what was reported in the earlier survey and *Chara* sp. showed a 25% increase in 1971 weight data. Macrophytes with almost the same dry content in both studies are as follows: *C. demersum*, *H. dubia*, *N. flexilis*, *P. pectinatus*, *P. zosteriformis*, *Ranunculus* spp., *V. americana* and *Z. palustris.*

BIOMASS CHANGES IN THE ZONES

Previously, I discussed changes of the individual taxa in total biomass (Fig. 3); next the changes in the individual macrophyte species collected in each zone in 1921 and 1971 as wet weights in grams are shown graphically in Figs. 4, 5 and 6. These are based on the numerical total wet weights (g/10 m^2) which are listed for each zone in Table 3 (Bumby 1972).

In zone 1 (Fig. 4), a shift of dominance occurred from *Chara* sp. and *Ceratophyllum demersum* to *Chara* sp. and *V. americana.* Altogether, 14 species were found in zone 1 in 1921 with wet weights ranging from 2,520 to 44 g, whereas 13 species were present in 1971 with wet weight ranging only 614 to 3.3 g. The total biomass of macrophytes of this shallow zone in 1971 was only about one-third that in 1921. The filamentous algae were the most important autotrophs in this zone in 1971.

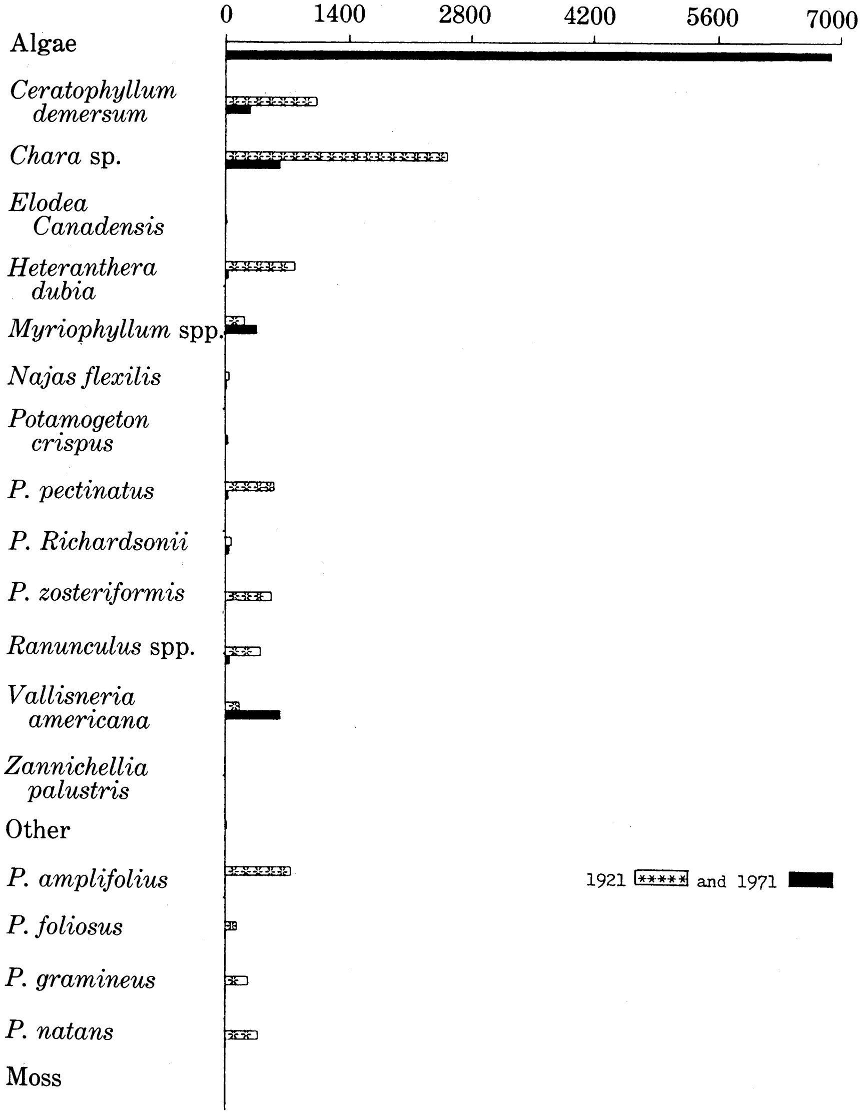


FIGURE 4. Total biomass in grams wet weight collected at zone 1 in 1921 and 1971

The 17 species found in 1921 in zone 2 (Fig. 5), varied in wet weights from 12,974 to 7.0 g whereas the 15 species present in 1971 varied from 4,543.2 g to a trace (X). This involved an obvious shift

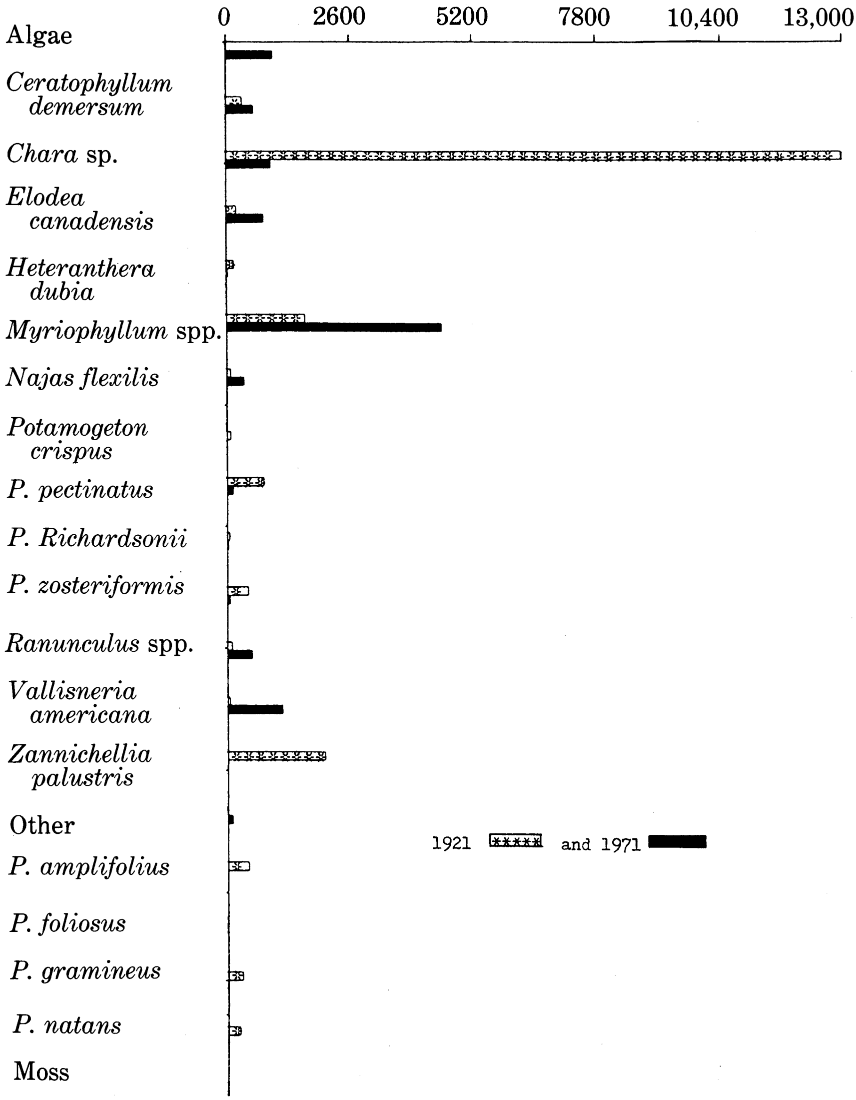


FIGURE 5. Total biomass in grams wet weight collected at zone 2 in 1921 and 1971

from *Chara* sp. to *Myriophyllum* and *Vallisneria* dominance at zone 2 during the 50 year period.

Of the 13 taxa found in zone 3 (Fig. 6) 50 years ago, the wet weights ranged down from 10,815 g. Although 11 of the 13 species

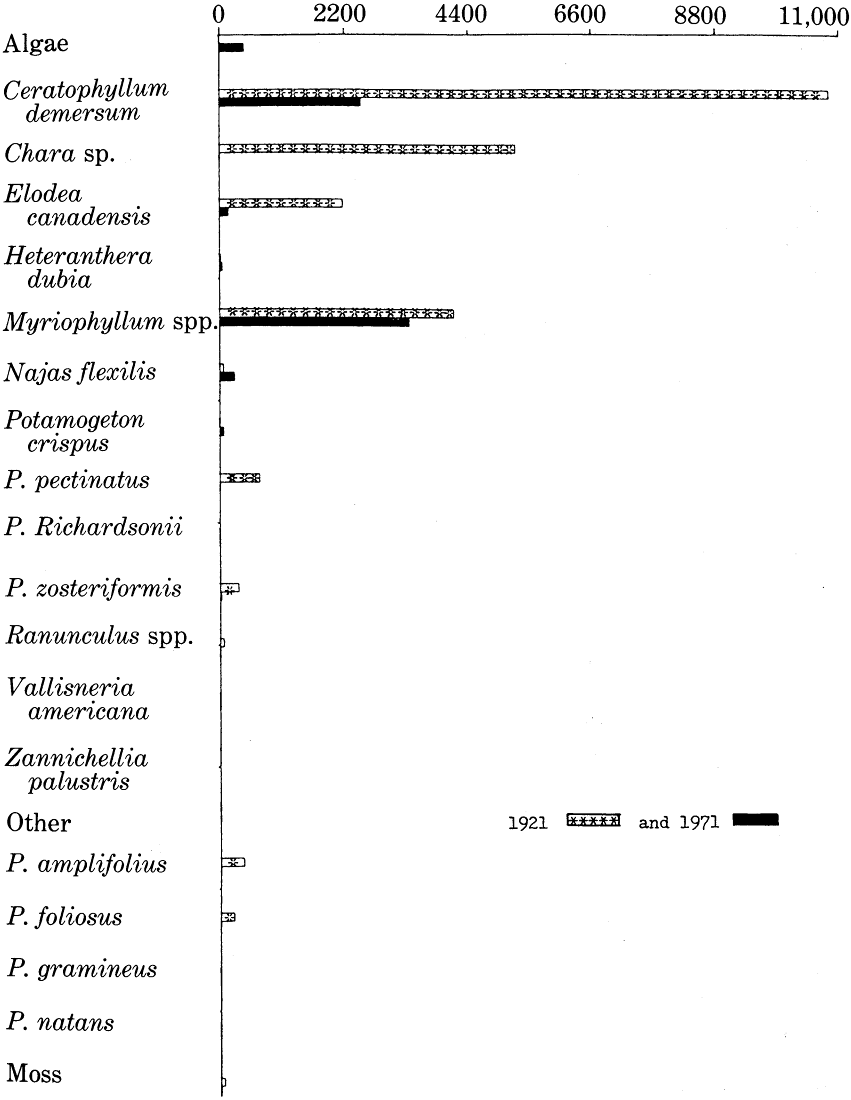


FIGURE 6. Total biomass in grams wet weight collected at zone 3 in 1921 and 1971

were present in 1971, their 3,370 g wet weights showed a reduction of about two-thirds in zone 3 and a shift of dominance from *Ceratophyllum demersum* and *Chara* sp. to *M. spicatum* and *C. demersum.*

The change in the diversity of the macrophytes is not clear because of the four *Potamogeton* species not found in the quadrats in 1971; it cannot be stated, then, that they moved to another zone or that they disappeared from the lake. These include *Potamogeton amplifolius, P. foliosus, P. gramineus* and *P. natans* which were present in all zones in 1921 except for *P. natans* (not reported in zone 3 by Rickett). In 1971, *Zannichellia palustris, Elodea canadensis* and *P. crispus* seem to be newcomers in zone 1; *P. crispus* and a trace of *Lemna trisulca* were observed in zone 2, and in zone 3, *P. crispus* was the only new plant which grew here if the changes in identification of both the *Myriophyllum* genus and the *Ranunculus* genus are agreeable and *P. crispus* was not lumped in with another similar species in 1921.

The total wet weight biomass in zones 1 and 3 diminished percentagewise in almost the same relationship (–73% and –74%), while in zone 2 it decreased the least (–53%). When attached filamentous algae were included, there is a gain in biomass in zone 1 (+16%) but still loss for both zones 2 (–48%) and zone 3 (–72%). The zone 3 figure reflects the relatively low total of algae in the deepest zone, while the zone 1 figure reflects the higher total weights of the algae there (Table 7 of Bumby 1972).

CHANGES IN TOTAL BIOMASS AMONG THE SELECTED STATIONS

Figures 7A, 8A, and 9A represent graphically the wet and dry weights of the submerged macrophytes present in 1921 and 1971 at each station within the separate zones. The station numbers are arranged according to the decreasing values of the total wet weights in g/10 m^2 of the plants tabulated by Rickett in 1921. Figures 7B, 8B and 9B include the wet and dry weights of the attached filamentous algae which were recorded in the 1971 study along with the weight of the macrophytes. These graphs are based on the data in Bumby (1972) Appendices A, B and C. The recent and past situations at these stations are quantitatively presented for the macrophytes and for the biomass of the algae in 1971 (by weight) which can be seen when any station in B is compared with the same station in A.

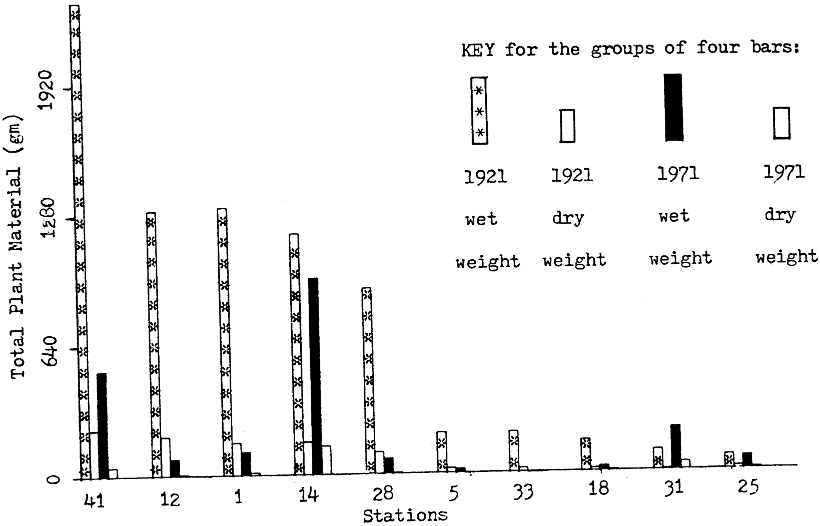


FIGURE 7A. Total macrophytic biomass in grams wet and dry weights collected at the ten stations in zone 1 in 1921 and 1971

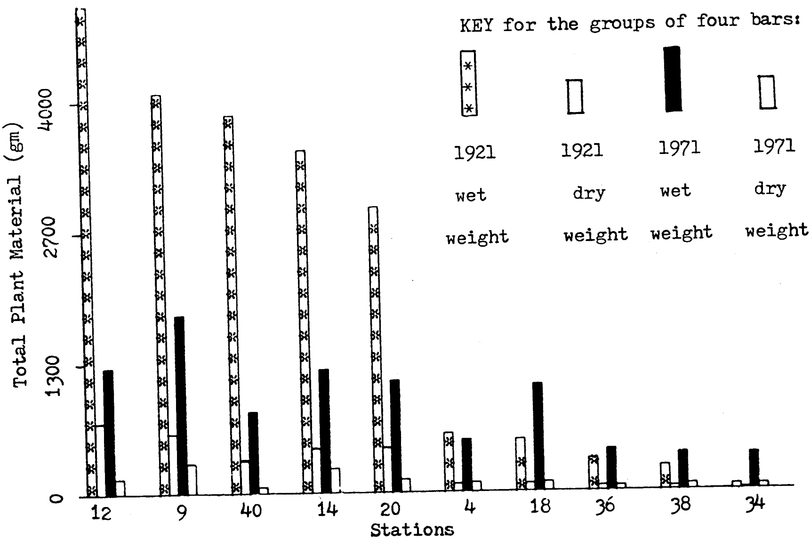


FIGURE 8A. Total macrophytic biomass in grams wet and dry weight collected at the ten stations in zone 2 in 1921 and 1971

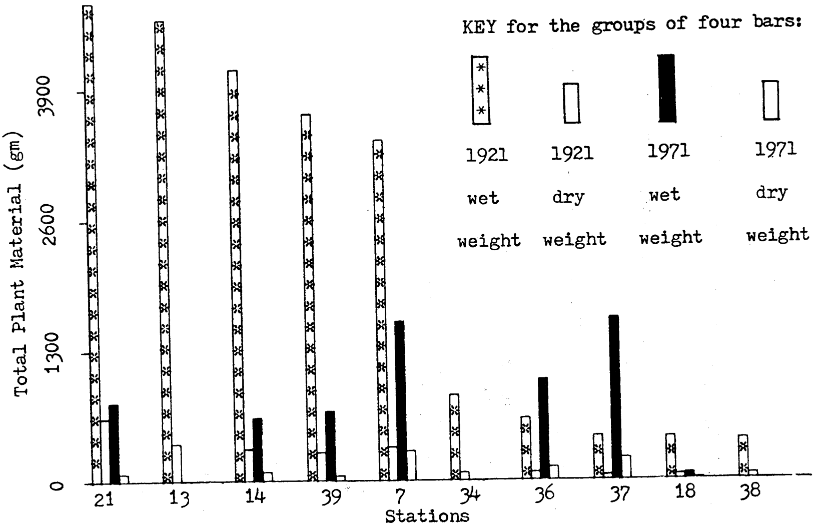


FIGURE 9A. Total macrophytic biomass in grams wet and dry weights collected at the ten stations in zone 3 in 1921 and 1971

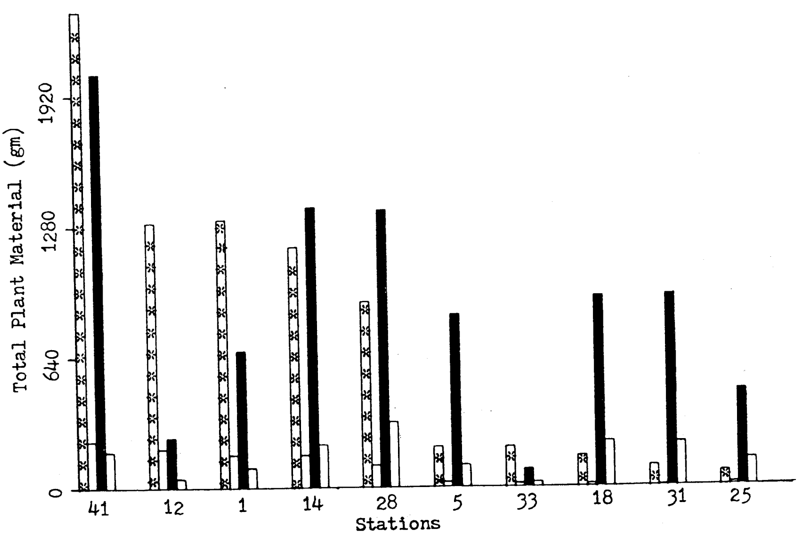


FIGURE 7B. Zone 1 with algae included in 1971 quantities

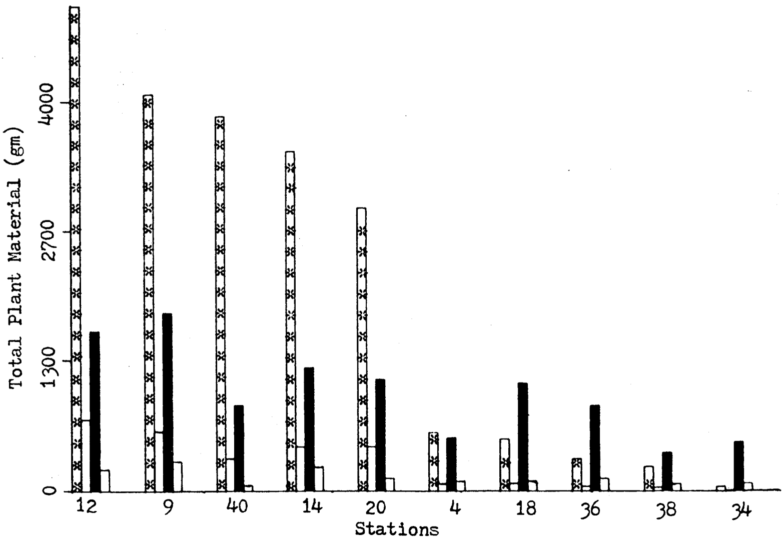


FIGURE 8B. Zone 2 with algae included in 1971 quantities

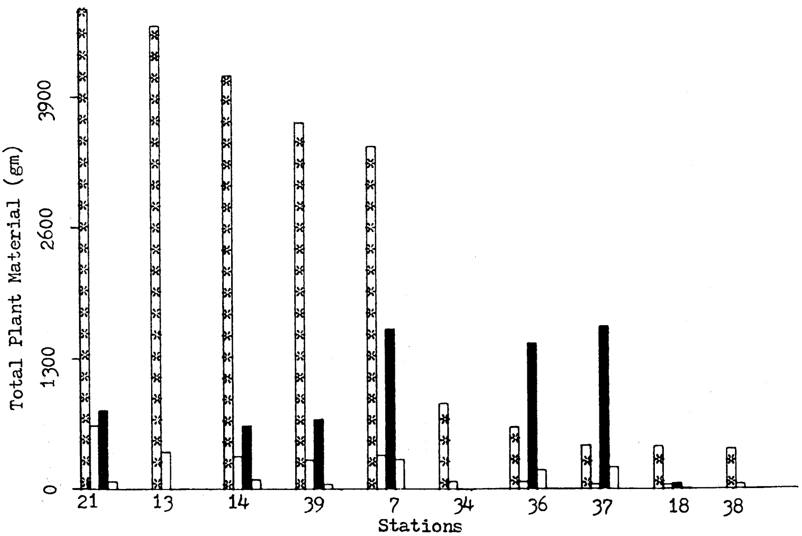


FIGURE 9B. Zone 3 with algae included in 1971 quantities

From these data, it appears that a comparison of the wet weight biomass at the low weight stations at three zones in 1971 and 1921 showed no specific pattern of change; i.e., some stations increased and some decreased. However, the high weight stations at all three zones showed a definite pattern of decrease in the wet weight biomass. The numerical decreases in total macrophyte biomass occurred at all 1921 high weight stations at every depth in the order: zone 1 least, zone 2 next, and zone 3 largest total decrease. At zone 3, stations 34 and 13 were devoid of vegetation and station 38 only had 3.2 g; the first two are located at areas where sewage effluent enters the lake (Fig. 2). This trend continues even when the weight of the attached filamentous algae is included in the biomass. Thus, it appears that the missing nutrients accompanying the reduction in macrophytic biomass have not been entirely incorporated into the attached filamentous algae growing in the littoral zone. This suggests that most of the nutrients may be accounted for in other biota, and the abundance of the phytoplankton (especially blue-green algae) observed in the summer of 1971 seems to corroborate this possibility. Although this work is chiefly on submerged macrophytes, some obervations were made on the plankton in ten water samples collected from three stations different from those used for the macrophytes (see Fig. 1). Many blue-green algae were found on or near the surface waters of the lake in 1971 including *Microcystis aeruginosa, Anabaena flos-aquae, Aphanizonemon flos-aquae* and *Gloeotrichia echinulata;* these were present in 50% to 70% of the samples. Diversified populations of diatoms, green algae and zooplankton were also present, too. (Bumby 1972).

THE PHYSICAL DATA

Secchi disc readings of Green Lake water taken in this 1971 study and by Lueschow *et al.* (1970) place this water body within the range of eutrophic Great Lakes such as Ontatio and Erie, according to Beeton (1965). However, there seems to be no change in light transmission, since Juday's 1942 study. The clinograde dissolved oxygen curve is well above the minimum levels for life in 1971 and also in the 1966 study by Hasler (1967).

DISCUSSION

Biological evidence, such as the decrease in the biomass of the macrophytes which this study shows, is more indicative of changes in the quality of the water in Green Lake than are the physical data collected in 1971. The 1971 stations devoid of vegetation at zone 3 (stations 34 and 13) and one with only 3.2 g (station 38) could reflect effect of sewage; this situation may be more prevalent in other areas of the lake not included in this study. (Fig. 2). The macrophyte change, the increase in the seston and the assumed but undocumented increase in phytoplankton are probably more indicative of change in light intensity in the littoral area than shown by the light penetration data, obtained only at Deep Station (Fig. 1). Macrophytes are greatly affected by the intensity and quality of light which are determined by turbidity, the color and "... the absorptive effect of the water itself" (Reid 1961).

The overall lower biomass, found in 1971 as compared with 1921, could be due in part to the shift in species composition. The magnitude of the decrease of the eight species which declined was simply much greater than the increase of the five species which increased in total biomass (Table 3 of Bumby 1972). The 1921 average percentage of dry weight was not an important difference to cause the lower biomass in this study (Table 1). Other studies have shown little change in the frequency of plants through a summer (Swindale and Curtis 1957), but the weights of the different species of plants can vary during a summer; viz., *Zannichellia palustris* and *Potamogeton crispus* mature early in the summer, while *Vallisneria americana* matures late in the summer. However, the similarity of collection times and techniques between Rickett's and the present study should rule out this problem. Belonger (1969) cited Dane's report of 1959 which showed that over a three year period, there was a definite change in aquatic plant distribution in New York ponds: thus, "... Appreciable changes can occur over relatively short periods." Consequently, the fact of analyzing only one summer for the approximations for both the 1921 and 1971 studies cannot be ignored.

Volker and Smith (1965) listed several of these factors pertinent to Green Lake in their study of a decrease in number and frequency of species of aquatic flora in Lake East Okoboji over a 46 year period. Increased human activity in and around its shores altered several factors believed to be responsible for the change. Factors which may be responsible for reduced vegetation are as follows: first, the increased nutrients in the lakes from agricultural fertilizers and increased sewage effluent from the increased population in the area; and, second, the increased siltation and turbidity due to real estate development in low areas, inlet waters and motorboat activity. Sculthorpe (1967) quoted Southgate (1957) that low concentrations of anionic detergents in most treated sewage effluents of that period, can be deleterious to some hydrophytes. Edmondson (1968, p. 165) points out that "... even drainage from fertilized fields is less rich than sewage effluent..." and that "... moderately hard-water lakes are probably more sensitive to sewage enrichment than soft-water lakes, all other things being equal."

The other school of thought is presented by Lind and Cottam (1969) who hypothesize that, because of human activity and natural aging, lakes become rich in nutrients with consequent tremendous increases in algae and macrophytes. This latter view does not explain the 1971 decline in Green Lake macrophytes in all zones and especially in the deepest zone. When the filamentous algae are included, an increase in biomass is evident in the shallow zone as measured in early summer; later, as the water warms, these autotrophs disappear. Perhaps the nutrients no longer in the macrophytes moved into the phytoplankton of the lake in 1971; more quantitative investigations in this area would be helpful.

The decrease in the aquatic macrophytes in Green Lake could be followed by blooms of phytoplankton, according to Mulligan (1969) who cited the 1903 report of Kofoid that algae blooms did not occur in a lake with large growths of benthic plants. Mulligan also wrote of Pond's (1905) observation that floating aquatic macroflora and phytoplankton competed for the same nutrients. Thus, the decrease in biomass of *Chara* sp. and *Ceratophyllum demersum* (both without root systems) could reflect increase in the phytoplankton with their competitive advantage of higher nutrient loading rates. However, other plants with root systems have diminished also, according to this study, so other factors are undoubtedly involved. The decline of *Chara* sp. in Green Lake may have a very significant effect on the lake because Schuette and Adler (1929) pointed out that this alga, which made up about half of the macrophytes found in Rickett's entire study, can cause deposition of almost 1000 metric tons of $CaCO_3$.

In early studies, Marsh (1898) noted there was never any large amount of "vegetable matter" in Green Lake. An *Anabaena* sp. usually appeared over the entire lake in July and August for a short time but was never enough to form a "scum" except in 1896, when an *Anabaena* sp. appeared in late June and lasted into August. Marsh also noted that diatoms were always abundant. Juday (1942) computed that the estimated standing crop of plankton in Green

Lake was 2944 kg/ha wet weight, which was one-third larger than in Lake Mendota. Green Lake is much deeper and the clarity of the summer water permitted the zone of photosynthesis to reach a depth of about 15 m.

From the present study, it appears that additional seston in the water of the littoral zone (originating from the inlet water, sheet runoff from rich farm land and from real estate development in low areas, motorboat activity and probably additional phytoplankton) has changed the penetration of light so that macrophytes, especially in the deepest littoral zone, have been significantly reduced. A change in the dominance of *Chara* sp. may be particularly significant to the total biomass results in 1971. Also, aggressive weedy species of foreign origin, e.g., *Potamogeton crispus* and *Myriophyllum spicatum* which are successful in polluted water, have moved into the aquatic community.

Perhaps Green Lake, so different from Lake Mendota in 1921 (Rickett 1924), is approaching the Mendota status of 50 years ago with *Chara* sp. less important, *Vallisneria americana* increasing in abundance, *Cladophora* sp. becoming dominant in the shallow zone among the autotrophs, and the seston in the water becoming a more important factor.

ACKNOWLEDGMENT

The author wishes to give appreciation and deepest thanks to the following persons and institutions: Dr. P. B. Whitford of University of Wisconsin-Milwaukee (UW-M) for suggestions and critical reading of the manuscript; Dr. Everett J. Fee for his guidance and assistance with the field work, taxonomy, identification of phytoplankton, critical reading of the manuscript and for the loan of equipment from the Center of Great Lakes Study; Dr. Charles Nichols of Ripon College for loan of equipment and use of College facilities; Dr. P. J. Salamun of UW-M for loan of equipment and critical reading of manuscript; Dr. A. M. Beeton of UW-M for critical reading of the manuscript; Margaret Summerfield for assistance with field work and taxonomy and also for collecting specimens for the UW-M herbarium; Dr. Scott Mori, F. M. Uhler and Dr. R. R. Haynes for determination of several aquatic macrophyte species; Dr. John E. Gannon for identification of zooplankton; the late Dr. Richard P. Howmiller for titrating the dissolved oxygen samples; Dr. Larry Claflin for the quantitative phytoplankton work; E. Curtis Rogers for SCUBA assistance with field work; Philip R. Haensgen whose able piloting resulted in the aerial photographs used in thesis; Dr. Larry Miller for the use of his depth finder; E. B. Boston and Arthur Carter for the use of their motorboats.

The author especially wishes to extend her appreciation to her parents — the late Mr. and Mrs. J. Harold Bumby — who helped this study in innumerable ways.

BIBLIOGRAPHY

Beeton, A. M. 1965. Eutrophication of the St. Lawrence Great Lakes. Limnol. Oceanogr. 10:240-54.

Belonger, B. J. 1969. Aquatic plant survey of major lakes in the Fox River (Illinois) watershed. Research Rpt. No. 39. Wis. Dept. Nat. resources.

Bumby, M. J. 1972. Changes in Submerged Macrophytes in Green Lake, Wisconsin from 1921 to 1971. Unpublished MS thesis. University of Wisconsin-Milwaukee. 114 pp.

Dane, C. W. 1959. Succession of aquatic plants in small artificial marshes in New York State. N. Y. Fish, Game Jour. 1:57-76.

Edmondson, W. T., ed. 1963. *Ward and Whipple's Fresh Water Biology.* 2nd Edition. J. Wiley and Sons, N. Y. 1248 pp.

Edmondson, W. T. 1968. Water-quality management and lake eutrophication: The Lake Washington case. *Water Resources Management and Public Policy.* Seattle: Univ. Wash. Press. pp. 139-178.

Fassett, N. C. 1960. *A Manual of Aquatic Plants.* Univ. Wis. Press. Madison. 405 pp.

Hasler, A. D. 1967. Biological aspects of eutrophication in Wisconsin lakes Mendota, Crystal, Trout and Green. Progress Rept. No. 4. Lab. of Limnol. Mimeo. 27 pp.

Hotchkiss, N. 1967. Underwater and floating-leaved plants of the United States and Canada. No. 44. Pub. Bureau of Sport Fisheries and Wildlife. U.S. Govt. Printing Office, Wash. D.C. 124 pp.

Juday, C. 1914. The inland lakes of Wisconsin, II. The hydrography and morphology of the lakes. Bull. No. 27, Wis. Geol. Nat. Hist. Surv. Madison, 137 pp.

Juday, C. 1942. The summer standing crop of plants and animals in four Wisconsin lakes. Trans. Wis. Acad. Sci., Arts, Lett. 34:103-135.

Lind, C. T. and G. Cottam. 1969. The submerged aquatics in University Bay: A study of eutrophication. Am. Midl. Nat. 81:353-369.

Livingston, R. B., and P. A. Bentley. 1964. The role of aquatic vascular plants in the eutrophic selected lakes in Western Massachusetts. Water Resources Research Center. U. Mass. 80 pp.

Lueschow, L. A., J. M. Helm, D. R. Winter, and G. W. Karl. 1970. Trophic nature of selected Wisconsin lakes. Trans. Wis. Acad. Sci., Arts, Lett. 58:237-264.

Marsh, C. D. 1898. On the limnetic crustacea of Green Lake. Trans. Wis. Acad. Sci., Arts, Lett. 11:179-224.

Marsh, C. D. and E. F. Chandler. 1898. Hydrographic Map of Green Lake, Green Lake County, Wisconsin. Wis. Geol. and Nat. Hist. Survey.

Marter, J. H., and R. N. Cheetham, Jr. 1971. A real measurement and nomenclature of watersheds in the southeastern Wisconsin rivers basin. Ref. Rept. No. 10. U.S. Dept. of Agri. 78 pp.

McCombie, A. M., and I. Wile. 1971. Ecology of aquatic vascular plants in southern Ontario impoundments. Weed Sci. 19:225-228.

Modlin, R. F. 1970. Aquatic plant survey of Milwaukee River watershed lakes. Res. Rept. No. 52. Wis. Dept. Nat. Resources. 45 pp.

Moyle, J. B. 1945. Some chemical factors influencing the distribution of aquatic plants in Minnesota. Am. Midl. Nat. 34:402-420.

Muenscher, W. C. 1944. *Aquatic Plants of the United States.* Comstock Publ., Cornell Univ., Ithaca, N. Y. 374 pp.

Mulligan, H. F. 1969. Management of aquatic vascular plants and algae. *Eutrophication: Causes, Consequences, Correctives.* Nat'l Acad. of Sci., Washington, D.C. 661 pp.

Nichols, S. A., and S. Mori. 1971. The littoral macrophyte vegetation of Lake Wingra. Trans. Wis. Acad. Sci., Arts, Lett. 59:107-119.

Ogden, E. C. 1943. The broad-leaved species of *Potamogeton* of North America, north of Mexico. Rhodora 45:57-105.

Pietenpol, W. B. 1918. Selective absorption in the visible spectrum of Wisconsin lake waters. Trans. Wis. Acad. Sci., Arts, Lett. 19:562-593.

Pond, R. H. 1905. The relation of aquatic plants to the substratum. Rep. U.S. Fish. Comm. 19:483-526.

Reid, G. K. 1961. *Ecology of Inland Waters and Estuaries.* Van Nostrand Reinhold Co., N. Y. 375 pp.

Rickett, W. H. 1922. A quantitative study of the larger aquatic plants of Lake Mendota. Trans. Wis. Acad. Sci. Arts, Lett. 20:501-527.

Rickett, W. H. 1924. A quantitative study of the larger aquatic plants of Green Lake, Wisconsin. Trans. Wis. Acad. Sci. Arts, Lett. 21:381-414.

Schuette, H. A., and H. Adler. 1929. A note on the chemical composition of *Chara* from Green Lake, Wisconsin. Trans. Wis. Acad. Sci., Arts, Lett. 24:141-145.

Sculthorpe, C. D. 1967. *The Biology of Aquatic Vascular Plants.* Edward Arnold Ltd. London. 610 pp.

Smith, G. M. 1920. The phytoplankton of the inland lakes of Wisconsin. Part I. Myxophyceae, Phaeophyceae, Heterokonteae, and Chlorophyceae exclusive of the Desmidaceae. Bull. No. 57 Wis. Geol. Nat. Hist. Surv. Madison, Wis. 243 pp.

Swindale, D. N., and J. T. Curtis. 1957. Phytosociology of the larger submerged plants in Wisconsin lakes. Ecology 38:397-407.

Volker, R., and S. G. Smith. 1965. Changes in the aquatic vascular flora in Lake East Okoboji in historic times. Proc. Iowa Acad. Sci. 72:65-72.

PHOTOSYNTHESIS OF THE SUBMERGENT MACROPHYTE *CERATOPHYLLUM DEMERSUM* IN LAKE WINGRA

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ABSTRACT

Apparent photosynthesis of *Ceratophyllum demersum* was measured in fall 1975 by a ^{14}C technique for a preliminary evaluation of its productivity. Productivity decline with depth was correlated with diminishing irradiance; laboratory studies indicate, however, that the decline in productivity was also controlled by increasing tissue age and reduction in leaf/stem ratio. The saturated photosynthetic rate of 2.3 mg $C \cdot g^{-1}$ (dry weight) $\cdot hr^{-1}$ for *C. demersum* was attained at 650-700 $\mu E\ m^{-2} \cdot sec^{-1}$ at a water temperature of 21 C.

INTRODUCTION

A number of studies (Wetzel, 1975) show that primary productivity of macrophytes can be an important parameter in aquatic ecosystems. Most lakes are small and shallow (Wetzel and Allen, 1972) with a well-defined littoral zone colonized by aquatic plants which effect fixation, utilization and transformation of energy. Macrophytic communities are often more productive than phytoplankton (Westlake, 1965). Submersed macrophytes may provide the greatest single input to the benthic carbon budget (Rich *et al.*, 1971).

Lake Wingra is a small, eutrophic, alkaline lake within the city limits of Madison, Wisconsin. *Ceratophyllum demersum*, in Lake Wingra, grows in scattered patches anchored in the soft sediment within the *Myriophyllum spicatum* community which dominates the littoral zone (Nichols and Mori, 1971). Although of secondary importance to *M. spicatum* in Lake Wingra, *C. demersum* dominates the submersed aquatic vegetation in several southern Wisconsin impoundments.

I conducted experiments under laboratory conditions and "in situ" using a carbon-14 technique to obtain measurements of photosynthetic rates of shoot sections and to examine factors influencing differences in these rates. Meyer (1939) studied the daily cycle of apparent photosynthesis of *C. demersum* and found a correlation with the daily curve for solar radiation. Effects of turbidity and depth on photosynthesis have been investigated by Meyer and Heritage (1941), while Carr (1969a) has given more attention to light intensity, light quality and water flow. She found that production of *C. demersum* increased with current of the water up to 0.54 cm· sec^{-1}. Carbon source, pH, temperature and effect of nitrogen supply on photosynthesis of *C. demersum* also influence photosynthesis (Carr, 1969b; Goulder, 1970; Goulder and Boatman, 1971). Depth distribution of photosythetic tissue, and light adaptation affect the total photosynthetic productivity in *Myriophyllum spicatum* (Adams *et al.*, 1974). I have considered the photosynthetic response to light and depth distribution of biomass with the other important factors controlled. These data for Lake Wingra allow a preliminary comparison between *C. demersum* and the littoral dominant *M. spicatum* characterized by Adams and co-workers (Adams *et al.*, 1974).

MATERIALS AND METHODS

Field studies

Photosynthesis of *Ceratophyllum demersum* within the *Myriophyllum spicatum* community.

a. *Natural Photosynthesis Profile.* Shoots grown in 2 m water depth were collected the morning of September 11, 1975, cut into 15-30 cm sections of 0.25-0.82 g dry weight, and incubated in 510 ml glass bottles at their natural depth. Bottles were filled with lake water to which 2 ml of ^{14}C-$NaHCO_3$ (specific activity of 1.5 μ Ci·ml^{-1}) were added. Period of incubation was 1 hr. Two dark bottles were also employed. At the end of each incubation the plants were briefly rinsed in 0.1 N HC1 to remove any ^{14}C-monocarbonates precipitated on the leaf surfaces during the experiment. Then they were quickly frozen in liquid nitrogen to stop photosynthesis.

The plant samples were returned to the laboratory, lyophilyzed, dried for two days, and weighed. Leaves and stems of each section were isolated and analyzed separately. The dried samples were ground to powder and 10 mg subsamples were wrapped in ashless filter paper (Whatman #40) and combusted in oxygen in a chamber described by Adams *et al.* (1974). Evolved ^{14}C-CO_2 was trapped in 5 ml of ethanolamine, an aliquot (0.2 ml) of which was pipetted into a modified Bray's solution (Bray, 1960) and counted in a Packard Tri-Carb scintillation counter. Water samples were titrated to determine total alkalinity, as mg.$CaCO_3$ 1^{-1} (Am. Public Health Assoc., 1965). From the alkalinity, pH and temperature, total carbon was calculated from the table of conversion coefficients of Saunders, *et al.* (1962). Photosynthetic rates were expressed as mg C per g dry weight of plant per hour and were calculated from the ^{14}C data with an isotope correction factor of 1.06, with correction for dark fixation of carbon.

Net irradiance during the experiment was measured with a recording pyranometer (Belfort) and the photosynthetically active radiation (PhAR) with a Lambda Quantum-sensor LI-170; the results are expressed as langleys·min^{-1} (= cal·cm^{-2}·min^{-1}) and μE m^{-2}·sec^{-1}, respectively.

b. Terminal portions (20 cm) from shoots collected near the bottom (water depth of 1.60 m) were used. Following the same ^{14}C procedure, the growing tips were incubated on the afternoon of October 3, 1975 at four depths within the water column (subsurface, 0.5, 1.0 and 1.60 m). Plant material varied between 0.3-0.6 g dry weight. This experiment was designed to isolate the effects of light and temperature on photosynthesis, holding other factors relatively constant.

Laboratory studies

a. Photosynthesis profile of *Ceratophyllum demersum* exposed to constant light and at a water temperature of 25C.

C. demersum was collected on August 25, 1975. Whole plants were placed in a 4.5 l Plexiglas cylinder chamber and incubated for 1 hr. in lake water previously filtered through a glass fiber filter paper (Whatman GFC) to which 20 ml (30 μCi) of ^{14}C-$NaHCO_3$ were added. *C. demersum* was exposed at saturating light intensity from a Lucalox lamp; a current flow of 2 l ·min^{-1} ensured adequate mixing of ^{14}C solution and uniform temperature within the chamber. After the exposure periods, the entire plants were removed and cut into 10 cm sections. Carbon-14 distribution in different plant sections was determined by the same procedure described previously.

b. Photosynthesis-light intensity curve of growing tips.

Apical portions of shoots of *C. demersum* were collected on September 18, 1975. For each of seven different light intensities, three replicates were incubated the next morning in filtered lake water; again, measurements were made in 1 hr. periods. Two ml (3.0 μ Ci) of ^{14}C-$NaHCO_3$ were added to each 510 ml glass bottle. Dark bottles were also incubated in the course of this experiment. Temperature was controlled at 21 ± 1 C (temperature of lake water at that time) by placing bottles in a water bath. Temperature, and initial and final pH, were recorded every time.

RESULTS AND DISCUSSION

The natural photosynthesis profile of *Ceratophyllum demersum* "rooted" in 2 m of water, is shown in Fig. 1. Temperature and PhAR at incubation depth, percent of total plant photosynthesis and percent of total plant weight are shown for each stem section. Average surface irradiance during the incubation period was 0.28 $ly \cdot min^{-1}$. Temperature decreased negligibly from the surface to the bottom (20.3-19.7). The first stem section (growing tips) had a photosynthetic rate of 3.40 mg $C \cdot g$ dry $wt^{-1} \cdot hr^{-1}$ expressed on total weight basis, well above the value of 1.06 mg $C \cdot g^{-1} \cdot hr^{-1}$ for *C. demersum* from Conneaut Lake (Western Pennsylvania) on 2 September presented by Wetzel (1965). The rate declined quickly to zero with increasing depth in association with rapidly attenuated light and gradually increasing stem/leaf ratio and tissue age. The most productive sections are the first two, with 84% of total productivity. This result is due, apart from the influence of light and stem/leaf ratio, to the greater biomass concentration which is found within 30 cm of the surface (33% of total plant weight) (Fig. 1). Dark carbon fixation is 0.21 mg $C \cdot g$ dry $wt^{-1} \cdot hr^{-1}$ and seems to have a significant effect on apparent photosynthesis, unlike in *Myriophyllum spicatum* (Adams *et al.*, 1974). In comparison with the August 14, 1972 photosynthesis of *M. spicatum* in Lake Wingra (Adams *et al.*, 1974), *C. demersum* plants show a much more rapid reduction of ^{14}C-uptake from growing tips to the bottom.

I have separately analyzed the leaves and stems of the same plant presented in Fig. 1, first to assess stem contribution to total photosynthetic productivity and, second, to evaluate variation due to changes in quantities of photosynthetic tissue with depth. Figure 2 indicates that, if translocation of ^{14}C-labeled photosynthate did not

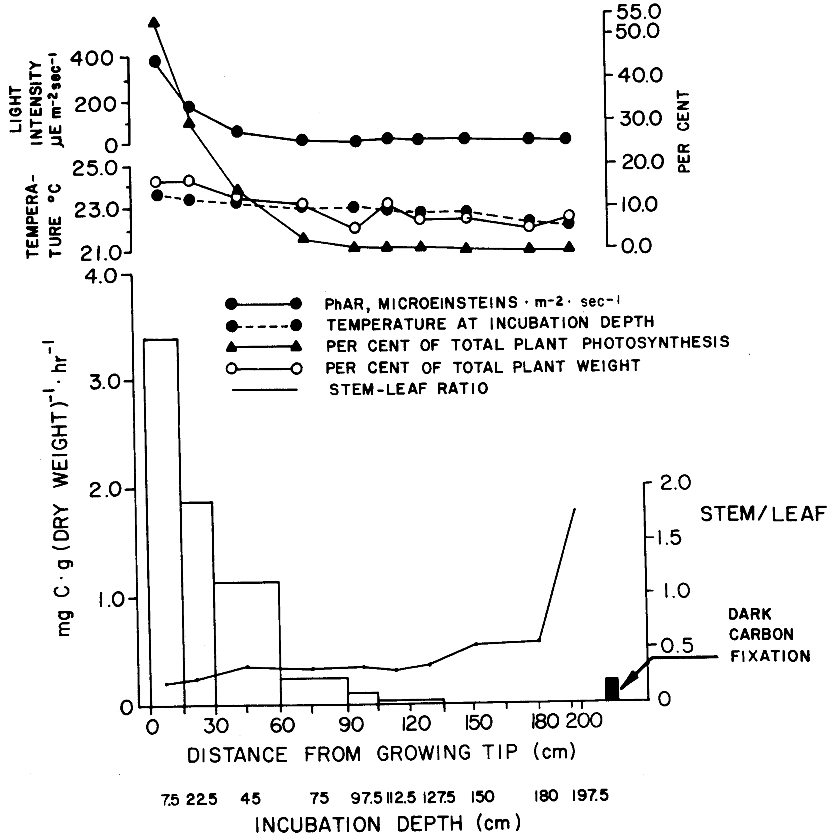

FIGURE 1. Apparent photosynthesis of 15-30 cm shoot sections of *Ceratophyllum demersum* incubated at natural depths within the *Myriophyllum spicatum* community on September 11, 1975.

occur, stem tissue is photosynthetically much less active than leaf tissue. The marked decline in apparent photosynthesis along the *C. demersum* shoot was not offset by conversion to a leaf weight basis, in contrast with data for *M. spicatum* (Adams *et al.*, 1974).

The photosynthesis profile of *C. demersum* under laboratory conditions is shown in Fig. 3 with the photosynthetic rates, light intensity, percent of total plant photosynthesis and percent of total weight. Again, the greatest photosynthetic rate occurs at the top (3.26 mg C·g dry wt^{-1}·hr^{-1}), but in this case there was an apparent plateau of photosynthetic rates near the surface (56% of the total photosynthetic productivity occurred in the first two segments), followed by a pronounced decline in the last three stem sections. With the light, temperature, current flow and water chemistry effectively constant, the different photosynthetic rates are probably due to the tissue age and stem/leaf ratio differences.

Figure 4 points out the effect of the variable natural light regime on photosynthesis. Since only growing tips were used, tissue age and stem/leaf ratio were relatively constant, as was temperature. With a mean surface irradiance of 0.30 ly·min^{-1}, C uptake declined markedly from 1.40 mg C·g dry wt^{-1}·hr^{-1} at the surface to less than 0.2 mg C·g dry wt^{-1}·hr^{-1} at 1.60 m.

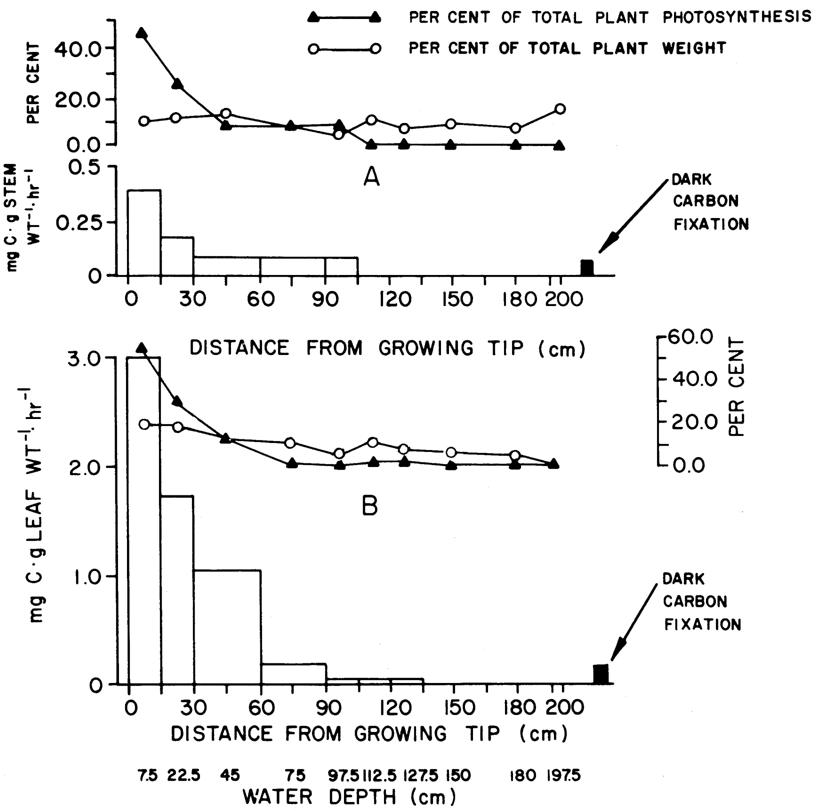

FIGURE 2. Carbon uptake of 15-30 cm sections of *Ceratophyllum demersum* incubated at natural depths within the *Myriophyllum spicatum* community. A. Stems; B. Leaves. 11 September 1975.

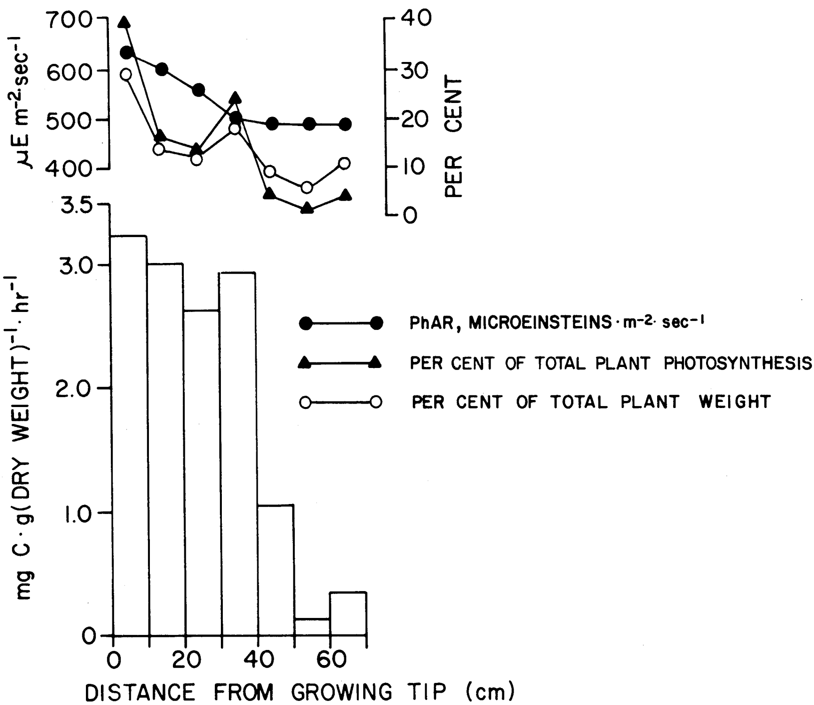

FIGURE 3. Vertical distribution of carbon-14 fixation of *Ceratophyllum demersum* under laboratory conditions. Water temperature 25 C, pH 8.8; alkalinity 124 mg $CaCO_3 \cdot 1^{-1}$.

The control of photosynthesis by light was quantified in the laboratory (Fig. 5). The light saturated photosynthetic rate of *C. demersum* apical shoots at 650-700 μ E.m^{-2}·sec-1 ($\cong$ 0.5 cal·cm^{-2}·min^{-1}) and 21 ± 1 C was 2.30 mg C·g^{-1} (dry weight)·hr^{-1}. Spence and Chrystal (1970) found a low saturation irradiance of 0.02 cal·cm^{-2}·min^{-1} for *Potamogeton obtusifolius;* W. Stone (personal communication) found saturated photosynthetic rate of 8.9 mg C·g^{-1} (dry weight)·hr^{-1} at about 1000 μE·m^{-2}·sec^{-1} for Lake Wingra *M. spicatum* in September.

Talling (1957) introduced a parameter Ik, the irradiance at which a straight line representing the initial slope of the light curve intersects a line representing the saturated photosynthetic rate; Ik is considered a measure of light-temperature adaptation and the onset of light saturation (Vollenweider, 1974). Calculating the initial slope of the *C. demersum* light curve by regression (r = 0.95) gives an Ik of 250 μE·m^{-2}·sec^{-1}. *M. spicatum* in September has an

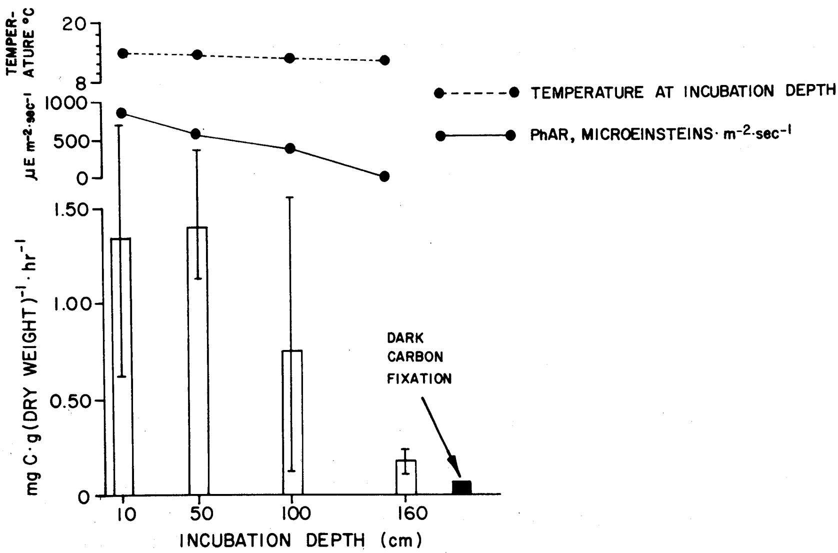

FIGURE 4. Apparent photosynthesis of growing tips of *Ceratophyllum demersum* incubated at four different depths within the community on October 3, 1975. Vertical bars are ranges.

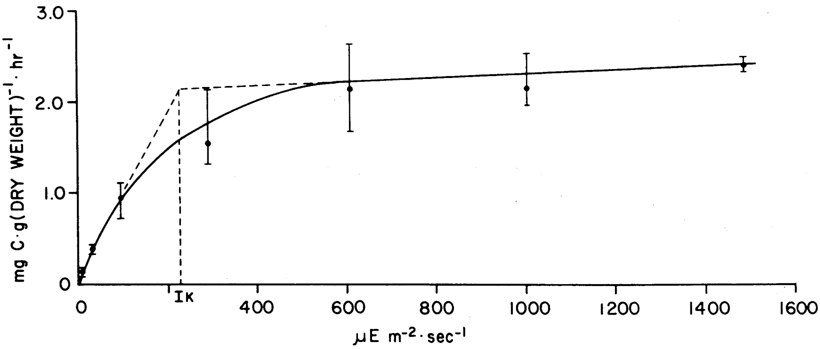

FIGURE 5. Apparent photosynthesis light curve of growing tips of *Ceratophyllum demersum* (3 replicates) on September 19, 1975. Circles are mean values; vertical bars are ranges. Water temperature 21 C; alkalinity 144 mg $CaCO_3 \cdot l^{-1}$; pH 8.7. Concerning Ik, see the text.

Ik of about 800 $\mu E \cdot m^{-2} \cdot sec^{-1}$ (W. Stone, personal communications). This indicates that *C. demersum* may be considered a "shade" species as suggested by Carr (1969b). The full significance of this shade adaptation is little studied, although others have recognized "sun" and "shade" adapted aquatic macrophytes (Carr, 1969b; Spence and Chrystal, 1970; Spence *et al.*, 1973).

Factors controlling the photosynthetic rates with depth of *C. demersum* include light, tissue age and stem/leaf ratio. Compared with *M. spicatum*, the dominant species in the Lake Wingra littoral macrophyte community, *C. demersum* may be characterized as a species adapted to low light intensity. Experiments in other seasons and further information about competition and relationships between these two species would be useful for studies of the dynamics and evolution of the littoral zone.

ACKNOWLEDGMENTS

My sincere thanks to Professor M. S. Adams and his group for the use of the laboratory, assistance and friendship. I am much indebted to J. E. Titus, M. J. Lechowicz and W. H. Stone, for reading the manuscript and offering many helpful suggestions. This research was supported by the Istituto Italiano di Idrobiologia, Pallanza, Italy and by National Science Foundation grant #BMS75-19777 to the Institute for Environmental Studies, University of Wisconsin, Madison (M. S. Adams, Department of Botany, Principal Investigator).

BIBLIOGRAPHY

Adams, M. S., J. E. Titus and M. D. McCracken. 1974. Depth distribution of photosynthetic activity in a *Myriophyllum spicatum* community in Lake Wingra. Limnol. Oceanogr. 19: 377-389.

American Public Health Association. 1965. *Standard Methods for the Examination of Water and Wastewater*, 12th ed.

Bray, G. A. 1960. A simple efficient liquid scintillator for counting aqueous solution in a liquid scintillation counter. Anal. Biochem. 1: 279-285.

Carr, J. L. 1969a. The primary productivity and physiology of *Ceratophyllum demersum.* I. Gross macro primary productivity. Aust. J. Mar. Freshwater Res. 20: 115-126.

Carr, J. L. 1969b. The primary productivity and physiology of *Ceratophyllum demersum.* II. Micro-primary productivity, pH, and the P/R ratio. Aust. J. Mar. Freshwater Res. 20: 127-142.

Goulder, R. 1970. Day-time variations in the rates of production by two natural communities of submerged freshwater macrophytes. J. Ecol. 58: 521-528.

Goulder, R., and D. J. Boatman. 1971. Evidence that nitrogen supply influences the distribution of a freshwater macrophyte, *Ceratophyllum demersum.* J. Ecol. 59: 783-791.

Meyer, B. S. 1939. The daily cycle of apparent photosynthesis in a submerged aquatic. Am. Jour. Bot. 26: 755-760.

Meyer, B. S., and A. C. Heritage. 1941. Effect of turbidity and depth of immersion on apparent photosynthesis in *Ceratophyllum demersum.* Ecology 22: 17-22.

Nichols, S. A., and S. Mori. 1971. The littoral macrophyte vegetation of Lake Wingra. Trans. Wis. Acad. Sci. Arts, Lett. 59: 107-119.

Rich, P. H., R. G. Wetzel and N. V. Thuy. 1971. Distribution, production and role of aquatic macrophytes in a southern Michigan marl lake. Freshwater Biol. 1: 3-21.

Saunders, G. W., F. B. Trama and R. W. Bachmann. 1962. Evaluation of a modified ^{14}C technique for shipboard estimation of photosynthesis in large lakes. Mich. Univ. Great Lake Res. Div. Pub. 8: 61 pp.

Spence, D.H.N., and J. Chrystal. 1970. Photosynthesis and zonation of freshwater macrophytes. 2. Adaptability of species of deep and shallow water. New Phytol. 69: 217-227.

Spence, D.H.N., R. M. Campbell and J. Chrystal. 1973. Specific leaf areas and zonation of freshwater macrophytes. Jour. Ecol. 61: 317-328.

Talling, J. F. 1957. Photosynthetic characteristics of some freshwater plankton diatoms in relation to underwater radiation. New Phytol. 56: 1-50.

Vollenweider, R. A. 1974. *A Manual on Methods for Measuring Primary Production in Aquatic Environments.* IBP Handbook No. 12, Blackwell Sci. Pub. Oxford.

Westlake, D. F. 1965. Some basic data for investigations of the productivity of aquatic macrophytes. Mem. Ist. Ital. Idrobiol., 18 Suppl.: 229-248.

Wetzel, R. G. 1965. Techniques and problems of primary productivity measurements in higher aquatic plants and periphyton. Mem. Ist. Ital. Idrobiol., 18 Suppl.: 249-267.

Wetzel, R. G. 1975. *Limnology.* W. B. Saunders Co. Philadelphia. 743 pp.

Wetzel, R. G., and H. L. Allen. 1972. "Functions and interactions of dissolved organic matter and the littoral zone in lake metabolism and eutrophication." In: *Productivity Problems of Freshwater.* Z. Kajak and A. Hillbricht-Ilkowska, Ed.: 333-347.

THE EFFECTS OF MADISON METROPOLITAN WASTEWATER EFFLUENT ON WATER QUALITY IN BADFISH CREEK, YAHARA AND ROCK RIVERS

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University Texas
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INTRODUCTION

In December, 1959, the Madison Metropolitan Sewerage District (MMSD), acting pursuant to the directions of the Legislature in Section 144.05 (1) of the Wisconsin Statutes, initiated diversion of their wastewater effluents from the Yahara River between Lakes Monona and Waubesa, to the Badfish Creek, which empties into the Yahara and Rock Rivers below Lake Kegonsa. This diversion was accomplished by the construction of a $3.5 million pipeline and diversion ditch from the Nine Springs Sewage Treatment Plant to Badfish Creek. The purpose of diversion was to improve water quality in Lakes Waubesa and Kegonsa by reducing the amounts of aquatic plant nutrients discharged to these lakes. Additional information on the diversion is discussed in Mackenthun *et al.* (1960), Wisniewski (1961), Wisconsin Department of Natural Resources (undated) and Teletzke (1953). It is generally agreed that this diversion did improve water quality in the two lower lakes (Lawton, 1961; Sonzogni and Lee, 1974). However, while the diversion of the Madison effluents lowered the nutrient levels within these lakes, the concentrations present after diversion were still sufficient to produce excessive growths of algae. These nutrients are primarily derived from urban and rural runoff, groundwater and the atmosphere (Sonzogni and Lee, 1975).

One of the frequently asked questions about this diversion was its effect on the Badfish Creek and Yahara and Rock Rivers. Beginning in 1953, stations on the Badfish Creek, Yahara and Rock Rivers have been sampled on a weekly to bi-weekly basis and analyzed for biochemical oxygen demand (BOD), dissolved oxygen (DO), suspended solids, nonvolatile solids, soluble and total phosphate, ammonia, nitrite, nitrate, organic nitrogen and coliforms at approximately 20 locations by the Madison Metropolitan Sewerage District. This paper presents a review of the chemical data and discusses the water quality in the Badfish Creek, Rock and Yahara Rivers based on the MMSD data.

DATA REDUCTION

Because of the large amounts of data available (over 50,000 data points), overall means and standard deviations were computed for each of the parameters measured at each of the sampling stations. The overall mean concentration should give a reliable estimate of the trends of water quality at each of the stations for the study period, generally from 1953 through 1970. The standard deviation for the data at any one station for any particular parameter gives a measure of the variability of the data from the mean. The data for the annual means with the various chemical parameters is presented in a report by Lee and Veith (1971). The sampling stations used by the MMSD are presented in Table 1 and Fig. 1.

The weekly to bi-weekly data on the concentrations of various chemical contaminants in the receiving waters for the Madison Nine Springs Sewage Treatment Plant effluent (MMSD-STP) provide a good index to water quality at that location in the receiving streams. The data, however, do not provide quantitative information on the relative significance of various sources of these contaminants. In order to make quanitative estimates of this type, discharge measurements of each of the tributary sources must be available. In general, discharge information was not available with the result that this paper has to discuss the effects of the Madison

TABLE 1. SAMPLING STATIONS: BADFISH CREEK, YAHARA AND ROCK RIVERS

Station	Stream	Location
NS		Nine Springs Sewage Treatment Plant effluent
A		Aerator No. 1 (End of Diversion Pipeline)
B	Diversion Ditch	Berman Bridge on E-W road Sec. 31 Dunn Tn.
1	Badfish Creek - N. Branch	N-S road between Sec. 4 and 5 Rutland Tn.
3	Badfish Creek - S. Branch	County Trunk A culvert Sec. 16 Rutland Tn.
4	Combined Badfish Creek	County Trunk A bridge Sec. 15 Rutland Tn.
8	Combined Badfish Creek	St. Hy. 59 bridge Sec. 4 — Porter Tn.
9	Yahara River	St. Hy. 59 bridge Sec. 10 — Porter Tn.
10	Yahara River	Stebbinsville Dam — in pond
14A	Yahara River	Fulton Power House Tailrace
15	Rock River	Below Indianford Dam at Power Plant
16	Rock River	St. Hy. 14 bridge N of Janesville

Sampling stations indicated are the same as those used by the Madison Metropolitan Sewerage District.

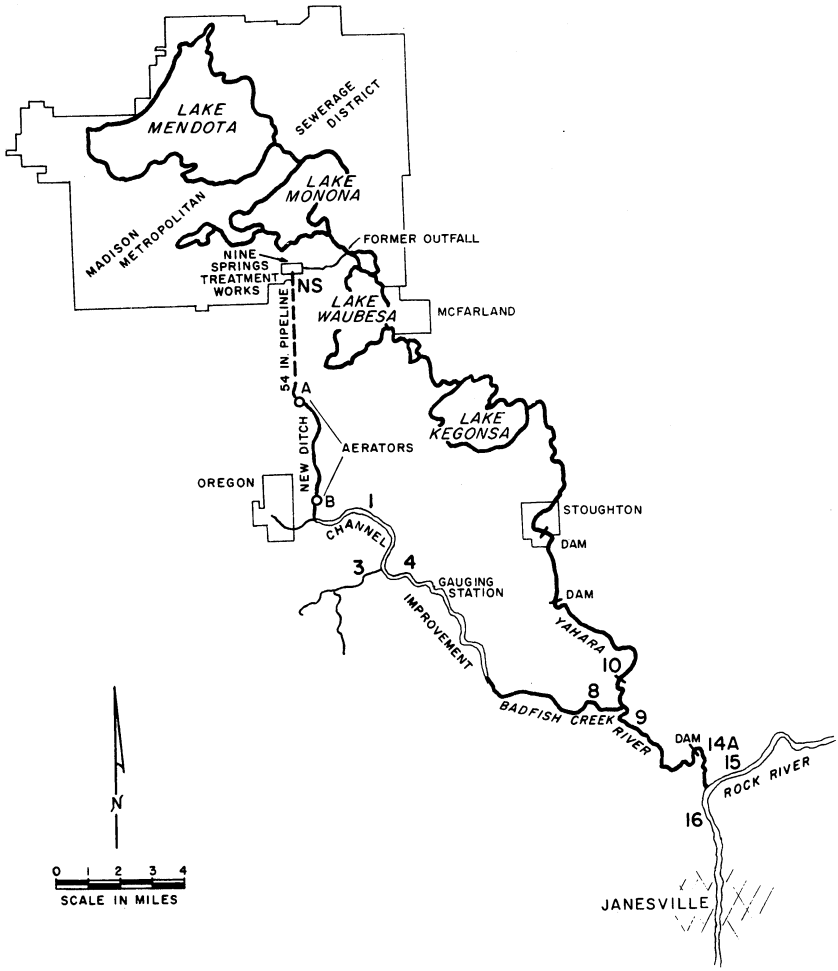

FIGURE 1. SAMPLING LOCATIONS ON THE BADFISH CREEK, YAHARA AND ROCK RIVERS.

Nine Springs Sewage Plant effluent on the receiving waters in a qualitative to semi-quantitive manner.

Quality of the Nine Springs Sewage Treatment Plant Effluent

The Madison Nine Springs Sewage Treatment Plant (STP) of the Madison Metropolitan Sewerage District is a primary and secondary treatment facility. It is designed to remove suspended solids and oxygen demand in the form of BOD (biochemical oxygen demand). The plant consists of primary sedimentation tanks followed by either trickling filters or activated sludge aeration tanks with approximately 72 percent of the flow passing through the activated sludge treatment process. Both the activated sludge and trickling filter process water go to secondary settling tanks, the effluent of which is chlorinated and pumped via the 1959 diversion pipeline and ditch to the Badfish Creek. The solids removed in the primary and secondary sedimentation tanks from the trickling filter part of the plant, and the waste activated sludge obtained from the secondary sedimentation tanks of the activated sludge part of the plant, are combined and digested at elevated temperatures. The digesters are fixed-cover, completely mixed systems. The digested sludge is pumped to sludge-holding tanks and then to sludge lagoons located adjacent to the STP. In 1962-63, during the time that the plant was expanded to handle an additional wasteload, the digester supernatant was pumped with the sludge to the lagoon.

TABLE 2. MADISON NINE SPRINGS SEWAGE TREATMENT PLANT AVERAGE FLOWS, EFFLUENT BOD AND SUSPENTED SOLIDS*

Year	Flow (MGD)**	Average BOD-5 day (mg/1)	Average Suspended Solids (mg/1)
1952	16.7	20	16
1953	16.2	16	15
1954	17.1	17	21
1955	17.7	16	23
1956	17.5	16	23
1957	17.6	21	27
1958	17.7	21	27
1959	20.8	34	49
1960	22.5	30	39
1961	21.7	34	40
1962	22.0	45	51
1963	22.8	47	52
1964	23.0	18	23
1965	24.5	19	24
1966	26.0	21	24
1967	27.2	18	17
1968	29.3	22	24
1969	31.3	20	21
1970	30.7	21	27

*Data based on information provided in the annual reports of the Metropolitan Sewerage Commission.
**Million gallons per day.

Prior to that it was returned to the sedimentation tank. Since the summer of 1970 some of the liquid present in the sludge lagoons was pumped back to the primary tanks.

From an overall point of view the MMSD-STP is doing an excellent job in removing suspended solids and BOD (see Table 2). Normally, plants of this type have a residual BOD in the order of 20 mg/l after treatment. During the period from 1964 to 1970, the MMSD-STP achieved an effluent BOD of approximately 20 mg/l. In 1961 through 1963, when the plant was under construction for expansion,the BOD in the effluent became approximately twice this value, indicating relatively poor treatment compared to what could be achieved, and what was previously achieved.

The total suspended solids in the MMSD-STP effluent since the plant has been reconstructed has averaged about 20 to 25 mg/l, which indicates a good removal of solid material. As in the case of BOD, there were high values of suspended solids found only during 1961-1963 construction period.

These results are in accord with the report from the Wisconsin Department of Natural Resources (Wis. DNR, 1971) in which they stated that in a 19-month period, from February 1969 through August, 1970, the average effluent BOD from the plant was 20.1 mg/l, and the average suspended solid concentration 23.0 mg/l They concluded that the present treatment efficiency was good.

It should be noted that in the period since the 1959 diversion, the flow in the MMSD-STP has increased from about 20 million gallons per day (mgd) to approximately 31 mgd. Also, it should be noted that in 1962-63, at the time of plant expansion, the flows were approximately 22 mgd. Therefore, since the last expansion, the flows have increased approximately 9 mgd and the plant has still maintained a high treatment efficiency with good removal of BOD and suspended solids.

Effect of Treated Effluent on the Badfish Creek

The prediversion data were generally taken at Stations 1, 3, 4, 8, 9, and 10 for the period 1953-58 for BOD_5 , nonvolatile suspended solids, nitrate, nitrite, and ammonia. In general, 237 samples were taken from these stations for these parameters. Prediversion sampling of Station 8 did not start until 1956, in which time 110 samples were taken. Total phosphorus, soluble phosphate and organic nitrogen prediversion samples were collected from Stations 1, 3, 4, 8, 9, 10, 14A, 15, 16 and 17. The post diversion samples were taken from all stations listed in Table 1 from 1959-1970 during which time approximately 395 samples were taken from each station.

In the period 1953 to the present, the MMSD has sampled at weekly, and later at bi-weekly intervals at three locations in the Badfish Creek. In addition, some samples have been taken from the wastewater in the diversion ditch before the water enters the Badfish Creek North Branch. Also, routine sampling has been conducted on the South Branch of the Badfish Creek. Station 1 represents the composition of the North Branch of the Badfish Creek at a point below where the MMSD-STP effluent enters this creek (see Fig. 1). At this point, the Badfish Creek contains the sewage treatment plant effluent from the Village of Oregon, storm water drainage from Oregon, the effluent from the MMSD-STP effluent and any drainage arising from agricultural lands. It is estimated that approximately 50 to 80 percent of the flow at this station is derived from the MMSD-STP effluent. The Village of Oregon expanded its wastewater treatment facility in 1969. It is expected that this plant should achieve BOD and suspended solid removals such that its effluent should have approximately the same characteristics as that of the MMSD-STP. This would not have been true prior to the reconstruction of this plant. However, when mixed in the Badfish Creek, because of the relatively large discharges of MMSD effluent, it is estimated that MMSD-STP contributes about 99 percent of the wasteload (Wis. DNR, 1971) to the Badfish Creek at Station 1.

BOD and Dissolved Oxygen

Prior to the introduction of the MMSD-STP effluent to the Badfish Creek, the BOD_5 in the Creek at Station 1 ranged from 4 to 7 mg/l (see Table 3). After diversion it has increased to approximately 20 mg/l, with a maximum in 1962 and 1963 of 27 and 31 mg/l, respectively for the annual average BOD_5. Since the expansion of the plant in 1963, the annual average of BOD_5 at Station 1 has been in the order of 12 to 17 mg/l. A comparison between the STP effluent and this station's data shows that there is a reduction in the BOD_5 from the effluent at the STP to Station 1. This reduction is probably due to dilution from the Badfish Creek water and due to removal of BOD through sedimentation and biochemical processes in the diversionary pipe and ditch.

TABLE 3

OVERALL MEAN CONCENTRATIONS OF SELECTED CONTAMINANTS IN THE MMSD EFFLUENT, DIVERSION DITCH, BADFISH CREEK AND YAHARA RIVER

Parameters	Station STP	3		1		3		4		8		9		10		14A		15		16
	Post Div	Post Div	Pre Div	Post Div	Pre Div	Post Div	Pre Div	Post Div	Pre Div	Post Div	Pre Div	Post Div	Pre Div	Post Div	Pre Div	Post Div	Pre Div	Post Div	Pre Div	Post Div
BOD$_5$ (mg/1)	28	23	6	19	2	21	3	17	3	19	6	11	6	7	6	9	7	7	6	8
Nonvolatile suspended solids (mg/1)	4	7	9	18	28	18	31	18	43	36	19	25	9	12	18	21	24	34	20	20
Total Phosphorus (mg P/1)	—	4	0.5	3	0.04	0.06	0.1	2.0	0.09	2.0	0.4	0.9	0.4	0.1	0.3	0.6	0.1	0.1	0.1	0.2
Soluble Phosphate (mg P/1)	—	3	0.4	2	0.02	0.03	0.09	2	0.04	2	0.3	0.6	0.3	0.08	0.2	0.3	0.04	0.06	0.07	0.1
Nitrate (mg N/1)	2	0.8	2	0.9	3	3	3	1	3	2	0.5	1	0.2	.02	0.4	1	0.2	0.5	0.2	0.6
Nitrite (mg N/1)	0.3	0.3	0.2	0.3	0.02	0.03	0.04	0.3	0.04	0.4	0.03	0.2	0.03	0.03	0.04	0.2	0.02	0.2	0.02	0.07
Ammonium (mg N/1)	15	12	1	12	0.2	0.2	0.3	9	0.5	7	0.2	3	0.4	0.3	0.3	2	0.1	0.3	0.2	0.3
Organic Nitrogen	3	1	3	0.5	0.6	0.8	1	0.7	2	2	2	2	2	2	2	2	2	2	2	2

*Post div = Post wastewater diversion
**Pre div = Pre wastewater diversion

The suspended solids data for Station 1 show that (Table 3), in general, they are approximately the same as the MMSD-STP effluent, although occasionally some relatively high values are found which are probably derived from storm water drainage from the Village of Oregon and agricultural lands.

The best way to examine the effect of the STP effluent BOD on water quality at Station 1 on the Badfish is to examine the dissolved oxygen levels at this station. In the case of dissolved oxygen, annual means should not be used for comparison purposes, since it is the critically low DO values which are of importance to aquatic organisms. Examination of the data (see Lee and Veith, 1971) for Station 1 shows that at several times during each year the dissolved oxygen (DO) levels at this station are less than 3 mg/l, and frequently are less than 1 mg/l, especially during the summer and fall of 1970. Normally, a DO of 5mg/l or more is desirable (US EPA, 1976), with 3 to 4 mg/l being the minimum for maintenance of some of the desirable forms of fish. It is concluded that the dissolved oxygen concentrations at Station 1 are sufficiently low to have a significant adverse effect on aquatic life at this location.

In order to ascertain whether it is the MMSD-STP effluent or some other conditions which are causing this low DO at Station 1, examination of the data from Stations A and B should be made. Station A is located at the effluent from the cascade aerator at the point where the effluent enters the diversion ditch from the pipeline. Station B is approximately one half mile from this point on the diversion ditch. In general, in recent years the effluent from the cascade aerator has run between 4 to 8 mg/l of dissolved oxygen. By Station B occasionally zero DO values have been reported, with frequent values less than 3 mg/l. Generally, whenever low values are reported at Station B, even lower values are reported at Station 1. Further study will be necessary to ascertain the relative flow times and the expected rates of BOD exertion in the diversion ditch between the cascade aerator and Station 1. However, from a cursory examination of the data, it can be expected that there would be a significant reduction in the amount of dissolved oxygen in this ditch due to residual BOD present in the MMSD-STP effluent.

Prior to the 1959 diversion, data collected by the Committee on Water Pollution, State of Wisconsin (Mackenthun *et al.*,1960 and Wisniewski, 1961), and the Madison Metropolitan Sewerage District show that low dissolved oxygen values were found at Station 1. At times, essentially zero dissolved oxygen was found at this station. It is possible that the low dissolved oxygen values found at Station 1 prior to diversion were due to the discharge of wastewaters from the Village of Oregon to the Badfish Creek. Since the 1959 diversion, this pattern has not changed to any significant extent. The primary difference in the data before and after diversion is with respect to Stations 4 and 8. Both the Committee on Water Pollution and the MMSD data show that no critically low dissolved oxygen values were found at the lower two stations in the Badfish Creek prior to diversion. However, after diversion occasionally low dissolved oxygen values were found.

Examination of the DO and BOD_5 data for Station 4, which is located about four miles downstream on the Badfish Creek below Station 1, shows that occasionally critically low DO concentrations are encountered at this station, which can be attributable to the MMSD-STP effluent. The South Branch of the Badfish Creek joins the North Branch between Stations 1 and 4. Examination of the data for DO and BOD_5 for station 3 on the South Branch of the Badfish, shows that it does not contribute to the low DO values which are observed at Station 4. If anything, it would tend to raise the DO values at Station 4 slightly above what would be encountered without the dilution water brought in from South Branch.

The critically low DO values shown in the MMSD data for Stations 1 and 4 are supported by the Department of Natural Resources 1971 Report in which they state on page 32 (Wis. DNR, 1971) that in this reach of the stream the organisms found are indicative of high levels of pollution just below the outfall, while at Station 4, the stream is considered to be in a semi-polluted condition.

The next station that was routinely sampled by the MMSD on the Badfish Creek was Station 8, which is located just above the confluence of the Badfish Creek with the Yahara River. Station 8 is approximately 12 miles below Station 4. Between these two stations several small tributaries enter the Creek. In addition, it can be expected that during periods of rainfall appreciable amounts of pollutional materials derived from agricultural lands, such as crop land, small feed-lot operations, and drainage of marshes, would contribute to the wasteload of the stream. Of particular importance would be the drainage from wetlands. Lee, Bentley and Amundson (1975) found the drainage from wetlands in south-central Wisconsin to have adverse effects on water quality in the receiving stream. Frequently, this drainage contained low dissolved oxygen, high nitrogen and phosphorus.

Examination of the DO data for Station 8 shows that occasionally DO levels of less than 4 mg/l are encountered at this station. In general, the BOD values found at Station 8 are equal to or greater than those found at Station 4, thereby indicating that, since appreciable BOD removal would be expected in the stream between these two stations, significant BOD addition occurs in this stream, due to several sources. First, because of the large amounts of plant nutrients present in the stream, a prolific growth of aquatic plants is found. These plants tend to contribute to the BOD of the stream; however, examination of the winter data, when the growth of aquatic plants would be minimal, does not show that this is a significant source of BOD for the stream.

Another factor to consider is the possible effect of nitrification on the BOD of the stream. It is conceivable that little or no nitrification has occurred by Stations 1 and 4, while by Station 8, significant nitrification is in progress. This nitrification would possibly show up in the normal BOD_5 test at Station 8 and not be present at Stations 1 and 4. There is some support for this suggestion, based on the changes in the ammonia and the nitrate concentrations from Stations 4 and 8 for the Badfish Creek (see Table 3).

In general, there is an increase in suspended solids in the Badfish Creek from Stations 1 to 4 and 4 to 8 (Table 3). This increase indicates either the amounts of algae present in the creek or the large amounts of materials contributed from rural runoff. Since the organic nitrogen content of the stream remains essentially constant throughout its length, it is possible to tentatively rule out increases in algae as a cause of the increases of the solids. It is more likely, based on the data available, that this is due to an increase in the amounts of erosional material brought into the stream from the farmlands.

An additional point that should be made with regard to the effects of the MMSD-STP effluent on Badfish Creek is that this effluent will likely increase the amounts of aquatic plants, particularly attached filamentous algae, in the creek. These aquatics become sufficiently thick at times that they have caused the MMSD to purchase a weed cutter for harvesting weeds from the diversion ditch. Probably the most significant problem caused by the luxuriant growth of aquatic plants in Badfish Creek is the effect of these plants on the DO in the stream. It is reasonable to expect that the Badfish Creek would show a large diurnal DO fluctuation with a maximum DO in late afternoon and a minimum in the morning just before sunrise. This marked change in DO would be related to the photosynthesis and respiration of the aquatic plants and the respiration of the bacteria in the stream utilizing the organic matter in the water. Data showing the magnitude of the diurnal fluctuations in DO were unavailable except for a limited study by the graduate students in Sanitary Engineering at the University of Wisconsin-Madison (Sanitary Engineering, 1969). Based on the fact that the MMSD data were all collected during the day at a time when DO would be expected to be higher than in the early morning, it is reasonable to expect that the minimum DO values would likely be lower due to this diurnal DO fluctuation. In some streams of this type a several mg/l diurnal DO fluctuation is encountered, so that even a 5 mg/l DO in midday might have a just-before-sunrise minimum DO of 3 mg/l or less. Additional study would be necessary in order to ascertain the significance of the diurnal DO fluctuations arising from the luxuriant aquatic plant growth on the DO concentration of Badfish Creek.

Another problem which is caused by the discharge of the MMSD-STP effluent to the Badfish Creek is the large amounts of ammonia ($NH_3 + NH_4^+$) that are contributed. Ammonia has been shown to be acutely toxic to fish at concentrations of a few mg/l or less in 96 hours at the pH range in the Badfish Creek (US EPA, 1976). The US EPA has established 0.2 mg/l as unionized ammonia as a safe level for chronic exposure of fish at pH 8 and 20 C. This concentration is equivalent to a total ammonia ($NH_3 + NH_4^+$) of approximately 0.5 mg/l as N. Measurements of pH by the MMSD showed the averages ranged from approximately 7.5 to 8.5 in the MMSD-STP effluent and in waters of Badfish Creek, Yahara and Rock Rivers. The STP effluent has between 12 and 20 mg/l of ammonia nitrogen (NH_3 + NH_4^+). At Station 1 the 12-year average, since diversion, is 10.6 mg/l of ammonia nitrogen, while at Station 8 this average is 6.7 mg/l N. There can be little doubt, based on the data available, that the primary source of ammonia is the MMSD-STP and that this ammonia would be expected to show toxicity to fish in the Badfish Creek throughout its length. Further, as noted above, ammonia concentrations of this level would exert a significant oxygen demand on the Badfish Creek.

Effect of the Madison Metropolitan Sewerage District Effluent on the Yahara River

In order to examine the effects of the discharge of the MMSD effluent on the Yahara River, Stations 8, 9 and 10 have been sampled since 1956 on a weekly, and more recently on a bi-weekly basis, with Stations 9 and 10 being sampled since 1953. Station 8 is located on the Badfish Creek approximately 1.5 miles above the point where this stream enters the Yahara River. Station 10 is located on the Yahara at the Stebbinsville Dam above the point where the Badfish enters the Yahara. Station 9 is located at the State Highway 59 bridge where this highway crosses the Yahara River below the confluence of the Yahara River and Badfish Creek.

Examination of the BOD_5 data for Stations 8, 9 10 (Table 3) shows that the annual mean concentrations at Station 8 are always higher than that at Station 10. The resultant BOD_5 at Station 9 is between the two values reported at Stations 8 and 10. In general the minimum DO at Station 9 is in the order of 5 mg/l; however, since this is a daytime value, it is possible that it could drop to what would be considered critical levels for some aquatic organisms, including fish, in the vicinity of aquatic plants in the river. There is some indication from the data available that some of the low values in DO that are found at Station 9 on the Yahara River are due in part to the BOD contributed from the Badfish Creek. However, as pointed out above, there appear to be other sources of BOD in Badfish Creek besides the Madison Metropolitan Sewerage District. With the data available at this time it is impossible to determine whether the MMSD-STP discharge is contributing significant amounts of BOD which causes the near-critical measured values for DO in the Yahara River.

Examination of suspended solids data for Stations 8, 9 and 10 shows that, in general, Station 8 on the Badfish has higher suspended solids values than Stations 9 or 10. Therefore, the Badfish is contributing suspended solids to the Yahara River. However, since Station 9 shows considerably higher suspended solids normally than Stations 1 and 4 on the Badfish, it must be concluded that the suspended solids present in the MMSD-STP effluent are not contributing significantly to the suspended solids present in the Yahara River.

The ammonia data for Stations 8, 9 and 10 shows that the Badfish Creek is contributing to excessive concentrations of ammonia in the Yahara River. These concentrations are sufficiently great to cause fish toxicity problems in this river near the confluence of the Badfish and the Yahara. It appears that the excessive concentrations of ammonia in the Yahara River at Station 9 are due to a major extent to the discharge of large amounts of ammonia from the MMSD-STP.

Examination of the nitrogen and phosphorus data for the Yahara River, Badfish Creek and the confluence of the two at Station 9 shows that the MMSD-STP effluent is contributing to the large amounts of nitrogen and phosphorus present in the Yahara River at Station 9. Excessive concentrations of nitrogen and phosphorus in the Yahara River would be considerably less than that for the Badfish Creek, since the Badfish Creek is a rapidly moving stream with essentially no impoundments or standing water. However, the Yahara River has numerous impoundments, many of which are constructed for power production. These impoundments create relatively low velocity water and lake-like conditions. Typically it has been found that inorganic nitrogen in excess of about 0.3 mg/l N,and soluble orthophosphate in excess of 0.01 mg/l P (0.03 mg/l $PO_4^{\equiv}$) (Sawyer, (1947) can cause excessive growths of algae and other aquatic plants in lakes. The Yahara River, before the Badfish enters it, has concentrations of nitrogen and phosphorus in excess of these values. The addition of the waters from the Badfish greatly increases the amount of nitrogen and phosphorus in the Yahara and will likely increase the problems of excessive growths of algae in various impoundments of the Yahara River.

Examination of the data for the two stations on the Yahara River below the point where the Badfish enters, shows that there is a slight reduction in BOD, soluble phosphate and ammonia as the water flows from Station 9 to 14A. Station 14A is located at Fulton, Wisconsin, on the Yahara River. There is an increase in nitrate which is probably attributable to nitrification of the ammonia and inflow of groundwater. Suspended solids data appears to be highly variable with no discernible pattern evident from the data available.

From an overall point of view there is an improvement in water quality in the Yahara River from Station 9 to 14A. In general, the DO values for Station 14A are above the critical value. It is possible that they might drop below critical values of 3 to 4 mg/l during early morning.

Effect of the Madison Effluent on the Rock River

Four sampling stations were established in order to ascertain the effect of the MMSD-STP effluent on the Rock River. Station 14A is located on the Yahara River at Fulton, above where the Yahara enters the Rock; Station 15 is at Indianford Dam on the Rock River, and Station 16 is at State Highway 14 bridge just north of

Janesville. The MMSD also sampled Station 17, located in the center of Janesville, but these data are not included because influenced by inputs from the city of Janesville. Examination of the DO data for these three stations shows that adequate DO is present at all stations throughout the year to maintain desirable aquatic life in the stream.

From examination of the 5-day BOD data, it is doubtful that the MMSD-STP effluent has any effect on the BOD levels found in the Rock River. The ammonia data show that the Yahara River is contributing increased concentrations of ammonia to the Rock River, as evidenced by an increase in the concentrations of this compound at Station 16 compared to 15; however, in general, the concentrations of ammonia at Station 16 are less than the critical concentrations for excessive growths of algae and for toxicity to aquatic organisms. On the other hand, comparison of the nitrate values for Stations 14A, 15 and 16 shows that the Yahara generally has higher levels of nitrate nitrogen than does the Rock River. Mixing the two increases the nitrate to levels that would produce excessive growths of algae. If the nitrate and ammonia are added together in order to calculate the inorganic nitrogen, it is found that in excess of a mg/l of inorganic nitrogen is present in the Rock River below the confluence of the Yahara and the Rock, and that this value is derived to some extent from the discharge of MMSD-STP effluent into the Badfish Creek. It will be necessary to do additional study in order to ascertain the amount of the inorganic nitrogen present in the Rock River at Janesville that can be attributed to the discharge from MMSD-STP.

The same type of pattern obtains for soluble phosphorus, where MMSD-STP effluent is contributing to excessive concentrations of soluble orthophosphate in the Rock River above Janesville. The inorganic nitrogen and soluble orthophosphate would be expected to contribute to the excessive growths of algae in the Rock River.

The suspended solids data do not show any discernible trends attributable to the discharge of MMSD-STP effluent to the Badfish Creek. It is doubtful that the discharge has any effect on the suspended solids which are found in the Rock River.

From an overall point of view; the only readily discernible effects of Madison discharge of wastewater effluents to the Badfish Creek on water quality in the Rock River above Janesville is an increase in the inorganic nitrogen and soluble orthophosphate above the levels that are said to cause excessive growth of algae in lakes and impoundments. Schraufnagel (1971) has estimated that approximately 90 percent of the phosphorus present in the Yahara River just before it enters the Rock River is derived from sewage plant discharges from DeForest, Windsor, Arlington, Waunakee, Cottage Grove, Oregon and Madison. Because of the relative size of these communities, by far the major part of the phosphorus is derived from Madison. He also estimates that approximately 60 percent of the phosphorus present in the Rock River immediately below confluence with the Yahara, is derived from municipal wastewater sources. Based on these estimates the MMSD-STP effluent contributes between 30 to 40 percent of the phosphorus present in the Rock River just above Janesville.

DISCUSSION

The purpose of the December, 1959 diversion of the Madison wastewater effluent from the Yahara River above Lake Waubesa to the Badfish Creek, which enters the Yahara River below Lake Kegonsa, was to reduce the amounts of aquatic plant nutrients, nitrogen and phosphorus compounds, that enter these small lakes. Generally, lakes do not have significant water quality problems in the surface waters due to low DO; however, lakes frequently tend to grow excessive amounts of algae more readily than do streams. There is little doubt that the diversion of the MMSD-STP effluent did result in improved water quality in Lakes Waubesa and Kegonsa, as evidenced by less excessive growth of obnoxious algae. There has, at the same time, been a deterioration in water quality in the upper parts of the Badfish Creek, which can be directly attributed to the discharge of effluent to this creek. The diversion of the nitrogen and phosphorus from Lakes Waubesa and Kegonsa to the Badfish has most probably created serious water quality problems in the Badfish and Yahara River at the point where the Badfish enters the Yahara, due to the high concentrations of ammonia which could lead to toxicity to fish and to excessive growths of algae in the Badfish Creek.

A comparison of the data (Table 3) available on the concentrations of nitrogen and phosphorus present at Station 9 on the Yahara River below the point where the Badfish empties into it prior to the diversion and after the diversion, shows that the amounts of inorganic nitrogen and soluble orthophosphate found in the river at this point have increased. As would be expected, Lakes Waubesa and Kegonsa would tend to act as nutrient traps by accumulating in the lake sediments some of the nitrogen and phosphorus that used to be discharged to these lakes. After diversion, there is an approximate doubling in the amount of phosphorus present in the Yahara River below the Badfish. There is essentially little opportunity on an annual basis for this phosphorus to be removed in the Badfish Creek.

The same pattern is found for the Rock River in that the diversion of the effluent around Lakes Waubesa and Kegonsa increased the concentrations of inorganic nitrogen and phosphorus present in the Rock River below the point where the Yahara River enters. It should be mentioned, though, that some of the increase in phosphorus found today in the Rock River just above Janesville would be attributable to the overall increase of phosphorus in the MMSD-STP effluent since 1959, i.e. almost a doubling in the amounts of soluble orthophosphate from 1959 to 1968. In the same period the total phosphorus present has remained essentially the same. It is interesting to note that this increase in soluble orthophosphate has occurred even though the 1962-63 expansion of the plant eliminated the return of digester supernatant to the primary sedimentation tanks. It was likely that even if the effluent had continued to be discharged through Lakes Waubesa and Kegonsa, the overall concentrations of soluble orthphosphate in the Rock River above Janesville would have increased somewhat due to the increases in concentrations in the MMSD-STP effluent during this same period of time.

ACKNOWLEDGMENT

This report was supported by the Madison Metropolitan Sewerage District, the University of Wisconsin-Madison Department of Civil and Enviromental Engineering and EnviroQual Consultants & Laboratories, Plano, Texas. Data reduction was accomplished by Jeffrey Young. This report also received assistance from S. Dodson of the Laboratory of Limnology and G. D. Veith.

BIBLIOGRAPHY

Lawton, G. W. 1961. "Limitation of Nutrients as a Step in Ecological Control." In: *Algae and Metropolitan Wastes* U. S. Dept. Health, Educ. and Welfare. Robt. A. Taft Sanitary Engineering Center, Cincinnati, Ohio. pp. 108-117.

Lee, G. F., and G. D. Veith. 1971. Report on the Effect of the Discharge of the Madison Metropolitan Sewerage District Wastewater Effluent on Water Quality on the Badfish Creek, Yahara and Rock Rivers. University of Wisconsin-Madison, Water Chemistry Program.

Lee, G. F., E. Bentley, and R. Amundson. 1975. "Effect of Marshes on Water Quality." In: *Ecological Studies 10, Coupling of Land and Water Systems*. Springer-Verlag, New York, pp. 105-127.

Mackenthun, K. M., L. A. Lueschow, and C. D. McNabb. 1960. A study of the effects of diverting the effluent from sewage treatment upon the receiving stream. Trans. Wis. Acad. Sci., Arts, Lett. 49: 51-72.

Sanitary Engineering Students. 1969. Badfish Creek Stream Survey. University of Wisconsin-Madison.

Sawyer, C. N. 1947. Fertilization of lakes by agricultural and urban drainage. J. New Engl. Water Works Assoc. 61: 109-127.

Schraufnagel, F. H. February 22, 1971. Memorandum to Thomas G. Frangos. Phosphorus Contribution to the Rock River.

Sonzogni, W. C., and G. F. Lee. 1974. Diversion of waste waters from Madison Lakes. Jour. Environ. Eng. Div. ASCE *100*: 153-170.

Sonzogni, W. C., and G. F. Lee. 1975. Phosphorus sources for the Lower Madison Lakes. Trans. Wis. Acad. Sci., Arts, Lett. 63: 162-175.

Teletzke, G. H. 1953. A Sanitary Survey of the Yahara River and the Badfish Creek. M. S. Thesis, Civil Engineering, University of Wisconsin-Madison.

U. S. Enviromental Protection Agency. 1976. Quality Criteria for Water. EPA-440/ 9-76-023. Washington, D. C. 501 pp.

Wisconsin Department of Natural Resources. 1971. Lower Rock River Pollution Investigation Survey, February 1971. DNR, Div. Environ. Protection, Madison.

Wisconsin Department of Natural Resources. Undated. A Review of Chemical Monitoring on Badfish Creek and Lower Receiving Rivers, 1960-1965.

Wisniewski, T. W. 1961. The Badfish River before and after diversion of sewage plant effluent, algae and metropolitan wastes. Public Health Service publ. SEC TR W61-3, Cincinnati, Ohio.

BACK TO THE LAND!
RURAL FINNISH SETTLEMENT IN WISCONSIN

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The only language the stumps understand . . .
is. . . Finnish.[1]

Although the Finns left an indelible imprint upon certain areas of Wisconsin, they never numbered among the state's largest foreign-born groups. Between 1900 and 1920, for example, Wisconsin's Finnish-born population grew from some 2,000 to 6,750 inhabitants, but more than fifteen other non-native contingents had larger representations during both census years.[2] The relatively small number of Finns in Wisconsin is even more evident when the figures are compared to those for Michigan and Minnesota, the two states which provided a bifurcated focus for the largest number of Finnish immigrants to this country. During 1920, Michigan and Minnesota each had a population of about 30,000 Finnish-born persons; and together the two states accounted for approximately forty percent of the United States' total Finnish community.

How, then, did the Finns develop and nurture a distinctive identity within Wisconsin? There were undoubtedly several reasons but a few factors were of paramount importance. One was that the majority of these Finns settled in relatively few areas of the state and thereby maintained a tightly-contained geographic identity and cohesiveness. Secondly, unlike most participants in the major migration waves between 1880 and World War I (the so-called "new immigration"), the Wisconsin Finns settled predominantly in rural rather than urban centers. Hence, it was somewhat easier for them to maintain a distinctive identity and culture. Thirdly, certain Finnish institutions, serving a regional or national audience, have been headquartered in Superior, Wisconsin. Of particular note is the Central Cooperative Exchange,[3] a Finnish-sponsored economic venture which was initiated during 1917. Before it merged with Midland Cooperatives, Inc., of Minneapolis in 1963, the wholesaling facility had an affiliated network of 244 local outlets spread throughout the Upper Midwest and did some $21 million worth of business during its peak year of operation.[4] Another important institution in Superior has been the Finnish language press. Its best known journalistic efforts have been the *Työväen Osuustoimin-*

talehti (Workers' Cooperative Journal), which is the primary news organ of the Finnish-American cooperative movement, published between 1930 and 1965; and the *Työmies (Workingman),* which moved from Hancock, Michigan to Superior during 1914. Even today, the latter newspaper and its associated activities continue to provide a portion of North America's Finnish-readers with a politically left-of-center news outlet.

To many observers of the Wisconsin landscape, the most evident and interesting Finnish imprint lies in the various vernacular architectural elements built by this immigrant group. Ranging from the *sauna* and *riihi*[5] to log houses and barns, the craftsmanship and functional integrity of these structures have found an appreciative audience among folk architecture aficionados. The Finnish farm complex at Old World Wisconsin, located at Eagle, is an effort to display and preserve a major portion of this ethnic and cultural legacy. In addition, an 1898 Finnish log structure in the Brantwood area (the Matt Johnson or Knox house) recently was nominated for inclusion on the National Register of Historic Places.

Although Wisconsin's Finnish communities were relatively small, their activities reflect those of the overall Finnish population in America. The Wisconsin Finns helped to load Great Lakes ore carriers on the docks of Ashland and Superior; entered the treacherous waters of Lake Superior at Herbster and Bark Point to search for lake trout; ventured into deep underground mines at Hurley, Iron Belt and Montreal; felled trees and skidded logs in the forest surrounding Brule and Brantwood; tended assembly lines in factories at Milwaukee, Kenosha and Racine; and most importantly, cleared and farmed the land in various areas of Wisconsin's cutover region.

Since the basic story of Finnish settlement and institutional development in Wisconsin has been related by Kolehmainen (1944) and Kolehmainen and Hill (1951), this article will look more explicitly at the migration of Finns to the state and the agricultural enclaves they formed. A brief overall sketch of Finnish settlement activities will be given, but the major portion of the discussion will focus upon two rural communities in Wisconsin: Oulu (pronounced Oh-loo) and Owen-Withee. Separated by about 175 miles and settled during different periods, the two enclaves illustrate some of the geographic and temporal differences which characterized Wisconsin's Finnish settlement picture. The primary sources for this analysis include church records; the original manuscripts from the

Federal and Wisconsin State Censuses; U.S. Federal Land Office records; Finnish-American newspapers; and personal interviews conducted by the author.

FINNISH-AMERICANS AND RURAL SETTLEMENT

With the exception of a small number of Swedish-speaking Finns, primary Finnish settlement did not commence until the mid-1880s. As such, the major movement of Finns into the state occurred some twenty years after the initial bridgehead in America had been established in the Copper Country of Northern Michigan during 1864 (Holmio, 1967). These first Finns, recruited to work as miners in Michigan, eventually were followed by thousands of others. For many Finns, Michigan's mining communities served only as temporary way stations in their search for an always elusive American *El Dorado*. Many migrated to the rich iron ore fields of northeastern Minnesota; some sought work in the copper, coal and gold mines of the western United States; and others pursued a variety of activities which ranged from logging and railroad construction to the establishment of private businesses. Some emigrés returned to Finland, or made the trans-Atlantic crossing several times. Of greatest significance, however, were the agricultural activities initiated by Finns in several areas of the Upper Midwest. During the latter half of the 1860s, a few small Finnish agricultural enclaves were established on the prairies of Minnesota (Kaups, 1966); but by the 1880s little prime agricultural land remained for the vast majority of later Finnish immigrants. Because of this, thousands of Finns acquired small acreages in the Lake Superior cutover region[6] and began the massive task of clearing the land of stumps and boulders, draining and planting fields, constructing farmsteads and developing a network of Finnish oriented communities and cultural, social and economic institutions.

Possessing an undeniable land hunger, many Finns who retreated to the land during the nineteenth century were inspired by the teaching of Lars Laestadius, a Swedish religious revivalist who found many adherents in rural areas of western and northern Finland—the primary area for early emigrants to America. Espousing a life of piety and simplicity, the Laestadians (Apostolic Lutherans) believed that the maintenance of traditional ethnic values in a new country could be best accomplished by developing rural communitarian enclaves (Kaups, 1975). By the turn of the century, however, larger numbers of Finns began to emigrate from less conservative areas of their homeland (Kero, 1973, 1974); an appreciable number of these Finns had been politicized by an oppressive Russian czarist government in Finland.[7] Imbued with a strong belief in socialism, many quickly formed political and social organizations in America and began to call for higher wages and better working conditions, most notably in the mining areas of Michigan and Minnesota. By serving as leaders and participants in several strikes, but especially the infamous conflicts on Minnesota's Mesabi Range in 1906 and 1916 and Michigan's Copper Country during 1913, a number of Finns were blacklisted by the mining and steel corporations. Unable to secure work, many of them, as well as other Finns who were affected by the strikes, lockouts and shutdowns, moved to the woods and began to carve out a precarious existence on forty to eighty acre parcels of land (Ollila, 1975).

Whether conservative or radical, none of the Finns could escape the dangerous and often oppressive conditions they faced in the mines and several other employment pursuits. Finnish language newspapers solemnly announced the figures: a total of 63 Finns dead in a mine disaster at Scofield, Utah during 1900; almost 100 killed while mining coal at Hannah, Wyoming in 1903; 146 deaths in the mines of Houghton County, Michigan between 1900 and 1903; *ad infinitum* (Kolehmainen and Hill, 1951; Yli-Jokipii, 1971). Although not quite as dangerous, conditions in logging camps were far from idyllic. One woodsman working in northern Wisconsin reported that at his place of employment the food was poor, the land wet and the camp accessible only after a long trek through the woods (Kolehmainen, 1946). Other lumberjacks died from pneumonia or injuries when they did not receive adequate medical attention in the camps. In a rather widely reported story of 1907, four Finnish lumberjacks were jailed for fifteen days in northeastern Minnesota when a camp operator claimed they had left his place of employment before discharging a debt. The Finns stated that their departure had been hastened because they were given dull and rusty tools (an insult to a Finn!), had not been able to secure adequate food and had been forced to sleep three to a bed. They were jailed when the camp operator claimed they still owed him 77 cents apiece for transportation to the camp.[8] Small wonder then, that thousands of Finns in America heeded the call: "Back to the land!—'mother Earth will provide for all of us' " (Kolehmainen, 1946).

FINNISH SETTLEMENT IN WISCONSIN

Although major Finnish settlement activities in Wisconsin did not commence until the mid-1880s, some Finnish-born persons entered the state at a considerably earlier date. Most of these earliest pioneers, though born in Finland, either were of direct Swedish stock or spoke Swedish as their mother tongue (i.e., Swede-Finns). Undoubtedly the most important individual in this group was Gustaf Unonius, a minister and author who was born in Helsinki, Finland during 1810. Unonius later emigrated to America and in 1841 founded Wisconsin's first Swedish settlement at Pine Lake (*Nya Upsala*). Located in Waukesha County, the colony never prospered and by 1850 only a few settlers remained of the dozen or so families who had heeded Unonius' original call in 1841 (Nelson, 1943). During the 1870s and 1880s a small group of Swede-Finns settled in the vicinity of Bailey's Harbor; however, this contingent, whose numbers never exceeded fifteen to seventeen members, quickly intermingled and intermarried with Door County's Irish, German and Scandinavian population. Somewhat later in the nineteenth century, a larger group of Swede-Finns established farms in Wood County's Sigel Township; and the nucleus for a fairly large urban settlement was established in Ashland during the same period. Although the Swede-Finns in America identified more closely with Swedes than with Finns, Silfversten (1931; cited by Nelson, 1943) aptly noted the dilemma they faced: "They have their native country in common with the Finns, their language in common with the Swedes and their national history in common with both."

When considering Wisconsin's Finnish-speaking population, Aine (1938) and Kolehmainen and Hill (1951) have noted that the first permanent settlement was established in Douglas County during 1885. According to U.S. Federal Land Office records, a few Finns acquired homesteads during the summer of that year in what are now Amnicon and Lakeside Townships (the Wentworth-Poplar area). Since there were no roads into the area, provisions and livestock were brought from Duluth and Superior in small boats; after landing along the Lake Superior shoreline, the cattle, goods and personal belongings were transported inland by the settlers.[9] Once this initial node had been established, more extensive settlement took place as the land seekers moved steadily eastward through Douglas County and into Bayfield County (Fig. 1). By 1886

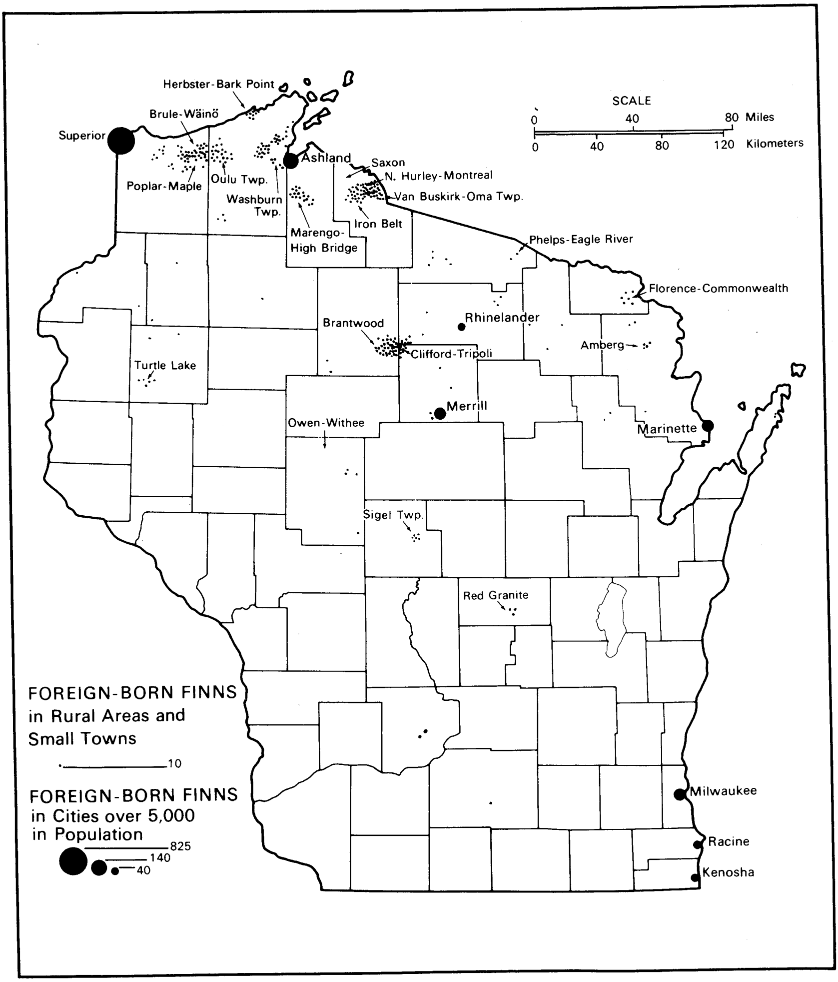

FIGURE 1. Distribution of Foreign-Born Finns during 1905, and Major Finnish Settlements in Wisconsin. With the exception of Saxon and Owen-Withee, the basis for all major Finnish settlements in Wisconsin had been established by 1905. Source: Wisconsin State Census, 1905

Finns had settled in the Maple area, and during the following year another group began to establish farms in the vicinity of Brule-Wäinö. The settlement wave reached Bayfield County in 1888, with the major Finnish concentrations emerging in what eventually would become Oulu Township. During the late 1880s Finns also established themselves in the City of Superior and in various communities along Iron County's Gogebic Range (Hurley, Montreal and Iron Belt). While a large number of the Iron County Finns worked as miners, they often acquired small acreages of land proximate to the mines and engaged in part-time farming. Eventually, larger farms were established just south of Hurley in a relatively extensive area centering upon Van Buskirk and Oma Township.

In the 1890's, other Finns began to purchase land in some Ashland County townships which had been forfeited by the Wisconsin Central Railroad.[10] Situated between Marengo and High Bridge, a large number of the Finns who moved to this area in subsequent years were attracted from both the Michigan and Wisconsin sections of the Gogebic Range. The latter years of the nineteenth century saw another important Finnish colony established at Brantwood and Clifford-Tripoli. With new settlers and land agents touting the virtues of the area, the settlement quickly became one of the fastest growing communities in Finnish-America (Kolehmainen and Hill, 1951).

With the exception of Saxon and Owen-Withee, by 1905 a nucleus had been established for all major Finnish settlements in Wisconsin. In addition to the communities mentioned above, Finns were situated in rural areas around Turtle Lake (Barron County); Florence and Commonwealth (Florence County); Washburn Township, Herbster and Bark Point (Bayfield County); Phelps-Eagle River (Vilas County); and Amberg (Marinette County). During 1902 some Finns began to work in the granite quarries of Red Granite, and in the 1890s and early 1900s a limited migration was underway to the cities of Ashland, Kenosha, Marinette, Merrill, Milwaukee, Racine and Rhinelander.

Once permanent settlements had been established, various institutions were developed by the Finns. Among the first to emerge were the churches, with three Lutheran variants (Suomi Synod, National Lutheran and Apostolic Lutheran) represented in many communities. A rather unique organization which soon developed in several of the older Finnish communities was the temperance society. Often, though not always aligned with church interests, most societies built halls where members could engage in social activities as well as pledge their opposition to demon rum.

When a greater number of politically active Finns moved to the state during the early twentieth century, socialist halls and locals were established in most of Wisconsin's Finnish-American communities. Many of these locals were rather short-lived, but at least twenty-three were initiated between 1905 and 1914 (Kolehmainen and Hill, 1951). A Finnish-sponsored institution with greater longevity, however, has been the consumers' cooperative. In addition to the cooperative wholesale facility located in Superior, some eighteen local cooperative stores and retail outlets were developed by the Finns in Wisconsin prior to World War II. Two stores organized in the Brantwood-Clifford area at the turn of the century even were among the very first consumers' cooperatives developed by Finns in the United States (Alanen, 1975). Although their numbers have dwindled and the original concepts and ideals have changed, the most evident legacy of Finnish institutional activity is provided by the churches and cooperative stores which still can be found in northern Wisconsin.

OULU AND OWEN-WITHEE: A COMPARISON OF TWO FINNISH COMMUNITIES

Oulu Background

As mentioned previously, Finnish settlement in the immediate Oulu area commenced during 1888. Some thirty settlers had claimed homesteads by the turn of the century, but the majority had to purchase their small acreages from private agencies or individuals (Kolehmainen and Hill, 1951). By 1915 the rapid development of Oulu Township[11] had been noted by outside, non-Finnish speaking observers; a highly laudatory article published in the *Wisconson Agriculturist*, for example, observed that Finnish immigrants had cleared the land in a few short years and that Oulu Township already could boast of nine schools, three churches, a socialist hall and a cooperative creamery and store. Stating that the Finnish farmer had a sickening fear of debt and a passion for cleanliness, dairy cows and dynamite (to blast stumps), the writer went on to exclaim:

> We must admit their adaptability to pioneer conditions. They are superior in intelligence, physical strength, patience and persistence. They are self contained and somewhat apart from the rest, but they are the makers of history as it will be written of this new empire.[12]

While the Oulu Township portion of the "new empire" supported close to 1,100 residents by 1920, a steady population decline occurred thereafter (by 1940 there were 910 residents, and by 1970 only 505 persons.) Oulu Township, as such, reflects the agricultural evolution of the entire cutover region. Envisioned as a new frontier for rural settlement at the turn of the century, the cutover was the target for recruitment by private companies and public agencies; special efforts were made to attract European immigrants who, unlike native Americans, ". . . would devote all their time to farming" (Helgeson,1962). Although the Finns persisted in their efforts to a greater extent than other groups, and indeed were still seeking land in the 1920s, many of the newly established farms were abandoned during agricultural recessions; other settlers ceased their efforts once it was recognized that at least twelve to thirteen years of steady effort were required to develop anything even approaching a productive farm (Hartman and Black, 1931).[13] Differences between the bounteous potential of the region as envisioned by the promoter, and reality as encountered by the settler often were quite striking. One account written during 1893, for example, claimed that farm life in the north woods of Wisconsin might not be entirely pleasurable, but neither was it all drudgery. The observer went on to state that by cutting down a few trees, dynamiting the stumps and dropping some seed potatoes into the pits, an "enormous return" would be assured.[14] By way of contrast, the actual back-breaking and slow task of carving out an existence in the cutover region was tellingly stated by an early Finnish settler in the vicinity of Oulu:

> With the snow still in the ground, in the spring, the whole family worked to clear the brush. We cleared out stones and blasted stumps. With the stones and stumps, we built the fence. The second year, we had three acres of potatoes to show the world. Everyone worked as hard as anyone can work (Doby, 1960).

Owen-Withee Background

The movement of Finns into the Owen-Withee area began around 1910, or more than twenty years after the Oulu Township development. Because of this rather late date, these Finns were not able to secure homesteads; however, the sale of land to immigrants in this section of northern Clark County comprises one of the more interesting segments of Wisconsin's Finnish-American settlement history.

After the John S. Owen Lumber Company had harvested most of the marketable timber in the Owen-Withee area, the company's holdings were put up for sale. National advertising campaigns were initiated, and the Owens sought to promote agricultural endeavors on their cutover land by "... selling on easy terms to those who gave promise of permanence."[15] One person, however, was responsible for bringing the largest number of Finns to Owen-Withee: land agent John A. Pelto. Bilingual agents such as Pelto often were hired by land holding companies, be they railroads, timber operations or speculators, to assist in the disposal of property. Undoubtedly finding it easier and more profitable to sell land to their foreign-born counterparts than to clear and farm the soil themselves, the agents used their powers of persuasion and hyperbole to entice settlers. Pelto, acting as an agent for the Owen Company, placed large advertisements in Finnish-American newspapers and journals which exclaimed: "Become a farmer in a place where there are possibilities—Owen, Wisconsin. . ." (Fig. 2). The ads praised the

FIGURE 2. Tulkaa Farmareiksi—"Become a Farmer" Ads such as this, praising the attributes and agricultural potential of the Owen-Withee area in Wisconsin, appeared in many Finnish language newspapers during the second decade of the twentieth century. Source: *Pelto ja Koti* (Superior, Wis.), March 1, 1917

area's level terrain and the ease with which land could be cleared and planted; the five railroad connections which made the community something more than just a "backwoods" location; the eighteen cheese factories located within a distance of twelve miles; the pickle factory, creameries, good roads and schools; and the expanding Finnish community itself. All of this, Pelto pointed out, was available for prices which began at fifteen dollars an acre.

Many Finns could not resist such mellifluous phrases and by 1920 Clark County contained a Finnish-born population of about 280 residents. Situated along the southern rim of the cutover area, the agricultural attributes of the "Clover Belt" did indeed prove to be significantly better than in Finnish settlement areas farther to the north. Despite such agricultural advantages, the arduous task of removing stumps and clearing fields still awaited the first settlers. One articulate second generation Finnish-American, for example, recalled that when her father was clearing land, he sometimes would stop work, wipe his brow, shake his fist in the air and shout: *Tämäkö on Pellon Jussin Amerika!* ("So this is John Pelto's America!"). Nevertheless, once land clearing had been accomplished and full-scale farming established, the Owen-Withee settlement emerged as the most prosperous of Wisconsin's larger Finnish communities. Although curses and vitriolic comments often were directed at land agents, in the Owen-Withee area John Pelto apparently had ". . . endeared himself in the hearts of his countrymen" (Kolehmainen and Hill, 1951).

Finnish Backgrounds of Oulu and Owen-Withee Residents

Recent studies by other investigators have sought to determine whether certain foreign-born groups (primarily Swedes) that settled in the Midwest formed culturally homogeneous enclaves (Ostegren, 1973; Rice, 1973). The studies have shown that at least in some cases, immigrants from relatively contained areas of Sweden did develop identifiable settlements in America; this, in turn, indicates that such immigrants undoubtedly shared a particular cultural uniqueness and heritage. Large-scale Swedish emigration to America, of course, began at an earlier date than did major Finnish migration; hence, many Swedes (and other early immigrant groups) were able to settle directly in America on inexpensive and often fertile land. Very few Finns could partake of these opportunities. Not only did the later arrival date mean that

Finnish agricultural endeavors were limited primarily to the nation's cutover region, but a large number of Finns from all areas of their homeland first intermixed in mining and other areas of the United States. Thus, the direct transfer of people from individual Finnish communes to specific American areas was very uncommon.

In spite of these conditions, it still was possible that some Finns formed relatively homogeneous enclaves in America—even after they had lived in this country for some time. Such occurrences would have been more likely during the nineteenth century when some homesteads still were available and when a number of immigrants from specific Finnish areas could have selected contiguous or proximate areas of land. Since few homesteads with any agricultural potential were available after 1900, it could be hypothesized that Finnish-American settlements formed after this date would represent a much broader geographic cross-section of the Finnish population spectrum.[16]

To explore these hypotheses in a preliminary manner, the Finnish birthfields for a sample of Oulu and Owen-Withee residents were investigated. Samples from both communities have been used, since there is no complete record of all Finns who moved to or resided in the two communities. Most information was derived from church records, especially those of the Suomi Synod, the American transplant of the Finnish State Church. Although the quantity and accuracy of information varied from congregation to congregation, the records of American Suomi Synod churches were relatively analogous to the meticulous church files maintained in Finland. The records used in this study generally included the date and place of birth, baptism, confirmation and marriage; date of arrival in America and the local community; and former place of residence in America. However, rather few of the professionally trained National Lutheran's clergy and certainly very few of the Apostolic Lutheran's lay ministry were thoroughly acquainted with the record keeping systems; hence, much less information could be derived for members of these two church bodies. In addition, it must be pointed out that many Finnish immigrants, especially during the post-1900 era when there was an array of political and other groups from which to choose, did not join any church (Kero, 1975).

Given these limitations, it was necessary to seek information other than ecclesiastical. Some secondary documents (e.g., Ilmonen, 1926) did provide data, but the most useful additional information was supplied by second generation Finnish-Americans living in

Oulu and Owen-Withee. By combining the information from these various sources, it was possible to develop complete or partial background data on 106 adult Finns in Oulu and 113 in Owen-Withee. The years covered by the samples were between 1889-1929 for Oulu and from 1911-1928 for Owen-Withee.

A large proportion of Oulu Township's population left their homeland during relatively early stages of Finnish emigration; hence, the greatest number of the township's Finnish-born residents came from the two provinces which sent the largest number of emigrants to America: Vaasa and Oulu.[17] Two birthfields are indicated: one, a rather widely dispersed area (radius=62 km), centering on Lapua, Kauhava and several adjacent communes in the Province of Vaasa, and the other, a much more concentrated pattern (radius=35 km), focusing on the communes of Lohtaja, Kalajoki and Alavieska in the Province of Oulu (Fig. 3). Thirty-four percent of the immigrants considered in the Oulu Township sample came from the former birthfield, and twenty-eight percent from the latter. It must be noted, however, that the birthfield in Vaasa Province served as the point of departure for twelve percent of all Finnish emigrés to America; whereas that in Oulu Province was under one percent.[18] Although the largest number of residents in the Oulu Township sample came from these two general areas of Finland, undoubtedly those born in the three communes of Oulu Province formed the township's most homogeneous group.

For the place of birth for Finns in the Owen-Withee sample, the geographic dispersion is much greater (Fig. 4). The majority were born in the western area of the country, but this pattern also reflects the overall Finnish emigration picture. Some Owen-Withee residents, however, hailed from other areas of Finland, indicating, of course, that some emigrated at a later date than did their Oulu Township counterparts. As hypothesized before, it seems unlikely that Finnish-American enclaves formed after 1900 had any major linkages with specific communal areas in Finland.

Migration within America to Oulu and Owen-Withee

Regardless of the rural area they eventually selected in the United States, virtually all Finns had to work at other occupations in the New World before they could secure the means to purchase land.[19] As stated previously, factors such as dangerous employment and labor unrest and conflict in the mining areas contributed to this

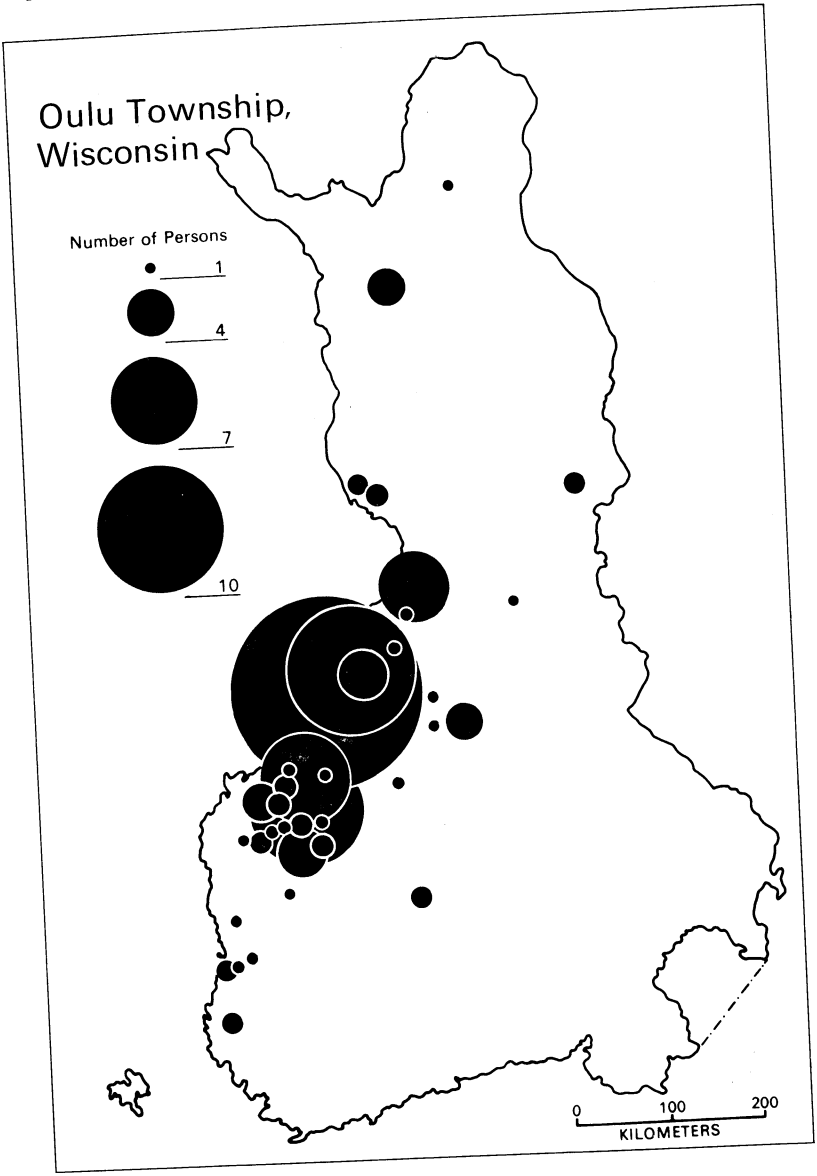

FIGURE 3. Place of Birth in Finland for Oulu Township Immigrants. The largest number of immigrants came from a grouping of communes in the two adjacent Finnish provinces of Oulu and Vaasa. Sources: Church Records, Ilmonen (1926), *Historical Sketches of the Town of Oulu*, and Personal Interviews

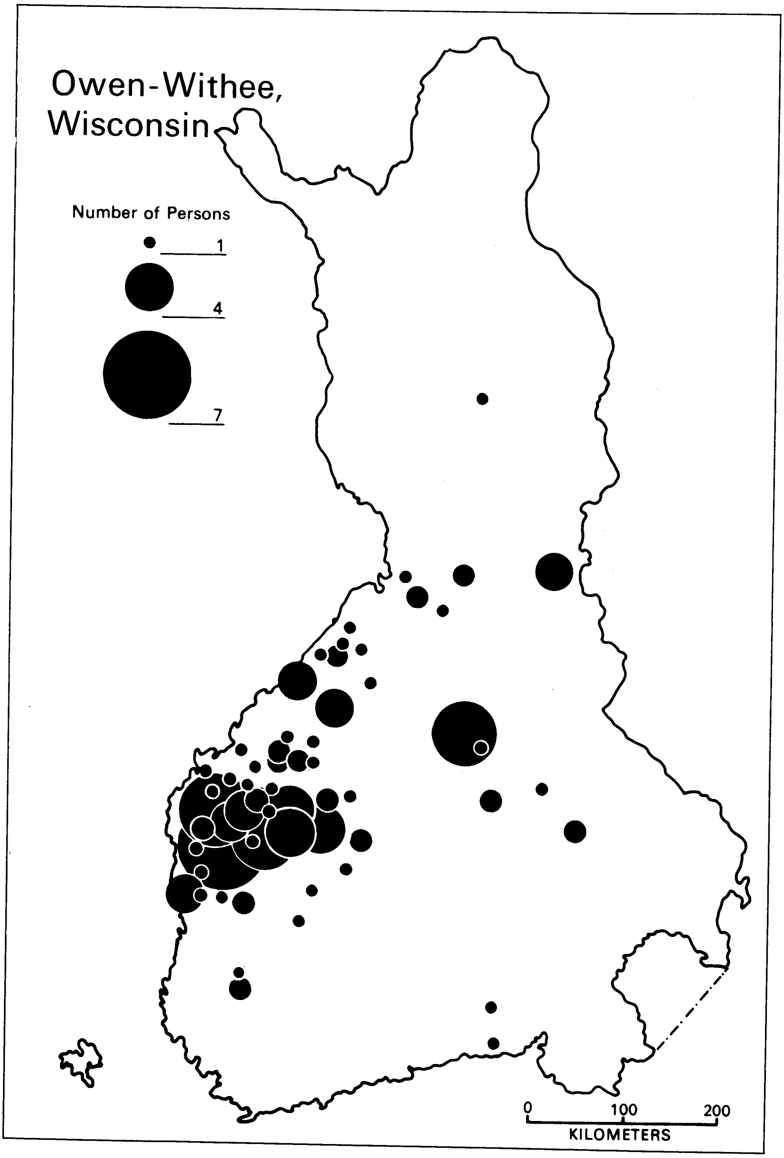

FIGURE 4. Place of Birth in Finland for Owen-Withee Immigrants. Settled at a later date than Oulu Township, the immigrants who established themselves in the Owen-Withee area came from a relatively wide area of Finland. Sources: Church Records, Ilmonen (1926), and Personal Interviews

back-to-the-land phenomenon. Although the movements considered in this study are based upon population samples only, the migration of Finns to Oulu and Owen-Withee does depict two representative threads in a much larger Finnish-American settlement fabric (Figs. 5, 6, 7).

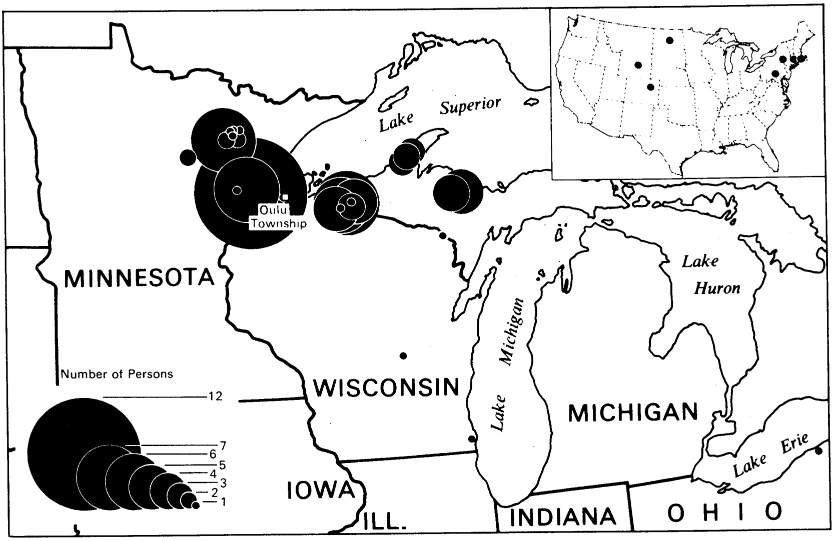

FIGURE 5. Prior American Residence of Finnish-Born Residents in Oulu Township, 1889-1929. The largest number of Finns who moved to Oulu Township came from the Gogebic Iron Range of Wisconsin and Michigan and from Northeastern Minnesota. Sources: See Fig. 3.

As could be expected, the greatest number of Finns who moved to Oulu and Owen-Withee came from the mining districts of the Lake Superior area. The magnitude and timing of the moves, however, varied significantly. During the early years of settlement in Oulu Township the largest number migrated from the Gogebic Iron Range, with lesser numbers coming from Michigan's Copper County and Marquette Iron Range. At the turn of the century, migration from the iron mining districts of Michigan continues, but was supplemented by an approximately equivalent number of arrivals from Minnesota. Many of the Minnesotans came from the Mesabi Iron Range, although several individuals migrated from the large Finnish colony centered in Duluth. During this entire period, a small but steady stream of land seekers also emanated from Superior; and a few from New England, Pennsylvania, Ohio, some

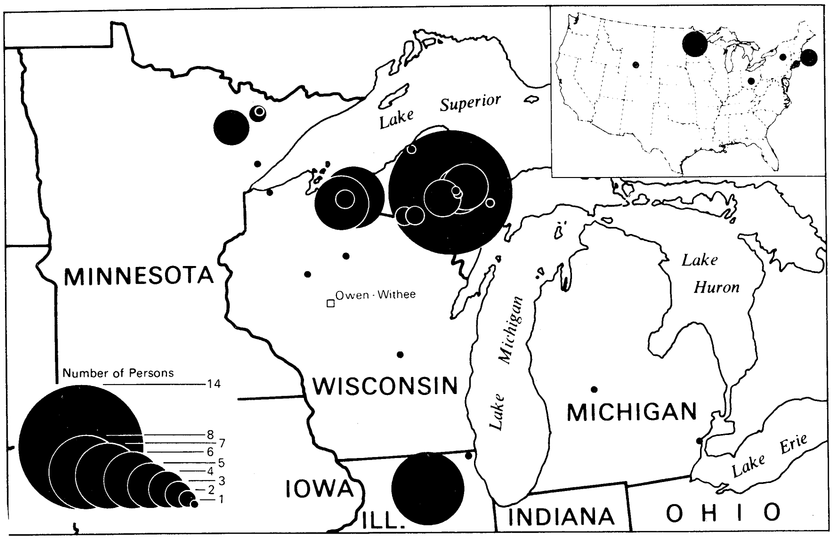

FIGURE 6. Prior American Residence of Finnish-Born Residents in the Owen-Withee Area, 1911-1928. Before moving to the Owen-Withee area, many Finns lived in Northern Michigan and DeKalb, Illinois. Sources: See Fig. 4

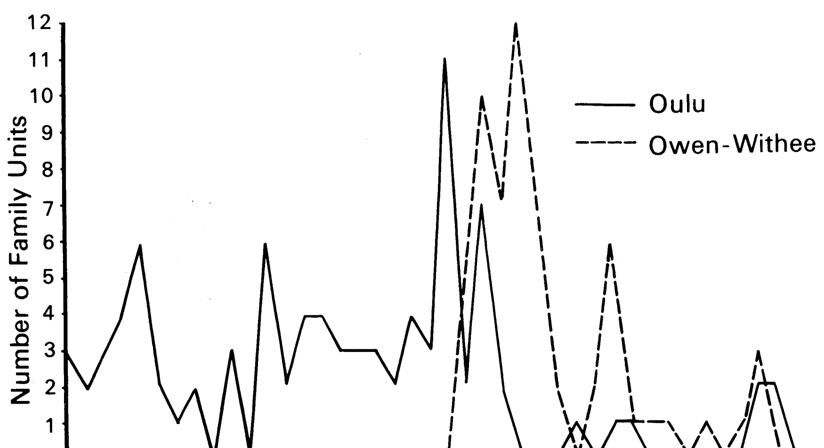

FIGURE 7. Number of Finnish Family Units Migrating Annually to Oulu Township and the Owen-Withee area, 1889-1929. Sources: See Figs. 3 and 4.

of the western states and a few Wisconsin communities. Overall there was a rather constant stream of Finns moving from Michigan to Oulu Township between 1889 and 1914. Migration from Minnesota, however, peaked during the years following the 1906 Mesabi Strike; of the twenty Minnesota Finns counted in the sample, more than one half arrived during the 1906-1910 interim.

When considering the previous American residence of Finns who moved to Owen-Withee, it is clear that the vast majority came from northern Michigan. Most of these individuals settled in the area during the 1911-1919 interim, the period of greatest sales promotion by the Owen Lumber Company and land agent John Pelto. As with Oulu Township, a significant amount of migration originated in the Gogebic Range with the greatest number coming from Wakefield, and from the Marquette Range city of Ishpeming. When compared to Oulu Township, the number of Finns arriving from Minnesota was much smaller. Although some migrated from Sparta, Ely and a few other Minnesota settlements, the availability of cutover lands in their home state undoubtedly lessened land hunger for Wisconsin property. One community outside the normal purview of Finnish-America, however, did contribute substantially to the Owen-Withee total: DeKalb, Illinois. Unlike urban Finns in Milwaukee, Kenosha and Racine who never were enticed to leave their relatively high paying industrial jobs for rural areas, a rather large proportion of DeKalb's Finnish-American community heeded John Pelto's clarion call: "Become a farmer. . ."

The timing of migration to Owen-Withee requires final mention. Migration activities peaked during 1914, the year of Pelto's most extensive promotional efforts; however, this also was the year following the Michigan Copper Country Strike. While it might have been expected that many jobless Finns in the Copper Country would migrate to Owen-Withee, relatively few individuals considered in this study chose this course of action.[20] Instead, it was Finns from the Marquette Range who most vigorously sought land in the Owen-Withee area. It is still possible, nevertheless, that the migration decisions of several Marquette Range inhabitants were influenced by the conflict and carnage which occurred throughout the Copper Country during 1913 and 1914.

CONCLUSION

Whether analyzed as an individual experience or as a collective phenomenon, the migration process generally involves a complex web of social, economic, political and/or psychological variables. The migration regimen for many Finns who moved to the Upper Midwest consisted of two major phases. The first involved the journey from Finland to America, followed immediately by a period of employment in one or more communities or areas.[21] The second phase occurred when the Finns left the mines, lumber camps and urban areas to pursue life as farmers, primarily in the cutover region. Whether this move was undertaken voluntarily or under duress, the settlement and institutional activities of these individuals constituted a distinguishing feature of the Finnish experience in America.

Given the amount of information available, it appears that the origins of a significant number of Oulu Township's settlers can be traced to two general areas or birthfields in Finland. Since the birthfield located in the Province of Vaasa was a major area for many Finnish emigrants, other Finnish-American settlements also claim significant numbers of residents coming from this area of the homeland. However, the other birthfield, focusing upon three communes in the Province of Oulu, sent a larger proportion of its emigrés to Oulu Township than might have been anticipated. The source area pattern for the Owen-Withee community, on the other hand, was much more dispersed and reflected the broader geographic base which characterized general Finnish migration during the early twentieth century.

Before too much is made of the seemingly homogeneous group that settled in Oulu Township, further work should be undertaken in other early Finnish-American settlements. It is possible that the transfer of cultural traits (e.g., architecture, cuisine, dialects, etc.) might be studied more effectively if the specific communal or home area of the immigrants is known and considered. Nevertheless, many distinguishing cultural traits and nuances undoubtedly blended together or were modified in some way once Finns came in contact with large numbers of other Finnish natives, other immigrant groups and Americans. As has been pointed out by several observers (e.g., Jaatinen, 1972), most rural Finnish communities in America were distinguished by their overall cultural cohesion and homogeneity. Seeking ". . .to create permanency amidst an impermanent environment" (Kaups, 1975), many Finns, regardless of their place of origin in Finland or political persuasion in America, participated collectively in the development of rural communities within a new and sometimes hostile land.

NOTATIONS

1. This quote, describing conditions in Northern Michigan, has been attributed to J. H. Jasberg, an effervescent Finnish land agent who was active throughout the Lake Superior area (Wargelin, 1924).
2. These figures, and those for Michigan and Minnesota, have been derived from the Federal Censuses for 1900 and 1920. Any numerical ranking of the total foreign-born population by country of birth or ethnic background has to be undertaken with a great deal of caution. During 1900, for example, Poles were listed by their place of birth: Austria, Germany, Russia or unknown. Canadians, on the other hand, were divided into French and English speaking groups. Although often thought to be an ethnically homogeneous group, the Finns were distinguished on the basis of their native or mother tongue. In 1920, about 12 percent of the Finnish-born population listed Swedish as their mother tongue, and just under one percent claimed Lappish and other languages; the remainder were Finnish speakers.
3. The name of the Central Cooperative Exchange was changed to the Central Cooperative Wholesale in 1930 and to Central Cooperatives, Inc., during 1956.
4. *1964 Yearbook, Central Cooperatives, Inc.* (Superior, Wis: Midland Cooperatives, Inc., 1964), p. 37.
5. Whereas the *sauna* has become a popular institution in America, the *riihi*—a building for the drying, threshing and winnowing of grain—is less well known. For lucid descriptions of these two vernacular building types see Kaups (1972; 1976).
6. Although the Finn who acquired a homestead could claim up to 160 acres of land, many did not; the majority bought 40 to 80 acre parcels from land agents, land companies and other parties.
7. Finland was a Grand Duchy of Russia from 1809 to 1917.
8. *Duluth News Tribune*, March 4, 1907, p. 5.
9. One account of early settlement in the area reported the exploits of two Finns who dragged a sled, ladened with a heavy stove, from Superior to Lakeside Township during the dead of winter. A severe blizzard slowed them down, whereupon they were forced to spend the entire night making tracks through the snow so the stove would not tip off the sled when they pulled it (Aine, 1938).

10. For a description of the land fever which gripped Ashland during this period, see the account in the "Annual Edition" of the *Ashland Daily Press*, May 1893, p. 88.
11. Oulu Township was organized and named largely through the efforts of Andrew Lauri, a tailor born in Finland's Oulu Province. Since local residents felt that Bayfield County officials did not devote enough time and money to the western area of the county, they petitioned to form their own township. After some procrastination by the County Board, Oulu Township was organized in December 1904, with Andrew Lauri serving as the first chairman. See *Historical Sketches of the Town of Oulu: Bayfield County, Wisconsin, 1880-1956* (Oulu, Wis.: Sunnyside Homemakers' Club, 1956); and *Amerikan Uutiset* (New York Mills, Minn.), Sept. 10, 1976, p.4.
12. "Our Most Thickly Populated Township," *Wisconsin Agriculturist*, Vol. 39 (Feb. 1915), p. 8.
13. For a broader summary of agricultural conditions in the cutover region and Oulu Township, I am indebted to R. Zeitlin's "The Rankinen House," unpublished manuscript prepared for the Old World Wisconsin Research Office (Madison: State Historical Society of Wisconsin), Oct. 26, 1976.
14. "Annual Edition," *Ashland Daily Press*, May 1893, p. 88.
15. *The Book of the Years: The Story of the Men who Made Clark County* (Neillsville, Wis.: Clark County Press, 1953), p. 23.
16. Also, emigration activity was more extensive throughout Finland during the post-1900 period.
17. Between 1870 and 1914, approximately 16 percent of all Finnish immigrants came from the Province of Oulu and 49 percent from the Province of Vaasa (Kero, 1974).
18. The overall figures for the communes have been derived from Appendix A of Kero (1974).
19. Of the individuals considered in the two samples, only three males and three females came directly from Finland to Oulu Township; and one male and one female made the direct crossing to Owen-Withee.
20. During and after the strike, a large number of Finns from the Copper Country moved to Detroit and rural areas of Michigan (Holmio, 1967).
21. A striking facet of Finnish-American settlement was the rather considerable amount of geographic mobility displayed by many immigrants. These moves were not undertaken randomly, however, for a communications system consisting of letters,

newspapers and person-to-person contacts directed Finns to new areas and employment opportunities in America.

BIBLIOGRAPHY

Aine, K. Sept. 15, 1938. Lehtien Amerikan erämaaraivauksesta. *Työväen Osuustoimintalehti* (Superior, Wis.): 16.

Alanen, A. R. 1975. The development and distribution of Finnish consumers' cooperatives in Michigan, Minnesota and Wisconsin, 1903-1973. In *The Finnish Experience in the Western Great Lakes Region: New Perspectives*, M. G. Karni, M. E. Kaups and D. J. Ollila, eds. Institute for Migration, Turku, Finland: 103-130.

Doby, H. R.. 1960. A study of social change and social disorganization in a Finnish rural community. Ph.D. dissertation, University of California, Berkeley.

Hartman, W. A., and J. D. Black. 1931. Economic Aspects of Land Settlement in the Cut-Over Region of the Great Lakes States. U. S. D. A. Circ. No. 160: U.S. Dept Agriculture, Washington, D. C.

Helgeson, A. 1962. Farms in the Cutover: Agricultural Settlement in Northern Wisconsin. State Hist. Soc. Wisconsin, Madison.

Holmio, A.K.E. 1967. *Michiganin Suomalaisten Historia.* Michiganin Suomalaisten Historia-Seura, Hancock, Mich.

Ilmonen, S. 1926. *Amerikan Suomalaisten Historia.* Vol. III. Suom.-Lut. Kustannusliikkeen Kirjapainossa, Hancock, Mich.

Jaatinen, S.T. 1972. Colonization and retreat in the cut-over lands of the Lake Superior region. In *International Geography, 1972*, W. P. Adams and F. M. Helleiner, eds. University of Toronto Press. Toronto, 1972: 1320-1322.

Kaups, M. E. 1966. 'Suuri Lansi'—or the Finnish discovery of America. Ph.D. dissertation, University of Minnesota, Minneapolis.

______________1972. A Finnish *riihi* in Minnesota. Jour. Minn. Acad. Sci. 38: 66-71.

______________ 1975. The Finns in the copper and iron ore mines of the western Great Lakes region, 1864-1905: some preliminary observations. In *The Finnish Experience in the Western Great Lakes Region: New*

Perspectives, M. G. Karni, M. E. Kaups and D. J. Ollila, eds. Inst. Migration, Turku, Finland: 55-89.

____________. 1976. A Finnish savusauna in Minnesota. Minn. Hist. 45: 11-20.

Kero, R. 1973. The roots of Finnish-American left-wing radicalism. Pub. Inst. Gen. Hist., Univ. Turku, Finland. No. 5: 45-55.

____________. 1974. Migration from Finland to North America in the Years between the United States Civil War and the First World War. Inst. Migration, Turku, Finland.

____________. 1975. The social origins of the left-wing radicals and "church Finns" among Finnish immigrants in North America. Pub. Inst. Gen. Hist., Univ. Turku, Finland. No. 7: 55-62.

Kolehmainen, J. I. 1944. The Finns of Wisconsin. Wis. Mag. Hist. 27: 391-399.

____________. Feb. 2, 1946. Takaisiin maalle!—'Maaemo se meidät kaikki elättää.' *Työväen Osuustoimintalehti* (Superior, Wis.): 5 and 8.

____________ and G. W. Hill, 1951. Haven in the Woods: The Story of the Finns in Wisconsin. State Hist. Soc. Wisconsin, Madison.

Nelson H. 1943. *The Swedes and the Swedish Settlements in North America.* Carl Bloms Boktryckeri, Lund, Sweden.

Ollila, D. 1975. From socialism to industrial unionism (IWW): social factors in the emergence of left-labor radicalism among Finnish workers on the Mesabi, 1911-19. In *The Finnish Experience in the Western Great Lakes Region: New Perspectives,* M. G. Karni, M. E. Kaups and D. J. Ollila, eds. Inst. Migration, Turku, Finland: 156-171.

Ostegren, R. C. 1973. Cultural homogeneity and population stability among Swedish immigrants in Chisago County. Minn. Hist. 43: 255-269.

Rice, J. G. 1973. *Patterns of Ethnicity in a Minnesota County, 1880-1905.* Geog. Rpt. 4. Dept. Geog., Univ. Umea, Sweden.

Silfversten, C. J. 1931. *Finlandssvenskarna i Amerika. Deras materiella och andliga strävanden.* Duluth, Minnesota.

Wargelin, J. 1924. *The Americanization of the Finns.* Finnish Lutheran Book Concern, Hancock, Mich.

Yli-Jokipii, P. 1971. The cultural geography of Kaleva, a Finnish immigrant community in Michigan. Acta Geographica 22: 1-24.

ACKNOWLEDGEMENTS

Research support was provided by the College of Agricultural and Life Sciences, University of Wisconsin-Madison, and by the Immigration History Research Center, University of Minnesota. The author is indebted to Dr. R. Michael Berry (currently with the Turku School of Economics in Finland) for his assistance in gathering background information for this paper, and to the following individuals for the insights and help they provided: Dr. Matti Kaups (University of Minnesota, Duluth), Dr. Arthur Puotinen (Suomi College, Hancock, Michigan), Dr. Richard Zeitlin (State Historical Society of Wisconsin) and Prof. William Tishler (University of Wisconsin, Madison). A special vote of appreciation is extended to the many Finnish-Americans in Wisconsin who contributed a great amount of revelant information.

GROWTH PATTERNS, FOOD HABITS AND SEASONAL DEPTH DISTRIBUTION OF YELLOW PERCH IN SOUTHWESTERN LAKE MICHIGAN

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ABSTRACT

Yellow perch, *Perca flavescens* (Mitchill), entered shallow water (9 m) about June and spent the remainder of the summer there. About the month of October they moved to water of intermediate depth (18 - 27 m) where they spent the winter. The summer diet of adult yellow perch consisted principally of slimy sculpins, *Cottus cognatus* (55% by volume) and alewives, *Alosa pseudoharengus* (43% by volume). Perch grew to the following average total lengths during their first seven years of life: 77, 138, 175, 200, 228, 247 and 269 mm.

INTRODUCTION

The yellow perch, *Perca flavescens* (Mitchill), is important to both commercial and sport fishermen of Lake Michigan. It is a native of Lake Michigan and at one time was very abundant.

Previous researchers have studied various aspects of the ecology of the yellow perch in the Great Lakes including their distribution (Wells 1968; Smith 1968), food habits (Ewers 1933; Price 1963; Brazo 1973; Rasmussen 1973), and growth patterns (Hile and Jobes 1941 and 1942; Jobes 1952; Joeris 1957; El-Zarka 1959).

Specific objectives of the following study included the determination of their seasonal depth distribution, their food habits, and their growth patterns.

METHODS

This study was performed in the southwestern portion of Lake Michigan just north of the Milwaukee harbor. Four collection transects were established from which yellow perch were taken between May, 1974 and April, 1975. Data from these transects were combined for all calculations.

All yellow perch were collected in 152 x 2 m experimental gill nets of mesh sizes 1.27, 1.90, 2.54, 3.81 and 5.08 cm. Each mesh panel was 30.5 m long. Starting in May, 1974, three gill nets were simultaneously set on one of the four collecting transects. The nets were anchored to the bottom in 9, 18, and 37 m of water, approximately 0.8, 1.6 and 6.4 km from shore respectively. Beginning in August, 1974, two additional nets, one at 14 m deep (1.2 km from shore) and one at 27 m deep (3.2 km from shore), were set with each collection. In general the nets were set at about 1400 hr and pulled at about 0900 hr the following day.

Catch per unit effort in terms of yellow perch collected per net-hour was calculated by dividing the number of yellow perch captured in a given net by the number of hours required to make the catch.

Each fish collected was weighed to the nearest tenth of a gram and its length measured to the nearest millimeter. Scales were taken from the area below the spiny portion of the dorsal fin and above the lateral line. Stomachs were removed and preserved in 10% formalin.

All yellow perch used in the food habits portion of this study were obtained between the months of May and September, 1974, and were in at least their second season of growth. An actual count of all invertebrates ingested was made and their volume determined by water displacement.

Fish found in the yellow perch stomachs which could not be immediately identified or measured to standard length were placed in KOH, stained with alizarin-red and preserved in glycerine. The original length of the prey species (alewife or slimy sculpin), before ingestion, was then reconstructed from the known lengths of the skeletal portions still intact. Measurements of whole skeletons showed 20% of the alewife standard length to consist of the head. Seventy-five percent of the alewife standard length was occupied by the 47 vertebrae. The remaining 5% of the alewife standard length consisted of the urostyle. Similar measurements for slimy sculpins showed the head to occupy 25% of the standard length, the 31 vertebrae to occupy 65% of the standard length and the urostyle to occupy the remaining 10% of the standard length.

Volume vs length curves for alewives and slimy sculpins were generated from whole specimens and used to assign a volume for each reconstructed prey length. This procedure permitted direct comparison between the original volumes of the ingested prey species without having to compensate for differential digestion rates.

Several scales from each specimen were cleaned, mounted and read twice at a magnification of 42X. Growth with age was then calculated from the annuli measurements, according to the following proportion $L_i = (S_i)(L_t)/(S_t)$ where L_i = the calculated total length of the fish at the time of the formation of the ith annulus; S_i = the distance from the focus to the ith annulus; L_t = the total length of the fish; and S_t = the length of the whole scale from focus to posterior margin.

In temperate waters yellow perch complete 100% of the season's growth by November (Jobes 1952). Therefore, fish captured between 1 January and the formation of a new annulus were credited with an annulus at the edge of their scales. As observed in other waters (Jobes 1952; Joeris 1957) most yellow perch of southwestern Lake Michigan added a new annulus during the months of June and July.

Coefficients of condition by age and sex were calculated according to the formula $K = (10^5)(W)/(L^3)$ where K = the coefficient of condtion; W = weight in grams; and L = the total length in millimeters.

The parameters "a" and "b" of the length-weight relationship, $W = (a)(L^b)$, were estimated by the method of least squares from the log form of the equation, $\log W = \log a + (b)(\log L)$. In the above equation W = weight in grams and L = total length in millimeters.

Distribution

Of the 714 yellow perch captured in this study, 698 were taken in water depths of 18 m or less. The preferred water depth for the yellow perch captured in this study was water of shallow to intermediate depth.

The seasonal depth distribution of yellow perch followed a definite pattern as determined from catch statistics (Table 1). Between the months of October and March they were more readily captured in water 18 m deep than in shallower waters of 9 or 14 m. In May and June they moved from intermediate depths (18 m) to shallow depths (9 m). Between the months of May and September the highest catch per unit effort figures were registered in water 9 m deep. The main outward movement of yellow perch in the fall took place in the month of October.

A summer preference for shallow water and a winter preference

TABLE 1. CATCH PER UNIT EFFORT IN TERMS OF NUMBERS OF PERCH CAPTURED PER NET-HOUR IN EXPERIMENTAL GILL NETS FROM MAY, 1974, TO APRIL, 1975, IN SOUTHWESTERN LAKE MICHIGAN.

	Depth of Collection				
	9 m	14 m	18 m	27 m	37 m
1974					
May	0.54		0.28		0.01
June	2.69		0.18		0
July	1.90		0.10		0
August	0.49	0.29	0	0.01	0
September	0.62	0.38	0.04	0	0
October	0.01	0.31	0.72	0.06	0
November	0	0.08	0.22	0	0
1975					
January	0	0	0.38	0	0
February	0	0.10	0.15	0	0
March	0.03	0.08	0.13	0.04	0
April	0.24	0	0	0	0

for deeper water has also been observed for other species of Lake Michigan fish (Wells 1968). Wells suggested that fish may move into deeper water in the winter because they seek the warmer temperatures found there. Such a mechanism may also obtain for the movement of yellow perch to even deeper water in the winter.

Food Habits

Only 111 of the 531 yellow perch stomachs examined in this study contained food. The other stomachs were either empty or had regurgitated their contents during capture of the fish.

An examination of those stomachs containing food indicated that adult yellow perch in southwestern Lake Michigan were very piscivorous. Ninety-eight percent of the reconstructed volume of the stomach contents consisted of either slimy sculpins, *Cottus cognatus* (55%), or alewives, *Alosa pseudoharengus* (43%), (Table 2).

TABLE 2. SUMMER DIET OF 111 ADULT YELLOW PERCH TAKEN FROM SOUTHWESTERN LAKE MICHIGAN.

Food Item	Frequency of Occurrence	% total volume (Reconstructed)	% by Number %	% by Number No. Found
Sculpins *(Cottus cognatus)*	48% (53 stomachs)	55%	76%	103
Alewives *(Alosa pseudoharengus)*	29% (32 stomachs)*	43%	23%	31**
Other	35% (38 stomachs)	2%	NA	NA

*Includes stomachs in which the only means of alewife identification was scales.

**Does not include stomachs in which the only means of alewife identification was scales.

By number, 76% of the forage fish found in yellow perch stomachs were slimy sculpins, and alewives 23%. One ninespine stickleback, *Pungitius pungitius*, was also found. Slimy sculpins occurred in 48% of all stomachs containing food whereas alewives occurred in 29% of the stomachs.

Only 2% of the reconstructed volume of the stomach contents consisted of food other than slimy sculpins or alewives. That 2% contained the following items: (1) larval insects (0.76% total volume) — mostly caddis flies of the family Phryganeidae, also midge larvae and several unidentifiable species of insect larvae; (2) fish eggs (0.60% by volume) — mostly alewife; (3) cladocera (0.37%); (4) unidentifiable fish remains (0.17%); (5) one ninespine stickleback (0.10%).

Although food other than slimy sculpins and alewives represented only a small portion by volume of the stomach contents it did occur in 35% of the 111 stomachs containing food and therefore accounted for a considerable portion of the forage activity.

The diet of male yellow perch differed somewhat from the diet of female yellow perch, although not statistically significant at $\alpha = 0.05$, (Table 3). A rather high percentage (48%) of the females with food in their stomachs had consumed alewives. Only 24% of the

TABLE 3. FREQUENCY OF STOMACHS CONTAINING VARIOUS FOOD ITEMS IN THE SUMMER DIET OF ADULT YELLOW PERCH IN SOUTHWESTERN LAKE MICHIGAN. THE DIET IS SPECIFIED BY SEX, DEPTH OF COLLECTION AND MONTH OF COLLECTION.

	Number of Stomachs	Number of stomachs in which the specified food item was observed				
		Sculpins	Alewives	Other**	Sculpins & Other**	Alewives & Other**
Males	82	35	18	20	7	2
Females*	21	7	10	3	1	0
Sex unknown	7	1	1	4	1	0
30 ft water	96	37	28	22	7	2
45 ft water	5	4	0	1	0	0
60 ft water	9	2	1	4	2	0
May	10	2	5	3	0	0
June	24	5	11	8	0	0
July	45	24	5	11	4	1
August	10	4	1	2	2	1
September	21	8	7	3	3	0

*The stomach of one female perch taken from 30 ft of water in June contained both sculpins and alewives. For the purpose of statistical analysis it was omitted from this table.

**"Other" refers to all food items other than sculpins and alewives.

males had alewives in their stomachs. The higher female utilization of alewives could be caused by several factors. The females grow faster than the males and at an earlier point in life could prey on alewives, which on the average are larger than sculpins. Also the possibility exists that female yellow perch are more pelagic than males (Rasmussen 1973) and therefore more free to prey on alewives (a pelagic species) than on sculpins (a bottom-dwelling species).

Since the introduction of the alewife into Lake Michigan in 1949 and its subsequent dominance of the lake, the yellow perch fishery has declined. The synchronous timing of the rise of the alewife and the fall of the yellow perch suggests a possible relationship between the two events. However, data from this study indicates little, if any, interaction for food between adult yellow perch and alewives. It is my opinion that any study seeking to identify mechanisms of perch-alewife competition in Lake Michigan should include some work on the food habits and distribution of young yellow perch.

Growth Patterns

The calculated total lengths by sex and year class for yellow perch in southwestern Lake Michigan are shown in Table 4. The most

TABLE 4. AVERAGE CALCULATED TOTAL LENGTHS IN MILLIMETERS AT END OF EACH YEAR OF LIFE FOR SEVEN YEAR CLASSES OF SOUTHWESTERN LAKE MICHIGAN YELLOW PERCH.

			Age in Yr.						
Year	Sex	No. of Specimens	1	2	3	4	5	6	7
(Age 1) 1973	M	5	111						
	F	0	-						
	C*	8	106						
(Age 2) 1972	M	14	76	140					
	F	8	116	157					
	C	27	84	144					
(Age 3) 1971	M	45	75	138	174				
	F	23	105	157	190				
	C	70	86	145	180				
(Age 4) 1970	M	57	69	134	170	198			
	F	14	77	138	175	200			
	C	74	70	135	171	198			
(Age 5) 1969	M	17	62	128	173	199	224		
	F	11	73	136	182	211	234		
	C	30	67	131	176	204	228		
(Age 6) 1968	M	4	59	118	164	195	217	236	
	F	9	71	128	176	208	231	250	
	C	13	67	125	172	204	227	246	
(Age 7) 1967	M	0	-	-	-	-	-	-	-
	F	4	64	131	168	202	229	251	269
	C	4	64	131	168	202	229	251	269
GRAND AVERAGES	M	142	72	135	172	198	222	236	-
	F	69	88	144	182	205	232	250	269
	C	226	77	138	175	200	228	247	269

*"C" refers to all specimens combined and includes males, females, and fish whose sex was undetermined.

rapid growth period was the first year of life during which the fish grew to an average total length of 77 mm. The first year's growth represented 31% of the total growth experienced by most specimens in a lifetime (approximately 6 years). In succeeding years growth increments were 25, 15, and av. 9.7% for the 4-5-6 years.

At each year of life females were longer than males, and at all ages less than 6 years the differences in length between males and females were statistically significant for $\alpha = 0.05$. Previous yellow perch studies have also shown females to grow faster than males (Weller 1938; Hile and Jobes 1941 and 1942; Beckman 1949; Carlander 1950; Brazo 1973).

The apparent rapid growth of the young (groups I, II, III) in this study may have resulted from the gill nets selectively capturing the largest (most rapidly growing) of the young perch.

Unlike annual increments in length, the weight increments increased with age (Table 5). A logarithmic increase in weight as length increased can be noted in Fig. 1. Again females showed faster growth than males. The correlation between growth in weight of males and females yielded statistically significant differences ($\alpha = 0.05$) for ages 2, 3, 4 and 5.

TABLE 5. AVERAGE WEIGHTS OF YELLOW PERCH IN SOUTHWESTERN LAKE MICHIGAN.

		Age in Yr.						
Sex		1	2	3	4	5	6	7
Male	No. specimens	5	14	45	57	17	4	0
	Weight (g)	13	44	74	103	142	197	
Female	No. specimens	0	8	23	14	11	9	4
	Weight (g)		82	102	128	216	249	307
Both	No specimens	5	22	68	71	28	13	4
	Weight (g)	13	58	84	108	171	233	307

The parameters "a" and "b" of the length-weight equation, $W = (a)(L^b)$, were estimated by the method of least squares and lead to the following equations. The length-weight equation for males became $W = (5.1076 \times 10^{-6}) (L^{3.14})$. For females the equation was $W = (1.1015 \times 10^{-6}) (L^{3.44})$. The length-weight equation for males and females combined was $W = (2.1079 \times 10^{-6}) (L^{3.31})$.

The coefficients of condition indicated that the sampled yellow perch population in southwestern Lake Michigan was in good

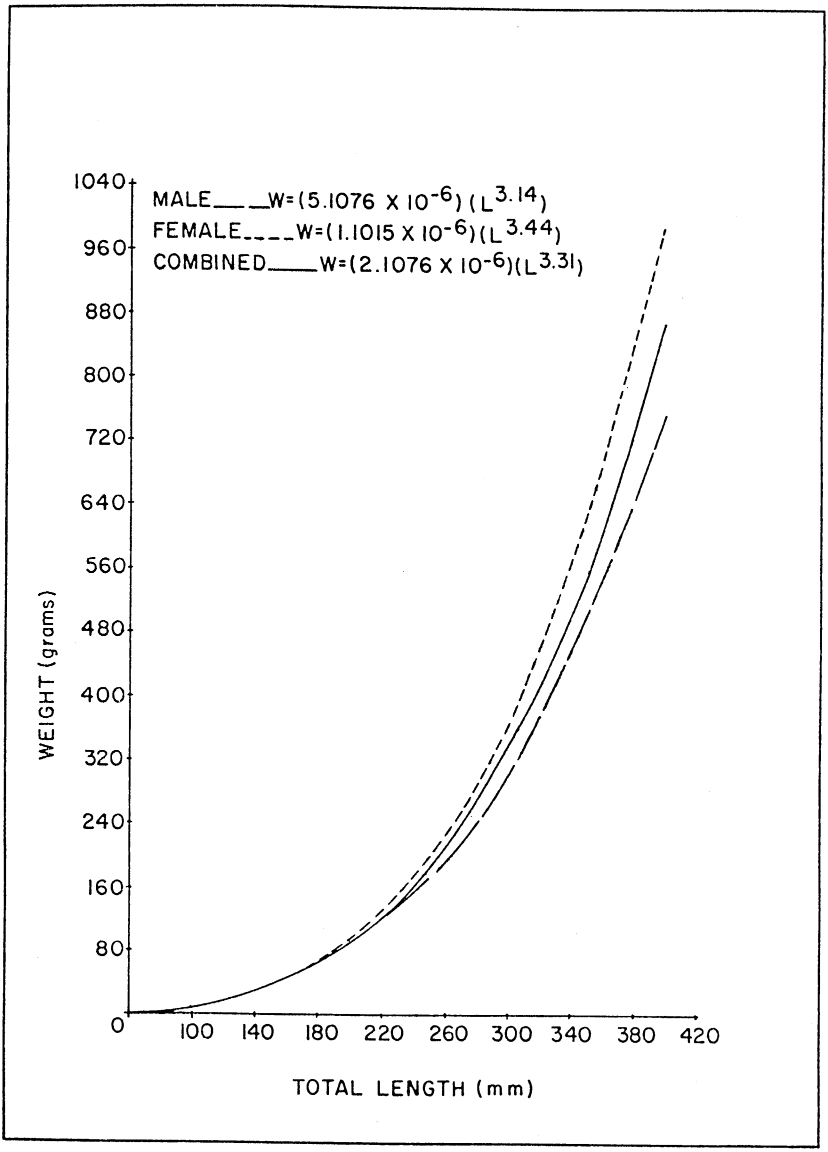

FIGURE 1. Weight as a function of total length for 557 male and 134 female yellow perch from southwestern Lake Michigan.

condition (Table 6). In general, the coefficients of condition for both males and females continued to increase for each successive year of life. Female yellow perch had higher coefficients of condition than males with statistically significant ($\alpha = 0.05$) differences for ages 2 and 5.

TABLE 6. COEFFICIENTS OF CONDITION FOR YELLOW PERCH IN SOUTHWESTERN LAKE MICHIGAN.

		Age in Yr.						
Sex		1	2	3	4	5	6	7
Male	No. of specimens	5	14	45	57	17	4	0
	Coefficient of condition	1.44	1.51	1.68	1.70	1.78	1.92	
Female	No. of specimens	0	8	23	14	11	9	4
	Coefficient of condition		1.73	1.76	1.87	2.15	2.05	2.31

$K = (10^5)(W)/(L^3)$

Of the 691 yellow perch of known sex captured in this study only 134 were females. The sex ratio was 4.16 males for every female. Although yellow perch do have a tendency to develop unbalanced sex ratios, usually the females outnumber the males. Hile and Jobes (1941) noted a 2.96:1 ratio in favor of females. Likewise Carlander (1950), Beckman (1949) and Schneberger (1935) observed the following female-weighted ratios respectively: 1.71:1; 1.56:1 and 1.31:1. Brazo, in a recent study of yellow perch in Lake Michigan (1973), captured more males than females.

A comparison between growth rates from several Lake Michigan yellow perch studies indicated that those observed by Brazo (1973) in eastcentral Lake Michigan grew considerably faster than all others. In terms of both length and weight the yellow perch in eastcentral Lake Michigan grew more rapidly than those in southwestern Lake Michigan. The growth rates observed by Hile and Jobes in 1942 for yellow perch in Green Bay and in northwestern Lake Michigan were somewhat slower than those observed in the present study of southwestern Lake Michigan. For the first five years of growth, yellow perch in southwestern Lake Michigan were longer than those in Green Bay in 1942. For ages above five years the Green Bay yellow perch were longer than those examined in the present study. At all ages the yellow perch in southwestern Lake Michigan were longer than those observed in northwestern Lake Michigan in 1942; however, as in the Green Bay population, the differences in length decreased with age.

SUMMARY AND CONCLUSIONS

The seasonal depth distribution of yellow perch in Lake Michigan followed a definite pattern. In June they entered shallow water (9 m) and remained there until September when they gradually moved to their deeper (18 - 27 m) wintering grounds.

Ninety-eight percent by volume of the summer diet of adult yellow perch in Lake Michigan near Milwaukee consisted of slimy sculpins, *Cottus cognatus* (55%), and alewives, *Alosa pseudoharengus* 43%). The other 2% included insects, cladocera, fish eggs and other fish.

Yellow perch attained the following average calculated total lengths during their first 7 years of life respectively — 77, 138, 175, 200, 228, 247 and 269 mm. The average weights for the first 7 years of life were 13, 58, 84, 108, 171, 233 and 307 g respectively. Females grew faster than males and lived longer than males. The sex ratio was 4.16 males to every one female.

ACKNOWLEDGMENTS

I am indebted to my major professor, Dr. Carroll R. Norden, for supervising this project and for reviewing the manuscript and to Ronald R. Rutowski for preparing the artwork for Fig. 1. I am grateful to Dr. Eugene Lange for his help with the statistical analysis and for his review of the manuscript. This study was partially funded by the Wisconsin Department of Natural Resources contract AFC-12 (144-F775).

BIBLIOGRAPHY

Beckman, W. C. 1949. The rate of growth and sex ratio for seven Michigan fishes. Trans. Amer. Fish. Soc. 76: 63-81.

Brazo, D. C. 1973. Fecundity, food habits, and certain allometric features of the yellow perch, *Perca flavescens* (Mitchill), before operation of a pumped storage plant on Lake Michigan. M. S. thesis, Michigan State University. 75 pp.

Carlander, K. D. 1950. Growth rate studies of saugers, *Stizostedion canadense canadense* (Smith) and yellow perch, *Perca flavescens* (Mitchill) from Lake of the Woods, Minnesota. Trans. Amer. Fish. Soc. 79: 30-42.

El-Zarka, S. E. 1959. Fluctuations in the populations of yellow perch in Saginaw Bay, Lake Huron. U. S. Fish. Wild. Serv., Fish. Bull. 59: 365-415.

Ewers, L. A. 1933. Summary report of crustacea used as food by the fishes of the western end of Lake Erie. Trans. Amer. Fish. Soc. 63: 379-390.

Hile, R., and F. W. Jobes. 1941. Age, growth and production of the yellow perch, *Perca flavescens* (Mitchill) of Saginaw Bay. Trans. Amer. Fish. Soc. 70: 102-122.

Hile, R., and F. W. Jobes. 1942. Age and growth of the yellow perch, *Perca flavescens* (Mitchill), in Wisconsin waters of Green Bay and northern Lake Michigan. Mich. Acad. Sci., Arts Lett. 27: 241-266.

Jobes, F. W. 1952. Age, growth, and production of yellow perch in Lake Erie. U. S. Fish Wild. Serv., Fish. Bull. 52: 205-266.

Joeris, L. S. 1957. Structure and growth of scales of yellow perch of Green Bay. Trans. Amer. Fish. Soc. 86: 169-194.

Price, J. W. 1963. A study of the food habits of some Lake Erie fish. Bull. Ohio Biol. Survey 2: 89.

Rasmussen, G. A. 1973. A study of the feeding habits of four species of fish, *Alosa pseudoharengus, Coregonus hoyi, Perca flavescens,* and *Osmerus mordax,* at three sites on Lake Michigan, as compared to the zooplankton, phytoplankton and water chemistry of those sites. Ph.D. thesis, Michigan State University. 97 pp.

Schneberger, E. 1935. Growth of the yellow perch (*Perca flavescens* Mitchill) in Nebish, Silver and Weber Lakes, Vilas County, Wisconsin. Trans. Wis. Acad. Sci., Arts, Lett. 29: 103-130.

Smith, S. H. 1968. Species succession and fishery exploitation in the Great Lakes. Jour. Fish. Res. Bd. Can. 25: 667-692.

Weller, T. H. 1938. Note on the sex ratio of the yellow perch in Douglas Lake, Cheboygan County, Michigan. Copeia, 1938, No. 2: 61-64.

Wells, L. 1968. Seasonal depth distribution of fish in southeastern Lake Michigan. U. S. Fish. Wild. Serv., Fish. Bull. 67: 1-15.

STANDING CROP OF BENTHIC INVERTEBRATES OF LAKE WINGRA AND LAKE MENDOTA, WISCONSIN

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ABSTRACT

Significant differences existed in the number and biomass of benthic invertebrates in Lakes Wingra and Mendota. Bottom organisms are highly diversified and more abundant in Lake Mendota than in Lake Wingra. Maximum differences occur in early summer and least differences in August. *Hyalella* was found in Lake Mendota samples but not in Lake Wingra. Chironomid larvae and Mayfly nymphs were caught from both lakes, although numbers and weights were higher in Lake Mendota.

INTRODUCTION

Like other fresh water fishes, bluegills are known to feed on insects and macro-food particles (Scott and Crossman 1973 and Carlander 1973). Thus, studies on benthic macroinvertebrates of Lake Wingra and Lake Mendota will reveal if fish of Lake Wingra feed selectively on microcrustaceans or whether the macrofauna of the lake has been depleted due to the dense fish community. It is also of importance to identify the role which benthic invertebrates of Lake Wingra play on the dynamics of the stunted fish population of the lake.

Study Sites

Lake Wingra and Lake Mendota are located in Dane County near Madison, Wisconsin. Lake Wingra is a relatively shallow lake with an average depth of 3 meters and a surface area of 140 hectares. Lake Mendota is larger with an area of 3938 hectares and a mean depth of 12 meters. Study areas in the two lakes were chosen to have similar depths and substrate structures, described as mostly muddy with few silted areas.

Methods of Collection

Bottom samples were taken with a 15 X 15 cm (225 cm^2) Ekman dredge of standard weight on the same dates (or consecutive dates) on both lakes from late June through August. Twenty samples, every 2 weeks, were collected from Lake Wingra, 4 at each station at north, south, east, west, and middle regions of the lake and at comparable depths as Lake Mendota samples (2 m). In Lake Mendota the bottom samples were taken at 4 stations along a transect from Picnic Point to a distance of about 200 m south along the shore line, at an average depth of about 2 m. Four replicates were collected at each station (50 m apart). Bottom fauna were screened (500 mesh), washed with distilled water, and counted. They were then classified to major taxonomic groups. Dry weights were estimated after the samples were kept for 48 hr at 85C.

RESULTS

Lake Wingra

Maximum number of bottom animals per 225 cm^2 dredge catch was found in mid-July and the minimum number at the end of August (Fig. 1-top). Dry weights followed closely the same pattern, as shown in Fig. 1-bottom. Differences among number of bottom animals caught in mid-June and August were significant. Average number of animals per dredge varied from 8.2 in early July to 2 animals per dredge in late August. Mean numbers of animals found per dredge declined from late June till late August.

Dry weight of bottom organisms of Lake Wingra was significantly low, from July through August. Although few bottom organisms were caught in the dredge, they were relatively large. The benthic collections of Lake Wingra have poorly diversified animal community. Species of the order *Diptera* constituted 95% or more throughout the sampling period. Members of *Ephemeroptera* were seldom found and *Amphipoda* were completely absent. Members of *Diptera* made up 99% of the benthic community in August. Average number per 225 cm^2 dredge varied from 3.5 in mid-August to 2 in late August. The corresponding dry weights were 3.9 and 3.7 mg per 225 cm^2, respectively. Species of *Diptera* made up the collection of benthic organisms in late June and in July. Number of *Diptera* rose sharply from 4.3 organisms per 225 cm^2 in late June to 8.2 animals in mid-July. Similarly, the biomass (dry weight per 225 cm^2) of benthic invertebrates varied from 2.5 mg in late June to an average of 5.2 mg in mid-July.

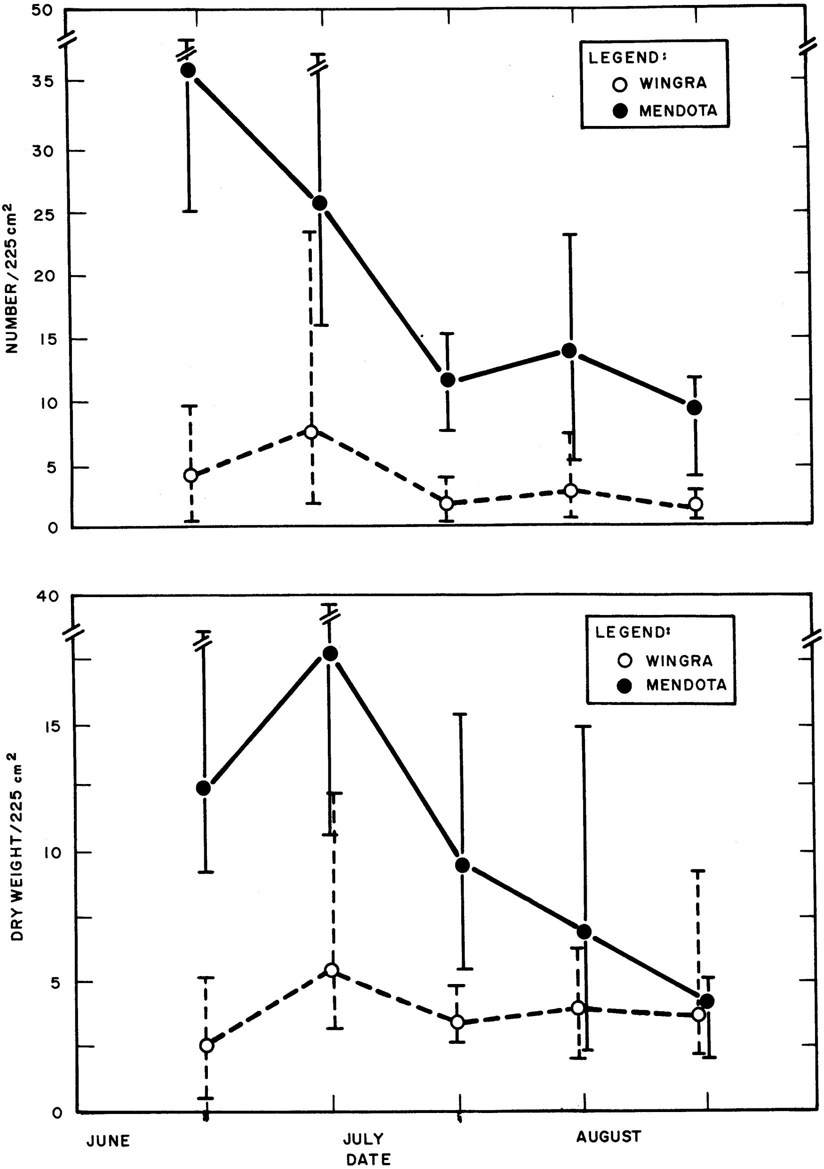

FIGURE 1. Total number (top figure) and total dry weight (bottom figure) in mg of invertebrates caught in 225 cm^2 Ekman dredge from Lake Mendota and Lake Wingra, June-August, 1972. Circles are means of 16-20 samples. Vertical lines are ranges.

Lake Mendota

Lake Mendota can be described as having a highly diversified benthic community. Members of *Amphipoda, Ephemeroptera, Tricoptera, Diptera,* and others were abundant and were represented in the collections at one time or another during the sampling period. Because of such diversity, the data are handled here in a detailed fashion.

Bottom organisms varied in abundance from mid-June through August. Dipterans and ephemeropterans constituted the bulk of the bottom fauna collected. A decline in dry weight of botton organisms per 225 cm^2 from June through August was obvious; the same can be said regarding the number of the organisms (Fig. 1).

Amphipoda. Hyalella sp. in the bottom samples were common, although not substantial. They varied in number from 1.3 animals per 225 cm^2 in June to 4.3 in August. *Hyalella* made up the bulk of the bottom fauna caught in August, with values of about 38% in number and 33% dry weight for all animals. The minimum contribution of *Hyalella* to the bottom fauna was in July when they were 3% and 1.5% of the total number and weight, respectively, of the animals caught per dredge. Data of the bimonthly samples do not show a consistent pattern in the abundance of these animals in the bottom collections. For example, from the second half of June through the end of August values for different samples were highly variable, with variation reaching 43% of the catch in the first half of July, 4.7% at the end of July, 44.2% in mid-August and 30.9% at the end of August. *Hyalella*, therefore, does not contribute significantly to the bottom fauna caught in June or July while it does in the month of August. The low values of *Hyalella* in June may mean that they were really few at this time or it could also be that *Hyalella* associate with the surrounding vegetation rather than settling at the bottom. Buscemi (1961) found few animals in the bottom samples taken from Parvin Lake, while many *Hyalella* were on the overlying vegetation. Similar observations were reported by Mundie (1959).

Ephemeroptera. Mayflies varied in number from an average of 0.5 to 2 animals per dredge and from 0.2 mg to 1.4 mg dry weight. They were available at all times but few animals were caught. They reached a maximum at the end of August with 19.4% of the total catch in terms of numbers and 18.1% in total dry weight. They have their minmum values of 5.4% and 11.1% of total number and weight, respectively, in June. Regarding their abundance, they occupy a third position after *Diptera* and *Amphipoda.*

Odonata and *Tricoptera.* Members of these groups were not significant in the bottom catch of Lake Mendota. *Odonata* make up 1% of the fauna per dredge caught in July and 0.9% of the August catch, while none was caught in June. *Tricoptera* were as scarce as *Odonata.*

Hirudinea. Although abundant in the area (personal observations), few leeches were caught in the dredge. It is possible that these animals were able to avoid the dredge because of their relatively high speed of swimming. None of these organisms was caught in June, while they made up 13.9% of the total number of organisms collected in late July and about 5% in August collections of bottom fauna. Their weights, however, varied from 6.2% to 2.8% of total dry weights of organisms collected per dredge during the same period.

Diptera. Diptera participated significantly in fauna caught throughout the summer. They constituted about 88.9% of total number of animals caught in August. Their weights constituted 75% to 68% of total weight during the same period.

Chironomid larvae comprised about 95% of all the dipterans, the remaining 5% being chironomid pupae. Mean number of chironomid larvae was as high as 33 animals per 225 cm^2 in June, 13 in July and 4.5 in August. It seems obvious that there is a descending trend from June through August which may be related to the time of emergence.

Hydracarina. Water mites, although caught in July and August, were of little importance in the bottom community. They constituted about 1.5% of the total number of bottom organisms in July and 2% in August. Mundie (1959) reported low uniform densities of water mites in all of his bottom catches.

DISCUSSION AND CONCLUSION

Extensive studies conducted on bluegill of Lake Wingra and Lake Mendota (El-Shamy 1976) indicated that fish of Lake Mendota grew faster than fish of Lake Wingra. In the same studies, all size classes of Lake Mendota bluegill were shown to have higher daily rations (food consumption) than those of Lake Wingra. The least differences existed among small fish but there were significant differences for larger fish. When the daily ration of Lake Wingra bluegill was compared to data from the literature, Lake Wingra bluegill showed smaller values than those given by Seaburg and Moyle (1964) and Keast and Welch (1968) for bluegill in other lakes.

Data from stomach analyses of Lake Wingra and Lake Mendota fish revealed the importance of the macroinvertebrates in the bluegill diet. Studies on stomach contents of panfish by other investigators (Buscemi 1961, Etnier 1971, and Baumann 1972) also emphasized the significance of the macroinvertebrates in the diet of the fish. However, stomach analysis of Lake Wingra bluegill revealed their dependence on planktonic organisms throughout the growing season. Measurements of food particles recovered from their stomachs showed an interesting characteristic: small and large fish fed on similar size food particles. In contrast, Lake Mendota fish preyed almost exclusively on benthic macroinvertebrates. They also showed a definite correlation between food particle size and fish size.

It should be emphasized that there is more energy expenditure in catching these small organisms than in catching the large organisms. Therefore, Lake Wingra bluegill actually waste more energy in feeding. Also, large organisms should have less indigestible materials relative to their body weight than do miscroscopic animals, i.e. the amount of chitin, for example, per unit dry weight in *Hyalella* or chironomid larvae should be less than that in small cladocerans or copepods of equivalent weight. Animals caught from Lake Wingra were mainly chironomid larvae and, to a very limited extent, water mites and Mayfly nymphs. *Hyalella* was completely absent and damsel flies and caddis flies were rare. In contrast, *Hyalella* was abundant and caught throughout the summer from Lake Mendota, while damsel flies, caddis flies, and stone flies were only occasionally found. Thus it is seen that Lake Wingra bluegill, by feeding on these microscopic animals, actually receive less digestible material than do their counterparts in Lake Mendota which feed on larger organisms.

In summary, then Lake Wingra bluegill feed on the small planktonic organisms available, expend a considerable amount of energy in pursuit of food, receive more indigestible materials per unit of food consumed, and attain smaller body size and weight than bluegill in other, more nutritive waters.

Other facts related to the history of Lake Wingra and its fish during the last 70 years are of interest in relation to the feeding habits discussed. Helm (1958) reported changes in species and their relative abundance as well as changes in growth rates of fish in the lake. Also, three fundamental changes in Lake Wingra over the past decades have taken place (Baumann et al. 1974a and b): 1. A decline in large predators such as northern pike and northern long nose gar, 2. An increase in the population density of pan fish, and 3. The disappearance of large invertebrates such as *Hyalella* which were reported to be abundant in the lake in the early twentieth century.

We therefore conclude that the decline in the benthic invertebrate population in Lake Wingra has played a significant role in the dynamics of the fish population in the lake.

BIBLIOGRAPHY

Baumann, P. 1972. Distribution, movement, and feeding interactions among bluegill and three other panfish in Lake Wingra. M.S. thesis, Univ. of Wisconsin, Madison. 48 pp.

Baumann, P. C., and J. F. Kitchell. 1974a. Diel pattern of distribution and feeding of bluegill (*Lepomis macrochirus*) in Lake Wingra, Wisconsin. Trans. Amer. Fish. Soc. 103: 255-260.

Baumann, P. C., J. F. Kitchell, J. J. Magnuson, and T. B. Kayes. 1974b. Lake Wingra, 1837-1973: A case history of human impact. Wis. Acad. Sci., Arts, Lett. 62: 57-91.

Buscemi, P. A. 1961. Zoology of bottom fauna of Parvin Lake, Colorado, Amer. Micro. Soc. Trans. 80: 266-307.

Carlander, D. K. 1973 *Handbook of Freshwater Fishery Biology*, Vol. 2, Iowa State University Press.

El-Shamy, F. 1976. A comparison of the growth rates of bluegill (*Lepomis macrochirus*) in Lake Wingra and Lake Mendota, Wisconsin. Wis. Acad. Sci., Arts, Lett. 64: 144-153.

Etnier, D. A. 1971. Food of three species of sunfish (*Lepomis centrarchidae*) and their hybrids in three Minnesota lakes. Trans. Amer. Fish. Soc. 100: 124-128.

Helm, W. T. 1958. Some notes on the ecology of panfish in Lake Wingra with special reference to the yellow bass. Ph. d. thesis, Univ. of Wisconsin, Madison, 88 pp.

Keast, A. and L. Welsh, 1968. Daily feeding periodicities, food uptake rates, and dietary changes with hour of day in some lake fishes. Fish. Res. Bd. Canada 25: 1133-1144.

Mundie, J. H. 1959. The diurnal activity of the larger invertebrates at the surface of Lake la Ronge Saskatchewan. Can. Jour. Zool. 37: 945-956.

Scott, B. and E. Crossman, 1973 *Freshwater Fishes of Canada,* Fish. Res. Board Canada, Ottawa, 966pp.

Seaburg, K. G. and J. B. Moyle, 1964. Feeding habits, digestion rates, and growth of some Minnesota warm water fishes. Trans. Amer. Fish. Soc. 93: 269-285.

ACKNOWLEDGMENT

I am grateful to Dr. J. Magnuson and Dr. J. Kitchell of the University of Wisconsin for support and creative criticism of the original research.

DISTRIBUTION OF FISH PARASITES FROM TWO SOUTHEAST WISCONSIN STREAMS

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ABSTRACT

Between 1971 and 1974, 15 species of fish parasites (three acanthocephalan, six cestode, four trematode, one nematode and one crustacean species) were recovered from 15 hosts (8 families) from the Pike and Root rivers, southeast Wisconsin. A complete parasite-host listing is included with notes on differential distribution of parasites in the two streams and related information.

INTRODUCTION

The Root River (Milwaukee and Racine Counties) and Pike River (Racine and Kenosha Counties) drain eastward into Lake Michigan. Some of the fish parasites were previously treated by Amin (1974, 1975 a-d) and Amin et al. (1973). Others were more recently recovered and additional information has now become available. A comprehensive listing of parasites and their hosts is included here for the first time. Attention is called to the differences in the infestation picture in the two streams and to the possible cause.

MATERIALS AND METHODS

All fishes from both streams were seined and examined during the autumn of every year (1971-1974) and occasionally also from the Pike River during the spring and/or summer. They were kept on wet ice until examined for parasites in the laboratory within 24-48 hours. Recovered parasites were processed as follows. Trematodes and cestodes were stained in Semichons carmine, cleared in xylene and whole mounted in Canada balsam. Acanthocephalans were stained in Harris' hematoxylin or Mayer's acid carmine, cleared in beechwood creosote or terpineol and whole mounted in Canada balsam. Nematodes were not permanently mounted but cleared in glycerol.

RESULTS AND DISCUSSION

Of 26 species of fishes (10 families) examined from the Root (R) and Pike (P) Rivers, 15 (8 families) were infested with parasites.

Fishes which were negative include: *Alosa pseudoharengus* (Wilson) (alewife) (R:5); *Esox americanus* Le Sueur (grass pickerel) (R:1); *Chrosomus erythrogaster* (Raf.) (southern red-belly dace) (P: >74); *Notropis cornutus* (Mitchill) (common shiner) (R: >35; P: >7); *N. heterolepis* Eigenmann and Eigenmann (blacknose shiner) (R:13): *N. stramineus* (Cope) (sand shiner) (P: > 3); *Ictalurus nebulosus* (Le Sueur) (brown bullhead) (R:1); *Noturus flavus* (Raf.) (stonecat) (R:4); *Lepomis gibbosus* (Linn.) (pumpkinseed) (R:2); *L. megalotis* Raf. (longear sunfish) (R:1).

A listing of parasites recovered and their hosts follows. Host names are followed by the number examined from each stream and a symbol denoting frequency and intensity of infestation (-:negative, ± :scarce/accidental, +:light/infrequent, ++:moderate/somewhat common, +++:heavy/frequent). Asterisks denote new locality records in southeastern Wisconsin.

ACANTHOCEPHALA

Acanthocephalus parksidei Amin, 1974

Salmo gairdneri Richardson (rainbow trout) (P:2, ++ to +++)
Notemigonus crysoleucas (Mitchill) (golden shiner) (P:9,+) (R:32,-)
Pimephalus promelas (Raf.) (fathead minnow) (P:17,+)
Semotilus atromaculatus (Mitchill) (creek chub) (P: > 398, ++ to +++) (R:66,-)
Semotilus margarita (Cope) (pearl dace) (P: 54, ±) (R:665,-)
Catostomus commersoni (Lacépède) (white sucker) (P: > 231, ++ to +++) (R:479, ±)*
Ictalurus melas (Raf.) (black bullhead) (P:7, ++ to +++*) (R:1,-)*
Culaea inconstance (Kirtland) (brook stickleback) (P:11,+)
Lepomis cyanellus Raf. (green sunfish) (P: >48, +++ to +++) (R:131, ±)*
Lepomis macrochirus Raf. (blue gill) (P: >2, ++ to +++) (R:17,-)
Micropterus salmoides (Lacépède) (largemouth bass) (P: >2, ++ to +++) (R:3,-)

Neoechinorhynchus sp.

Lepomis cyanellus Raf. (green sunfish) (P: >48,+) (R:131,-)

Pomphorhynchus bulbocolli (Linkins, 1919) Van Cleave, 1919

Catostomus commersoni (Lacépède) (white sucker) (P: >231, ±) (R:479,-)

CESTODA

Biacetabulum biloculoides Mackiewicz & McCrae, 1965

Catostomus commersoni (Lacépède) (white sucker) (P: >231, + to ++) (R:479, ±)

Biacetabulum macrocephalum McCrae, 1962

Catostomus commersoni (Lacépède) (white sucker) (P: >231,-) (R:479, +)

Hunterella nodulosa Mackiewicz & McCrae, 1962

Catostomus commersoni (Lacépède) (white sucker) (P: >231, + to ++)* (R:479: +to ++)*

Glaridacris catostomi Cooper, 1920

Catostomus commersoni (Lacépède) (white sucker) (P: >231,+) (R:479: ±)*

Bothriocephalus cuspidatus Cooper, 1917

Lepomis cyanellus Raf. (green sunfish) (P: >48, +) (R:131,-)

Proteocephalus buplanensis Mayes, 1976

Semotilus atromaculatus (Mitchill) (creek chub) (P: >398, + to ++) (R:66, ±)*

Lepomis cyanellus Raf. (green sunfish) (P: >48,+) (R:131,-)

TREMATODA

Triganodistomum attenuatum Mueller & Van Cleave, 1932

Catostomus commersoni (Lacépède) (white sucker) (P: >231,+) (R:479,+)

Ornithodiplostomum ptychocheilus (Faust, 1913) metacercariae

Semotilus atromaculatus (Mitchill) (creek chub) (P: >398, + to ++) (R:66,-)

Posthodiplostomum minimum (MacCallum, 1912) metacercariae

Semotilus atromaculatus (Mitchill) (creek chub) (P: >398, + to ++) (R:66,-)

Neascus sp. metacercariae

(Black spot; pigmented cysts in skin)
Specific information not available (P:+)* (R: + to ++)*

NEMATODA

Dorylamus sp.

Catostomus commersoni (Lacépède) (white sucker) (P: >231,++) (R:479,-)

CRUSTACEA

Lernaea cyprinacea Linn.

Umbra limi (Kirtland) (central mudminnow) (P: >4,-) (R:33, + to ++)
Cyprinus carpio (Linn.) (carp) (R:2, + to ++)
Notemigonus crysoleucus (Mitchill) (golden shiner) (P:9,-) (R:32,+)
Semotilus atromaculatus (Mitchill) (creek chub) (P: 398,-) (R:66, + to ++)
Semotilus margarita (Cope) (pearl dace) (P:> 54,-) (R:665,+)
Catostomus commersoni (Lacépède) (white sucker) (P:231, ±)* (R:479, + to ++)
Lepomis cyanellus Raf. (green sunfish) (P:> 48,-) (R:131,+)
Lepomis macrochirus Raf. (blue gill) (P:> 2,-) (R:17,+)
Micropterus salmoides (Lacépède) (largemouth bass) (P: >2,-) (R:3, + to ++)
Etheostoma nigrum Raf. (Johnny darter) (R:74,+)

The above data indicate that the parasitic fauna of Pike River fishes is considerably richer than that of Root River fishes. Nine of the 15 recovered parasites were common in the Pike River: *A. parksidei*, *Neoechinorhynchus* sp., *B. biloculoides*, *G. catostomi*, *B. cuspidatus*, *P. buplanensis*, *O. ptychocheilus*, *P. minimum* and *Dorylamus* sp. Only two parasites, *B. macrocephalum* and *L. cyprinacea*, were more common in Root River fishes. Two species, *H. nodulosa* and *T. attenuatum*, were about equally common in suckers (*C. commersoni*) of both streams. The above distributional pattern might be caused by the differential distribution of supporting intermediate hosts. If true, then the presumably "poorer" invertebrate fauna of the larger Root River might be influenced, at least in part, by its higher flow rate as well as its higher non-fecal organic pollutant content than in the Pike River (Southeastern Wisconsin Regional Planning Commission, 1966). However, only quantitative surveys can validate the above statement.

During the course of these investigations, annual cycles in certain parasites were observed. Root River fishes were extensively surveyed during the autumn of 1971 and 1974. During 1971, only *B. macrocephalum* was recovered from suckers. In 1974, Root River suckers were commonly infected with *H.nodulosa* (48% of 82 were infested with approximately 350 worms; about 80% were mature adults) whereas infestations with *B. macrocephalum* were very scarce. Furthermore, *L. cyprinacea* infestations were common in Root River fishes during autumn, 1971, but were absent during the same season, 1974. Root River fishes examined in 1974, particularly suckers and chubs, were relatively larger (older) than those previously surveyed from the same stream. In the Pike River, *Dorylaimus* sp. was commonly found in suckers examined during autumn, 1972. This nematode was not recovered from suckers from the Pike River during any other season or during the same season in other years. Host size associations might have been partially involved in some of the above cycles. Lighter and less frequent infestations with *L. cyprinacea* and *Dorylaimus* sp. (as well as with *T. attenuatum*) were previously found associated with increased host size (Amin et al., 1973, Amin, 1974). Future investigations might reveal the presence of additional parasites from these two streams. However, the above trend of heavier infections in Pike than in Root River fishes will probably continue if water and host conditions remain essentially unchanged.

ACKNOWLEDGMENT

For help in the identification or confirmation of *H. nodulosa* and *G. catostomi* from Root River, I am grateful to J. S. Mackiewicz, State University of New York, Albany.

BIBLIOGRAPHY

Amin, O. M. 1974. Intestinal helminths of the white sucker, *Catostomus commersoni* (Lacepede), in S.E. Wisconsin. Proc. Helm. Soc. Wash. 41:81-88.

_____ 1975a. Intestinal helminths of some southeastern Wisconsin fishes. Proc. Helm. Soc. Wash. 42:43-46.

_____ 1975b. *Acanthocephalus parksidei* sp. n. (Acanthocephala: Echinorhynchidae) from Wisconsin fishes. J. Parasit. 61:301-306.

_____ 1975c. Variability in *Acanthocephalus parksidei* Amin, 1974 (Acanthocephala: Echinorhynchidae) J. Parasit. 61:307-317.

_____ 1975d. Host and seasonal associations of *Acanthocephalus* *parksidei* Amin, 1974 (Acanthocephala: Echinorhynchidae) in Wisconsin fishes. J. Parasit. 61:318-329.

Amin, O. M., J. S. Balsano, and K. A. Pfalzgraf. 1973. *Lernaea cyprinacea* Linn. (Copepoda: Crustacea) from Root River, Wisconsin, fishes. Amer. Midland Nat. 89:484-487.

Southeastern Wisconsin Regional Planning Commission, 1966. Water quality and flow of streams in southeastern Wisconsin. Tech. Rep. 4, 342 pp.

CHANGING ROLE OF THE EMERGENCY ROOM AND ITS ACCEPTANCE BY HOSPITAL PERSONNEL

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ABSTRACT

The hospital, in response to the changing health care needs of society, has undergone numerous transitions, since its inception as an institution of refuge for the ailing indigent. One example is the development of a "protocol" method of patient care and its incorporation into an emergency room Acute Care Unit. It was the purpose of this study to assess the feasibility, efficiency, and acceptability of care provided by the protocol method for a large midwestern hospital.

Methods consisted of clinical analysis, personnel interviews, and data comparison with other protocol studies. Sample size totaled 1,683 patients. Analysis of results adjudged the protocol method to be a feasible, safe, and acceptable means of providing health care to patients.

INTRODUCTION

Through history, the hospital has reflected society's health care needs and attitudes. During the Roman Empire, for instance, army hospitals were developed for wounded and ill soldiers; however, the concept was not embraced by the general society. The people thus relied upon traditional household medicine for their needs and ignored the potential benefits of emergency care (Scarborough, 1969).

In the eighteenth century, hospitals were viewed as a refuge for the ailing indigent (McLachlan and McKeown, 1971). Later, with the advent of anesthetics and antiseptic procedures, they became institutions where the sick went to be cured rather than to die. As a result, middle and upper class patients began to utilize hospitals along with the poor (Shryocke, 1969). This trend has continued up to the present.

Today, mounting numbers of non-emergent* patients are

*Komaroff (1974a) classifies patients entering emergency rooms as either emergent or non-emergent patients. Emergent patients will suffer permanent impairment if not treated within one-half hour, while non-emergent patients will not.

creating crises in hospital emergency rooms (E.R.s) (Ginzberg, 1971; Komaroff, 1974a). This results in inefficient utilization of E.R. staff and facilities. To cope with this problem, "protocol" methods of patient care have been designed and incorporated into E.R. based Acute Care Units (A.C.U.) (Komaroff, 1974a and b).

The protocol method (Komaroff, 1974a and b; Bragg, 1972) employs clinical algorithms (C.A.s) to appraise and manage health problems. C.A.s concentrate on the patient's primary complaint; — his age, sex, past illnesses, and current medications determining the laboratory tests, and physical examination to be obtained. After data appraisal, proper treatment is specified by the C.A.

It was the purpose of this study to assess the feasibility, efficiency, and acceptability of care provided by the protocol method.

METHODS AND MATERIALS

The study took place at a major metropolitan hospital in midwestern United States for four weeks in January 1975. The evaluation consisted of three parts:

I. *Clinical Analysis:*

A. Determination of the four most common complaints seen in the A.C.U. This assumes that a small number of illnesses are responsible for a large percentage of A.C.U. visits (Komaroff, 1974b).

B. Determination of the A.C.U. patient flow. This assumes that knowledge of the patient flow will identify bottlenecks in the system.

C. Determination of the time lag (time elapsed) between a patient entering the Unit and his examination. This assumes that a positive value accrues from examining patients rapidly. Speedy examination also eliminates patient backlog at a critical juncture in the system.

D. Determination of the time lag (time elapsed) between the patient's examination and the issuing of his final orders. This assumes the positive value of speedy patient examination will diminish, if the patient is forced to wait a prolonged time for final orders. In addition, rapid issue of final orders eliminates patient backlog at another important juncture.

E. Determination of the number of patients given a "nurse provisional treatment plan" and having it reviewed by physicians before being discharged. This assumes a small number of tasks represent a large percentage of work in the workup of non-emergent illnesses and that the tasks are performed almost identically well by either physicians or trained non-physician personnel (Komaroff, 1974a and b).

F. Determination of the number of patients treated by the A.C.U. but who, in reality, belonged under E.R. jurisdiction. This assumes the protocol method is efficient, if the number of treated A.C.U. patients actually belonging under E.R. jurisdiction is small (arbitrarily, the maximum limit is set at 20% of the total A.C.U. patient load).

II. *Personnel interviews:*

A. Patient interviews were conducted to ascertain their reaction to the A.C.U.'s care (personal communication). This assumes the patients' reaction may influence their recovery.

B. Nurse and physician interviews were conducted to determine the staff's reaction to the Unit's care (personal communication). This also assumes that staff attitudes may affect the delivery of care.

C. Staff interviews were conducted to determine the protocol method's feasibility in the delivery of health care (personal communication). This assumes that individuals involved with the provisional treatment plan are in an excellent position to comment on the feasibility of employing the protocol method in the future.

III. *Data comparison with other A.C. U. studies.* This permits any meaningful similarities in data to be identified.

RESULTS

Sample size totaled 1,683 patients. The four most common presenting complaints were:

Upper respiratory infection	485 (29%)
Abdominal pain	122 (7%)
Urinary tract infection	109 (6%)
Gynecological	103 (6%)
N = 1683 Total:	819 (49%)

Upon entering, the patient reported to the triage nurse and proceeded in accord with the flow in Diagram I. The mean total time spent by a patient in the A.C.U. was 119 minutes; of this total, only a mean of 12.5 minutes was spent waiting for examination, whereas a mean of 106.5 minutes was spent waiting for final orders (Table 1). Of the 1,683 patients entering the A.C.U., 159 (9%) were referred to other medical units. Of the remaining total, 1,463 (87%) were given a nurse provisional treatment plan and had it reviewed by a physician before being discharged, while only 61 (4%) were

DIAGRAM I

DIAGRAM OF ACUTE CARE UNIT PATIENT FLOW

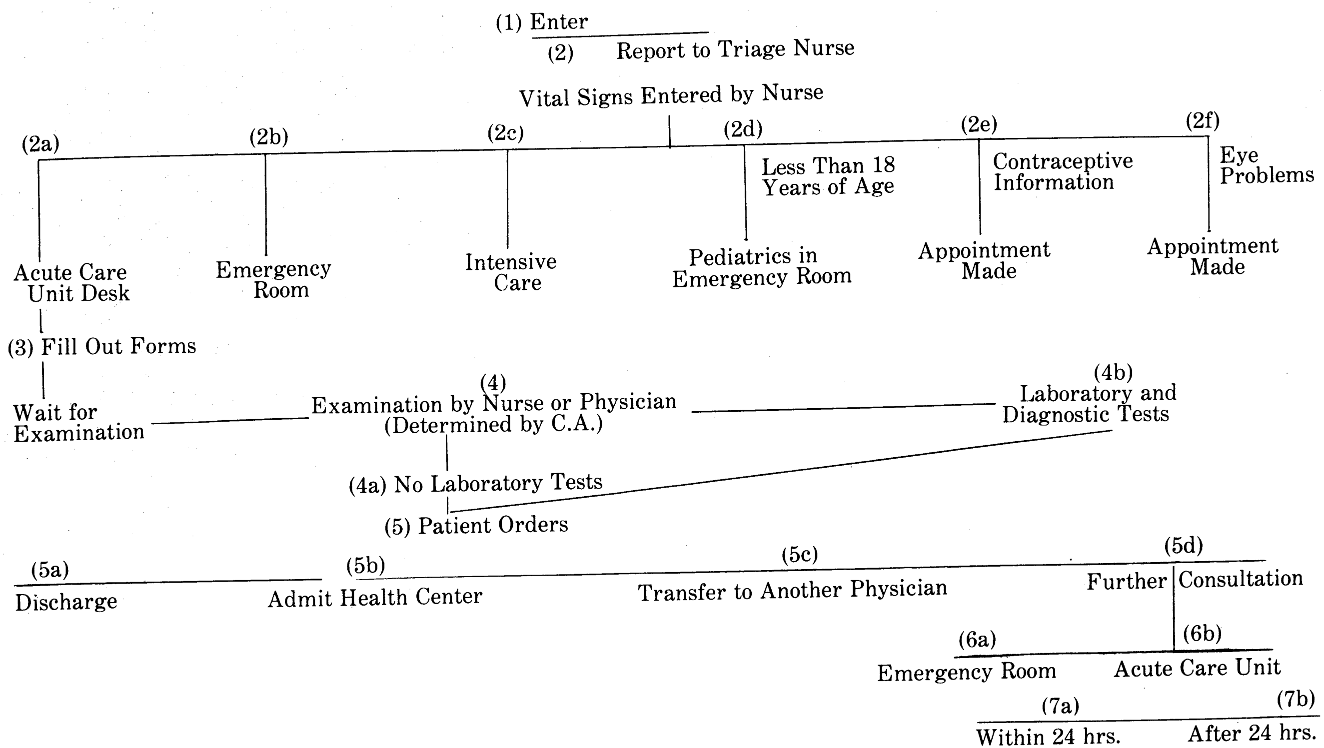

DIAGRAM I
DIAGRAM OF ACUTE CARE UNIT PATIENT FLOW

Patient enters the E.R. and reports to the triage nurse (1.2). Here, using the presenting symptoms or vital signs of the patient, the nurse selects the appropriate C. A. The C. A. assists the nurse in screening the patient for the A.C.U., E.R., or Intensive Care (2a, b, and c). If the patient is under 18 years of age, has an eye problem, or requests contraceptive information, the appropriate referral or appointment is made by the nurse (2d, e, and f).

If the C. A. determines the patient can be treated by the A.C.U., he is directed to the A.C.U. desk and waiting room (3). Here the patient completes the appropriate forms (home address, race, sex, next of kin, etc.) and waits for examination. The examination may be administered by either a nurse or physician, as specified by the C. A. (4). Laboratory and diagnostic tests, if required by C. A. or examiner, are also administered at this time (4a, b).

Upon completion of the examination and any tests, the patient returns to the waiting room to await further instructions (5). These instructions, based upon clinical data and the examiner's medical experience, are usually determined by the C. A. However, instructions deviating from the C. A. may be issued, if the appropriate physician has been consulted and permission obtained.

Final instructions include the patient's discharge, admittance to the Health Center, transfer of care to another physician, or further consultation (5a, b, c, and d). If further consultation is required, the patient is either transferred immediately to E.R. (6a) or asked to return to the A.C.U. (6b). Should the patient be requested to return, the C. A. specifies whether it should be within or after 24 hours (7a, b).

TABLE 1: TIME LAGS IN PATIENT FLOW

	From Entering A.C.U. Until Examination (min.)	From Examination Until Discharge (min.)
A.M. SHIFT	15	86
P.M. SHIFT	10	127
Average	12.5	106.5
Total Average Visit Time (min.): 119		

treated but adjudged to actually be under E.R. jurisdiction.

Fifty-one patients were interviewed. Forty-seven (92%) responded that the triage algorithm/nurse provisional treatment method of care was as good or better than that of their regular physician. Eleven nurses (the entire A.C.U. nursing staff) and six residents were interviewed. Of these, all nurses (100%) and five residents (83%) expressed approval of the Unit's method of care, and complete confidence in its ability to assess and treat patients (Table 2).

TABLE 2: RESPONSE FINDINGS

	Reaction to Acute Care Unit				Confidence in Acute Care Unit			
	Positive		Negative		Positive		Negative	
	%	No.	%	No.	%	No.	%	No.
PATIENTS (N=51)	92	47	8	4	N.A.	N.A.	N.A.	N.A.
NURSES (N=11)	100	11	-	-	100	11	-	-
RESIDENTS (N=6)	83	5	17	1	83	5	17	1

N. A. = Not Available

TABLE 3: PRESENTING COMPLAINTS

Complaint	Acute Care Unit			Kaiser - Inglewood Clinic*		
	%	No.	Rank	%	No.	Rank
Upper Respiratory Infection	29	485	1	27	797	1
Abdominal Pain	7	122	2	10	289	2
Urinary Tract Infection	6	109	3	3	87	15
Gynecological	6	103	4	3	94	13
Total	49	819 N=1683	-	44	1267 N=2909	-

*(Komaroff, 1974b)

In a comparable study at the Kaiser-Inglewood Clinic, presenting complaint data were (Table 3) (Komaroff, 1974b):

Upper respiratory infection	797 (27%)	Rank: 1st
Abdominal pain	289 (10%)	2nd
Urinary tract infection	87 (3%)	14th
Gynecological	94 (3%)	12th
N = 2909 Total:	1267 (44%)	

Other findings show the mean time lag between a patient entering the A.C.U. and his being examined was 14 minutes (Greenfield, 1974a). Others report that 70-89% of protocol treated patients were discharged without significant deviance from the protocol disposition decision (Komaroff, 1974b; Winickoff, 1974; Greenfield, 1973), whereas only 2-11% of the protocol treated patients were discovered to be actual E.R. cases (Table 4) (Bragg, 1972; Winickoff, 1974; Greenfield, 1973).

TABLE 4: COMPARISON of TIME LAGS, DISCHARGED PATIENTS, and TRUE EMERGENCY ROOM CASES

Time	Acute Care Unit			Other Studies*		
	%	No.	Time (min.)	%	No.	Time (min.)
Time Lag Between Patient Entering A.C.U. and Examination	-	1683	12.5	-	212	14
Patients Given Provisional Treatment Plan Or C. A. Treatment	87	1463	-	70-89	146-226	-
Patients Treated But Were True Emergency Room Cases	4	61	-	2-11	N.I.	-

N.I.=Not Included
*(Bragg, 1972; Winickoff, 1974; Greenfield, 1973, 1974a)

DISCUSSION

Comparison of our data with other protocol studies indicates certain parallels, namely:

1. Time elapsed between patients entering the A.C.U. and their being examined (12.5 min. in this study, 14 min. in others)
2. Percentage of patients treatable by the protocol method (theoretically 87% in this study, 70-89% in others)
3. Percentage of patients treated by the A.C.U. but actually belonging under E.R. jurisdiction (4% in this study, compared 2-11% in others)
4. Patient, nurse, and physician response to provisional treatment or protocol method (this study as well as others indicates an almost unanimously positive response).

These similarities in data soundly support the conclusion reached by other authors; namely, that the protocol method is a feasible, safe, and acceptable means of providing health care to non-emergent patients (Komaroff, 1974a, b and c; Winickoff, 1974; Greenfield, 1973, 1974a and b).

In addition, other advantages of the protocol method include (Komaroff, 1974a):

1. Improving the basic education and comprehension of pathophysiology in medical students by studying the logic built into the protocols.
2. Providing medical-legal safeguards by stating explicitly what was and was not administered to the patient and by representing tested, validated standards of care.

However, the protocol method has its shortcomings. The most apparent is the tremendous amount of time the patient spends waiting for final orders. Experience suggests the delay stems from the turnabout time required for laboratory tests. Accordingly, the protocol method's efficiency might be improved, if the turnabout time for tests was reduced. A potential solution includes assigning a special laboratory fulltime to the A.C.U. Further research is necessary, however, before the final conclusion can be determined.

CONCLUSIONS

The protocol method established in an Emergency Room based Acute Care Unit is adjudged to be a feasible, safe, and acceptable means of providing health care to non-emergent patients. Further research is recommended, to determine if increased protocol efficiency would result from attaching a fulltime laboratory to the Acute Care Unit.

BIBLIOGRAPHY

Bragg, F. E. 1972. Evaluation of Aide Triage of Ambulatory Patients II. ACP 27, Lincoln Lab. Massachusetts Inst. Tech. 47 pp.

Ginzberg, E. 1971. *Urban Health Services.* Columbia Univ. Press, New York and London. 479 pp.

Greenfield, S. 1973. Management of certain GU complaints by a physician extender and a specified protocol. Presented at 101st Amer. Pub. Health Assoc. Conference, San Francisco. (Abstract cited in Komaroff, 1974b.)

Greenfield, S. 1974a. An upper respiratory complaint protocol for physician extenders, Arch. Internal Med., 133: 294-299.

Greenfield, S. 1974b. Management of low back pain by a protocol and a physician. Presented at the Amer. Fed. Clinical Res., Atlantic City. (Abstract cited in Komaroff, 1974b.)

Komaroff, A. L. 1974a. "Protocols for physician extenders." In Kallstrom, M., and Yarnall, S (eds.). *Advances in Primary Care.* Med. Computer Sci. Assoc., Seattle, Washington. pp. 75-88.

Komaroff, A. L. 1974b. Ambulatory Care Project Progress Report 11A: 1969-1974. Lincoln Lab. Massachusetts Inst. Tech. 75 pp.

Komaroff, A. L. 1974c. Ambulatory care protocols improve efficiency and quality of care, Hos. Med. Staff, 3: 1-10.

McLachlan, G., and T. McKeown (eds.). 1971. *Medical History and Medical Care.* Oxford Univ. Press, London and New York. 245 pp.

Scarborough, J. 1969. *Roman Medicine.* Cornell Univ. Press, Ithaca, New York. 238 pp.

Shryocke, R. H. 1969. *The Development of Modern Medicine.* Hafner Pub. Co., New York. 479 pp.

Winickoff, R. 1974. Management of minor respiratory illnesses by nurses using a protocol. Presented at the Amer. Fed. Clinical Res., Boston. (Abstract cited in Komaroff, 1974b.)

ACKNOWLEDGEMENTS

The author wishes to thank Norris M. Durham, Ph.D., Joseph V. Messer, M.D., and Philip R. Liebson, M.D., for their assistance in preparation of this paper. The author also wishes to acknowledge a special debt to W. C. Kaufman, Ph.D., whose guidance and patience made this manuscript a reality.

OCCURRENCE OF THE BREGMATIC BONE IN THE RACCOON, *PROCYON LOTOR*

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ABSTRACT

A total of 214 specimens of *Procyon lotor* from Southwestern Wisconsin were collected and prepared for the study; of these, 140 specimens were suitable for consideration, the rest being damaged or having occluded sutures due to advanced age. Museum collections yielded 78 specimens, 48 of which were suitable for study. Four bregmatic bones were found in specimens from the study area (2.86%); one from museum collections (2.08%). Final analysis of the data placed the occurrence of the bregmatic bone in the raccoon at 2.66%.

INTRODUCTION

The bregmatic bone, an anomalous accessory bone at the junction of the frontal and coronal sutures is present in various species of mammals. Bregmatic bones may be symmetrical or asymmetrical in both shape and position, the location being best described as the center of the dorsum of the skull. They generally present well sutured boundaries to the surrounding cranial elements until the sutures are obliterated by advancing age. The exact origin of the bone is not precisely known. Many researchers (Gulliver, 1890; Wortman, 1920; Troitsky, 1932; Sitsen, 1933; DeBeer, 1937) have discussed the origin and occurrence of bregmatic bones.

Bregmatic bones have been reported in some sixty-three species of mammals belonging to ten orders (e.g. v. Jhering, 1915; Schultz, 1923). The best compilation of data is by Schultz (1923); this illustrated report includes cases of single and multiple occurrences. The only information available for the genus, *Procyon*, is that of v. Jhering (1915) who reported the occurrence in *Procyon cancrivorous* to be 45.4% (five of eleven specimens). The bone was described as a single, centrally located structure of considerable size.

This study was conducted to provide statistics for bregmatic bone occurrence in the raccoon of Southwestern Wisconsin. Several museum collections were also examined for the presence of bregmatic bones in *Procyon lotor* skulls.

MATERIALS AND METHODS

Specimens were obtained from sportsmen of Southwestern Wisconsin, during the period 15 October to 20 December 1973. Each specimen was cataloged with respect to age, sex, location and date of capture. Fresh and frozen specimens were boiled with a bio-enzyme detergent, rinsed, bleached, and dried prior to examination. A bregmatic bone was judged to be present when clearly discernible sutures along the perimeter of the bone were present.

RESULTS

Nearly 300 specimens were obtained during the study; many were unsuitable for processing due to damage during collection. Of 214 specimens prepared for the study, 74 possessed occluded sutures or were otherwise unsuitable for consideration. Of the 140 specimens suitable for study, four (2.86%) possessed the bregmatic bone.

FIGURE 1. Number 108, a specimen of unknown sex from Harrison Township.

A specimen of unknown sex from Grant County (Fig. 1) displayed the largest bregmatic bone (13 x 6 mm). The bone was medial and had well defined sutures. A male specimen from Grant County was the only specimen with multiple bregmatic bones. The anterior bone was small (9 x 2 mm) and located somewhat sinestral to the sagittal suture; the posterior bone (6 x 7 mm) was medial and showed no sign of bisection by the sagittal suture. Another Grant County specimen of unknown sex (Fig. 2) displayed a medially

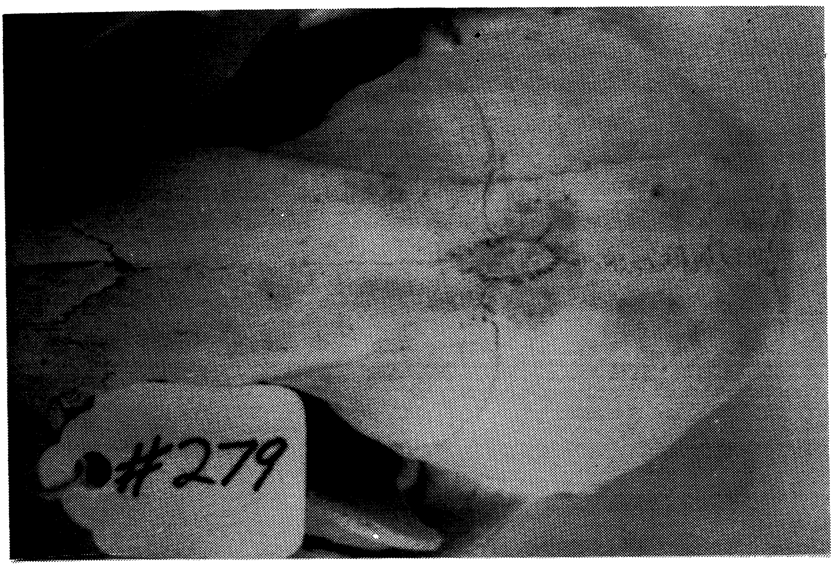

FIGURE 2. Number 279, a specimen of unknown sex from Platteville Township.

situated bregmatic bone (10 x 4 mm), and a female from Lafayette County had a medially located bregmatic bone (15 x 3 mm). Skulls without the bregmatic bone (Fig. 3) have a clearly defined intersection of the sagittal and coronal sutures. Eventually, with advancing age these sutures occlude and a sagittal crest forms.

In addition to the specimens prepared by the author, several museum collections of raccoon skulls were examined for bregmatic bones (Table 1). Of 78 museum specimens 48 of which were suitable for study, only one (2.08%) bregmatic bone was found. The specimen, of unknown sex, was one of ten specimens, five of which at the Davenport Museum, Davenport, Iowa (No. 277) were suitable for study. The sample from Southwestern Wisconsin (214 specimens, 140 suitable for study) added to the museum sample (78 specimens, 48 suitable for study) totaled 188. The final percentage of occurrence of the bregmatic bone in the raccoon was 2.66%.

FIGURE 3. Number 114, a specimen lacking a bregmatic bone.

TABLE 1: THE OCCURRENCE OF BREGMATIC BONES IN MUSEUM COLLECTIONS OF RACCOON SKULLS

Collection Location	Curator	Total Specimens	Suitable for Study	With Bregmatic
Calvin Hall, Univ. Ia., Iowa City	Holme Semken	20	15	0
Davenport Museum, Davenport, Ia.	Peter Peterson	10	5	1
McBride Hall, Univ. Ia., Iowa City	George Schrimper	2	1	0
Noland Hall, Univ. Wis., Madison	Elizabeth Pillaert	46	27	0

DISCUSSION

Bregmatic bones were found to occur in both male (1) and female (1) specimens. None of the juvenile skulls examined possessed supernumerary fontanelle bones. The anomaly does not appear to be restricted geographically nor would a genetic factor be a safe assumption based on the data obtained at this point. Examination of the literature presented two basic theories of bregmatic bone origin, one genetic (Troitzky, 1932) and one traumatic (Sitsen, 1933). More information on the origin of bregmatic bones might be obtained from a species which displays a statistically high occurrence of the bone, e.g. *Erethizon dorsatus* (Schultz, 1923). Bregmatic bones are of little phylogenetic significance, but their anomalous nature and uncertain origin arouse the curiosity of various researchers from time to time.

ACKNOWLEDGMENTS

This study was pursued in partial fulfillment of the requirements for the degree of Master of Arts, Biology, University of Wisconsin-Platteville. The author wishes to express his appreciation to Professor Thomas J. Munns who served as advisor during the study and to Drs. Robert H. Foulkes and Harry O. Pearce who served on the review committee. I am indebted also to the sportsmen of Southwestern Wisconsin who assisted in the collection of specimens.

BIBLIOGRAPHY

De Beer, G. R. 1937. *The Development of the Vertebrate Skull.* pp. 368, 369, 387, 485, 486, 488. Oxford Univ. Press. London.

Gulliver, G. 1890. A skull with wormian bones in the frontal suture. Proc. Anat. Soc. Gt. Brit. Jour. Anat. Physiol. 25: 27.

Schultz, A. H. 1923. Bregmatic fontanelle bones in mammals. Jour. Mammal. 4:65-77.

Sitsen, A. E. 1933. Zur. Enturcklung der Nante des Schadeladaches. Zeit. Anat. 101: 121-152.

Troitzky, W. I. 1932. Zur Frage der Formbildung des Schadeladaches. Zeit. Morphol. Anat. 30: 504-574.

v. Jhering, R. 1915 O osso bregmatico de "procyon" e em geral dos simios, carnivoros e desdentados brazileiros. Ann. Paulistas Med. Cirurg. 5: 102-106.

Wortman, J. L. 1920. On some hitherto unrecognized characters in the skull of the Insectivora and other mammals. Proc. U.S. Nat. Museum 57: 1-52.

TOXICITY OF ANTIMYCIN A TO *ASELLUS INTERMEDIUS, DUGESIA DOROTOCEPHALA, GAMMARUS PSEUDOLIMNAEUS,* AND *HYALELLA AZTECA*

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ABSTRACT

Antimycin A, a registered fish toxicant, was tested in the laboratory on *Asellus intermedius, Dugesia dorotocephala, Gammarus pseudolimnaeus,* and *Hyalella azteca. H. azteca* and *G. pseudolimnaeus* were very sensitive with 96 hr LC 50s < 10 μg/1. *A. intermedius* also showed mortality at this level in one series of experiments. *D. dorotocephala* showed no mortality at 15 μg/1 of Antimycin A for eight days. The 96 hr ECT 50 values at 10 μg/1 of Antimycin A were determined for *G. pseudolimnaeus* (1.4 hr) and *H. azteca* (5.3 hr). Based on these results, the 10 μg/1 level of Antimycin A normally used in fish control would probably eliminate *G. pseudolimnaeus* and *H. azteca,* two important fish food organisms.

INTRODUCTION

Antimycin A, a respiratory inhibitor registered as a fish toxicant in 1966, has received increasing use for rough fish control in lake and stream management. Much laboratory and field experimentation has been done with Antimycin A, as a piscicide (Berger et al., 1969; Gilderhus et al., 1969; Lennon and Berger, 1970; Marking and Dawson, 1972), but there is a lack of information on the toxicity of the compound to common invertebrates. In view of the use of the chemical for a large-scale fish removal project in the Rock River, Wisconsin, we were encouraged to conduct toxicity experiments with the amphipods *Gammarus pseudolimnaeus* Bousfield and *Hyalella azteca* (Saussure), the isopod *Asellus intermedius* Forbes, and the planarian *Dugesia dorotocephala* (Woodworth).

These species are abundant in portions of the Rock River system and are important fish foods. *Gammarus spp.* are important in the diet of a wide variety of gamefish species including brown trout (Reimers et al., 1955; and Maitland, 1965), brook trout (Rawson and

Elsey, 1950), and walleye (Kelso, 1973). *Asellus spp.* are abundant in the diets of warmouth and largemouth bass (Larimore, 1957) and brown trout (Ellis and Gowing, 1957). *H. azteca* occurs in the diets of black crappie and bluegill (Seaburg and Moyle, 1964) and largemouth bass (McCammon et al., 1964).

Another consideration in the choice of these test organisms is the fact of their totally aquatic life cycles. Repopulation would be difficult in waters where they were completely eliminated. Insect species with a winged adult stage for dispersal could more easily reinvade such streams and long-term eradication would be avoided.

Lennon and Berger (1970) reported invertebrate mortalities observed in field trials, i.e. nearly total kills (99%) of rotifers, cladocerans and copepods, with partial kills of fresh-water shrimp and *Gammarus spp.* In their discussion they indicate that fall frosts may have been responsible for the zooplankton decline and postulate that the partial kill of freshwater shrimp was due to locally high toxicant concentrations. They suggest that dosage levels of Antimycin A used for fish control (10-15 μg/1) do not ordinarily adversely affect aquatic invertebrates.

Recent studies on clams (Antonioni, 1974), ostracods (Kawatski, 1973) and caddis flies and *Gammarus* (Lesser, 1972) indicate that these animals suffer mortality at low dosage levels of Antimycin A (10-15 μg/1).

EXPERIMENTAL PROCEDURE

The formulation of Antimycin A used was Liquid Fintrol Concentrate (Ayerst Laboratories, Inc.). An initial stock solution was prepared in acetone to insure uniformity and provide a stable solution. The final mixing with water for the desired treatment dosages was done just prior to the start of each experimental run. The Antimycin A stock solution was mixed according to directions of the manufacturer to arrive at the desired dosage.

Individual experiments were conducted with two-liter glass vessels containing twelve organisms of a single species. These containers were placed in a water bath maintained at 15C under constant light.

A. intermedius and *G. pseudolimnaeus* collected from the Bark River, Waukesha Co., Wis. were tested with two different types of water, Biotron tap water (Antonioni, 1974) and Bark River water collected with the organisms. In these tests, the water was aerated and the containers were covered with a plastic sheet to prevent evaporation. Three Antimycin A concentrations between 5 and 15 μg/1 were employed to determine the concentration causing a 50% mortality (LC 50).

H. azteca from Lake Mendota, Dane Co., Wis., *G. pseudolimnaeus* from Parfrey's Glen Creek, Sauk Co., Wis.; and *D. dorotocephala* from Turtox-Cambosco Biological Supply Company were tested in Biotron tap water without aeration.

In addition, time series experiments were run with *H. azteca* and *G. pseudolimnaeus.* These animals were added to the toxicant at 10 μg/1 and were then removed, rinsed, and transferred to untreated water at various time intervals. This allowed determination of the time of exposure to cause a 50% mortality (ECT 50).

All experimental animals were acclimated for 24 hr in the laboratory prior to the experiment. Observations for death were made at 24 hr intervals, and dead organisms (those failing to respond to mechanical stimulation) were removed and held in fresh water for further observation to confirm death. Sick or weak individuals were not removed.

Mortalitites at 96 hr were analysed by the graphical method of Litchfield and Wilcoxon (1949) to obtain LC 50 and ECT 50 values.

RESULTS

H. azteca was the most sensitive organism tested with LC 50 of 1.4 μg/1. *G. pseudolimnaeus* was also quite sensitive with LC 50 values of 7.2 and 9.0 μg/1. The series of *A. intermedius* run in river water gave an LC 50 of 11.8 μg/1, but the tap water series showed no significant mortality at 15 μg/1 for 240 hours. This discrepancy prevents drawing any positive conclusions for *Asellus* but indicates the need for more intensive investigation. We found no significant mortality *D. dorotocephala* at 15 μg/1 for 192 hr. These results are summarized in Table 1 and Fig. 1.

While *H. azteca* was more sensitive in terms of concentration than *G. pseudolimnaeus,* it had a higher ECT 50 at 10 μg/1, 5.3 hr compared to 1.4 hr (Table 2, Fig. 2).

DISCUSSION

Lesser's (1970) values for *Gammarus* are noticeably lower than ours. However, we used different water, a different temperature, and a different species of *Gammarus.* Any or all of these factors could account for the observed differences.

TABLE 1. TOXICITY OF ANTIMYCIN A (LIQUID FINTROL CONCENTRATE) TO SELECTED AQUATIC INVERTEBRATES AT 15°C.

Organism	Water	pH	96 hr LC 50 and 95% Confidence Interval (μg/1)
Asellus intermedius (isopod)	Bark River	8.35	11.8 (7.4-18.9)
	Biotron tap	7.45	No significant mortality at 15 μg/1 for 240 hours
Hyalella azteca (amphipod)	Biotron tap	7.45	1.4 (0.9-2.2)
Gammarus pseudolimnaeus (amphipod)	Bark River	8.35	7.2 (5.3-9.7)
	Biotron tap	7.45	9.0 (6.6-12.4)
Dugesia dorotocephala (planarian)	Biotron tap	7.45	No significant mortality at 15 μg/1 for 192 hours
	Biotron tap	7.45	No significant mortality at 15 μg/1 for 192 hours

Work with fishes has shown the toxicity of Antimycin A to decline as pH increases (Berger et al., 1969). Lesser's work indicates this to be true for *Gammarus* as well. Our data for *A. intermedius* and *G. pseudolimnaeus* show an opposite trend (Table 1), and some factor in river water may have acted synergistically with Antimycin A to cause a higher mortality.

The differences in ranking of ECT 50 and LC 50 values for *H. azteca* and *G. pseudolimnaeus* were unexpected, but similar differences in ECT 50s and LC 50s have been reported for several fish species (Berger et al., 1969).

Possible toxicity resulting from the acetone in the stock solution cannot be distinguished from Antimycin A toxicity in our experiments. No control was run, with acetone and water, since the primary purpose of our experiments was to determine whether certain invertebrates would be killed by Antimycin A as administered in the field, and field formulations used for river systems in Wisconsin are mixed with acetone.

Our studies indicate that *H. azteca* and *G. pseudolimnaeus* are susceptible to Antimycin A at levels used in fish management (10-15 μg/1). Since these fish food organisms might be slow to reinvade

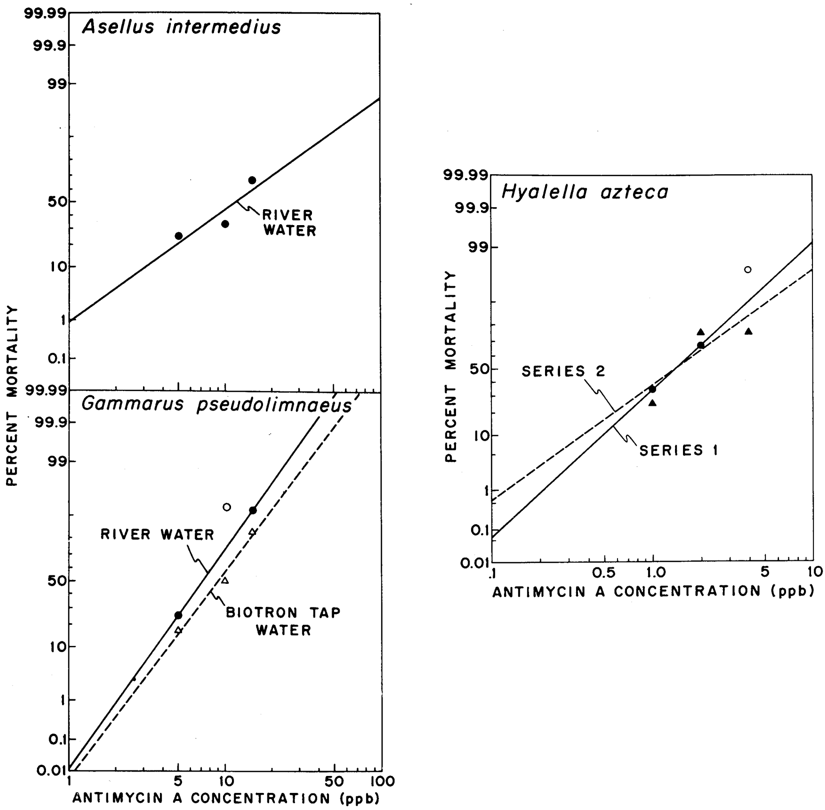

FIGURE 1—The dose effect for Antimycin A on *Asellus intermedius*, *Gammarus pseudolimnaeus*, and *Hyalella azteca*.

waters once they have been eliminated, their restocking should be considered in fish management projects. Since these invertebrates are not readily available an alternative course might be to leave some parts of the drainage basin untreated for natural repopulation.

Due to their sensitivity and ease of handling, both *H. azteca* and *G. pseudolimnaeus* are suitable for bioassay of Antimycin A. These animals might be preferable to fish for bioassay work because of easy transportation and maintenance of enough individuals.

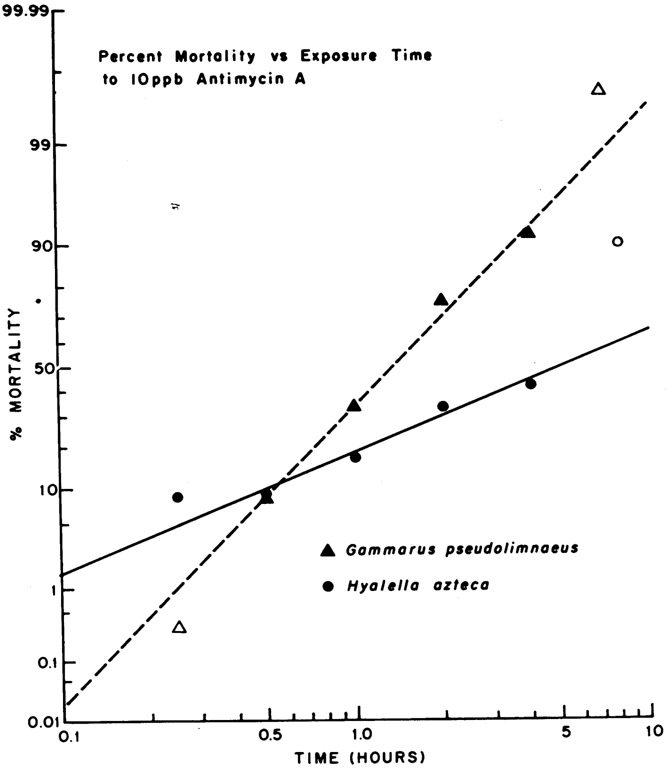

FIGURE 2—The time of exposure effect at 10 μg/1 of Antimycin A on *Gammarus pseudolimnaeus* and *Hyalella azteca.*

TABLE 2. TOXICITY OF ANTIMYCIN A (LIQUID FINTROL CONCENTRATE) AT 10 μg/1 TO SELECTED AQUATIC INVERTEBRATES AT 15C.

Organism	Water	pH	96 hr ECT 50 and 95% Confidence Interval (hours)
Hyalella azteca (amphipod)	Biotron tap	7.45	5.3 (2.3-12.5)
Gammarus pseudolimnaeus (amphipod)	Biotron tap	7.45	1.4 (0.9-2.1)

ACKNOWLEDGMENTS

We thank Dr. John C. Neess and Dr. John J. Magnuson for their review of the manuscript.

Funds for the use of the Biotron facilities were provided by the Graduate School Research Committee through Dr. Neess. We appreciate the assistance of the Biotron staff in implementing this research.

BIBLIOGRAPHY

Antonioni, Mary Ellen. 1974. Antimycin—beyond teleocide. Trans. Wis. Acad. Sci. Arts, Lett. 62: 285-301.

Berger, B. L., R. E. Lennon, and J. W. Hogan. 1969. Laboratory studies on Antimycin A as a fish toxicant. Invest. Fish Control: U.S. Bur. Sport Fisheries, Wildlife, 26, 1-21.

Ellis, R. J., and H. Gowing. 1957. Relationship between food supply and condition of wild brown trout, *Salmo trutta* Linnaeus, in a Michigan stream. Limnol., Oceanog. 2: 299-308.

Gilderhus, P. A., B. L. Berger, and R. E. Lennon. 1969. Field trials of Antimycin A as a fish toxicant. Invest. Fish Control: U.S. Bur. Sport Fisheries, Wildlife, 27, 1-21.

Kawatski, J. A. 1973. Acute toxicities of Antimycin A, Bayer 73, and TFM to the ostracod *Cyprette kawatai.* Trans. Amer. Fish. Soc. 102: 829-831.

Kelso, J. R. M. 1973. Seasonal energy changes in walleye and their diet in West Blue Lake, Manitoba. Trans. Amer. Fish. Soc. 102: 363-368.

Larimore, R. W. 1957. Ecological life history of the warmouth. Ill. Nat. Hist. Surv. Bull. 27: 1-83.

Lennon, R. E. and B. L. Berger. 1970. A resume on field applications of Antimycin A to control fish. Invest. Fish Control: U.S. Bur. Sport Fisheries, Wildlife, 40, 1-19.

Lesser, B. R. 1972. The Acute Toxicities of Antimycin A and Juglone to Selected Aquatic Organisms. Unpubl. Master's Thesis, Univ. Wis., La Crosse, Wis. 41 pp.

Litchfield, J. T. Jr., and F. Wilcoxon. 1949. A simplified method of evaluating dose-effect experiments. Jour. Pharm., Exp. Therap. 96: 99-113.

Maitland, P.S. 1965. The feeding relationships of salmon, trout, minnows, stone loach, and three-spined stickelbacks in the River Endrick, Scotland. Jour. Anim. Ecol. 34: 109-133.

Marking, L. L., and V. K. Dawson. 1972. The half-life of biological activity of Antimycin determined by fish bioassay. Trans. Amer. Fish. Soc. 101: 100-105.

McCammon, G. W., D. LaFaunce, and C.M. Seeley. 1964. Observations on the food of fingerling largemouth bass in Clear Lake, Lake County, California. Calif. Fish and Game 50: 158-169.

Rawson, D. S., and C. A. Elsey. 1950. Reduction in the longnose sucker population of Pyramid Lake, Alberta, in an attempt to improve angling. Trans. Amer. Fish. Soc. 78: 13-31.

Reimers, N., J. A. Maciolek, and E. P. Pister. 1955. Limnological study of the lakes in Convict Creek Basin, Mono County, California. U.S. Fish and Wildl. Serv., Fish. Bull. 56: 437-493.

Seaburg, K. G., and J. B. Moyle. 1964. Feeding habits, digestive rates, and growth of some Minnesota warmwater fishes. Trans. Amer. Fish. Soc. 93: 269-285.

GOVERNMENTAL BODIES CAN OBTAIN INTEREST FREE LOANS

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Government officials should learn that there are ways for governmental bodies to borrow the funds they need without being required to pay interest charges for those funds. A small service fee would have to be paid to cover the cost of servicing the loans, but that is not an interest charge.

So long as those making the loans do not have to pay interest on the funds they loan out, they do not have to charge interest from the borrowers. Commercial banks do not pay interest on the *bank credit* they loan out. They only pay interest on their reserves and on any cash they may loan out. The Federal Reserve Banks do not pay interest for the *bank credit* loans they make. They do not even have any reserves for the checks they issue. Their checks are redeemed with bank credit, on which they pay no interest.

All of us, especially government officials, will benefit if we learn of the actions taken by the people in the state of North Dakota. In the latter part of the 1800s and the early part of the 1900s they were not happy with the conditions under which they had to borrow money. Over the years, they organized politically in what was called Populist Movements. In the election of 1918, the Non-Partisan League gained control of the State government. In 1919 the State Legislature passed the laws which established the Bank of North Dakota for the purpose of "Encouraging and promoting Agriculture, Commerce, and Industry." With headquarters at Bismarck it is the only bank of its kind in the United States.

From its beginning the North Dakota Bank did not intend to compete with the existing privately owned banks, but rather to cooperate with them to best serve the needs of the people. That policy still exists. The Bank makes no loans to private corporations or individuals, with the exception of loans under VA (Veteran Administration), FHA (Federal Housing Administration), and FISL (Federal Insured Student Loans).

A State Industrial Commission composed of the Governor, who acts as chairman, the Attorney General, and the Commissioner of Agriculture, operates the Bank. Mr. H. L. Thorndal, the president, has stated that the Bank of North Dakota is able to loan to the political subdivisions all the funds they need. But the Bank usually insists that every issue of notes or bonds over $150,000 be put up for public sale and the Bank of North Dakota bids on the issue. On issues of less than $150,000, the Bank will negotiate directly with the political subdivisions for the rates and terms.

The Bank charges interest for its loans and after paying its expenses, the remainder, the profit, is turned over to the general fund of the State. In 1974 the Bank made a net profit of $9,268,770.41.

The above is what the Bank does. However, because the Bank is a government agency operating to perform a public service, it is *not necessary that it make a profit for the State.* Of course it should not incur a loss either.

As a public service, a policy could be adopted that the profits would be returned to the governmental bodies concerned in the borrowing, instead of being paid to the State. The borrowers who paid the interest then really could say, "we are paying the interest to ourselves." The result would be the same as if no interest were paid.

The people of North Dakota could go one step further. They could operate the Bank of North Dakota on a 100% *bank credit* system in a manner similar to the Federal Reserve Banks operation. The Bank could adopt the policy that it would not receive or pay out any cash. It would make loans to governmental bodies by issuing checks on itself and it would receive payments only in checks. It would be a completely cashless bank. Let us illustrate with an example:

Let us say the City of Fargo wishes to borrow $1,000,000 from the Bank of North Dakota. The City will issue $1,000,000 worth of bonds payable to the Bank of North Dakota over a period of five years, with $200,000 worth of the loan to be paid back annually. No interest will be charged, only a service fee sufficient to cover the cost of making and servicing the loan. Let us say a total flat fee of 1% ($10,000). or an annual fee of $2000 will be charged and payable, also, at the end of each of the five years.

The City of Fargo, on its part, must levy an irrevocable tax of $202,000 for each of those five years in order to make the payments. The Bank will then issue a check of $1,000,000 payable to the City of Fargo. The City will deposit the check in its demand deposit account at the Fargo Local Bank and receive $1,000,000 worth of *bank credit*. The Fargo Local Bank will then send the check back to the Bank of North Dakota and receive $1,000,000 worth of *bank credit* in its account there.

The City of Fargo then can issue checks against its account up to $1,000,000. The persons receiving the checks can deposit in any bank and receive credit in their accounts. They in turn can write checks against their accounts. Thus by everyone using checks in lieu of cash as their medium of exchange, buying and selling can take place in the usual manner.

When taxpaying time arrives, the people can pay their taxes with checks to the City of Fargo. The City of Fargo will deposit those checks in its Fargo Local Bank and receive credit for them.

At the end of each year when the payments on the bonds are due, the City of Fargo will issue a check for the amount due and send it to the Bank of North Dakota. The Bank will credit the City for the amount paid and debit the Fargo Local Bank for that amount and return the endorsed check to the Fargo Local Bank which will debit the City of Fargo's account and return the cancelled check to the City Treasurer.

That procedure will be repeated at the end of each of the five years at which time the principal will be repaid without any interest charges. The bank's cost of operations will be taken care of by the $2000 annual fee.

The reason it will not be necessary for the Bank to charge any interest on its loans is because it will not use any of its own cash and it will not have to borrow cash from anyone or pay interest to anyone. The only income the Bank will need is the amount necessary to pay the total cost of its services, i.e. the annual fee of $2000.

The reason the Bank of North Dakota can issue checks without having any cash on hand is because the Fargo Local Bank and 167 of the 170 banks in the state maintain an account with it and it acts as the clearing bank for those banks. That is the same reason that Federal Reserve Banks can write out checks with no cash needed to cash them.

If an annual interest rate of 6% were paid on that $1,000,000 loan, it would amount to $60,000 for the first year, $48,000 for the second year, $36,000 for the third year, $24,000 for the fourth year, and $12,000 for the fifth year. A total of $180,000! Whereas, the total service fee would be only $10,000.

Conclusion: The problems caused by the interest bearing debts of governmental bodies are almost overwhelming. Is it not time that some efforts be made to devise a means of freeing ourselves from the burden of those huge interest payments?

Surely, we and our government officials should at least want to benefit from the experience of the people in North Dakota. Even though the Bank of North Dakota does charge interest on the loans it makes to governmental bodies, it turns much of that interest into the general fund of the State, thus reducing by that amount, the need for levy of state taxes. North Dakota has made a good start. Let us carry on from there.

ASPECTS OF THE BIOLOGY OF *NELUMBO PENTAPETALA* (WALTER) FERNALD, THE AMERICAN LOTUS, ON THE UPPER MISSISSIPPI

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ABSTRACT

Several populations of the American lotus in the vicinity of La Crosse, Wisconsin have been studied for several years. Most of the habitats now occupied in this area did not exist before the creation of extensive backwater areas by the lock and dam system in the late 1930s. The populations studied are each relatively uniform as to certain morphological features, but usually differ significantly in these features from one another. They demonstrate high pollen fertility and few chromosomal aberrations, but relatively low seed set. Comparison of the results of inter- and intra-populational crosses carried out in 1974 indicates that the low seed set occurring naturally in these populations may not be due solely to the source of pollen in a cross, but to factors which include the nature of the pollinating mechanism, the parasitism of the plants by larvae of the Pyralid moth, *Ostrinia penitalis* (Grote), and the damage caused by *Agelaius phoeniceus* L., the redwing blackbird, seeking these larvae in the flowers of the lotus.

INTRODUCTION

This study was initiated to determine the reasons for the low seed set observed in some local populations of the American lotus. The scope of the work has expanded as more of the biology of this organism became known and its role in the ecosystem better appreciated. The area of study on the Upper Mississippi River presently possesses one of the largest concentrations of lotus in the United States. The completion of the lock and dam system on the Upper Mississippi River in the late 1930s and the subsequent formation of the so-called navigation pools, which are in essence large backwater reservoirs that aid in the maintenance of the present nine-foot navigation channel, created the habitats presently inhabited by the species in the area.

Although work has been stimulated by the unique longevity of the seeds of the Oriental lotus (Ohga, 1926a, b, c ,d; Shinano et al. 1966; and Toyoda, 1965, 1967), and although considerable anatomical, morphological, and taxonomical studies have been done with the genus (Cheadle, 1953; Cronquist, 1968; Khanna, 1965; van Leeuwen, 1963; Li, 1955; Lyon, 1901; Takhtajan, 1959; Wood, 1959; York, 1904), little has been done on the reproductive biology of the genus as it exists in nature. Meyer (1930) studied the growth and vegetative development of the American lotus, and Hall and Penfound (1944) studied certain aspects of the biology of the same species in the Tennessee Valley Administration Lakes.

METHODS AND MATERIALS

The field studies were conducted during the summers of 1972, 1973 and 1974. The populations utilized are described in Table 1. To randomly sample the populations for the morphological features measured, a string was stretched between two poles and all of the emergent leaves underneath this string and all of the flowers associated with these leaves, were sampled. An emergent leaf is usually associated with a flower which arises from the same node. The smaller floating leaves produced earlier in the growing season were never utilized for these measurements.

All crosses were carried out in the field. Flowers were bagged with Duraweld 9" x 12" pollinating bags (Scarborough, England) one to several days before anthesis, and all crosses after the first year were carried out only with flowers that had opened in the bags. The bags were identified, and the flowers were staked in order to prevent them from tipping into the water (Plate 1, Fig. 13, 14).

As it proved impossible to determine whether a certain number of flowers in a given population were produced by the same or different plants, all flowers were considered borne by separate individuals. A possible source of error, therefore, was introduced into all of the intra-populational crosses. The vegetative intermingling of different individuals, results from the fact that vegetative growth proceeds from the many tubers produced by a single plant the previous year; thus it is difficult, if not impossible, to pick out individual plants with any certainty. The experimental design called for five groups. Two consisted of flowers that were bagged without prior treatment and flowers that were bagged after the stamens had been removed. Two other groups consisted of

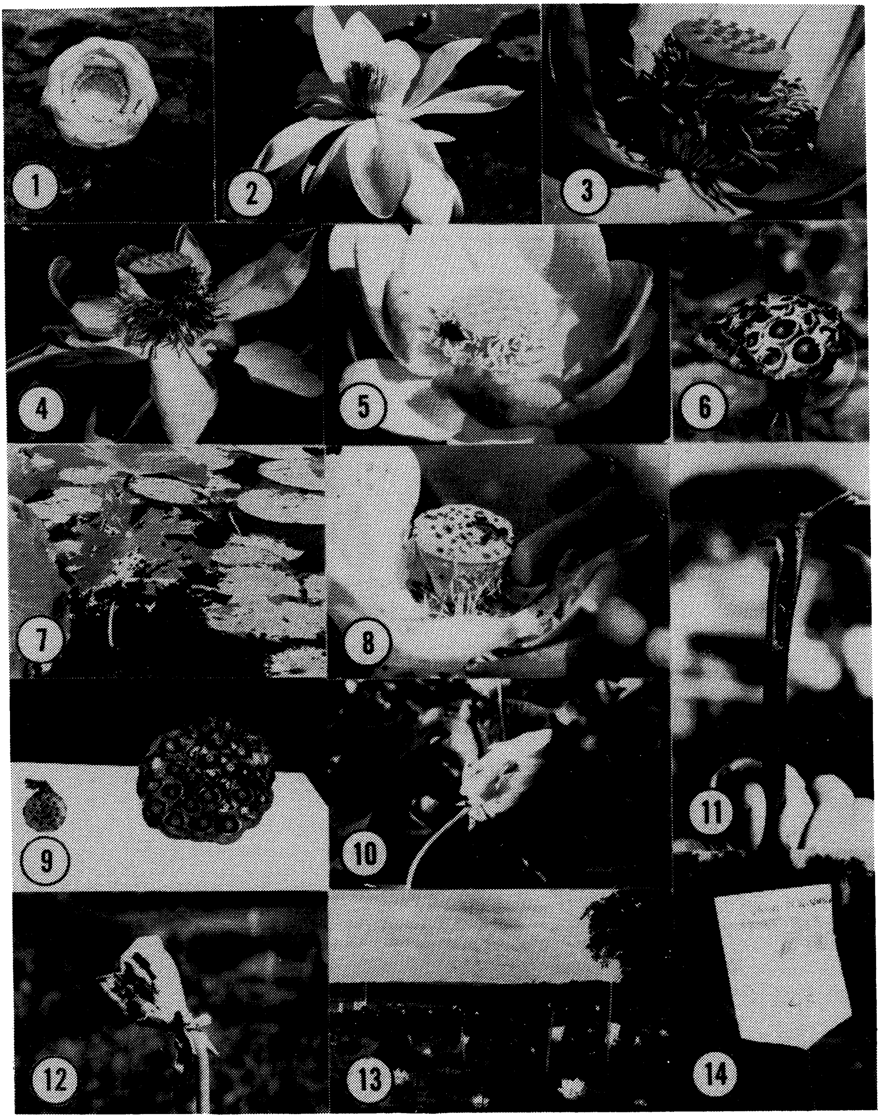

PLATE 1, FIGURES 1-14

1. Recently opened flower. X 1/5. 2. Recently opened flower with tepals pulled away to reveal stamens tightly appressed to the receptacle. X 1/6. 3. Flower on morning of third day. The perianth has spread away from the receptacle and the anthers have begun to dehisce. X 1/5. 4. Flower on afternoon of third day. Anthers have dehisced and along with most of the tepals, will soon abscise. 5. Flower on morning of the third day with the

anthers beginning to dehisce. An individual of *Apis mellifera* L. is gathering pollen. X 1/5. 6. Nearly mature receptacle with fruit visible in the carpellary pits. Several undeveloped carpels are in the undeveloped part of the receptacle in narrow and pinched carpellary pits. X 1/5. 7. Floating and early aerial leaves, showing severe damage caused by the larvae of *Ostrinia penitalis* (Grote). X 1/10. 8. A young receptacle severely infested by *O. penitalis* larvae. One nearly mature larva shown on top of the receptacle. X 1/3. 9. Undeveloped and developed receptacles. Neither the carpels nor the receptacle at left developed. X 1/5. 10. Flower damaged by *Agelaius phoeniceus* L., the redwing blackbird, as it searched the flower for larvae of *O. penitalis*. 11. Larva beginning pupation in the petiole. X 3/7. 12. Maturing receptacle damaged by redwing blackbirds. X 1/5. 13. One of the populations utilized in the study. Stakes used to prevent pollinating bags from tipping into the water. 14. Pollination control bag (9″ x 12″).

flowers that were bagged and utilized in the intra- and interpopulational crosses. The fifth group consisted of flowers (= individual as above defined) that were staked and marked, but not bagged. These open pollinated flowers were the controls.

Floral buds at the appropriate stage of development for cytological analysis were collected in a modified Carnoy's fluid consisting of chloroform: absolute ethanol: acetic acid (4:3:1). The apical portions of the perianths were removed before the buds were placed in the fluid in order to insure immediate penetration to the anthers. After 24 hours or more they were stored in 70 percent ethanol in a refrigerator until used. The cytological preparations were made by squeezing the pollen mother cells out of the anthers in a drop or two of aceto-orcein. Chromosome configurations were studied and photographed several hours after preparation.

For the germination experiments, the fruit walls were surface sterilized in a 50 percent solution of chlorox for several seconds, washed, and then nicked with a hacksaw. They were placed in flat, wide trays into each of which a constant flow of tap water was directed. The experiment terminated 10 days after the last observed germination.

RESULTS

Population structure

The populations are found in backwaters or in protected sites along sloughs out of the direct flow of water. They occur in depths from 0.15 to 1.4 m, as measured at the onset of flowering. Most of the populations were found in about 1 m of water at anthesis. Substrates vary from a relatively firm mucky sand to very soft muck. Organic matter and silt are high in the substrates at all sites. The rhizomes and tubers lie from 5 to 40 cm below the surface of the substrate, but usually between 10 and 25 cm. They are found deeper in mucky substrates than in sandy substrates.

Intra-populational morphological variation was shown to be significantly less than inter-populational variation during analysis of variance (p=.05). This tends to support the observations of Heritage (1895), Lowry (1924), Meyer (1930), and Hall and Penfound (1944), that vegetative reproduction is responsible for most of the growth in an established population. See Meyer (1930) and Hall and Penfound (1944) especially for their reviews and study of the rate and nature of vegetative spread of the lotus and the role of the tubers in this regard.

The populations appear to be isolated by the physical parameters of water depth and the rate of water flow. Given favorable conditions in a given area, a population will expand and eventually occupy that entire area. However, there will be no vegetative intermingling between two populations occupying favorable areas that are separated by an unfavorable discontinuity in water depth or flow. A fast-flowing slough, for example, may be relatively narrow, but the barrier it presents to the vegetative spread of populations on either side is probably absolute. While the intra-populational variation is relatively small, there are frequently startling differences between populations (Table 1, 2). These differences are statistically significant (p=.05.). A hypothesis concerning this inter-populational variation is yet to be tested and is the subject of another phase of this work.

Flowering

Flowering begins in this region in late July and continues until mid or late August. This is nearly 2 months later than the flowering period reported by Hall and Penfound (1944). There may be as much as a two-week difference in the onset of flowering of local populations. There are many commentaries regarding flowering (Lowry, 1924; Robertson, 1889; Taylor, 1927, to mention a few early reports). These authors recognized that variation was to be expected in floral behavior even within the same population. Fig. 1-4 show some of the stages in the flowering process. Flowers usually close during the first two nights after anthesis and open in the

TABLE 1. LOCALITIES AND MEASUREMENTS OF CERTAIN CHARACTERISTICS OF SAMPLE POPULATIONS OF NELUMBO PENTAPETALA.

Population	N^a	Leaf blade width (cm) $\bar{X} \pm$ S.E.	Leaf blade width (cm) Range	N^a	Petiole L. (cm) $\bar{X} \pm$ S.E.	Petiole L. (cm) Range	N^a	Peduncle L. (cm) $\bar{X} \pm$ S.E.	Peduncle L. (cm) Range	N^a	No. of Carpels $\bar{X} \pm$ S.E.	No. of Carpels Range	Location, Description
I	50	26.5±4.3	16-33	50	67.3±6.7	47-79	50	87.1±8.9	57-102	80	16.6±3.4	11-24	Adjacent to boat ramp, Louis Nelson Park, French Island, La Crosse, Wis.
II	63	35.9±4.0	28-44	63	107.5±8.6	90-124	63	122.6±9.1	99-147	109	19.7±3.4	11-29	N E of boat ramp, Louis Nelson Park, French Island, La Crosse, Wis.
III	56	44.1±5.5	32-53	56	121.2±19.8	85-145	56	139.9±16.1	99-169	94	21.9±3.8	14-30	Near Wigwam Slough about 1 mile S of boat ramp, Goose Island, Vernon Co., Wis.
IV	49	33.1±4.4	25-49	49	77.5±7.4	64-90	49	92.5±10.7	70-125	37	21.0±3.8	15-30	Shallows opposite the Lawrence Lake Boat Landing, 1 mile N of Brownsville, Minn.

N^a = number of individuals sampled for that characteristic.

TABLE 2. COMPARISON OF THE SIGNIFICANT DIFFERENCES BETWEEN THE POPULATIONS OF LOTUS UTILIZED IN THE STUDY WITH RESPECT TO CERTAIN MORPHOLOGICAL CHARACTERISTICS.

Populations (See Table 1)	Characteristics (+[a] −[b]) Blade Width	Petiole Length	Peduncle Length
I X II	+	+	+
I X III	+	+	+
I X IV	+	+	−
II X III	+	+	+
II X IV	−	+	+
III X IV	+	+	+

+[a] = significant difference exists between the populations compared for that characteristic (p = .05)

−[b] = no significant difference exists between the populations compared for that characteristic (p = .05)

morning. During the first two days the stigmas are receptive and the anthers are held tightly against the sides of the receptacle by the perianth. The flowers are protogynous and there is apparently no overlap between receptive stigmas and dehiscent anthers but this can vary, as mentioned above. None of the flowers that were bagged before anthesis and left alone produced fruit or seed. The numerous perianth parts begin to turn yellow several days before anthesis. The opening usually occurs during the morning. The experimental crosses that were successful were those made with fresh pollen and carried out before 12M.

Nelumbo pentapetala is entomophilous. The flowers attract a variety of insect visitors, as has already been shown by Robertson (1889), and from his list, as well as our observations, pollination appears to depend principally on members of the Apidae, and Andrenidae (Hymenoptera), and Syrphidae (Diptera). Individuals of *Apis mellifera*, the common honey bee, were the most frequently observed insects gathering pollen (Fig. 5). Most insect activity is over by 12M. Greatest activity occurs between 8 and 10 a.m. on a sunny day. There is no correlation between opening and closing movements of flowers and pollination by beetles here.

Development of the fruit

If pollination is followed by fertilization in a given flower, the receptacle rapidly expands in size as the fruit develops. The carpellary pits expand to accommodate the developing fruit. As the fruits shrink in the final stages of development, they come to lie loosely in saucer-shaped depressions (Fig. 6). That the development of the fruit has a direct bearing on the development of the surrounding portions of the receptacle is shown by the fact that if a receptacle has, for example, only 3 or 4 fruits developing out of a possible 25, only that portion of the receptacle surrounding the developing fruit also develops. The receptacles of flowers with undeveloped fruit do not enlarge at all (Fig. 9). Mature fruits can be gathered 4-6 weeks after pollination and are usually chocolate-brown or purplish-brown in color. I should here point out that I use the strictly botanical terminology concerning the fruit. The receptacle is not part of the fruit, and the indehiscent nut which is the fruit should not be called a seed when the entire fruit is meant.

Post-fertilization movements of the receptacle are well-documented and readily observed. Often, the portion of the peduncle below the receptacle causes the receptacle to turn (Fig 12). There is literature alluding to the receptacle breaking off at the point of attachment to the peduncle and floating, carpellary pit side downward, and thus acting as a float to disperse the fruit (Sculthorpe, 1968; Wood 1959). In the area of study, however, the receptacles often remain attached to the peduncles into the fall and throughout the winter as well, and are usually empty of their fruit by the time they do fall. The fruits sink at first but rise when germination begins. The young seedlings float for a time also.

Pollen Sterility and Cytology

The populations were sampled for pollen sterility during 1973 and 1974. Approximately 500 pollen grains were scored for each flower. Pollen which did not take up stain, and micropollen were considered sterile. The number of these kinds of pollen for each flower was averaged to yield the populational totals, reported separately for each year in Table 3. All of the populations were investigated cytologically. Most meiotic divisions appear normal, and the haploid number of chromosomes in these populations was found to be eight, as previously reported by Farr (1922) and Langlet and Soderberg (1927). Aberrations, particularly the presence of univalents, occur sporadically in all populations. The presence of univalents provides the cytological basis of the occurrence of the micropollen (Table 3) observed.

TABLE 3. SEED SET AND POLLEN STERILITY IN THE SAMPLE POPULATIONS OF NELUMBO PENTAPETALA.

Population	% Seed Set			% Unstained Pollen						% Micropollen					
				1973			1974			1973			1974		
	Intra-Populational Crosses (S^a)	Inter-Populational Crosses (S^a)	Open-Pollinated Flowers (S^a)	N^b	Avg.	Range	N^b	Avg.	Range	N^b	Avg.	Range	N^b	Avg.	Range
I	46.8(92)	58.7(254)	19.9(1097)	16	10.7	2.9-26.6	16	8.6	2.1-23.3	16	1.9	0.0-7.9	16	0.7	0.0-1.6
II	44.1(93)	48.6(675)	10.3(1346)	20	22.5	8.1-59.6	43	24.8	15.0-34.5	20	0.9	0.0-3.7	43	1.8	0.0-2.5
III	6.5(248)	17.6(888)	8.2(931)	18	10.8	2.9-22.2	16	6.3	2.4-8.8	18	2.5	0.0-11.1	16	0.6	0.0-1.7
IV	21.8(147)	33.1(175)	16.2(402)	12	12.2	6.7-20.5	12	9.4	4.1-21.5	12	1.8	0.0-3.8	12	1.1	0.0-3.4

S^a = the total number of carpels produced by the individuals utilized in a particular group. Each carpel matures into a single-seeded fruit.

N^b = the number of individual flowers sampled for pollen. Approximately 500 pollen grains were scored per flower.

Crossing Experiments and Seed Set

It was apparent after the conclusion of the first season of work that *Nelumbo pentapetala* in the Upper Mississippi is either self-incompatible or the protogynous mechanism is completely efficient. It was also apparent that seeds are not produced apomictically. No mature or developing seeds or fruit were ever found in the experimental group in which the flowers were bagged before anthesis and permitted to proceed through the season in that fashion. This was repeated each year with the same results. No seeds or developing fruit were found in the flowers from which the stamens had been removed and which were bagged, prior to anthesis and treated as the former group.

In referring to seed set in *Nelumbo,* one refers actually to the fruit, as mentioned previously, as each seed is found singly within a very hard fruit wall. There was no difficulty encountered in interpreting mature ovules as the ovules and the fruit expanded in size after successful fertilization. Frequently, fruit expanded a little in unpollinated flowers but remained abnormally small, and dissection of such a fruit demonstrated that the ovule within it had not developed. All mature fruit with seeds were taken as evidence of successful crosses.

During the course of the seed germination experiments, it was discovered that no population demonstrated a germination rate of less than 50 percent and population III had a germination rate of 77.4 percent. Despite the experimental design of the germination experiments the seeds were attacked by the water mold, *Saprolegnia;* otherwise the germination rate would probably have been greater. In any case, the relatively high germination substantiates the interpretation that fully expanded fruits contain fertile seeds.

Table 3 records all the inter- and intra-populational crosses for 1974, the year in which the mechanics of performing the crosses was perfected. For the purposes of this paper, all inter-populational crosses that occurred within a given population are combined regardless of the pollen source. The author will make available on request a list of the actual crosses made. Again, for the purpose of comparing inter- versus intra-populational crosses in a given population, the number of seeds set in the experimental individuals is measured against the total number of carpels that were present in those individuals.

Parasitism by Moths

The American lotus is liable to attack by a variety of insects. In the Upper Mississippi, the larvae of the lotus borer, *Ostrinia penitalis* (Grote), (Pyralidae), cause a considerable amount of damage in many populations. Welch (1919) has treated various aspects of the morphology, taxonomy and biology of *O. penitalis*, and a detailed description of the morphology and habits of the larvae in the Illinois River area is given by Hart (1895). The basic life history of the species has been dealt with in some detail by Ainslie and Cartwright (1922), concerning a population of the lotus in East Tennessee.

On American lotus in the Upper Mississippi River, the larvae of *O. penitalis* appear on the early emergent leaves of the plant sporadically during the early part of the growing season (Fig. 7). However, as the floral buds appear and develop, the number of larvae also increases until a peak is reached during anthesis. The early larvae on the leaves are usually not numerous enough to cause much damage, as they eat their way across the lamina to the centrally located petiole into which they bore and pupate (Fig. 11). An experiment performed in 1974 in which mature receptacles were placed in wire cages and left exposed to the elements during the winter of 1974-75 demonstrated that the larvae can overwinter in silk-lined chambers in the receptacles, and pupate in the spring. Adult moths began emerging on 17 May 1975, which was about the same time that the first floating leaves of the lotus appeared locally. This more or less confirms what Ainslie and Cartwright (1922) suspected as the manner in which the life cycle is completed.

It is the larvae which hatch from eggs placed on the flower buds or flowers that cause the greatest amount of damage to the plant, for they will cause the destruction of all or a part of the developing carpels, depending on the number of larvae and the stage of development of the flower (Fig 8). As many as 15 larvae have been recovered from individual receptacles. A plant without any larvae at all was rare in any population in 1974. Ainslie and Cartwright (1922) found that 5.9 percent of the lotus population they worked with was infested. They estimated that about 35 percent of the potential seeds in the infested flowers were destroyed. The redwing blackbird, very common in the area during the summer, amplifies the potential damage of the moth larvae, for they have learned to slash apart the flowers and the expanding receptacles in search of the larvae (Fig. 10,12). In population III for example, all of the controls were infested with larvae and most had been slashed by the redwing blackbird. This latter damage obscures that caused by the larvae and both kinds of damage obscure the number of carpels that fail to develop in a given flower due to lack of pollination and/or fertilization.

DISCUSSION

The majority of the habitats presently occupied by lotus in the study area were formerly alluvial forests, meadows, and marshes. Evidently, between the original inundation after dam building in the late 1930's the lotus moved into areas as they became favorable.

Unfortunately, we have no record of the flora of the area, except in general terms, before the locks and dams were constructed. We can assume, however, that the lotus was found, probably infrequently, in the quieter parts of the river. From these established populations, propagules in the form of seeds or seedlings would have been dispersed to new areas as these habitats became available, and this radiation permitted the juxtaposition of elements of the lotus which may have been geographically isolated along the old river. At what point these habitats became "closed" to the establishment of propagules is unknown, but the situation now is probably one where all available habitats are occupied and further increase will result mainly from the vegetative expansion of existing populations into adjacent areas that become ensilted as time passes.

It is probable that the morphological uniformity of most populations is based on a relatively low genetic variability imposed by the manner in which a population is established and is maintained. Open environments conducive to the growth of *Nelumbo pentapetala* must, as noted, be colonized by seeds or seedlings, as the tubers are not readily dispersed. The nature of the population that develops is therefore dependent upon the genetic composition of the disseminules. Once a population is established, it is doubtful whether new seedlings can compete successfully with the rapid vegetative growth of that population (Meyer, 1930). Rhizomes are long, branch regularly and frequently, and give rise to the tubers that carry the species through the winter and from which new growth proceeds the following spring.

The effect of sexual reproduction in populations of *Nelumbo pentapetala* on the Upper Mississippi River is felt over a long rather than short period. The year-to-year maintenance of populations is probably due to vegetative reproduction. However, as mentioned, seeds and seedlings must be the means of establishing populations in newly created favorable environments or in areas where the former populations have been destroyed. The mechanics of flowering and particularly the protogynous nature of the flowers indicates a strong tendency to favor outcrossing. It comes as a surprise at first, therefore, to see that sometimes there may not be a great difference between the experimental inter-populational crosses and intra-populational crosses as measured by seed set. With the information provided by seed set in the controls however, one soon realizes that the relatively low seed set observed in populations of the lotus may be due not so much to the source of the pollen, as orginally hypothesized, but rather to other factors, such as the damage caused by the larvae of *O. penitalis* (Grote). The experimental crosses were, as far as sexual reproduction is concerned, carried out under the best possible conditions for the plant. Fresh pollen was placed on all the receptive stigmas of the flowers, the flowers were searched for larvae which were removed, if found, usually at stages before they had bored into the receptacle. Also, the bags over these flowers not only protected them from extraneous pollen, but also from further infestations by the moths and attacks by the redwing blackbirds. The results of the experimental crosses indicate that, given the best possible conditions for pollination, seed set will usually be higher than one would normally expect from merely observing populations. This is true, whether one uses pollen from within a population or from a different population. An incompatibility factor is probably involved, however, particularly in population III, because all intra-populational crosses were less fruitful than inter-populational crosses. At this point it has not yet been possible to perform the critical experiment of knowingly crossing flowers produced by the same individual within a population, because it has been impossible to recognize with certainty a given individual in the field. Isolation of a single tuber in an isolated farm pond would yield the conditions whereby this could be determined with our local populations. Population III is also the one which has constantly suffered the greatest insect attacks, and the low seed set of its controls, relative to the controls in the other populations, reflects this. The results of the control group on population II may be related to the consistently higher pollen sterility in this population.

ACKNOWLEDGEMENTS

This study has been supported by grants from the University of Wisconsin-La Crosse Institutional Studies and Research Committee, and from the River Studies Center of the University. A number of individuals have at one time or another accompanied me into the field and aided me: Dr. John R. Porter, Dorothy Demaske, Kathy Jaeger, Steven Swanson, and Sally Markos. Ms. Deon M. Nontelle first pointed out to me the low seed set in one of the populations. I thank Drs. Robert W. Cruden, Jerry D. Davis, Thomas O. Claflin, D. Jay Grimes, and an anonymous reviewer, for reviewing the manuscript, and Ms. Donna Pedersen for typing it. Dr. Ronald Hodges of the Systematic Entomology Laboratory of the U.S.D.A. identified the Pyralid moth and other insects for me and has furnished me with the basic taxonomic history of the organisms. Ms. Laura Schuh has given much time and effort to the entomological aspects of this study.

BIBLIOGRAPHY

Ainslie, G. G., and W. B. Cartwright. 1922. Biology of the Lotus Borer *(Pyrausta penitalis* Grote). U.S.D.A. Bull. 1076. 14 pp.

Cheadle, V. I. 1953. Independent origin of vessels in the monocotyledons and dicotyledons. Phytomorph. 3:23-44.

Cronquist, A. 1968. *The Evolution and Classification of Flowering Plants*. Thomas Nelson and Sons, Ltd., London 396 pp.

Farr, C. H. 1922. The meiotic cytokinesis of *Nelumbo*. Amer. Jour. Bot. 9:296-306.

Hall, T. F., and W. T. Penfound. 1944. The biology of the American lotus, *Nelumbo lutea* (Willd.) Pers. Amer. Midl. Nat. 31:744-758.

Hart, C. A. 1895. On the entomology of the Illinois River and adjacent waters. Bull. Illinois State Lab. Nat. Hist. 4:149-273.

Heritage, B. 1895. Preliminary notes on *Nelumbo lutea*. Bull. Torrey Bot. Club. 22:265-271.

Khanna, P. 1965. Morphological and embryological studies in Nymphaeaceae. II. *Brasenia schreberi* Gmel. and *Nelumbo nucifera* Gaertn. Austral. Jour. Bot. 13:379-387.

Langlet, O. F. J., and E. Soderberg. 1927. Über die Chromosomenzahlen einiger Nymphaceen. Acta Hort. Berg. 9:85-104.

Li, Hui-Lin. 1955. Classification and phylogeny of Nymphaeaceae and allied families. Amer. Midl. Nat. 54:33-41.

Lowry, R. B. 1924. The American lotus. Fl. Grower 11:1-5.

Lyon, H. L. 1901. Observations on the embryogeny of *Nelumbo*. Minn. Bot. Stud. 2:643-655.

Meyer, W. C. 1930. Dormancy and growth studies of the American lotus, *Nelumbo lutea*. Plant Physiol. 5:225-234.

Ohga, I, 1926a. The germination of century-old and recently harvested Indian lotus fruits with special reference to the effect of oxygen supply. Amer. Jour. Bot. 13:754-759.

Ohga, I. 1926b. A comparison of the life activity of century-old and recently harvested Indian lotus fruits. Amer. Jour. Bot. 13:760-765.

Ohga, I. 1926c. A double maximum in the rate of absorption of water by Indian lotus seeds. Amer. Jour. Bot. 13:766-772.

Ohga. I. 1926d. On the structure of some ancient, but still viable fruits of Indian lotus, with special reference to their prolonged dormancy. Jap. Jour. Bot. 3:1-20.

Robertson, V. 1889. Flowers and insects. III. Bot. Gaz. 14:297-304.

Sculthorpe, C. D. 1967. *The Biology of Aquatic Vascular Plants*. Edward Arnold, Ltd., London. 610 pp.

Shinano, S., Y. Shimada, and G. Tamura. 1966. Studies on protease in lotus seed. Part I. Detection of protease in crude extract of lotus seed and partial purification of the enzyme. Agr. Chem. 40:185-189. (In Japanese)

Takhtajan, A. 1969. *Flowering Plants: Origins and Dispersal*. Oliver and Boyd, London. 310 pp.

Taylor, H. J. 1927. The history and distribution of yellow *Nelumbo*, water chinquapin or American lotus. Proc. Iowa Acad. Sci. 34:119-124.

Toyoda, K. 1965. Glutathione in the seed of *Nelumbo nucifera*. Bot. Mag. Tokyo 78:443-451.

Toyoda, K. 1967. Hydrogen evolution in seeds of *Nelumbo nucifera* and other angiosperms, Bot. Mag. Tokyo 80:118-122.

van Leeuwen, W. A. M. 1963. A study of the structure of the gynoceium of *Nelumbo lutea* (Willd.) Pers. Acta Bot. Neerland. 12:84-97.

Welch, P. S. 1919. The aquatic adaptions of *Pyrausta penitalis* Grote (Lepidoptera). Trans. Amer. Entomol. Soc. 12:213-226.

Wood, C. E., Jr. 1959. The genera of the Nymphaeaceae and Ceratophyllaceae in the Southeastern United States. J. Arnold Arbor. 40:94-112.

York, H. H. 1904. The embryo-sac and embryo of *Nelumbo.* Ohio Nat. 4:167-176.

COMPARISON OF WOODY VEGETATION IN THREE STANDS NEAR NECEDAH, WISCONSIN

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ABSTRACT

Forest stands studied west of Necedah, Wisconsin are compositionally similar but vary considerably in abundance and size measurements across the drainage catena. *Pinus strobus, P. banksiana, Quercus ellipsoidalis, Q. alba, Q. velutina,* and *Acer rubrum* are the dominant species in the area, and are generally found in the various stands, but they range from high importance status at one end of the gradient to minor importance at the other. The composition, abundance, and total stem size of stands are influenced by past physical influences, such as fires and logging, as well as by topographic and edaphic features.

INTRODUCTION

On the east side of the Wisconsin River between the Petenwell and Castle Rock flowages, 4 miles east of Necedah in Adams County, are woods that have been variously affected by human activities and physical factors. A long history of influences by Indian and white men precedes the present situation. With fire, by far the most important influence prior to European colonization, the Indian changed a large portion of the entire vegetational complex of Wisconsin (Curtis 1959). Fires were set to drive game, to improve berry crops, and to make traveling easier. In the early years of European settlement, the most important vegetational changes were caused by the reduction of fires. Most of the present pine forests date back to the beginning of protection from fires in the late 1800s (Curtis 1959). The major influence by white man upon vegetation was logging. By 1898, nearly the entire Wisconsin area had been logged. In recent times, the area has been developed mostly for agriculture, forestry, and recreation, although it is sparsely populated. A relatively rich terrestrial floral and faunal assemblage occurs here, as well as good quality aquatic habitat.

While conducting a baseline survey to determine the composition and abundance of terrestrial biota within a 2000-ha area, a vegetational gradient was detected relative to the drainage catena. Although presence of arborescent species is generally uniform across the catena, relative proportions vary considerably. The objective of this paper is to examine three wooded stands located along the catena from lowland (near the river) to upland (inland), and to describe their relationships.

The site is physically located in the Maple-Basswood Forest Region, but the woods are much like those of the Great Lake Section of the Hemlock-White Pine-Northern Hardwoods Region (Braun 1950). The wooded stands key to Curtis' Dry-Mesic Northern Hardwoods (Stand 1) and Dry Northern Hardwoods (Stands 2 and 3) communities.

Geology and Soils: The site lies in the Driftless Section of the Central Lowland Physiographic Province (Braun 1950). The terrain is generally flat with sandy plains, marshy lowlands, and low hills. The elevation ranges from 890 ft. to 950 ft.; wetlands are generally below the 900 ft. contour. The area has glacial outwash deposits. Soils range from poorly drained in Stand 1 near the Wisconsin River to excessively drained in Stand 3 away from the river (U.S. Dept. Agr. 1970).

The soils of Stand 1 are primarily of the Adrian Series with portions of the Morocco Series; both are poorly drained. The Adrian soils consist of 45-100 cm of muck overlain by sand or loamy sand. The water table is high and the soil has moderately rapid permeability with high available water capacity. The Morocco soils are coarse textured, both in the surface layer and in the subsoil with low available water capacity; permeability is very rapid.

In Stand 2, soils are of the Plainfield Series, with moderate to excessive drainage. Soils are generally sandy, overlain by acid sand on outwash plains and stream benches. They have low available water capacity and rapid permeability.

Soils of Stand 3 are of the Sparta Series which are excessively drained sandy soils with thick dark surface layers. They have low available water capacity with moderately rapid permeability.

Climate: The Wisconsin climate is typically continental. The average annual temperature varies from -8.5 to 22.4 C, with a mean of 7.5 C recorded at the Hancock Experimental Farm. The mean maximum January temperature is -2 to -4 C, whereas the mean minimum is -14.5 to -15 C. July mean maximum temperatures are 27.8 to 28.9 C and the mean mimimum is 23.2 C. The mean annual precipitation is 75.4 cm with an average of 91.4 cm of annual snowfall. Two-thirds of the annual precipitation falls during the growing season (freeze-free period, mean of 120 days). Wind is highest in winter from a general northwest direction, and lowest in the summer from south-southwest. Mean relative humidity varies from 75 to 86% at midnight and from 51 to 70% at noon.

METHODS

Wooded stands showing the least amount of recent disturbance during the life of the current generation of trees were selected for sampling in 1974-1975. Stands were also selected on the basis of uniform topography, size, and apparent homogeneity. Trees were measured by the point method, with 40 points per stand; saplings were measured by 15-m line intercepts, located at alternate points perpendicular to the transect; and, seedlings were counted in 1 m^2 circular plots, centered at each point. The presence of vines, shrubs, and herbs was also recorded in the plots and/or along line intercepts. The size classification adopted for the arborescent species was as follows: seedlings, less than 30 cm high; saplings, greater than 30 cm high, but less than 2.5 cm dbh (diameter at breast height); and trees, 2.5 cm dbh and greater. Absolute and relative values of frequency, density, and dominance were determined for trees; importance values were calculated as the sum of the relative values. Nomenclature follows Gleason and Cronquist (1963).

RESULTS AND DISCUSSION

Fifteen tree species were recorded in the present survey. Most were represented by trees with diameters 30 cm dbh and larger, a group constituting 23% of the 480 trees sampled. In Stand 1, the most mesic area, 30% of the trees sampled were 30 cm dbh or larger; in Stand 2, located approximately midway along the moisture gradient, 25% were in this size category; and, in Stand 3, the most xeric area, only 14% were 30 cm dbh or larger. Trees of representative species with the greatest girths sampled in the three stands were: *Pinus strobus*, 67.3 cm dbh; *Quercus ellipsoidalis*, 66 cm dbh; *Q. velutina*, 63.5 cm dbh; *Q. alba*, 47 cm dbh; *Acer rubrum* 44.2 cm dbh; *Pinus banksiana*, 30.2 cm dbh and *Populus grandidentata*, 30 cm dbh. Height of the three stands ranged between 14.8 and 18.0 m. The forests of this site are second growth. Extensive areas south and northwest of the study area are marsh, where aspen dominates the borders. Aspen are also locally important in several lowland areas, but are generally considered to be species of relatively short duration in any particular site. They generally mature in 40-60 years (Fralish 1975) in favorable sites and are succeeded by hardwood-conifer components. In some sites, however, aspen communities are regenerated because as nearly pure stands mature, uneven deterioration occurs leaving openings where miscellaneous tree and shrub species invade. In other sites, as a stand matures, it deteriorates rapidly and there is a rapid conversion with shade-tolerant species from the understory (Fralish 1975).

Stand 1:

Pinus strobus was the dominant tree with 10.1 cm dbh or larger in Stand 1 (Fig. 1). Common associates were *Q. alba*, *Q. ellipsoidalis*, and *A. rubrum*. The importance value of *P. strobus* (119) was equal to the sum of the importance values of the two oak species. Species in the stand that occurred less frequently were *Betula papyrifera*, *Pinus resinosa*, *Populus grandidentata*, *Prunus serotina*, and *Quercus velutina*, with a cumulative importance value of 28.

Basal area, indicating dominance, reflects the total area occupied by stems. The basal area of trees 10.1 cm dbh or larger was 37.5 m^2/ha. *Pinus strobus* contributed 50% of the basal area for the entire stand. *Quercus alba*, *Q. ellipsoidalis*, and *A. rubrum* cumulatively contributed 44.5% of the basal area.

Of the smaller trees 2.5-10.0 cm dbh, *A. rubrum* and *Q. alba* were prominent species with *P. strobus* a strong associate. These three species represented over two-thirds of the total importance value for this size class. Species of lesser importance were *P. serotina*, *Q. ellipsoidalis*, *P. virginiana*, *Crataegus* sp., *B. papyrifera*, and *Ulmus americana*.

Tree density in Stand 1 was 956 stems/ha, of which 416 stems/ha (44%) were small trees 2.5-10.0 cm dbh. The densities of *P. strobus* and *Q. alba* were nearly equal, approximately 250 stem/ha, followed by that of *A. rubrum* with 200 stems/ha. *Pinus strobus* demonstrated the most even distribution of stem sizes in the 8 size classes (Table 1), ranging from 7 stems/ha in the largest class of stems 55 cm dbh and larger, to 60 stems/ha in the 10.1-17.5 cm dbh size class; 35 stems/ha were recorded in each of two categories 2.5-6.1 cm and 6.2-10.0 cm (presented as one size class in Table 1). Greater densities were recorded of both *A. rubrum* and *Q. alba* small trees 2.5-10.0 cm dbh, than of *P. strobus* stems of relative sizes.

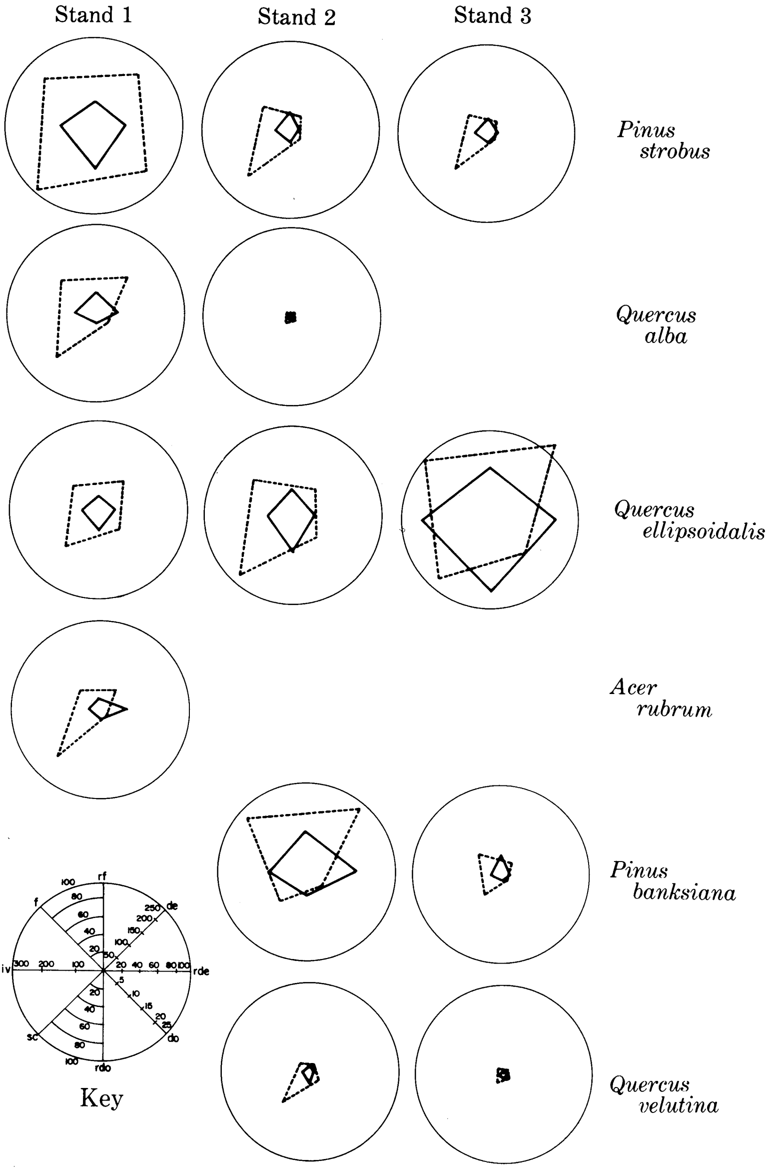

FIGURE 1. Phytographs of dominant arborescent trees. Dotted lines represent absolute frequency (f), density (de), and dominance (do) and percent representation among size classes (sc). Solid lines represent relative frequency (rf), density (rde), and dominance (rdo) and the importance value (iv). The key in the lower left indicates the scale of values.

However, the density of *P. strobus* stems in the larger classes 10.1 cm dbh and greater was 71% higher than that of *A. rubrum* and 36% higher than that of *Q. alba.*

Arborescent species with the most frequent occurrence in the seedling and sapling classes were *A. rubrum, P. serotina, Q. alba,* and *P. virginiana* (Table 1). *Acer rubrum* ranked first in both categories.

Herbs and low shrub species of the ground layer of Stand 1 were *Elymus virginicus, Cornus* sp., *Sanicula,* sp., *Smilax hispida, Pteridium aquilinum, Rosa* sp., *Carex* sp., *Geranium maculatum, Galium boreale, Desmodium nudiflorum, Maianthemum canadense, Uvularia sessilifolia, Dioscorea villosa, Lathyrus tuberosa, Lysimachia ciliata, Trientalis borealis, Lysimachia quadrifolia, Amphicarpa bracteata, Osmunda regalis, Spiraea latifolia, Onoclea sensibilis, Agrimonia gryposepala, Parthenocissus quinquefolia, Monarda fistulosa, Thelypteris palustris, Phlox* sp., *Smilacina stellata, Rhus radicans, Goodyera repens,* and *Aster* spp.

Non-tree species occurring in the sapling (shrub) stratum were *Corylus americana, Ilex verticillata, Cornus racemosa, Viburnum dentatum, Smilax hispida, Ribes missouriense,* and *Vaccinium angustifolium.*

Stand 2:

Pinus banksiana was the most important large tree species (importance value of 128.2), followed by *Q. ellipsoidalis* (94.0), *P. strobus* (47.5), *Q. velutina* (22.8) and *Q. alba* (7.5). In the small size class of 2.5-10.0 cm dbh, *P. strobus* and *P. banksiana* demonstrated nearly equal importance (100), and *Prunus serotina, Q. alba,* and *Q. ellipsoidalis* demonstrated equal values of approximately one-fourth that of the pines.

The total basal area of trees 10.1 cm dbh and larger in Stand 2 was 22.4 m^2/ha. *Quercus ellipsoidalis* contributed 39.7% of the total basal area, *P. banksiana* — 26.8%, *P. strobus* — 15.6%, and *Q. velutina* — 14.3%. *Quercus velutina* and *Q. ellipsoidalis* were the most abundant seedlings. In the sapling stratum, *P. serotina* also ranked high in frequency of occurrence.

The density of trees in Stand 2 of 942.3 stems/ha was nearly equal to that in Stand 1; however a greater portion of the stems (58%) were small trees in Stand 2. Although a greater percent of the small stems of the 2.5-10.0 cm class were *P. strobus* (37%) with the second

TABLE 1. RANK (R) OF SEEDLINGS (S), SAPLINGS (SA), AND TREES OF VARIOUS DIAMETERS IN CENTIMETERS WITH THE PERCENTAGE REPRESENTATION OF EACH SIZE CLASS PER ARBORESCENT SPECIES.

Location/Species	S	Sa	2.5-10.0		10.1-17.5		17.6-25.0		25.1-32.5		32.6-40.0		40.1-47.5		47.6-55.0		> 55.0		
	R*	R	R	%	R	%	R	%	R	%	R	%	R	%	R	%	R	%	R
Stand 1																			
Pinus strobus	5		3	27.0	1	23.4	2	8.8	2	5.9	2	5.9	1	11.7	1	14.6	1	2.9	1
Quercus alba	3		2	44.8	1	24.5	1	12.3	1	9.2	1	9.2							2
Acer rubrum	1	1	1	65.4	2	15.5	3	7.7	3	3.8	3	3.8	2	3.8					3
Quercus ellipsoidalis	6	5	5	14.1	1	49.0			2	12.3	3	6.0			2	12.3	1	6.0	4
Prunus serotina	2	4	4	84.5			4	15.5											5
Prunus virginiana	4	3	5	100.0															6
Betula papyrifera			5	27.4	3	72.6													7
Crataegus sp.	6	6	5	100.0															8
Ulmus americana			6	100.0															9
Quercus velutina					4	100.0													10
Populus grandidentata									3	100.0									11
Pinus resinosa											3	100.0							12
Populus tremuloides	5	2																	13
Stand 2																			
Quercus ellipsoidalis	2	3	5	35.7	3	3.2	2	3.2	1	22.4	1	22.4	1	9.7	1	3.2			1
Pinus banksiana		6	2	42.1	1	31.5	1	18.9	2	7.6									2
Pinus strobus	3	6	1	80.7	2	9.7	2	1.9	3	3.9	2	1.9					1	1.9	3
Quercus velutina	1	1									3	33.3			1	33.3	1	33.3	4
Quercus alba	3	4	4	91.7									2	8.3					5
Prunus serotina		2	3	100.0															5
Prunus virginiana		5	5	100.0															6
Quercus macrocarpa		6	6	100.0															7

(Table 1 continued)

Location/Species	S R*	Sa R	2.5-10.0 R	%	10.1-17.5 R	%	17.6-25.0 R	%	25.1-32.5 R	%	32.6-40.0 R	%	40.1-47.5 R	%	47.6-55.0 R	%	>55.0 R	%	R
Stand 3																			
Quercus ellipsoidalis	1	2	2	16.8	1	12.5	1	31.9	1	31.9	1	4.2	1	1.4	1	1.4			1
Pinus banksiana			1	62.6	2	26.2	2	11.2											2
Pinus strobus		6	2	57.4	3	19.0	3	9.5			2	9.5	1	4.7					3
Prunus serotina	3	1	3	100.0															4
Quercus velutina	2	3	4	63.5									1	36.5					5
Prunus virginiana		4	5	100.0															6
Populus grandidentata		5																	7

*Rank of seedlings and saplings was determined by actual frequency, and rank of trees within size classes was determined by actual density.

largest being *P. banksiana* (30%), larger tree densities (10.1 cm dbh or larger) were predominantly of *P. banksiana* (58%), *Q. ellipsoidalis* (25%), and *P. strobus* (12%). Most of the large stems over 32.6 cm dbh were oaks. *Quercus ellipsoidalis* reflected the most even distribution in the various size classes.

Herbaceous species in the ground layer of Stand 2 were *Carex* sp., *Rubus* sp., *Euphorbia corollata, Smilacina stellata, Rumex acetosella, Rhus radicans,* and *Vitus* sp. Non-tree species occurring in the shrub stratum of Stand 2 were *Corylus americana, Zanthoxylum americanum, Ribes missouriense, Rubus allegheniensis, Vitis* sp. and *Cornus* sp.

Stand 3:

Quercus ellipsoidalis was the dominant tree species of stems 10.1 cm dbh and greater in Stand 3 (importance value of 212). Other species present were *P. strobus, P. banksiana,* and *Q. velutina* with importance values of 42, 38, and 8, respectively (Fig. 1). *Pinus strobus, P. banksiana* and *Q. ellipsoidalis* shared high importance values of 92.5, 90.6, and 78.8, respectively, in the small tree size class of 2.5-10.0 cm dbh.

The total basal area of trees 10.1 cm dbh and greater was 18.1 m^2/ha; *Q. ellipsoidalis* contributed 78.5%, and *P. strobus* contributed 12.7%. *Quercus ellipsoidalis, Q. velutina,* and *P. serotina* were the most abundant seedlings and saplings.

The density of trees in Stand 3 was 592.3 stems/ha. Most trees were large, with only 36.5% in the 2.5-10.0 cm dbh size class. Of the small trees, 78.5 stems/ha were *P. banksiana* and 56.8 stems/ha were recorded each for *Q. ellipsoidalis* and *P. strobus. Quercus ellipsoidalis* was the most dense large tree of 10.1 cm dbh and greater with 282 stems/ha, 75% of the total. *Quercus ellipsoidalis* demonstrated the most even distribution among size classes of any species. *Pinus banksiana* and *P. strobus* each had approximately 45 stems/ha, each 12% of the total large tree density.

Herbaceous and low shrub species in the ground layer were *Carex* sp., *Rubus* sp., *Chimaphila umbellata, Smilacina stellata, Euphorbia corollata, Apocynum* sp., *Rhus radicans, Rosa* sp., and *Lactuca biennis.*

Non-tree species in the shrub stratum of Stand 3 were *Rubus* spp., *Cornus racemosa, Vaccinium angustifolium, Rosa* sp., *Corylus americana,* and *Amorpha canascens.*

Stand Comparisons:

Stand 2 exhibited the greatest total similarity to Stand 3 in all strata (Fig. 2). The greatest similarity was betweeen the small tree strata (79%), largely due to the common occurrence of *P. strobus* and *P. serotina* in the understory. The large tree and seedling strata exhibited nearly equal similarity values, 70.4% and 69.4%, respectively, whereas the similarity between sapling strata was only 56.4%. The high percent similarity between large tree strata

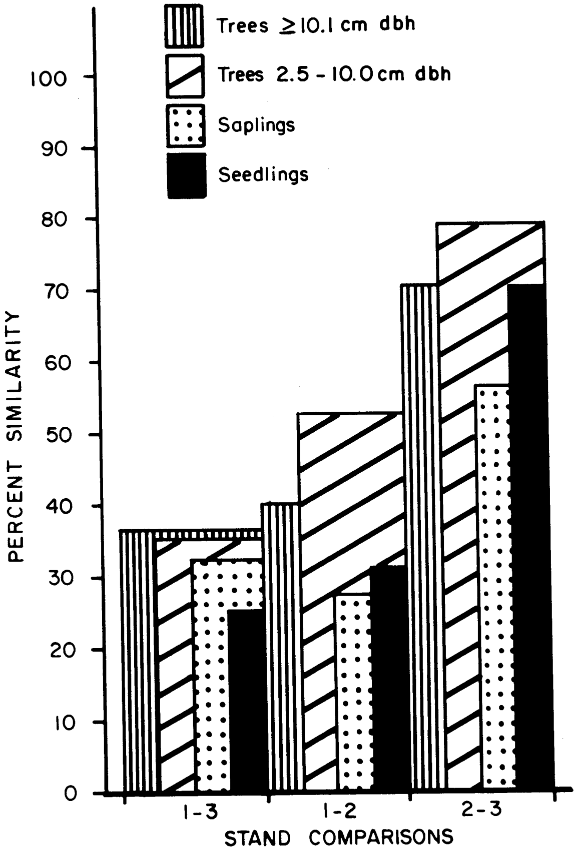

FIGURE 2. Percent similarity of stands by strata. Values are based on relative frequencies using 100 *a*/*b*, where *a* is the sum of the shared values of the two compared strata and *b* is the sum of the values exhibited individually.

was largely due to similar occurrences of *Q. ellipsoidalis, P. banksiana,* and *P. strobus* in Stands 2 and 3, whereas that of the seedling class was due to *Q. ellipsoidalis* and *Q. velutina.*

In a comparison of Stand 1 with Stand 2, small tree strata demonstrated a moderate similarity (51.4%), largely due to the similar occurrence of *P. strobus* and *P. serotina* in both stands. Other strata comparisons indicated less than 41% similarity. The occurrence of *P. strobus* and *Q. ellipsoidalis* in the large tree strata was similar between the two stands.

All percent similarities of strata between Stand 1 and Stand 3 were below 37%. The large tree strata demonstrated the greatest similarity (36.7%), followed by the small tree strata (34.9%), sapling strata (32.7%), and seedling strata (25.2%). In the over-story, *P. strobus* and *Q. ellipsoidalis* demonstrated the most similar occurrence in both stands. In the small tree strata, *P. strobus* and *Prunus serotina* had the most similar occurrences. The occurrence of *P. serotina, P. virginiana,* and *Q. ellipsoidalis* contributed most highly to the similarity index of the sapling strata. Seedlings of *Q. ellipsoidalis* and *P. serotina* had similar high occurrences in both stands.

Several phytosociological trends were seen along the drainage catena. Absolute and relative values of frequency, density, and dominance for *P. strobus* increased along the moisture gradient (Stands 3 to 1, Fig. 1). The greatest variety of *P. strobus* stem sizes was found in the most mesic area. *Quercus alba* demonstrated a similar trend; *Q. alba* was most important in the most mesic habitat, with little representation in the two most xeric stands. The trend of *Q. ellipsoidalis* was opposite that of *P. strobus;* all parameters measured for *Q. ellipsoidalis* increased from the mesic to the most xeric area. Percent representation of *Q. ellipsoidalis* stems in the size classes was equal in the two xeric stands. These trees are susceptible to damage by ground fires but rapidly regenerate afterward by sprout production. The presence of *A. rubrum* was notable only in the most mesic habitat of Stand 1. *P. banksiana* was most prominent in Stand 2, although this species was represented by a limited variety of stem sizes. Logging and fires tend to enhance conditions for *P. banksiana* at the expense of *P. resinosa* and *P. strobus* (Braun 1950). Stems were dense but of uniform size. The basal area of *P. banksiana* was low in both Stand 2 and 3. *Quercus velutina* had its greatest development in Stand 2, although it was not particularly prominent in the forests of the Necedah area. *Q. velutina* tends to grow best in sites of moderate available moisture.

Although the species is generally considered to be intolerant of shade, it is frequently found beneath *Q. ellipsoidalis*.

Total basal area of small trees 2.5-10.0 cm dbh increased along the catena, with 0.6 m^2/ha in Stand 3, 1.0 m^2/ha in Stand 2, and 1.3 m^2/ha in Stand 1. Small tree stems were most dense and represented the greatest percent of the total density of stems 2.5 cm dbh and greater in Stand 2 (549 stems/ha, 58% of total); Stand 1 had 416 stems/ha, 43% of total; and Stand 3 had 216 stems/ha, 36% of total. Basal area of trees 10 cm dbh and larger decreased across the gradient from Stand 1 to Stand 3. Similarly, density of large trees decreased across the gradient, but that of Stand 2 (394 stems/ha) approximated that of Stand 3 (376 stems/ha); Stand 1 had a density of 540 stems/ha of trees 10 cm dbh and greater. The total density of all trees 2.5 cm dbh and greater was nearly equal in Stands 1 and 2, whereas that in Stand 3 was much less.

The stability of these stands is low. In the absence of fire or other disturbances, they are essentially one-generation forests. Pines are intolerant of their own shade and may gradually be replaced by hardwoods. *Pinus strobus*, although certainly a dominant in Stand 1 and more shade tolerant than *P. banksiana* or *P. resinosa*, will probably eventually give way to *A. rubrum* and *Q. alba*, provided that the moisture regime remains constant. Due to the xeric conditions in Stands 2 and 3, successional trends will probably lead to *Q. ellipsoidalis* dominated forests. The composition and abundance of species in future forests at these locations will probably follow a similar trend along the drainage catena.

BIBLIOGRAPHY

Braun, E. L. 1950. *Deciduous Forests of Eastern North America.* Hafner Press, New York. 596 pp.

Curtis, J. T. 1959. *The Vegetation of Wisconsin.* University Wisconsin Press, Madison. 657 pp.

Fralish, J. S. 1975. Ecological and historical aspects of aspen succession in northern Wisconsin. Trans. Wis. Acad. Sci. Arts Lett. 63: 54-65.

Gleason, H. A. and A. Cronquist. 1963. *Manual of Vascular Plants of Northeastern United States and Adjacent Canada.* Van Nostrand Reinhold Co., New York. 810 pp.

U. S. Dept. Agr. 1970. Soils interpretations. Soil Conservation Service, Friendship, Wisconsin.

MEXICAN-AMERICAN MIGRANTS IN WISCONSIN, WITH PARTICULAR EMPHASIS ON MIGRANT FARM LABOR

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The article sketches the immigration of people of Mexican heritage to Wisconsin and explores some aspects of the adaptions they have made, and some of the social, economic and cultural-ideological consequences of these adaptations.

The Mexican-American group is composed of Americans of Mexican heritage, many of whom are long-time residents of the United States, even before there was a United States of America in some cases. The group also contains more recent immigrants, legal and illegal, from Mexico. We call these two categories of people Mexicanos.

Most Mexicanos live in the Southwestern United States: in Texas, New Mexico, Arizona, Colorado, Utah and California (see Table 1). United States acquisition of these territories was a process attended by disputation in the mid-nineteenth century; it changed a number of Mexicans to American citizens. Systematic land expropriation, largely by informal means, left these new citizens with little regard for the U.S.A. and its justice.

Furthermore, there is the matter of continuing immigration. Emigration from Mexico to the United States occurred at a slow rate, on the basis of demand for migrant labor mainly in the Southwest, until the Mexican Revolution of 1910-1920. Attended by much civil disorder, the Revolution precipitated rapid migration to the United States (Gamio, 1930), again largely to the Southwestern U.S.A.

Focusing on the Midwest

During World II labor shortages led to the use of Mexicanos in Midwestern United States (Hill, 1948). The importation of labor from areas of labor surplus to areas of labor scarcity took two forms: either urban (and permanent) or rural (and seasonal).

Urban migration attracted Mexicano workers as cheap labor in times when labor was scarce. Since World War II the rate of in-migration to the cities has fluctuated in response to numerous factors, including job availability in the Southwest vs Midwest, the

TABLE 1. MEXICAN-AMERICANS AS A SEGMENT OF POPULATION OF THE SOUTHWESTERN

State	Total Population	Mexican-American Population	
		No.	%
Arizona	1,811,500	270,000	15
California	20,830,000	1,675,000	8
Colorado	2,110,000	187,000	8.8
New Mexico	1,085,000	356,000	32.8
Texas	11,380,000	1,883,000	16.5
**Total	37,216,500	4,371,000	11.7

*Grebler et al. 1970 pp. 605-608

**It is estimated that census gathering of data on Mexican-Americans is sufficiently in error to allow an estimated additional 700,000 individuals in the total number of Mexican-Americans in the Southwest.

general economic climate and so on. In some cases the migrants returned home, when work slackened.

Social science studies of Mexicano migrants to the urban Midwest include: Humphrey (1944) for Detroit, Mich., Macklin (1963) for Toledo, Ohio, Taylor (1930) for Bethlehem, Pa., Shannon and McKim (1974) for Racine, Wis., and Samora and Lamanna (1967) for East Chicago, Ind. The following generalizations emerge from these studies:

1. Language problems are a persistent difficulty in effective communication of the Mexicano migrant with other citizens.
2. Employment is almost entirely in blue-collar jobs of low skill levels.

This latter statement is a continuing fact. For example, Samora and Lamanna (1967) found that in East Chicago, a community with a Mexicano component dating to before World War II, 90% of Mexicanos had blue-collar jobs. Shannon and McKim (1974) found some improvement in Racine in the proportion of white collar Mexicano employees between 1960 and 1971, but the percentages are still in the range found by Samora and Lamanna.

As these blue-collar Mexicano communities grow, largely by *chain migration*[2], ethnic enclaves with discrimination and lack of social, educational and skill resources develop into persistent components of the cities involved. In Wisconsin, Racine, Milwaukee and Kenosha are excellent cases in point.

According to Shannon and Morgan's study of Racine (1966) Mexicanos were significantly worse off than either Anglos or Blacks in terms of such factors as income, education, status of employment, social participation, occupational mobility, standard of living and level of aspirations. Thus urban Mexicanos not only tend to become ethnic enclaves but their future chances are poor because they are not acquiring those things which would permit them to break out of their situation.

Let us now turn to rural Wisconsin Mexicano migrants.

In the period of severe labor shortage of the 1940s, Wisconsin farmers and canners sought outside labor to supplement the local sources depleted by military service. A major available source was Mexicano migratory labor from South Texas. The workers were skilled; they worked hard; they accepted long hours and relatively low wages, and were generally available year after year. Thus the investment of time, money and effort to provide the cyclic migrants with housing, transportation and other needs was worth it to the farmers and canners. (Hill, 1948).

Many workers were needed because of the labor-intensive system of picking and packing the crops involved. For the most part, this situation was due to the inherent difficulties of mechanization or to the small effort to mechanize those crops on the part of agricultural engineers. This fact is significant for the future of farm labor, since efforts to mechanize go forward only so long as price for the crops involved warrant it. As successful machines are built, they will be used, thus reducing the need for migratory labor to the vanishing point for that crop, local skilled labor being sufficient to fully mechanized agriculture.

In the 1940s the newly recruited Mexicanos worked so well that after the World War II they continued to be employed. In fact, particular growers and particular migrant families or crew leaders often established a vertical mutual dependence or patron-client relationship in which: inexpensive, skilled farm labor was provided at the right time in exchange for work and seasonal housing.

This relationship between farmer and migrant is often personalistic and affective (this is less likely in relation to universalistic, affectively neutral canneries). One can speak of the *paternalism* of the farmers and the *loyalty* of the migrants, which is actuated by self-interest, but often the affection seems genuine enough, nevertheless. Examples of the paternalism include growers bailing migrants out of jail following arrests on drunkeness charges, giving credit references for migrants at local businesses and even lending money to migrants to buy a farm and "settle out" of the migrant stream (Provinzano 1971). The last goes rather farther than pure self-interest would dictate. Although it is unusual, it is not strikingly out of character for at least some of the growers.

Wages

Despite the above, wages of the migrants still tend to be extremely low. The following example will indicate the problem, as it pertains to cucumber workers (WSES, 1967).

Mean hours worked per day	5.89
Mean hourly earnings, $	1.51
Mean pounds harvested per hour	79
*Mean earnings per day $	8.89
Mean earnings per 6 day, $	53.34

*U.S. farm labor in general earned $10.05 per day (mean).

The above data cover all categories of workers—adults and children working as family unit.

Computed from the migrants' average wage, $3541.77 would be the income of a family of four, all working full time for the maximum number of days migrants work, about 100. If one compares this income with the $3200 rural poverty level set by the President's Council of Economic Advisors (1969) for that year, one can see that it seems hardly worthwhile to work in such circumstances. Especially is this true considering how hard migrant work is.

Working and Living Conditions

Working and living conditions of migrant farm laborers have been exposed in television specials (e.g. CBS classic *Harvest of Shame*), countless news and feature articles in the popular press and in many other organs of communication and otherwise. Conditions in Wisconsin do not seem as bad as some described and pictured elsewhere.

Farm workers, whether field or cannery workers, work long hours, broken by gaps caused by rain, uneven ripening of produce and, frequently, poor grower organization and planning. All but the latter cause are endemic to agriculture and mostly unavoidable. The poor organization and planning of growers, however, occurs because many farmers themselves are not highly skilled managers. In order to make best use of farm labor, a farmer should plan so that the workers can be kept continuously busy. Examples include the planting of successional crops or planting the same crop in series to make hand harvesting more possible. He can also plant the crops, fertilize, and irrigate so that yield per plant makes the piece-working farm laborer feel that the effort expended is worthwhile.

Unfortunately, for both the farmer and the laborer, many farmers do not do these things well. This leads the migrant worker to seek work primarily with farmers whose fields are attractive. This is especially true of the family-type worker unit, which will establish a rather lasting tie with a particular farmer provided their experience is profitable. If it is, they may return year after year and maintain contact over the winter through occasional letters.

Cannery workers are also subject to violent fluctuations in amount and duration of work, since the crop will not wait and eighteen-hour days at a rush, succeeded by idle days, are part of the nature of the job. Canners' attempts to reduce this boom-and-bust cycle have been largely ineffective.

Farmers and canners generally provide housing as part of the overall financial arrangement. Those utilities which are provided (minimally electricity and water) may or may not be charged for. Housing is generally cramped, at times scandalously so, but is generally clean. Bathing and clothes washing facilities are often provided, but are often rather primitive and inadequate. Canneries usually provide a commissary at which food, usually cooked by a Mexicana, is provided for a fee. Old barns and even old chicken coops occasionally are provided as "housing". Luckily this is becoming rare in Wisconsin. In one instance very poor housing was provided by a farmer, but it was hard to criticize him when his own house had dirt floors. The range of variation of housing quality is rather great. Canneries will generally paint up their housing to look nice at a distance and put a good sized field between it and public highways.

The application of regulations on migrant housing through enforcement procedures is very difficult. Inspectors are few, camps are many and scattered, and harvest seasons are short enough that compliance may come after the housing has been vacated.

Problems of Organization

The migrants have little power to improve wages, working conditions or living conditions. First of all, they lack the wealth to sustain a strike. The nature of their economic resources can be surmised from the information on wages given previously. However, if this were the only obstacle to organization, they would probably have been organized effectively long ago through affiliation with larger labor unions with the resources to support a strike.

Other obstacles to organization include the following:

a. *Insecurity:* There is first of all a surplus of farm labor most of the time. Mechanization and related efficiencies, plus crop diversification has reduced job availability. Secondly, the relationship between a farm worker and employer often is not simply employee-employer, but personal and long-term as well. The worker is a "client", the farmer is a "patron". This makes the worker unwilling to offend this source of livelihood and perhaps this "friend", too. The affective component should not be ignored.

b. *Labor cost:* Planting a labor-intensive crop has depended upon a substantial supply of skilled, cheap labor. If the cost of that labor were to go too high, the farmer would tend to purchase a machine to do the job, if one exists for the crop involved, or he would switch to a mechanized crop. In the case of canneries the wealth and labor surplus factors are also applicable, whereas the long-term employer-employee relationship and mechanization factors are less significant. However, canneries are usually part of a large company which has many plants and which can afford losses at any one for extended periods. In some cases, especially if the plant is not very profitable, they may even shut down a plant troubled by labor organization (this did happen at one plant during the author's research).

The above facts lead to the disturbing conclusion that far from warmly embracing organization attempts, migrant farm workers find that such attempts threaten what they do have.

Impact of Migrant Workers on the Community

The migrant farm workers do have a substantial impact on the communities they service. First of all, although their incomes are relatively small, their aggregate buying power in this, their flush time, is considerable in the communities of relatively small population surrounding their work places. They buy food, dry goods and even durable goods. Most merchants look forward to their coming and often stock certain items especially to appeal to them (eg. pinto beans, western hats and the like).

Furthermore the migrants' presence creates jobs for people such as State Employment Service local coordinators, irrigation gangs (local people, generally), social service aides, extra retail sales employees and so on. The migrants' presence can mean community prosperity. In fact the migrants are the key to the labor-intensive agricultural system in the communities they visit and work in.

Discrimination—A Surprise?

Based upon the above description, an outside observer might expect the farm workers to be hailed as welcome, though temporary additions to the community, since after all they are indispensable to the economic life of the communities as that life is currently defined. We find, however, that this is not so. Mexicano migrants are not welcome in most local bars; they are patronized or treated rudely in retail establishments; they are treated with a wary, contemptuous suspicion by officers of the law. People say that they are drunks, that they carry knives, that they are stupid, that women are not safe around them.

One may explain these local attitudes as the normal xenophobia of an insular farming community, except for the following facts: tourists in these areas are welcome with much less hostile resentment, and the farmers tend to be less likely to share these negative attitudes (presumably personal contact reduces the tendency to stereotype). A more plausible explanation may be that of racist stereotype: Anglos discriminating against Mexicanos. There is undoubtedly more to this explanation than to the previous one, but it is incomplete as well, since Anglo farm workers tend to meet the same attitudes, *if* their occupation is known to the townspeople. Thus a complete explanation of the phenomenon of prejudice and discrimination should include xenophobia, racism plus a contempt for people who are poorly paid, transient, and live in poor accommodations. The migrants do not live the good life, as it is defined in materialistic America. Therefore they are *stigmatized.*

As should be clear from the foregoing discussion, the stigmatizing of Mexicano farm workers in Wisconsin is a complex process with many constituent elements in it. To describe the causes of the stigmatization as being due to the rapacious cruelty of farmers and canners is as oversimplified as was the portrait of Simon Legree in UNCLE TOM'S CABIN an oversimplification of the nature of slavery. If one were seeking to put together a tract with organizational ends in mind (eg. to be used to help unionize farm workers), then such oversimplification is pragmatically justifiable (but only to "fan the flames of discontent"). However, such tracts should not then be labelled social science.

Whatever circumstances may be for migrant farm workers in other parts of the country, in Wisconsin they are caught up in a system in which their desirability as workers is their low cost, their proficiency and their availability for short term seasonal work. Anything that would tend to alter any of these three factors would tend to make them less desirable employees. Since most of their employers are small, not very efficient and under-capitalized farmers who are being squeezed by cost-price pressures themselves, organization of field workers in labor unions is a very unrewarding venture. Efforts to turn cannery workers in the direction of unionization have met with more success and organizers have, therefore, increasingly focused upon this latter group.

What the Future Holds

For migratory farm workers, especially for field workers who are the majority, increasing mechanization, rampant inflation and increasing resentment of stigmatization all have led to search for alternatives to migrant agricultural work. The obvious possibility is to leave the migrant stream, and many have done this. They "settle out", in many cases simply by staying home and trying to make a go of it in places like Brownsville and Crystal City in Texas. These are places of labor surplus, and so this solution is not very satisfactory. Many settled-out migrants in Wisconsin described to the present author what appeared to them to be the limited choices available to them, which eventually brought them to take up permanent residence in Wisconsin.

Generally speaking, there are two modes of settling-out at some point on the migrant stream:

1. *Involuntary settling-out.* Those who settle out of the migrant stream out of desperation are included in this category. Often their decision has an unplanned quality. They do not know what to do: previously dependable sources of agricultural employment have dried up, financial resources of agricultural employment have been spent, relatives or friends offer as their only real aid the suggestion that they settle down in X community. The involuntary settled-out usually find X community to be the hispanic ghetto of a central city. In Wisconsin it is often Milwaukee.

   The author has seen people in this category on welfare or with very menial jobs. However, a few do succeed in finding positions of some substance, although always blue collar work. Whether they eventually find relative prosperity or not, individuals in this group tend to feel that they are not actively involved in charting their own destinies.

   Much attention has been paid to the involuntarily settled-out migrants by service agencies, both public (esp. United Migrant Opportunity Services) and private (eg. the Catholic Church). This is as it should be, since this category contains those who are most in need of aid. There is, however, another category of settled-out migrants to whom less attention is generally paid.
2. *Voluntary Settling-Out.* This category contains individuals or, more frequently, families who settle out of the migrant stream because they wish to improve their economic situation and choose to do so, not out of desperation, but because alternatives to migration seem attractive and they feel some confidence that they can manage the new life.

   The author's research on this latter group has focused on a rural area and a medium-sized city, both in Central Wisconsin. Individuals in this group are more like the indigenous Anglo population than they are like the average migrant (Table 2). They have more schooling than the average migrant (3.3 years more), are bilingual, have small families (4.4 persons vs. migrants' 7+) and, very significantly, have voluntarily settled into an Anglo community which has no coherent Mexicano community whatsoever. The author found in Fond du Lac (population approximately 40,000) that the twenty-seven

TABLE 2. SETTLED-OUT MEXICANOS COMPARED WITH NON-SETTLED-OUT MEXICANOS (SAME LOCALITY) AND WITH ANGLOS OF FOND DU LAC, 1971.

	Mexicanos		Anglo families
	Settled-out	Non-settled-out	
No. families	27	58	25
No. persons (adults+children)	120	435	92
Mean family size	4.4	7.5	3.7
% adults bilingual	100	58	--
% migrated in parental generation	97	--	6
Mean residence in city, years	16	--	22
Mean schooling adults	8.1	4.8	*10.4
% HS graduates	35	8.8 (10 of 114)	*44.2
% male laborers (construction, general)	50	--	* 4
Mean family $ income, yr	6,040	2,631	*7,837
Income range, $	Unemployed to 12,500	Unemployed to 6,100	*Unemployed to 50,000

*Source—Wisconsin Statistical Reporting Service and U.S. Census Bureau, Regional Census Data.

settled-out Mexicano families were not even aware of each other's existence in many cases. Specifically, no one family knew of more than six other Mexicano families and the mean was three.

The first problem was locating them. As a dispersed non-group, social angencies were of little help to us. We found that "Chicano ex-migrants" was more an analytical and less a folk category than we had believed possible. Finally we located them by chain identification. That is, each family knew about one or two others until we had located the full 27 families.

A few of the migrants who settled-out did so at great obvious advantage to themselves and with very little risk. One individual, for example, bought a good working farm on the outskirts of town with the money to pay for it lent, interest free, by a former employer, a local grower-patron. Such a situation is most unusual. Generally those who settled out did so to enter wage work with little risk-reducing aid.

In interviews and other contacts, as the researchers came to know the ex-migrants and to comprehend their adaptations, a contrast of the general parameters of those who voluntarily settle-out, as compared to those migrants who do not settle out, began to emerge. Some factors are quantifiable or are expressible in mutually exclusive categories as in Table 2.

This form of settling-out also was a long-term phenomenon (one family had settled-out in 1946). Mean income in 1971 was $6,040 per family, compared to $7,837 for the city's Anglos. Other comparisons are equally instructive. For example: income differentials indicate clearly that self-selected or voluntarily settled-out families earn substantially more than those who continue migrating. On the other hand, the income differential between the settled-out group and the other Fond du Lac families can generally be explained on the grounds that the settled-out group tends to be involved almost exclusively in non-managerial, blue collar laboring and related fields.

Based upon the above data, we may summarize the characteristics which separate the voluntarily settled-out migrant from the continuing migrant and, from the involuntarily settled-out migrants as follows—they:

1. have a smaller number of children
2. have a greater facility in English
3. have more formal education, often including high school graduation
4. have substantially greater income without the child labor of farm work
5. have the willingness to go it alone, even to sever supporting ties

of kinship and friendship with other Mexicanos (Provinzano, 1971).

The above characteristics (especially the last) suggest that there are in the voluntarily settled-out group, some rather "Anglicized" Mexicanos. This type of voluntary settling-out, isolated as it is from the familiarity of a Mexicano community and the support of kinsmen, generally requires that the family possess a fair skill with English, confidence that the family breadwinner can get and keep a job, relative lack of dependence on traditional supportive (kinship or friendship) ties and some sophistication at self-integration into the Anglo community.

The question which occurred to our research team at this point was as follows: Was submergence of ethnicity necessary for comfortable adaptation to an Anglo sociocultural context? Subsequently, was any anti-Mexican prejudice encountered in the community? Relevant to these questions, two of the student team members did in-depth interviews with eleven adolescents from settled-out families. Most of these adolescents (8 of 11) had been born in Fond du Lac. From this investigation the following generalizations emerged:

1. The adolescents expressed little feeling of pride in, or knowledge of *La Raza* or of Mexicanness, although one parent or both had been born in Mexico in 80% of the cases.
2. There was little knowledge of the Brown Power Movement. Cesar Chavez was just a public figure name to most of them.
3. Five of the eleven spoke only English. Places of birth: Fond du Lac 8; Texas 2; Mexico 1.
4. They seemed to be aware of discrimination on a very low and subtle level, but tended to attribute it to idiosyncracies of the individual Anglo involved, rather than a group trait of Anglos.
5. They concurred that opportunities for them were not quite what they would be for an Anglo, but seemed to feel that by hard work they could make up the relatively small inequity.

These adolescents admittedly live in a community peripheral to main, traditional Mexican-American population centers and peripheral to Chicano activism as well. However, this does not gainsay the fact that they have carried further a process begun by their parents (who express much more awareness of discrimination in Fond du Lac). The phenomenon described above may well be called the process of Anglicization and assimilation. It suggests that successful, dispersed settling-out into Anglo communities is possible, but only at the price of submergence of ethnicity. If the ideology of Brown Power does not penetrate Chicano consciousness in Fond du Lac soon, one can hypothesize attempts to "pass" as Anglos, name changing, and eventual efforts to achieve a dissolution of Chicano identifiability and consciousness.

This possibility may be viewed as not only inevitable, but desirable by many of those involved. If so, it will be interesting to see how far such dissolution goes, and also interesting to see how the darker-skinned individuals deal with color problems, especially as more inter-marriage with Anglos is attempted. Some future experience with Brown Power may be hypothesized, the results of which in Fond du Lac may be significant, though we tend to doubt it, unless the individual migrates to an area with a high Chicano population density in another city.

It is, perhaps, unfortunate that the cost of assimilation in this context at least, is the apparent loss of cultural distinctiveness and heritage. Alternatively, the involuntarily settled-out family may live in a situation that does permit the maintenance of Mexicano tradition, although often enmeshed in a spiral that spells poverty.

NOTATIONS

1. The author has been leading a team conducting research from 1969 to the present on Mexican migrant farm workers in a rural Wisconsin county as well as on settled-out migrants in a number of areas in Central Wisconsin.

2. Chain migration is a process by which migrants aid and encourage friends and relatives from the home area to join them. Obviously there is substantial potential for geometric growth.

BIBLIOGRAPHY

Gamio, M. 1930. *Mexican Immigration to the United States.* Chicago, University of Chicago Press.

Grebler, L. et al. 1970. *The Mexican-American People.* New York. Free Press.

Hill, G. W. 1948. Texas-Mexican Migratory Agricultural Workers in Wisconsin. Mimeo. Wis. Agr. Expt. Sta., Madison

Humphrey, N. D. 1944. The Detroit Mexican immigrant and naturalization. Social Forces 22: 332-335.

Macklin, B. J. 1963. Structural Stability and Culture Change in a Mexican-American Community. Ph. D. Dissertation. Univ. Pennsylvania.

Provinzano, J. 1971. Chicano Migrant Farm Workers in a Rural Wisconsin County. Ph. D. Dissertation. Univ. Minnesota.

Samora, J., and R. Lamanna. 1967. Mexican-Americans in a Midwest Metropolis: A Study of East Chicago. Advance Report 8, Mex-Amer. Study Project. Los Angeles: Univ. Chicago.

Shannon, L., and J. McKim. 1974. Mexican-American, Negro and Anglo improvement in labor status between 1960 and 1970 in a Midwest community. Soc. Sci. Quart. 55: 91-111.

Shannon, L., and P. Morgan. 1966 The prediction of economic absorption and cultural integration among Mexican-Americans, Negroes and Anglos in a northern industrial community. Human Organization 25: 154-162.

Taylor, R. S. 1930. Mexican Labor in the United States: Bethlehem, Pennsylvania. University of California Publ. in Econ., Vol 7, No. 1.

U. S. President's Council of Economic Advisors. 1969. Economic Report to the President, January. Washington, D. C. U. S. Govt. Printing Office.

WSES. 1967. Cucumber Wage Survey in Waushara County, Wisconsin. Wisconsin State Employment Service, Madison.

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MADISON LITERARY CLUB

— Centennial Dinner Program —

November 8, 1977

ORDER OF EVENTS

Presiding: President Merton M. Sealts, Jr.

Toastmaster: Mark H. Ingraham

Reading of the Papers and the Poem

Foreword

It is appropriate for the Wisconsin Academy of Sciences, Arts, and Letters to offer to publish the following papers, which were delivered at the Centennial Dinner of the Madison Literary Club. The Academy and the Club have an impressive community of interests and of longevity in the Madison area, both having attained the magic age of one hundred years. Membership roles of the two organizations reveal an early and continuing interlocking of names from Dr. Joseph Hobbins (founder of the Club and charter member of the Academy) to more than fifty members and co-members at the present time. The Ella Giles referred to in the Academy's letter to President Sealts became an Academy member during the very year that she aided in the founding of the Madison Literary Club. The exchange of letters between the Academy and the Club concerning the Centennial festivities is herewith recorded.

Professor Merton M. Sealts, Jr.
University of Wisconsin
Department of English
7165 White Hall
Madison, Wisconsin 53706

Dear Professor Sealts:

On behalf of the Wisconsin Academy of Sciences, Arts and Letters, please accept, and extend to the membership of the Madison Literary Club, our sincere congratulations and best wishes upon the occasion of the centennial of the founding of your esteemed organization.

As you may know, the Wisconsin Academy was chartered by the State Legislature only a few years prior (1870) to the founding of the Madison Literary Club. In fact, Ella A. Giles, who was a principal figure in the establishment of your Club, was among the first group of women to apply for and gain acceptance into the Academy membership. Interestingly enough, this was in the year of the founding of the Madison Literary Club. In its earliest years, the Academy took the position that "science and letters have neither country, color or sex."

And so, in scholarly interest and in the spirit of fellowship that governs our two organizations, as well as in historical background and in membership, we have much in common. It is, perhaps, only natural that we therefore take special note of your one-hundredth anniversary and that we rejoice with you in your sense of accomplishment and in your hopes and plans for the years ahead.

Sincerely,

Elizabeth McCoy
Honorary President

EM:sd

11 November 1977

Professor Elizabeth McCoy
Honorary President, Wisconsin Academy
of Sciences, Arts & Letters
1922 University Avenue
Madison, Wisconsin 53705

Dear Professor McCoy:

On behalf of the Madison Literary Club I am writing to thank you for your kind letter of congratulations on the occasion of the Club's centennial.

As President for 1977-78 I had the pleasure of reading your letter to the membership at our anniversary dinner last Tuesday evening. Like Ella A. Giles, whom you mentioned so appropriately, a number of the Club's members are also members of the Academy (as I am myself), and you are certainly correct in saying that the two organizations have much in common. May both continue to flourish in the years to come!

Cordially,

Merton M. Sealts, Jr.
President, 1977-78
Madison Literary Club

THE TOASTMASTER'S OPENING REMARKS	Mark Ingraham
THE PAPERS AND THE POEM	
On Dr. Joseph Hobbins	John Mendenhall
On Charles N. Gregory	Ruth Doyle
On James D. Butler and William F. Allen	Herbert Howe
On Burr Jones	Janet Ela
On Edward A. Birge	Alfred Swan
The Tardy Muse — Votive Verses to the Madison Literary Club	Frederic Cassidy
THE TOASTMASTER'S CLOSING REMARKS	Mark Ingraham

THE TOASTMASTER'S OPENING REMARKS

Mark Ingraham

Before I let anyone else have the floor I want to make one motion and read a few statistics.

Mr. President: I move that the affectionate greetings of the Club be sent to Miss Anna (Nan) Birge who took over the duties of a co-member on the death of her mother in 1918, entertaining the Club ten times before the death of her father in 1950, when she became an honorary member. She is now ninety-four, living in the Attic Angel Nursing Home and, though not physically strong, is clear of mind. [The motion was passed by acclamation.]

For the last three quarters of a century I have been fascinated by numbers and, through my connection with the State Teachers Retirement System even before its official start in 1921, I for some time have been interested in longevity. I wish to give you a few Club longevity records and names.

There have been at least 64 persons who have been members, regular, co-member or honorary, for over forty years and this may be an underestimate, since we probably do not have a complete account of some of the earlier co-members. The record for length of membership is not that of E. A. Birge but of Mrs. F. K. Conover. Starting in 1886 she was an active member for five years as Miss Grace Clark, then for twenty-eight years a co-member, and for forty-four years an honoray member, a total of seventy-seven years! Until extreme old age she came to the meetings regularly, using the privilege of bringing a guest to secure a chauffeur. Others who were members for sixty years or more were: E. A. Birge, 73; Mrs. Charles N. Brown, 67; Mrs. D. B. Frankenburger, 65; Gertrude Slaughter, 64, the last forty as active member; Mrs. E. C. Mason, 61, the first forty-one, until the election of her husband, as an active member; and Mrs. Walter Smith, the mother of one of our speakers tonight, 60 years.

Now, since I myself want to get in on a record, I will list the names of the men who have been active members for forty-five years or more: Birge, 73; Burr Jones, 58; Harry Russell, 51; Julius Olsen, 48; Frank Sharp and Alfred Swan, 46; and Charles Slichter and myself, 45. If Mr. Swan and I are at the 125th anniversary, we still will not have caught up with Birge. I, at least, am not going to eat yogurt to try to do so.

None of us today can compete with the early members for numbers of papers, since they often gave one a year and shared an evening's spotlight with one another. Birge read 19; James D. Butler 14 (two within three months); Charles N. Gregory and Gertrude Slaughter 11 (Gertrude

Slaughter gave the chief talk at the seventy-fifth anniversary); and Burr Jones and D. B. Frankenburger 10 apiece.

I list only one hostess, Mrs. Lucius Fairchild, who between 1884 and 1923 entertained the Club in her home thirty times, all but one of these in June. I would not dare to compute how many chairs from funeral parlors went in and out of her house in those four decades.

At least thirteen buildings and thirty portions of buildings on the Madison campus are named for members of this Club. From this count I omit plaques, trees and boulders, and Madison streets. Of course there have been many opportunities, for, of the present University buildings, only North, South, and Bascom Halls were in use when the Club was founded. As far as I know, Grace Episcopal Church is the only edifice on the Capitol Square, or should I say "Soglin Mall," standing from that date. It was some time before University Hall, usually called "Main Hall," was renamed Bascom Hall after John Bascom who gave Mad Lit its first non-promotional paper—entitled "Culture". Joseph Hobbins had used the first meeting to give a "pep" talk.

ON DR. JOSEPH HOBBINS

John Mendenhall

Toastmaster's Introduction

We will now proceed to consider some of the charter members. I shall repeat a story I have already told the Club about Dorothy Reed Mendenhall, co-member 1906-35, member '35-52, and honorary member '52-64, and for some years secretary-dictator of the Club. (I know for I served as president under her benign but strict guidance.) One day Merritt Hughes was moving furniture. Perhaps it was because he had acquired a new home or maybe because of Grace's feminine desire to change things around. He was clad in shorts only. The doorbell rang. He answered, and Mrs. Mendenhall was there. "Professor Hughes?" "Yes." "I have come to invite you to join the Madison Literary Club and of course you will." In telling me of the episode, he added: "And of course I did." When her son, Dr. John Mendenhall, wants people to behave he anesthetizes them. His mother did not find that necessary. Although I have made a valiant attempt to put you to sleep, and since statistics are not as potent as ether, tonight in speaking of our founder and first president, Dr. Hobbins, John may have to follow his mother's style and deal with you awake.

(John Mendenhall spoke at this point.)

Joseph Hobbins, physician, pioneer horticulturist, and founder of the Madison Literary Club, was born on December 28, 1816 in the town of Wednesbury, Staffordshire, England. His father, also Joseph, was descended from Sir Richard Hobbins, a knight of Elizabethan times. At the age of eleven he ran away and joined the Royal Navy, fought with Admiral Lord Nelson at Cape Trafalgar and retired at the age of 27 after 16 years of faithful service in the Royal Marines. He chose to start life again in the very grimy coal-mining and industrial area of the Midlands at Wednesbury in south Staffordshire near Birmingham. He prospered over the years and became an affluent businessman.

His son Joseph, Jr., one of five children, received his early education at Colton Hall in Rugely. At an early age he developed a love for writing verse and his youthful poems were published in local periodicals. Upon leaving school at the age of 16, he was apprenticed to a Dr. Underhill in the neighboring town of Tipon, where he remained for five years. He then completed one session in 1838 at Queen's College Medical School in Birmingham where he was graduated with honors. Next came two years of study at Guy's Hospital, London, one of the great schools of the day made famous by its Chief Surgeon, Sir Astley Cooper, and the physicians

Richard Bright and Thomas Addison. After receiving his diploma and becoming licensed as a physician, he did the usual brief tour of the hospitals in Edinburgh, Dublin, Brussels, and Paris. He then set out for the United States and a similar tour of the eastern seaboard.

Aboard ship he met Miss Sarah Badger Jackson who was returning from travels in Europe with her widowed mother to their home in Newton, outside of Boston. The voyage was a long one in those days and before leaving the ship Joseph and Sarah had become engaged. He spent much of the time during his tour in America visiting her family and finalizing their marriage plans. He was to return to England and Wednesbury to set up practice and she would come over to join him, staying first with a friend of her family near Liverpool. After many delays they were married in Liverpool on October 11, 1841. The bridegroom was almost 25 and his bride a year older.

Although the prospects of success for such a well trained doctor were encouraging in his native town, Sarah grew very homesick in the dreary surroundings of the Midlands. Her health became impaired and by September, 1842 they set sail again for the United States where they established a home in Brookline, Massachusetts. There he settled down to practice, becoming a fellow of the Massachusetts Medical Society and incidentally joining a Literary Society which impressed him greatly and which he was to use as a model for the Madison Literary Club. Although Dr. Hobbins did very well in practice, his health began to fail and soon he suffered from an irresistible longing for his homeland. At about this time he and his wife became grief stricken over the loss of their first child, Elizabeth, and so after three years of practice in Brookline, they once again set out across the Atlantic in May, 1846 to return to Wednesbury. Their second child and first boy, Joseph, died soon after birth in September of that year. Both parents were again overwhelmed with grief which necessitated another change of scene. Dr. Hobbins set out on an extensive walking trip with his brother-in-law through northern England, Wales, and Scotland which he described beautifully in letters to the *Boston Star*. His wife moved to her friend's house near Liverpool until they could build their own house outside of Wednesbury.

However, both were eager for a greater change and as early as 1848 they and their relatives were investigating the possibility of emigrating to Australia, then California and finally Wisconsin. Concerning the latter they had received from Governor Farwell maps and informational material about Dane County and beautiful Madison. During this period in England, their next three children were born, all girls — one in 1848, one in 1851, and one in 1853. Dr. Hobbins, however, was unable to sell his practice and his plans for emigration were delayed. At this time he decided to try for the

Senior Examination in Surgery in Edinburgh, and was greatly disappointed when he failed.

His sister Elizabeth and her family, and his younger brother, Dr. William and his wife and their children including William's step-son, thirteen year old James A. Jackson, were the first of the family to leave Wednesbury for America and Madison in September, 1853. Joseph Hobbins, Sr., his wife, and their other two daughters and their families together with servants, left a month later. All in all, by 1854 Madison was to receive over 40 immigrants from Wednesbury.

Finally in the Spring of 1854 Dr. Hobbins and his entire household, including his wife, three children and servants, set out for the United States after an absence of eight years. In spite of a harrowing ocean voyage, which included being shipwrecked on the coast of Ireland, they finally reached New York and started their twelve day journey westward: to Chicago by rail, to Milwaukee by boat, and to Stoughton by rail, with the final stage of the journey to Madison by horse and wagon. After thirteen years of married life, numerous ocean crossings, and several changes in location of family and practice, Joseph Hobbins settled down at last in Madison and here remained until his death forty years later.

Madison, in 1854, was a rapidly growing frontier village of just over 5,000 persons. It had been declared the Territorial Capital in 1836, while a settlement of only three inhabitants! It was incorporated as a village in 1846 with a population of 626. After Wisconsin became the 30th State in 1848 with Madison the capital, growth as a governmental, financial, educational, and social center was rapid. The University of Wisconsin opened in 1849, the first railroad came late in 1854, and Madison received a city charter in 1856.

After living for two years in the countryside on the shores of Lake Monona, directly across from Madison, Dr. Hobbins realized that he could not be a practicing physician and a country gentleman at the same time and so he moved his family into a house with a large garden area on West Main Street. Here he had plenty of room to develop his own horticultural interests with an orchard, vineyard, kitchen garden and flower beds. His surgical practice grew and he soon became active in the affairs of the growing community.

The University Regents were thinking of opening a Medical School and Chancellor Lathrop appointed Dr. Hobbins Professor of Surgery, with the task of organizing the School. The plan was dropped, however, due to legislative neglect. In 1856 Dr. Hobbins was elected to the first City Council and subsequently re-elected three times. He organized a local Board of Health and made an attempt to establish a city hospital. The sum of $6,000 was appropriated and ground purchased on Gorham and

Patterson Streets. The project failed for lack of support and later in 1890 the City sold the property and used the proceeds to buy a stone quarry and a steam roller. It was not until 1898 that the first city hospital, now Madison General Hospital, was erected, after earlier attempts to use boarding houses as private hospitals had failed. Before that, medical or surgical cases had to be taken care of in their own homes or in rooming houses or hotels.

Prior to the middle of the 19th century surgery was for the most part, limited to the treatment of diseases and injuries not involving the abdominal and chest cavities. There was an increasing number of daring major operations performed with astonishing technical skill and rapidity because of a lack of anesthetics. It was in 1846, shortly after Joseph Hobbins returned to England from Boston, that Morton first used ether anesthesia at the Massachusetts General Hospital, followed the next year by Simpson's first use of chloroform as an anesthetic agent in Edinburgh. The subsequent discovery of antisepsis by Lister (his carbolic-acid spray method was first published in 1867), and the development of aseptic surgery by the German surgeons in the 1880s, together with the progress in basic anatomy and pathology led to rapid and undreamed of advances in the study and practice of surgery by the turn of the century. Indeed, one International Medical Congress in London, at that time, included such great names in this rapidly developing field as Virchow, the father of cellular pathology, Rober Koch, the discoverer of the tuberculosis organism, Louis Pasteur, the developer of the germ theory of infection, and Lord Lister. To fill out the time framework, in 1889 Johns Hopkins Medical School was opened and in 1892 Dr. William S. Halstead became Professor of Surgery at that institution, joining the great Dr. William Osler to become the leaders in medical education in the United States. The year 1894 saw the death not only of Joseph Hobbins but also the famous Austrian surgeon Theodor Billroth, the first surgeon to successfully resect the larynx, the esophagus, and the stomach.

During Dr. Hobbins' years of training, surgical specialties were largely undeveloped and the general surgeons practiced obstetrics, gynecology, orthopedics, otolaryngology as well as general family practice including pediatrics. It was such a practice that Dr. Hobbins apparently engaged in. He was described as having a quiet, substantial professional career, useful to state and town. He dearly loved his profession and stood stoutly for its old-time code of ethics. He was a member of the Royal College of Surgeons. His membership in the Wisconsin State Medical Society dated from 1856 and he had a wide personal acquaintance with the doctors of the States. By 1880 Madison had a population just over 10,000 and Dane County some 52,000. There were 20 physicians in the city, two of them women. In 1885 at the age of 69 he was President of the Central Wisconsin (later to become Dane County) Medical Society. He remained in active practice up to the time of his death nine years later.

When the Civil War broke out Dr. Hobbins, a life long Democrat, supported the Union as a War Democrat. He organized the Medical Corps at Camp Randall where the Union recruits were being drilled. His brother, Dr. William Hobbins, enlisted as a surgeon in the 8th Wisconsin Volunteers and William's step-son, James A. Jackson, age 21, enlisted as a hospital steward. Soon part of Camp Randall was used as a camp for Southern prisoners and Dr. Hobbins, as U. S. Surgeon, was in charge of the health of Confederate prisoners and Union soldiers alike. His handwritten Register of Deaths records 152 deaths among the 3,000 prisoners for the three months of April, May, June, 1862 alone. Later he was appointed Medical Examiner of Northern soldiers claiming disability, and the same Register contains detailed examinations and recommendations on over 200 such cases with his objective evaluations.

Aside from his profession and his love of art and literature, Dr. Hobbins' greatest interest was his avocation of horticulture. An inept but enthusiastic gardener when he started as a gentleman farmer in 1854, he became a practical horticulturist, experimenting in his own garden with many varieties of fruits, vines, and shrubs and importing new seeds and plants from both sides of the ocean. In 1858 he helped found the Madison Horticultural Society of which he was president for twelve years. He is said to have been responsible for the planting of lilacs and crocuses and shade trees along the streets of Madison which led to the beautiful vistas enjoyed by future generations. In 1866 he was elected president of the newly formed Wisconsin State Horticulture Society, a position he held for five years. His efforts in this field earned him the title of "father of horticulture in the northwest."

Dr. Hobbins is not listed as author of any article in national medical journals in the Index Catalogue of the Surgeon General's Library, but he did write numerous articles on medical subjects not only for the medical societies but for such layman's journals as the *Northern Farmer, Home and Health Journal,* the *Western Farmer,* and *Field, Lawn and Garden* (a monthly journal of rural affairs, art and literature). His papers ranged in subject from the harmful effects of hair dyes and cosmetics to a series of 12 articles on the "Care of the Baby."

The story of the actual formation of the Madison Literary Club 100 years ago has been written and rewritten for the 10th, 25th, 50th and 75th anniversary celebrations and the Club's Memorial to its Founder's death in 1894 and most recently for the advanced newspaper publicity for this meeting. The influence on Dr. Joseph Hobbins of his earlier membership in a literary society in Brookline, Massachusetts and his efforts after his arrival in Madison in 1854 to organize a true literary society are cited. Joseph Hobbins and Sarah his wife had over the years invited local groups of persons with intellectual and literary tastes to their home for informal discussions of some chosen topic. At intervals he tried to arouse interest in the formation of a permanent organization. Time passed. Sarah Hobbins died in 1870 after a long illness, age 55. Then in February, 1872 Josephine, the doctor's oldest daughter, married the step-son of his brother, Dr. William Hobbins, by then *Dr.* James A. Jackson. Two months later Dr. Hobbins married Mary Elizabeth McLane, the youngest daughter of a well known Baltimore scholar and publicist, whose acquaintance he had made when she visited Madison the previous summer. Louis McLane Hobbins, their only child, was born in 1874 and the family moved to a new home on Wisconsin Avenue.

Finally in September, 1877, interest in a literary club seemed right and Miss Ella A. Giles, Professor Rasmus B. Anderson, and Dr. Hobbins met to draft their plans for the organization of the Madison Literary Club. A list was drawn up of persons "of acknowledged literary taste" to be invited to the next organizational meeting on October 1st. At that time a committee was appointed to draft a constitution, which was unanimously adopted on October 8, 1877. Dr. Hobbins was elected President and re-elected annually until his death in 1894 with the curious exception of 1881, when Mrs. Joseph Hobbins (Mary Hobbins), an active member in her own name, served as second Vice President.

On Monday evening, November 5, 1877, the first regular meeting was held at the Vilas House (later to become the Pioneer Hotel) with a paper by the President entitled "The Mission of the Club." It is interesting that the original constitution in Article III (*Object of the Club*) included the purpose of "becoming better acquainted with each other" between the initial phrase relative to bringing persons together for the purpose of social enjoyment and the final phrase "promoting so far as may be, the interests of literature in Madison, Wisconsin." Sometime in later years the phrase to "become better acquainted" was dropped.

Indeed, in his 1879 report to the Club, entitled "Two Years of Club Work," after his second term as President Dr. Hobbins remarked that the combination of literature and sociability is no new thing. "It is sociability and not literature," he said "that binds us together; literature attracts but the cohesive quality is social in its character. Therefore, let us not at some future time unwisely deem the social feature of our Club of less importance than the intellectual feature."

At the November, 1884, meeting held in the Hobbins home the Doctor read his third and last paper entitled "On the Status of Our Club," which he reported as being financially as well as culturally sound. During that period the society's format had slowly changed from that of a study club to something like a lecture course with a specialist giving the evening's paper and three or four persons discussing it.

At the conclusion of the June, 1887 meeting of the Club at the residence of General Lucius Fairchild, Professor Charles M. Gregory, in behalf of the Membership, presented to Dr. Hobbins a portrait of the doctor "as a memorial of your great services and of our warm gratitude." The portrait, which we have with us tonight at this meeting, was by Professor James R. Stuart, a member of the Club and one of the most talented and prolific artists of the period. It was accepted at that meeting by the State Historical Society of Wisconsin, "there forever to be preserved - - - - - - - - - as the enduring memorial of a good man and a good life." In thanking the members, President Hobbins urged them to "continue our interest in this society not only for our own sakes, but for the sake of those who come after us for you have assurances enough in the good you have gained from it to make you feel as I feel that we can leave our children few better legacies than a love for literature."

In Dr. Hobbins' last years most of his efforts were given over to organizing and conducting the literary club. He was described as a man of noble aspirations, high integrity, warm sympathies, and sound judgment, with the old-time hospitality of the English. As he grew older he "shook off all tendencies to melancholy, joined forces with the younger generation and lost none of his keen regard for the things of the day." There still exists a letter of resignation "for personal reasons" in his handwriting and with his signature dated April 2, 1892, that was either never presented or turned down by the Club for he continued as President in spite of failing health. In late January, 1894, he "gently succumbed" to what was diagnosed as "la gripe" and died on the evening of January 24, 1894 at a quarter past six o'clock, aged 77 years.

In the memorial tribute of his Madison Literary Club it was said that "those who knew him best, as physician, friend, and counselor, loved the dear old Doctor best — and no warmer praise than this can man earn."

ON CHARLES NOBLE GREGORY

Ruth Doyle

Toastmaster's Introduction

It is sometimes dull, boring, or even disagreeable to appear before a legislative committee. However, it was always pleasant to attend meetings of the Joint Finance Committee when Senator Porter and Assemblyman Ludwigsen were co-chairmen. Occasionally, even with their skill, one had to wait beyond the appointed hour before the University budget or the needs of the retirement system came up for consideration. On one such occasion a young, vivacious assemblywoman spoke clearly, persuasively and briefly for some budget item—an item which I have long since forgotten and bet that she has too. After she finished, Senator Porter leaned forward and in fatherly tones said: "Young lady, you would make a great legislator if only you were a Republican." That was the first time that I heard Ruth Doyle speak. I look forward to hearing her now discuss Charles N. Gregory.

(Mrs. Ruth Doyle spoke at this point.)

Charles Gregory was born in New York State in 1851, and moved with his family to Madison when he was very young. His father was an early mayor of Madison and the family was prominent in the political and social life of the growing city.

He was graduated from the University of Wisconsin in 1871 and in the following year, at age 22, from the Law School. He was awarded an L.L.D. from his alma mater in 1901.

He practiced law in the firm of Gregory and Pinney from 1872-1894, when he resigned to become Associate Dean of the Law School, in which position he served more or less happily until 1901. I say "more or less" because in his preserved correspondence there is at least one, and perhaps several, letters of resignation addressed to the Regents, citing his dissatisfactions with the treatment of the Law School and with his own salary, which had not been increased for several years running. It is an occupational attitude of law school deans, since the establishment and spread of legal education in the United States. In 1898, Dean Gregory read a paper to the Section on Legal Education of the American Bar Association, bearing the poignant title of "The Wage of Law Teachers." He reported on the under-support of law schools and the under-payment of faculty, mentioning a certain unnamed University in which the College of Agriculture received $75,000 annually, while its law school, with the same number of students, existed on its revenue from fees, about $14,000.

He concluded: "I mentioned this . . . to some of its faculty and expressed my pleasure at the liberal support of the science of Agriculture, and my hope that the science of law might at some time be as well maintained. They pointed out, with some heat, the usefulness of the Agricultural School, and said one of its professors had invented a convenient apparatus for testing milk. I was glad of this excellent achievement. I recalled that one of the law professors had published an able work on Evidence (a convenient apparatus for testing truth) and intimated that a good quality of justice was as important as a good quality of milk."

He nevertheless devoted a substantial period of his life to the administration of law schools. In 1901, when he left Madison, never to return, he became the Dean of the Law School at the University of Iowa and subsequently at George Washington University, where he retired in 1914.

Mr. Gregory was a prodigious writer. His works, which were widely published in Law Reviews and other scholarly organs, dealt with a wide variety of subjects from the Alaskan boundary disputes to tariff reform and election reform, and to the Law of Blockade. At the time of his death he was serving as one of the editors of the *American Journal of International Law.*

There are other dimensions to the life and accomplishments of Charles Gregory. He was a natural leader of the Madison Literary Club of his day—his reputation as a poet led to his designation by his admirers as the "Bryant of the West." His many papers presented to the Club dealt with such various subjects as Jeremy Bentham, Recent American Poets, Modern English Ballad and its Makers, Lawyers and the Makings of Them, and the Improper Use of Money in Elections. One of his papers was entitled "Paintings in Madison with Specimens Thereof." He himself was a prominent collector of paintings and other artisitic treasures.

Another great light went out on same day that Mr. Gregory died in 1932. The issues of the *Capital Times* and the *Wisconsin State Journal* which carried his obituary also reported the funeral services of the renowned Carl Russell Fish, professor of History. At the time of his death, Mr. Gregory was described by his friend A. O. Barton of the *State Journal* as "scholarly and aristocratic," with "cultured manners, an interesting and attractive type of gentleman that flourished in the smaller Madison of his day."

His business associate, law school colleague, and life-long friend Justice Burr Jones said of him that "his fine scholarship and love of the best literature gave him a leading place in the literary circle in our city." He "loved social life," added Justice Jones, and "there was something in his mode of dress and bearing which led strangers to think of him as an aristocrat . . ., but there were few among us who were more solicitous for the welfare of our fellow man. He was full of sympathy for dumb animals and would show a righteous indignation over any cruelty toward them . . ."

There is a postscript to the life of Charles Gregory. All of his papers, his treasured artifacts, and his paintings were bequeathed to the State Historical Society of Wisconsin. They were returned to Madison in October, 1932, in a huge locked van, which, by agreement, the driver was never to leave unattended. When the driver became ill in South Bend, the van was locked in a warehouse until a relief driver could be obtained. The opening of the exhibit was an event highly publicized in the Madison, Chicago, and Milwaukee newspapers.

Included in the collection were drawings attributed to Raphael, Michaelangelo, Tintoretto, Rubens, and Holbein. Mr. Gregory had paid modest sums for his collected items, using a prominent London art dealer as agent. Professor Lawrence Schmekebier, noted professor of art history, proclaimed the drawings to be fakes. He described one as obviously the work of an eleven-year old girl. The family, friends and admirers of Mr. Gregory reacted strongly, pointing out that Mr. Gregory was a man of great integrity, a connoisseur who dealt only with reputable dealers in Europe. The controversy termed by the press an "art war," raged for weeks, and was widely reported in the Wisconsin press. The Historical Society called on experts from the museums of New York, Detroit, and other places. Conclusions were mixed. The experts from the Metropolitan agreed with Schmekebier; those from Detroit agreed with Mr. Gregory's choices.

In recent years, the paintings and drawings from abroad have been housed in the Elvehjem Art Center. The American works, held by the Historical Society, were returned to the family, the last member of which—a niece—has recently died.

The statement of a former Director of the Historical Society, Mr. Joseph Schafer, seems an appropriate conclusion: "While the Society regrets that the drawings are not all they are supposed to be, yet it is glad to know the mislabeled drawings are good in themselves and will serve a useful purpose." Which I am told they do to this day.

Toastmaster's Comment

I side with Gregory rather than Schmeckebier, since my best arguments could not convince the latter that mathematics is an art. How could we expect him to recognize a Rembrandt!

Young lady, you would make a great member if you were not a co-member. I want to tell you one thing more about Mrs. Doyle. She told me that she not only accepted the chance to speak, but desired it as the only opportunity for her to speak as a co-member. But with all her insight, she is not a historian. By tradition and long ago in print, wives and husbands of members "rank as co-members with full power." Mrs. Mendenhall and Mrs. Bleyer each gave a paper as co-members; Mrs. Burr Jones, two; and Mrs. Slaughter, five. This custom should be revived. Perhaps Women's Lib flourished better before it had that label.

ON JAMES D. BUTLER AND WILLIAM F. ALLEN

Herbert Howe

Toastmaster's Introduction

There are many good reasons to study calculus. I do not care by which path a man walks, or perhaps swims in the trackless waters of Mendota, so long as he gets to heaven. The next speaker chose to seek the secrets of calculus, not to build bridges or to forecast the stock market but to understand Zeno. Welcome, anyhow! He studies medicine, not for health which is maintained by exercise, but for the classical derivation of its terms. We have had a great tradition of classicists: our last president, Paul McKendrick; Ray Agard; Moses Slaughter; Grant Showerman; two secretaries, Katherine Allen and Annie Pitman; and two charter members, William F. Allen and James D. Butler. It is these two whom Mr. Howe, himself a classicist, will discuss.

(Herbert Howe spoke at this point.)

From the days of its foundation the University was caught up in the struggle over the proper purpose, method, and content of college education, and the two men I should like to consider with you, both founding members of this Club, might well serve as exemplars of the two sides. Their backgrounds were not unlike, and one succeeded the other as Professor of Classics. Yet between their personalities and aspirations for the University lay a vast gulf, a gulf which, however, did not affect their relations with each other. One of their common interests was this Club, to which both contributed as essayists and officers.

James Davies Butler was a New Englander, born in Vermont in 1815. He graduated from Middlebury and went on to Andover Divinity School. His plans of entering the ministry were interrupted when he took a long trip to Europe, but on his return he served several churches in the East and in Ohio, combining his ministry with teaching and lecturing. In 1858 he came to Madison as Professor of Classics, replacing Obadiah Conover in the chair on the twelfth ballot by the Regents. He was a gentle and witty man with an enormous store of out-of-the-way knowledge, but complained of his intellectual loneliness. One suspects that he did not greatly enjoy his contact with his classes. During the Civil War he served as Chaplain. When the Board of Regents was reorganized in 1866, his appointment was not renewed. He left the faculty in 1867, but lived in Madison until his death in 1905, though he spent a great deal of time travelling and lecturing. Most of his writing—he was a voluminous contributor to magazines, especially the *Nation*—was rather slight, but his paper on *"The Hapax Legomena of Shakespeare,"* first given before this Club, received the applause of as great a scholar as Halliwell-Phillips. He travelled widely and often, in Europe and the Near East, and when he was 75 years of age took a long trip around the world, with such side excursions as a voyage 2000 miles up the Yangtse. He was one of the first to cross the country on the new transcontinental railway, and on a side trip on the way managed to get lost in the Yosemite, only to be saved by a former student of his, one John Muir. Meanwhile he was a popular and prolific lecturer, in the great age of that form of teaching. We may have our suspicions of "Mental Culture among Teachers," given five years before he came to Madison, but I can only applaud the taste of a generation which turned out fifty times to hear him speak on "How Dead Languages Make Live Men." His greatest success was "The Architecture of St. Peter's," which he repeated 100 times, once in Rome. He kept up his activities to the end, and was, indeed, appointed chaplain to the State Senate when he was 80. He died in 1905.

Butler never wrote a book, and he seems to have viewed scholarship as a source of personal pleasure, rather than as an arduous and demanding pursuit. His successor, William Francis Allen, graduated from Harvard in 1851, fifteen years after Butler left Middlebury; but when Allen went abroad it was to study Roman history and antiquities at Berlin and Göttingen. Until 1862 he taught school in the East, and then worked during the Civil War with the Freedmen's and Sanitary Commissions. After the war he taught at Antioch, and came to Wisconsin in 1867 to replace Butler. As a teacher he was an immediate success. As a scholar he was productive in several fields, in Latin and in mediaeval history. Allen, his brother Joseph, and J. B. Greenough of Harvard collaborated on a number of school Latin texts. I suspect that I am not the only person here who studied from them, for they continued in use down to the Second World War. But Latin was not Allen's only field. When he first came he taught both ancient languages and history, the last being scarcely more than a perfunctory reading of a standard text. By 1871 he was freed of the obligation to teach Greek, and in 1886 he finally moved entirely, as a teacher, into history. From the beginning he insisted that his students should use primary sources, and he approached history topically rather than chronologically. He worked zealously for the growth of the University Library, as librarian after 1871. He was on the committee which responded to the horrendous report of the Board of Visitors that the health of women students was being ruined by their arduous intellectual work. He made one of his greatest contributions to the State in the years just before his death, when he and his student, assistant, and successor Frederick Jackson Turner arranged a series of lectures on the history of the Northwest, which later grew into the University Extension program.

Allen's last service to the University was an unintentional one. In the fall of 1889 a furious row had blown up over the matter of hazing; tempers were being lost, and Regents, administration, faculty, and students were being forced into positions from which they could not retreat. On December 9 Allen suddenly died. The quarrel was swallowed up at once in sorrow at his loss, and neither side resumed it later.

The papers the two men read to this Club show extraordinary diversity of subject. Butler wrote on Luther's Rock of Refuge and the Sanctuaries of St. Elizabeth; The *Hapax Legomena* of Shakespeare; English Folk-Lore; The Portraits of Columbus; The Character of Sir John Falstaff; Wonders of the Western Wild; Taychopera, or the Four Lakes Country; Our Composite Nationality; Lord Vernon's Dante; Dante, His Quotations and His Originality; Some Cities of the Great Moguls; Shakespeare as a Cicerone in Foreign Travel; The Names of Our Club Associates; and The Vocabulary of Shakespeare. Many of them were travelogues, and there is not a single paper on a classical subject. Allen wrote on Freedom of Thought and Speech; The Duke of Milan; Shakespeare as a Person; The History and Methods of Wood-Engraving; Coriolanus in History and in Shakespeare; The Roman Forum; and Historical Fiction.

Mrs. Allen, who continued in the Club until 1924, read several papers after her husband's death, on American Labor in New England Cotton Mills; Ann Grant of Laggan; Minstrelsy of the Scottish Border; and Dorothy Wordsworth. Their daughter Katharine, who like her father taught Latin and lived until 1940, was more a specialist: her papers reflected the growing professionalism of the times: Catullus; Records of Rome on the English Border; Ovid; and Seneca.

Butler belonged to an age in which universities tried to produce men capable of becoming talented amateurs in many fields; Allen led the way to a time which demanded highly trained professionals. They may serve as paradigms of the pressures which still beset not only our civilization, but each of us individually. Mad Lit, numbering this pair and others like them among its founders, may fairly claim to have become a synthesis of their virtues, and to have rejoiced for a century in making congenial talents as diverse as theirs.

ON BURR W. JONES

Janet Ela

Toastmaster's Introduction

Conjugalism is an official policy. But we have something else. If you want to be nasty, you call it "nepotism." If you want to be nice, you call it "hereditary genius." If you want to pun, you call it "gild by association" and spell it either with or without a "u." Whatever it is, we have lots of it. We have already had one speaker (J.M.) of whom both parents were active members of the Club. The same was true of Max Mason. In the cases of the Mendenhalls, the E. C. Masons, the Slaughters, the Conovers, and the Bleyers, both husband and wife were active members in succession. Now the Hartley Howes are members simultaneously. Katherine Allen was the daughter of William F. Allen; her mother gave four papers when an honorary member. "Father and son" are represented by the Spohns, the Beattys, the Weavers, and the Kiekhofers. The Frautschi brothers each served as president. But the championship goes to Janet Ela: her grandfather Burr Jones was a charter member and presided, post-presidentially, at the fiftieth anniversary meeting at which Birge was the chief speaker; her grandmother Olive Jones gave two papers and served as the second secretary of the Club; her father Walter Smith, long the University Librarian, was a member for thirty-eight years; her husband Walter Ela served as treasurer for seven years; and she herself as secretary for two years—in spite of which she is not tired of the Club. Her memories tonight will center around the charter member, Burr Jones.

(Mrs. Janet Ela spoke here.)

Mine is a happy assignment tonight. I speak about someone I knew intimately and loved very much — my grandfather, Burr W. Jones. If, in my knowledge that Burr Jones was the perfect grandfather, I tend to portray him also as the perfect Mad Lit member, this is not wholly a matter of bias, for the qualities that made him so endearing as a grandparent are ones that our Club values too.

Here is the grandfather of my early memories: a grown-up who spun marvelous stories and knew a very great deal but who was always eager to hear what you knew too, who relished cards and guessing games but didn't care who won, knew how to joke and tease without ever hurting, made comfortable space for every newcomer in his life, while you knew that your own place next to him was always safe. I am describing a happy man, generous and genial. But not bland. This Club does not cherish us if we are sociable only. In 1877 when our Club began, Burr Jones was a young lawyer of 31, the same age as the incorporated village of Madison. During his many years of membership, he grew into an eminent lawyer, teacher and judge, and he brought to Club meetings wisdom in his own profession, experience in politics, legal and social reform, plus seasoned tastes in literature, history and biography.

Obviously I did not know the young man, nor the boy who came before that. When Grandfather was 87, he wrote an informal little book called *Reminiscences of Nine Decades*, and it is from this account that I fill in the earlier years. Burr Jones was born March 9, 1846, in a log farmhouse in the vicinity of present-day Evansville, Wisconsin. His parents, of Welsh and English stock, were recent comers from up-state New York and Pennsylvania to the small mortgaged farm they worked. The father died when Burr was eight, and four years later, his mother married a neighboring widower, named Levi Leonard. His mother was ambitious for her boy to get an education, and the stepfather, though he had not completed grammar school, was an avid reader and a non-conformist in temperament, who helped to whet the boy's curiosity about ideas. Burr went through the available schools, a one-room schoolhouse and the Evansville Seminary, always doing heavy farm chores after school and during the summers. He then taught school for a bit, traveled around Iowa selling books, and managed at last to get to Madison to work his way through the University.

I find myself wondering how many of the early members of Mad Lit came from so lean and austere a background. Some faculty members, recently arrived from the East, may have been of a second or third generation that knew comfort and culture, but if other members were natives of Wisconsin, still a frontier state, they may have had origins as humble as Grandfather's. He recorded that among the University student body of about 200 in his day, he knew only two boys whose parents were wealthy enough to pay their tuitions.

The farm drudgery must have been highly distasteful to Burr Jones. He describes it in his Reminiscences with matter-of-fact neutrality, but it was wholly edited out of the boyhood that yielded stories for his grandchildren. Some ex-farm boys, turned prosperous, buy land in the country for nostalgic reasons. Not Burr Jones. He was absolutely urban and intellectual in his interests. He had no taste for gardening, a notable lack of manual and mechanical skills, and scant interest in athletics. He did a little fishing in earlier years, played sociable golf in later years. However, at no time in his life was he physically heavy or lethargic. He had a trim figure, a quick springy step, and it may well be that his ritual devotion to long walks was the secret of his remarkably good health.

In 1868 a law school had been founded on the Madison campus, in which one year's work earned a degree. In 1871, at age 25, Burr Jones emerged with this degree and began to practice law in Portage. Within months he was invited to be a junior partner by an established lawyer in Madison, and from that time on, his law offices were always in this city.

In 1872 he married Olive Hoyt, and they bought a house on Langdon Street near Frances, a site that Olive's Monona Avenue family called "way across town." This was the first of three houses owned by Burr Jones, all of them on Langdon Street. Some of you will remember the third house, at 17 Langdon, and its hostess, the lovely Katharine Macdonald who was Burr Jones' second wife. The house into which I fit Mad Lit meetings most suitably is the second one, at 112 Langdon, where Burr Jones lived some 35 years, a house which in my childhood was often filled with exciting guests. Indeed this ornate and marvelous house which Burr and Olive built, with its six fireplaces, its innumerable bay-windows and surprising L's, a tower room on the third floor, a billiard room on the ground level facing the lake, is background not only for actual memories, but my fertile source for stage sets whenever a 19th century novelist is skimpy with interiors. There was even a transom over one of the bathroom doors for Sherlock Holmes' *Speckled Band.*

It was in the same year as his marriage, 1872, that Burr Jones made his first foray into politics. He was elected Dane County district attorney and served for four years. In 1882 he was drafted by the local Democrats to run for Congress and won on a fluke, because there were two quarreling opponents on the other ticket. When Jones tried for re-election, the Republicans, having closed their rift, resumed their normal strength in the district and sent Robert M. LaFollette to Washington for his debut. Burr Jones thoroughly enjoyed his one term in the House, and he must have known that he had many qualifications for political success. He was a hard and conscientious worker, an excellent speaker and debater, who never had to resort to heavy rhetoric or sarcasm. He made sure that he knew his facts and then won easy rapport from an audience with his good-humored, conversational style. His Congressional defeat was doubtless disappointing at first, but on the whole he was relieved that attachment to the wrong party had nipped his ambitions quickly and sent him back to the profession he loved.

Soon after his return from Washington, in 1885, he was invited to become a lecturer at the Law School, and this sideline to active practice brought him deep pleasure. He devoted one day a week to classroom work for thirty years and took a very keen interest in his students. And I am sure that students ranked him high as a teacher, for I witnessed in various little trips about the state, the warmth, almost adoration, with which his "old boys" greeted him.

On the other hand, if I have suggested that Burr Jones was a first-rate practicing lawyer, I have been dealing with hearsay evidence, for I never actually heard him in conference with a client or speaking before a jury. We must indeed be cautious on the admissibility of evidence, for this is the territory in which Burr Jones won his widest reputation. During the 1890s, on request from the Bancroft-Whitney publishing firm, he worked diligently on a reference book which enjoyed good fame and strong sales in the course of numerous revisions and updatings. Students and lawyers throughout the country knew *Jones on Evidence*.

In 1920 Governor Philipp asked Burr Jones to fill a vacancy on the state Supreme Court. Jones, now 74, demurred at first, but because his health was excellent, he decided to accept. His six years on the bench were a great satisfaction to him; the work was heavy and the schedule more confining than his private practice, but he enjoyed the close working companionship with other scholars of the law.

So far I have not said much, have I, about my grandfather's role in Mad Lit, but I trust he has come through to you as a man who would be very much at home in this good Club. He was a member for more than 57 years, from the club's origin until his death on January 7, 1935. He prepared ten papers, the first in 1879, the last in 1932, and I shall read you their titles. But first let me note that it was Mrs. Burr Jones who spoke in December 1878 on the subject Life in Attic Greece. It was not until four months later that her husband read his initial paper. In those very early years, there was no fine distinction between member and co-member.

These were Burr Jones' ten titles in the order of their presentation: The Law of Primitive Societies, Growth of Socialism, Richard Cobden, The Management of the Anti-Slavery Agitation in the United States, The Expensiveness of Cheap Money, Chief Justice Marshall, The Homicide Problem in the United States, John Bright, Wendell Phillips, The Independence of the Bar. Recurring themes in these titles indicate constancy in Burr Jones' interests—the law itself as a subject, social and economic reform especially as it involved slavery and free trade, pleasure in studying the lives ot public figures who were leaders in his fields of interest.

I certainly cannot make out a case from these titles that Burr Jones was the full Renaissance Man, familiar with all fields of human knowledge. The fact is that he had very little background in any of the physical or biological sciences, almost no ear for music, appreciation but little expertise in the visual arts, and no small hobbies such as collecting stamps or railroad timetables. Curiously this absence in him of what we call hobbies never even occurred to me until a short time ago while I was preparing this essay. We tend nowadays to regard the hobby-less person with pity, as a slave to his work or a bore without inner resources. With Burr Jones, nothing could be farther from the truth. He loved the law but it was not his master, for he had two other pursuits which he loved with equal fervor and with great indulgence. One, he loved good books as only a person can who has craved them early and won them against odds. Two, he enjoyed the diversity of human nature more thoroughly than any one I have ever known. He had a talent for exploring the minds and hearts of others and it was a talent of great purity: he probed you gently with questions about yourself, not as a trial lawyer, a doctor, a novelist or any other specialist might do who planned to put findings to work, but simply because he wished to understand what *you* were doing and thinking. And you *knew* that nothing you said would ever be used against you. It will give you some measure of how genuine and rare his exploring method was when I say that even during my early teens it never embarrassed me that my grandfather asked my friends so many questions. It pleased me that even the shyest, most awkward of them liked his way of getting acquainted and flowered under his attention. Indeed he was never a "big talker" himself but in almost any informal gathering he was somehow the natural leader who encouraged conversation to flow in spontaneous fresh channels.

I regret that I do not know the text of any of the ten papers that my grandfather prepared for this Club. I feel confident that they were thoughtfully written and persuasively read, though not necessarily the most brilliant papers the Club has known. It is in the role of creative listener that Burr Jones was most surely a perfect Mad Lit member.

ON EDWARD ASAHEL BIRGE

Alfred Swan

Toastmaster's Introduction

In Birge's time the minister of the First Congregational Church was almost ex-officio a member of this Club. Eugene Updike came to that church in 1890 and became a Club member the same year. The election of Charles H. Richards in 1879 had been equally prompt. Alfred Swan came in 1930 but, although he was invited to join at once, he postponed membership a year to find out if we, i.e. our forebears, were respectable. His predecessor, Robbin Barstow, came to the church in 1924 and, if we can believe the semi-centennial booklet, was elected to the Club in 1825, a bit of predestination more befitting a Presbyterian than a Congregationalist. You might think that Birge believed every Congregational minister had *ipso facto* "acknowledged literary taste," the official criterion for membership. But that is not my theory. I hold that, being of some influence, Birge saw to it that only those *with* literary taste became pastors of his church.

Be that as it may, a warm friendship based on mutual interest and mutual respect grew between Edward Asahel Birge and the present senior member and former president of this club, Alfred Swan, who will speak on his great parishioner.

(Alfred Swan spoke here.)

To compress the near century of the life of Edward Asahel Birge into ten minutes, or to compass the five decades through which he served our University in five pages, would be to achieve an abbreviation that a typewriter cannot effect. First to be foreshortened, therefore, should be the more familiar facts of his life.

Though born in 1851 in Troy, New York, it was by accident of the fact that his father, a Connecticut Yankee, had moved there in the furniture manufacturing business. The young Birge spent many summers on a Connecticut farm. In Troy the family affiliated with a Presbyterian Church, where Edward learned the Westminster Shorter Catechism. But later in Madison he gravitated into his more ancestral Congregational Church, where he was for many years Deacon and Deacon Emeritus. He knew more theology than some of his ministers.

At Williams College, where he studied under John Bascom and Mark Hopkins, he graduated second in his class in 1873. Made a member of Phi Beta Kappa in his junior year, he later became a Life Senator of that organization, and appeared on several of its national program. He did graduate work at Harvard, at first under Louis Agassiz the Elder, where, by the fortuitous discovery of water fleas in a nearby pond, he became interested in *Daphnia* and in the life of fresh water lakes. He ended by becoming the world's leading limnologist. President Bascom brought him to Wisconsin in 1875 as an instructor in botany and zoology in the Academy. The closing of the Academy in 1880 gave the young scientist the chance to take the following year at Leipzig University, although his doctorate was at Harvard.

When Birge came to Wisconsin there were 249 students on the campus. When he retired in 1925 there were 8,142. What he would think of the 39,000 here now, we can only surmise. He served as Dean of the College of Letters and Science 1891-1918, as Acting President 1900-1903, and as President 1918-1925, after which he technically retired. But for another quarter century he pursued his research, wrote papers, and enriched the life of the community and the state. He went to his science office, in what is now appropriately called Birge Hall, to within eight weeks of the end of his life.

The field laboratories of the limnologist extended from Lake Mendota to Trout Lake in Vilas County. During the summers in Vilas County he got no haircut, for two reasons, he said:—to save money, and to find whether there was any relation between long hair and poetry. The muse did not touch him; and when he returned to Madison he paid Mr. Schubert, his barber at the University Club, for two haircuts. Only five feet seven but quick of step, he wore the last Grover Cleveland walrus mustache in these parts, and beneath a white pompadour and bushy brows flashed the sharpest black eyes that ever looked across a dean's desk.

He said he tried usually to vote Democrat, when they didn't spend too much money. He reported that his father thought the slavery issue might have been settled without a civil war. In 1894 he was a charter member of the University Cooperative Book Store. But he was no social reformer, and once said he sometimes feared the rise of the lower classes. He therefore endured, with or without patience, pulpit and platform pressures. If he did not like the sermon, he said he could always read the hymn book. He could read any book almost as rapidly as one would turn the pages. On Sunday afternoons he read the New Testament, in Greek.

It was his special interest to prepare pre-medical students with sound science courses, before they went on to Johns Hopkins Medical School, where his son took his M.D., but died in the flu epidemic of 1918. Upon the loss in the next year of his wife, Anna Grant, the only feminine member of his high school class at Troy to go on to "higher education," their daughter, Anna Grant Birge, left her library position in Chicago to become his official campus hostess. "Nan" Birge, now a nonogenerian at Attic Angels Home, has attended many meetings of this Club, and recalls most of its charter members. With the aid of Governor Emmanuel Philipp, in 1921 Dr. Birge achieved one of the great goals of his career in the establishment of the Medical School and the construction of the University Hospital, now about to be moved to the far west side of the campus.

After World War I, struggles ensued over requests by the Social Science Club to bring Scott Nearing and Eugene Debs to the university. President Birge distinguished between such appearances before clubs and the same speakers addressing the entire campus, which latter, he felt, would be construed by the public as approval of their positions. When in 1922 Upton Sinclair made a special appeal to the Board of Regents to be heard, and was granted permission, he proceeded in a newspaper interview to say, "It is a class struggle and President Birge is on the side of privilege." Whereupon Sociologist E. A. Ross, who had been expected to introduce the visitor, indignantly declined to do so, saying, "I have never experienced from Dr. Birge, as Dean or President, the least pressure to say or not to say, to do or not to do, anything my conscience prompted."

It was inevitable that anti-evolutionist William Jennings Bryan should call evolutionist Birge an "atheist." The attack drew from President Birge a public letter to his then pastor, the Rev. Edward Worcester, indicating that to him science and religion were in different realms, but that to him also religion was not inferior to science. That in the same year Upton Sinclair, whose son was a student at the university, called Dr. Birge a "desiccated biologist," made it possible for the eminent educator to point out, with some glee, that he was being attacked from both sides.

In the election of 1920 Florence Bascom, daughter of John Bascom, and therefore not to be confused with spritely Lelia Bascom, her kinswoman, wrote Birge, "Were you among those that stoned the prophet?" To which he responded, "Nobody stones a prophet. He always stones somebody else's prophet. . . . You must tell me whose prophet has been stoned." To which Miss Bascom returned, "I am sure you know the prophet to whom I alluded, the only prophet now in public life . . . and the more shame if he is not your prophet. The prophet is Wilson, and the stone is a Harding vote." Birge had the last word, "To tell the truth I had supposed the prophet was LaFollette. . . . I am quite ready, however, to accept Wilson as a prophet, all the more because he made such a mess of things as an administrator. That ordinarily goes with the prophetic temperament. I voted for Cox, and you must decide whether that is throwing a stone or a bouquet at the prophet."

If there was acerbity in such repartee, there was notable warmth in his sudden, change in the nature of his last commencement address as President of the University. Robert Marion LaFollette died on June 18, 1925, causing President Birge to begin the address of June 22 with a quotation from Rome of 1900 years before:

"Leaders are but mortal;
the commonwealth is everlasting;
therefore let us resume our wonted duties."

"Fifty years ago," said the President, now himself four-and-seventy, "Robert M. LaFollette and Charles R. Van Hise were here together near the beginning of their college studies, and in that year they were both enrolled in my college classes. Both received their college degrees at the commencement of 1879. Comrades throughout their college days, they remained comrades after graduation. Van Hise followed the academic life. LaFollette entered law and politics. But diversity of occupation did not effect a similar difference in common ideals of life, nor did it interrupt the intimacy of their friendship."

It is a happy fact that Dean George Sellery, in his *Memoir of E. A. Birge*, turned in the section on "The Religious Man" to Prof. Max Otto to provide report on notes taken from Birge's thirteen St. Paul's Day addresses at St. Andrew's Episcopal Church, 1930-1942, that is, between the ages of 79 and 91. Birge said he was drawn to St. Paul because the Apostle was a university man. And warmly did he appreciate Max Otto as essentially a religious man. The studies were scored on 3x5 cards, and are not in manuscript. But remarkable as they are, they do not include the whole perimeter of Dr. Birge's religious outlook.

On September 19, 1949, he talked with his then pastor, who profited thereby, about an experience when he was a Junior at Williams College in 1872. A felon on his left thumb, which permanently disfigured that minor member, forced him home for some weeks recovery. At that time he translated Goethe's *Faust*. In reading the "Prologue in Heaven," where the archangels appear, he said, he had come over him a sense of entering into the knowledge of the reality of God that he had never had before, and which he felt was equivalent to the experience of a new birth. To him it was the admission by the door of literature to an appreciation of ultimate truth. And he remarked that it had not come to him by the door of science, although that was to be his field of action in the years ahead.

Such was the mind and mood of the man who moved through mediaeval scholasticism, through renaissance humanism, and through modern science, without losing touch with any of them. And such was he who gave us 19 papers, from "George Eliot's Novels," November 4, 1878, to "A House Half-Built," November 12, 1936. We cannot retrieve them all, for the George Eliot paper was, with all his early science papers and specimens, lost in the burning of old Science Hall in 1884. The introductory part of "A House Half-Built" is briefly autobiographical, and discusses the relation of scientific to ultimate knowledge. But we would do well to keep in mind his discovery of how fresh-water lakes keep house, by turning themselves upside down each autumn and each spring, as in each case cold water sinks and warm water rises. The homily might induce us to do a bit of house-cleaning in our own files from time to time. This might apply to the 800 papers heard by this club in its First Century, as a considerable portion of them repose in not too orderly array in the archives of the State Historical Society of Wisconsin. But here we confess our debt to our charter member, Edward Asahel Birge, who so eagerly sought and so diligently served the fellowship of this Club.

In 1955 Max Otto said of him, "Dr. Birge is no more gone than the world is gone in which he was active." That world—the house of his ancestral faith, the limnologist's life on the fresh water lakes, the University which he so faithfully and ardently served for fifty years—is nowhere more completely exhibited than in his legacy of papers to the Madison Literary Club. Consider the amazing range of the 19 papers he presented here:

Nov. 4, '78 — George Eliot's Novels.
Mar. 3, '79 — Mandeville's "Travels".
Mar. 1, '80 — Christopher Marlowe.
Apr. 3, '82 — Lamarck.
Oct. 2, '85 — Darwin's Influence on the Thought of the Century.
Apr. 11, '87 — Earthquakes.
Sept. 10, '88 — Life and Death.
Apr. 14, '90 — The Germ Theory of Disease.
June 13, '92 — Science (Sic Granum Sinapis.)
Apr. 8, '95 — Problems of Lake Life.
Oct. 10, '98 — Huxley.
Dec. 12, '04 — Darwin in His Letters.
Jan. 13, '08 — William Morris.
Jan. 9, '11 — Coeli Enarrant (The Heavens Declare).
Dec. 14, '14 — Stevenson — Twenty Years After.
Nov. 10, '19 — In Lucem Gentium (For a Light to the Nations).
Dec. 12, '25 — Lucerna Corporis. (Lamp of the Body.)
Dec. 8, '30 — Lakes.
Nov. 12, '36 — A House Half-Built.

THE TARDY MUSE or VOTIVE VERSES TO THE MADISON LITERARY CLUB

Frederic Cassidy

Toastmaster's Introduction

Today we have had something that physicists call a "chain reaction," and politicians a "domino effect." Such sequences often lead to an explosion. This morning our president was given a manuscript, then it was passed to me, and now the explosion will be read by Mr. Fred Cassidy.

(Frederic Cassidy then read his poem.)

Come, come, my Muse, bestir your laggard feet,
(Iambic, and pentameter most meet)
Refurbish, please, your somewhat rusty wit
To sing in rousing praise of Old Mad Lit!
All hail, Mad Lit (and sometimes snow or rain)
Nothing deters our worship at your fane!

Sing first—or better, *say*, to spare our ears—
Who sought this lively dueling of peers?
Who sought the verbal challenge to fling out,
And tease some bold opponent to a bout?
Who longed to meet on Mondays once a month
With sage and critic—even him who pun'th—
In cordial fellowship of town and gown
Where each can hope to put his fellow down?

Hobbins it was, whose wish to hob and nob
With few "selected" spirits—not the mob—
Called all together on Guy Fawkes's day
A parliament where each could have his say,
With Giles and Anderson and Bascom too
One hundred years ago—a weighty crew,
Of literary taste already known,
To share the fruits of culture with their own.

Can reminiscent Muse resist the urge
To chronicle great names—as those of Birge,
A founding father, loyal to a fault,
And always handy with the Attic salt?
Adams, Van Hise, and Frank, and Turner too,
Historic names; Thwaites, Ely and Evjue;
Uncommon Commons, Vilas, Slichter, Snow,
Vinje and Fairchild, Wilcox—see them go—
Dewey and Olson, Draper—splendid row!

Closer to memory—voices still recalled—
Sellery, Slaughter, Schorger never palled;
No more did Knaplund, Kiekhofer the Wild,
Hagen or Ela. Helen White so mild,
Classic Orsini, geographic Clark,
All struck with the flint of wit and made their spark,
Fire of the mind that shields us from the dark.

The clock approaches eight; we take our seats.
Agog with hope of intellectual treats.
It's on the dot—the chair makes warning sounds—
The eager speaker to the lectern bounds—
Shuffles his papers, mugs the microphone,
And lo! Another meeting's on its own.
Wisdom and anecdote take even turns,
The avid audience chuckles as it learns:
Too soon the allotted time has ticked away—
But have no fear—there's other things to say.
Two commentators vie to share the bed,
And tell the speaker what he should have said.
Enthusiasm grasps them in its power
And fifteen minutes swell to half an hour.
But when the heart is warm and the mind is stirred
Who would be churlish, counting every word?

The meeting's open for discussion now.
Our bright ideas shudder, bend, and bow

As ruthless critics, smiling ear to ear,
Rend them to shreds with crocodilean tear.
The shattered speaker hears but daren't reply.
(His chance to score comes later, by and by!)
His partisans defend him to the death;
Opponents struggle to the final breath.
Nothing can save him from a hopeless doom
Except refreshments in the adjoining room.

Mad Lit! Yes, mad indeed, but kindly mad—
The truth? The truth—most pleasant times I've had,
And disappointments few indeed. Mad Lit,
It's been a pleasure knowing you. You fit
One of my wants—we share—to meet the kind
Of people we're at home with, feed the mind
With interests other than our own—enlarge
The borders of our world—take charge
Of fresh ideas, mark the shadows cast
By wisdom for the future from the past.

My Muse salutes you with no future fears
She vows you'll live another hundred years!

F.G. Cassidy
8 Nov., 1977.

TOASTMASTER'S CLOSING REMARKS

My deep affection for this Club tempts me to speak further but also keeps me from doing so. Rather I quote from the account of the fiftieth anniversary: "In concluding, Mr. Jones expressed the wish that the group gathered to celebrate the hundredth anniversary might have as pleasant an evening." We project these wishes forward.

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