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TRANSACTIONS OF THE WISCONSIN ACADEMY OF SCIENCES, ARTS AND LETTERS

Volume 68, 1980

Editor
FOREST STEARNS

TRANSACTIONS OF THE WISCONSIN ACADEMY

Established 1870
Volume 68, 1980

WISCONSIN ACADEMY OF SCIENCES, ARTS AND LETTERS

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This edition of the TRANSACTIONS
of the Wisconsin Academy of Sciences,
Arts and Letters is dedicated to:

DR. ELIZABETH F. McCOY

(1903-1978)

Dr. Elizabeth F. McCoy served as editor of the TRANSACTIONS of the Wisconsin Academy of Sciences, Arts and Letters from 1973 until the time of her death in March, 1978. She had served the Academy also as Vice President for Sciences in 1972 and as President in 1976. She was accorded the Academy Citation, highest award authorized by the Wisconsin Academy, in 1977 and in that same year was named by the Academy Council as the first Honorary President in the history of the organization.

Dr. McCoy's distinguished record as a professor of bacteriology at the University of Wisconsin-Madison; her many professional accomplishments; her remarkable life as teacher, researcher, environmentalist and benefactor; her reputation as a human being of warmth and wisdom—all have been well described in the pages of our companion journal, the *Wisconsin Academy Review,* and need not be recounted here.

For one who so singularly honored us through such service and friendship, it is difficult to find adequate honors to return. Perhaps, however, none would be more appropriate, nor more appreciated by Dr. McCoy in her modest manner, than the dedication of the 1980 issue of the TRANSACTIONS. Thus, we do so dedicate this volume: to Dr. Elizabeth F. McCoy, whose very life was characterized in part by the diversity and knowledge that are the hallmarks of the TRANSACTIONS and of its publisher, the Wisconsin Academy of Sciences, Arts and Letters.

Thank you, Elizabeth, for everything.

EDITORIAL POLICY

The TRANSACTIONS of the Wisconsin Academy of Sciences, Arts and Letters is an annual publication devoted to original papers, preference being given to the works of Academy members. Sound manuscripts dealing with features of the State of Wisconsin and its people are especially welcome; papers on more general topics are occasionally published. Subject matter experts review each manuscript submitted.

Contributors are asked to submit *two* copies of their manuscripts. Manuscripts should be typed double-spaced on 8½ × 11 inch bond paper. The title of the paper should be centered at the top of the first page. The author's name and brief address should appear below the title. Each page of the manuscript beyond the first should bear the page number and author's name for identification, e g. Brown-2, Brown-3, etc. Identify on a separate page, the author with his institution, if appropriate, or with his personal address to be used in Authors' Addresses at the end of the printed volume.

The style of the text may be that of scholarly writing in the field of the author. To expedite editing and minimize printing costs, the Editor suggests that the general form of the current volume of TRANSACTIONS be examined and followed whenever possible. For Science papers, an *abstract* is requested. Documentary *notations* may be useful, especially for the Arts and Letters papers, and should be numbered for identification in the text. Such *notations* as a group, should be separate from the text pages and may occupy one or more pages as needed. *Literature Cited* should be listed alphabetically at the end of the manuscript unless included in *notations.* The style of the references will be standardized as in the current volume to promote accuracy and reduce printing costs.

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Printing is expensive. Each paper will be subject to a per page charge to the author, the rate being determined yearly. When a paper is accepted, authors without departmental or grant funds for publication should request that the Director of the Academy (at the Academy address) waive page charges. Galley proofs and edited manuscript copy will be forwarded to the authors for proof reading prior to publication; both must be returned to the editor within one week. Reprints should be ordered when proof is returned; forms and instructions will be sent to the authors. Each author will receive one complimentary copy of the volume of Transactions in which his work appears.

Papers received on or before November 30 will be considered for the next annual volume. Manuscripts should be sent to:

PHILIP AND KATHRYN WHITFORD Co-Editors: TRANSACTIONS
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The editor wishes to express appreciation to the incoming editors, Philip and Kathryn Whitford, for their assistance in completing this volume. The work of many colleagues as reviewers and consultants is gratefully acknowledged. The editor appreciates also the patience that authors involved in this volume have shown with the editorial process.

FOREST STEARNS
Editor: TRANSACTIONS
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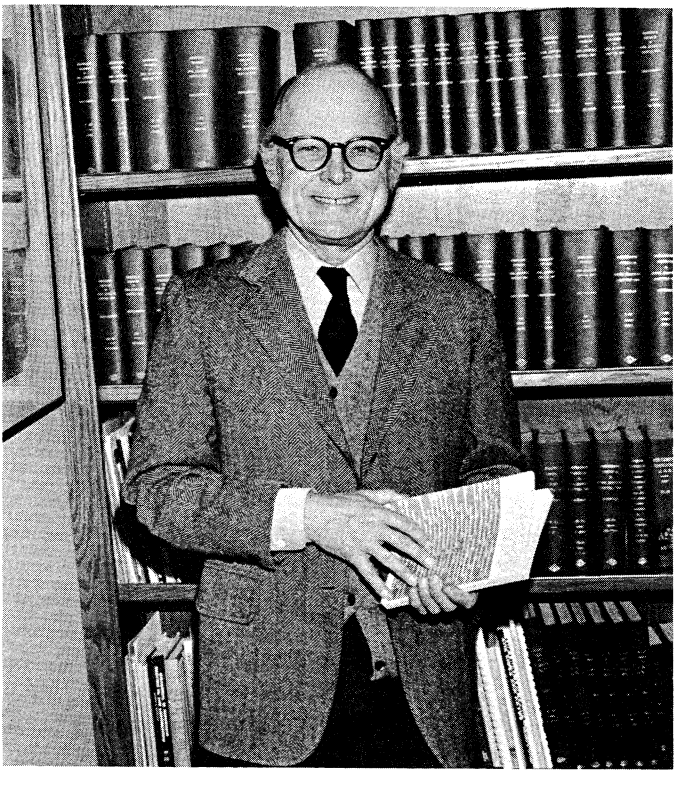

THOMPSON WEBB

58th President 1980

WISCONSIN ACADEMY OF SCIENCE,
ARTS AND LETTERS

PRESIDENT'S REMARKS

THOMPSON WEBB

April 1980

The twelve months since the annual meeting in Kenosha have been a difficult and painful period for the Academy. The officers have spent much time considering financial matters and adjusting Academy affairs to the dimensions of the Academy's reduced income. The McCoy Trust may or may not be irretrievably lost, but the income from that source on which the Academy had come to depend has dried up and will certainly not be available in the near future, if ever again. My distinguished predecessor bore the full impact of the unexpected termination of this revenue. President McCabe, Executive Director Batt, and members of the Council serving in that distressing time deserve the gratitude of all of us for the time and dedication that they gave to Academy affairs in making the transition to present fiscal circumstances as gracefully as they did.

That is now behind us. We can wish for return of the McCoy Trust; but, meanwhile, we have to live within present means. Squeezing Academy programs into a reduced budget in inflationary times has been no small task, a heavy burden especially on our Executive Director; but somehow here we are, one quarter into the current year with the prospects of a balanced budget and, so far, no major activity suspended. The Academy is not without resources. If they are used carefully and if realistic expectations for gifts materialize, no invasion of the endowment will be required this year. The Academy's transition to more straightened circumstances has been a process that has absorbed the full attention of both elected and staff officers for more than a year. It is time now that attention be returned to program.

It is regrettable that the staff has been reduced by one full position, which puts a greater burden on remaining personnel. The Academy is more dependent than at any time in recent years on grants from donors and on the dues of membership, and generating revenue of these kinds will inevitably take up increasing amounts of staff time. Nevertheless, the Academy must turn attention back to its program. The Executive Director and the elected officers must now consider the goals of the Academy, as defined in charter and by-laws and as eloquently expanded from time to time in our publications and committee reports. What is needed, and I consider this imperative, is a plan of action. The objectives of the Academy need no further statement; we know what they are. With the brush fires of recent months beaten back, what is urgently called for at this time is a concrete program based on a clear set of priorities, a program that identifies a short list of specific steps that are to be the Academy's principal concern through the short-term future.

A year or more ago, President McCabe set in motion important steps which, in time, may result in legislative support to supplement income from endowment, dues, gifts, and grants. Our Executive Director is actively and successfully engaged in soliciting donations, and he promises further efforts toward attracting additional members. On such activity the Academy depends; but we face what is almost a "hen-and-egg" problem. Funds are needed to support programs; but my feeling is that programs are needed to attract funds. When the Academy goes to the legislature for an appropriation, the question is what does the Academy do that deserves taxpayer's money? When foundation, commercial, and

business executives are approached, they want to see persuasive evidence of accomplishment. Surely the prospective new member wants to know how the Academy contributes to specific interests of his in order to be entitled to his support. To all these it is helpful but not wholly sufficient to point to *Transactions,* to the *Review,* to the Youth Program, and to other Academy work, though the questioners may respect those activities as we do. The Academy's major responsibility after *Transactions* is to facilitate studies and investigations, as we all know; but few funds are likely to be attracted on the basis of potential alone. This is a what-have-you-done-for-me lately matter. Initiative will have to come from the Academy. It should turn its attention as actively as present resources permit to the search for projects and programs of the kinds defined in our charter and to attracting funds to implement such activity. An outgoing schedule of that sort is an effective answer to questions from legislators, from foundations, and from prospective new members.

The Academy was established as a service agency. It has provided distinguished service for more than a century and is respected for its accomplishments and what it is continuing to accomplish, but laurels are not enough. The Academy must continue to look for jobs that need doing. The respect that it enjoys depends on its own ability to find significant ways of serving Wisconsin and our fellow citizens. I intend to make it my objective in my term of office, which continues through 1980, to consult closely with the Executive Director on the program of the Academy and the search for ways in which the Academy can contribute as in the past to the state and its people.

This brings me to a related, and final, point: consideration of the length of terms of elected officers. One year is simply not enough time for a president to become fully acquainted with Academy affairs, to develop a mature response to them, and to see any resulting program even well begun. He, and perhaps other officers, need longer terms in order to be effective and to contribute significantly to the direction of the Academy. I have therefore appointed a by-laws committee to review several constitutional questions, including lengths of terms. My predecessor, Robert McCabe, has agreed to serve as chairman of that committee and to report to us at the annual meeting next year in Madison with recommendations on this important issue.

As you see, complaining of the brevity of my term, I am obviously saying that my association with the Academy as its president seems too short. It is a pleasure to have a part in Academy affairs at an interesting if not always happy time. In 1981, I will pass my responsibilities to my distinguished successor, Professor Reid A. Bryson, confident that the Academy will be in competent hands and with gratitude to all of you for this opportunity to serve an organization that has contributed so much to the intellectual and cultural community that we share.

WISCONSIN ACADEMY AWARDS—1980

Wisconsin Academy of Sciences, Arts and Letters—Honorary Membership

Each year the Academy elects to honorary membership, residents of Wisconsin who have brought unusual recognition and honor to our state by achieving great distinction. At this time, the Academy extends honorary membership to three of our fellow citizens, Robert H. Burris, Joseph O. Hirschfelder and Verner E. Suomi. To each of them, the President of the United States gave the National Medal of Science, this country's highest award for scientific achievement.

Joseph O. Hirschfelder, Homer Adkins professor of theoretical chemistry at the University of Wisconsin-Madison, is credited with being the first scientist to predict that nuclear explosions would produce radiation fallout. Most of his research has been conducted in molecular quantum mechanics, theory of liquids, transport properties of gases, and flames and detonations. Joseph Hirschfelder is a fellow of the American Association of Arts and Science and holds the Debye Award of the American Chemical Society for his achievements in theoretical and physical chemistry, as well as the Sir Alfred Egerton Gold Medal of the International Combustion Society for his development of the theory of flames and detonations. The National Medal of Science was presented to him in 1976 for his fundamental contributions to atomic and molecular quantum mechanics. In presenting him an honorary doctor of science degree in January, the University of Southern California cited him as a respected and devoted teacher, caring advisor to students, and as one who "pursues with imagination and success the most rigorous and challenging research."

Verner E. Suomi, professor of meteorology, and director of the Space Science and Engineering Center of the University of Wisconsin-Madison, headed the Wisconsin team that developed experiments aboard Explorer VII and the TIROS-TOSS satellites. He invented the spin-scan cameras aboard the ATS-1 and ATS-3 satellites, and directed the design and construction of atmospheric heat-measuring devices on three of the Pioneer Venus probes. He holds the Mesinger Award for aeorological research achievement, the Carl-Gustof Rossby Research Medal, highest award of the Meteorological Society, and the Charles Franklin Brooks Award of the American Meteorological Society, an organization which he has served as president. He was honored recently with the Exceptional Scientific Achievement Medal from the National Aeronautics and Space Administration (NASA) for his role in the Pioneer spaceshot to Venus.

Robert H. Burris, W. H. Peterson Professor of biochemistry at the University of Wisconsin-Madison, is best known for his research on nitrogen fixation. His discoveries hold promise of great practical value for agriculture in Wisconsin and throughout the world. Robert Burris, author of more than 200 technical papers, is a member of the National Academy of Sciences, the American Academy of Arts and Sciences, the American Society of Biological Chemists, the American Chemical Society, and has served as President of the American Society of Plant Physiologists and on the Executive Committee of the Assembly of Life Sciences of the National Research Council. In 1977 he received the Charles Reid Barnes Life Membership Award, presented by the American Society of Plant Physiologists.

Academy Citations

Mark Hoyt Ingraham

Mark Hoyt Ingraham, born in Brooklyn, New York, came to Wisconsin in 1919 with a bachelor's degree in economics from Cornell in order to pursue a masters in mathematics. Since then, in more than sixty years, he has wandered off the reservation only twice, and then briefly—two years for his doctoral degree from the University of Chicago and two years as an assistant professor at Brown University. In 1927, he returned to Madison for good. I used the word advisedly. That is what Mark Ingraham has done for our University, our community, and our state for over half a century.

At 22, he was a captain in the United States Army in France. He has been president of the AAUP. He is a national authority on faculty retirement matters and has served for many years on University, state, and national boards concerned with them. He is the author of six books.

As a professor of mathematics, as Dean of Letters and Science, as counsellor to presidents and chancellors, and to all who consulted him, he has been friend and guide, and a source of wisdom to countless students and colleagues. A pillar of strength on fundamental issues—academic freedom, human rights, the true liberal education as opposed to narrow specialization, and faculty voice in academic affairs—Mark Ingraham has come to embody the liberalism and enlightenment that characterize Wisconsin far beyond the state borders.

With gratitude and respect, the Wisconsin Academy of Sciences, Arts, and Letters acknowledges a profound debt to Mark Hoyt Ingraham, for which this Wisconsin Academy Citation is offered as a token.

Frederick Nelson MacMillin

At the retirement in 1965 of Frederick Nelson MacMillin, the Milwaukee Journal described him as ". . . one of the strongest pillars undergirding the quality and the integrity of both local and state government in the last 35 years."

Born in Dayton, Ohio, educated at Columbia University and the University of Wisconsin, Frederick MacMillan became the first full-time executive secretary of the League of Wisconsin Municipalities in 1929, and he made it an effective voice of Wisconsin cities and villages. He served as president of the American Municipal Association, now known as the National League of Cities. He has been a lecturer in political science at the University of Wisconsin and a frequent contributor of articles to professional journals in the fields of municipal government and public management. In 1943, he formulated and was responsible for the enactment of what is now the Wisconsin Retirement Fund.

Frederick MacMillin was a charter member of the Wisconsin Investment Board, on which he served until after his retirement; and played a key role in making that board a national model. He wrote the constitutions of both the National Association of State Retirement Administrators and of the National Conference of State Social Security Administrators and served the latter as president. Through the Committee on Retirement of the American Municipal Association, he was influential in extending social security coverage to public personnel nationwide and guided through Congress in 1953 the bill that provides social-security coverage to persons under the Wisconsin Retirement Fund. He formulated and administered the group life insurance program as well as the group health insurance program for state personnel.

Frederick Nelson MacMillin has devoted his life to the advancement of the well being of the State of Wisconsin and its citizens. It is, therefore, with pleasure that the Wisconsin Academy of Sciences, Arts and Letters

takes this occasion to bestow upon him this Wisconsin Academy Citation, indicative of the honor in which he is held and the appreciation of his fellow citizens.

Martha Elizabeth Peterson

Martha Elizabeth Peterson, born and educated in Kansas, first became associated in higher education at the University of Kansas as a member of the faculty in mathematics and then as Dean of Women. In the latter capacity, she came to the University of Wisconsin in 1956, where for ten years she administered student affairs, becoming Dean of Students in the evolving University of Wisconsin System. In 1967, she left Wisconsin to spend eight years as President of Barnard College and Dean of Columbia University. Wisconsin, however, was fortunate enough to be able to claim her again in 1975, when she returned to take her present post, President of Beloit College.

She is also a trustee of Notre Dame University, a member of the President's Commission on White House Scholarships, a member of the Rhodes Scholar Committee in Wisconsin, recipient of sixteen honorary degrees, of numerous awards, and a member of an impressive list of major corporate boards.

At the University of Wisconsin, Martha Peterson was largely responsible for the major change in the policy in higher education from treating undergraduates as children to respecting them as adults. In Madison and in New York, she faced the problems of those troubled years with calm integrity, defending academic freedom and standards.

To Martha Elizabeth Peterson, citizen of our state, who has contributed in so many ways to the values that the Academy represents, the Wisconsin Academy of Sciences-Arts, and Letters presents this Wisconsin Academy Citation.

TECHNOLOGICAL ERRORS AND HUMAN DIGNITY— THE PROBLEM OF BIOMEDICAL PROGRESS

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One of the problems of biomedical progress can be summed up in one phrase—the confrontation between errors inherent in technology and the equally inherent dignity of human persons. The tragedy is that the confrontation threatens to resolve itself in a ruthless triumph of biomedical technology which reduces human dignity to nothing. And since biotechnics serves *human* welfare, elimination of humanness by such "successes" of biotechnics amounts to the latter's failure. The triumph of biotechnology is, therefore, precisely its failure; our biomedical progress is caught in a suicidal treadmill.

This paper proposes to attack the problem by (A) taking a close look at the nature of technological errors, in the light of which (B) a new understanding of human nature can be brought about. And from this new understanding (C) a fresh guideline can be derived for biotechnical progress which includes errors.

(A) First, consider the nature of human error. Technology is peculiarly ambiguous when it comes to error. On the one hand, one of the purposes of technics is to accomplish its goal with few, if any, errors. The intention of technical operation is to reduce the margin of error to zero; every error is an occasion for learning how not to repeat it in the future. On the other hand, since in this contingent world technics always partakes of the character of trial and error, error is operationally inherent in technics. Hence, the ambiguity: Technology can neither do with errors (whose elimination is its goal) nor can it do without them. Errors go inescapably with technics, the purpose of which is to eliminate them.

This technological ambiguity becomes serious when technics is medically applied to humans, for one cannot morally afford a single mistake on a human being. The significance of the difference in frequency of errors, usually taken as a distinguishing factor between a therapy and an experiment, is reduced by the equality, in both areas of operation, in the moral cruciality of biomedical errors.

Biomedical error takes on a sinister character when one turns from errors that are expected to those unexpected. There are many errors in biomedicine that at the moment of treatment are not at all apparent. They brood under the so-called experimental or therapeutic "successes." Consider, for instance, the use of Thalidomide by pregnant women. Effective as a tranquilizer, it turned out to be a cause of gross malformation in new-borns. It produced its intended benefit—it was a success—only to cause unforeseen tragic consequences. Genetic "improvement" is another example. We think we have succeeded in eradicating "bad" genes, such as sickle cell genes, only to strip ourselves of protection from malaria. "Bad" genes eliminated mean genetic elasticity reduced, and reduction of genetic variety impoverishes our ability to cope with environmental change. Genetic manipulation executed to meet present conditions sows the seed for future genetic havoc.[1]

Furthermore, not only are biotechnical errors serious (because they are concerned with humans) and sinister (because no one knows which present "successes" will be the cause of future disasters). The very success of biotechnics threatens to break down our idea of humanness. As Kass puts it,

> We are witnessing the erosion, perhaps the final erosion, of the idea of man as something splendid or divine, and its replacement with a view that sees man, no less than nature, as simply more raw material for manipulation.

As a result, we have lost our sense of who we are and where we are going:

> Hence, our peculiar . . . painful irony. our conquest of nature has made us the slave of blind chance. We triumph over nature's unpredictabilities only to subject ourselves to the still greater unpredictability of our capricious wills and our fickle opinions. That we have a method is no proof against our madness. Thus, engineering the engineer as well as the engine, we race our train, we know not where.[2]

This self-defeating predicament of biotechnics culminates the serious and sinister errors of biomedical revolution. When technics in our hands confronts ourselves, it tends to corrode ourselves; the situation is grim and pervasive. One only vainly tries to impose a solution external to the situation. For instance, an effort to stop or reverse scientific-technological progress is both otiose and impossible.

(B) However, it is not without reason that humans are plagued with such biotechnological errors. For it is human nature to change things (including humans themselves) by the use of tools, that is, to be technical. And if technics is error-prone, it is because humans are. Therefore, the solution to the above problem lies in discerning humanness through examining the nature of error itself. Then the ancient wisdom, "To err is human," shall be seen not only to yield fresh insights into human nature, but also to disclose *positive* significance within technological errors themselves.

Advancement in technics is part of human growth in power. And the progress of biotechnics is for an improvement of humanity. And yet, as was noted above, biotechnics is error-prone; the more biotechnics progresses, the more serious the errors it is likely to commit. Thus, the growth in biotechnical power amounts to an increase in the pendulum swing between improving humanity and annihilating it.

What is noteworthy is that the above fact implies more than a counsel of futility and despair. For "the pendulum swings" above is synonymous with the range of freedom. To be free is, among other things, to be prone to error. And to be free to err is to be human. Therefore, the growth in biotechnics is growth in human freedom, accompanied by growth in seriousness of errors which could destroy freedom. In short, thus to be free is to be human; that is, since biotechnics, the power of self-transformation, and its concomitant challenge, errors, are both typical of being human, to describe biotechnics and its threats (errors) is to describe humanness. And so, paradoxically, the growth in seriousness in errors testifies to the growth in humanness.

Moreover, a recognition of error is implied in its commission and its judgment. If to err is human, it is also human to *know* its commission. This is indicated in the human cries of warning, even of woes, such as Kass's mentioned above. But to warn oneself is to arm oneself. Cries of woes of biotechnics testify to an initiation of human self-rectification. Thus to cry out in warning is to grow in the capability to detect and to control what would, if unchecked, destroy humanness.

In short, to be human, to be technical, to be error-prone, and to be able to recognize error, are all mutually co-implicative. And it is this co-implication that is typical of humanness, and it is this humanness that will in the final analysis save humanity from self-annihilation. By recognizing error, human beings move toward the truth.

It is crucial to note how the above positive conclusion was derived from the seemingly negative notions such as "errors" and "cries of warning" thereof, both of which

were discerned to contain rays of hope. It is imperative to demonstrate that such reasoning is anything but arbitrary. In fact, the route to positive implications of humanness from the human proclivity to error is a well-trodden road in philosophy. It suffices here briefly to take note of three philosophers: R. Descartes, J. Royce and P. Ricoeur.

To Rene Descartes it is indubitable that "I" know I am imperfect, capable of "the infinitude of errors." The problem is how this knowledge is possible. I both must know that perfection exists, in the light of which I recognize my imperfection, and must not be perfection myself, before I can avow my imperfection, which is characterized by my errors. I must therefore be "something intermediate between God and naught." Thus is paved a Cartesian route from my imperfection (capability to err) to perfection, whose intimation I possess, and whose imperfect copy I am.

Josiah Royce discovered the condition for the definite possibility of error. There must be the All-Enfolder, the universal Thought, of which all judgments, true or false, are but fragments. It is a relational Whole, a Unity in which error is erroneous and truth true. Since to every truth there are opposed an infinite number of errors, and since those errors are real, such all-inclusive Thought must be infinite and real.

For Paul Ricoeur man is a "disproportion," (a) a noncoincidence with himself, (b) an internal polarity of the finite and the infinite, and (c) an act of intermediation between those two poles. Such an internal rift is responsible for man's fallibility, for man is capable of evil only because of that from which he falls, de-viates. Evil is to be understood by freedom, and freedom, by evil. Freedom recognizes evil as evil, and is responsible for it; evil, in turn, is an occasion for a deeper understanding of freedom.[3]

The three philosophers are at one in pointing to the possibility of error and its recognition that discloses the overall rubric of our intuition of the universal all-Enfolder, the Perfection. The significance of human life lies in this disproportionate intermediation between the finite and the infinite. Biomedical progress is one manifestation of such human life.

Now if the above analysis of the human capacity to err is tenable, our worries about the unpredictable future provide clues to what it means to be human. Our worries exhibit the following features about ourselves: 1) our tremendous growth in biocapability, 2) our capacity to remake ourselves, which in turn implies 3) our inchoateness, in its twofold meaning of imperfection and incipiency, and hence 4) our malleability, our openness to all possibilities. Besides, so long as we worry, we have 5) an intuition (albeit an imperfect one) of some perfection by which we measure our shortcomings.

Drawing on the works of biologist A. Portmann, anthropologist M. Landmann, and child psychologist S. Fraiberg, among others, Jack Bemporad said that the biological make-up of humans, in contrast to that of animals, is essentially incomplete, unspecified and open-ended. Hence the historical nature of man. Man *is* self-making. He is the artist of himself, open to the future by his decisions and his design of self-transformation.

Similarly, agreeing with physiologist and animal psychologist F. J. J. Buytendijk, Marjorie Grene said that only we humans have the freedom of self-determination in our handling of situations. In other words, only for man are things equivocal; only for man can an object take on several aspects and carry a multiplicity of possible uses. We have an open situation, because we are open, transcending our immediate milieu and needs. Thus we have an equivocal relation to our world in a variety of ways.[4]

In sum, the scholars agree on one point: Man is self-changing, as a consequence of his essential incompleteness and openness to the future. Biotechnical error is but one manifestation of such self-change. Since man

is open to alternative visions he sees things *differently* at different times. These differences create dissatisfaction with the status quo, and, hence, biotechnical transformation of man himself. These differences are also the basis for judging some biotechnical consequences to be errors. Thus man by his capacity to change himself is the source of his biomedical progress and its concomitant errors.

(C) What guidelines for biotechnics can be drawn from humanness disclosed in technological errors? How does human self-creation differ from self-manipulation that degrades his dignity? In order to answer these questions, one must return to examine human nature.

As stated above, man is open, unspecialized, and can/does plan and execute self-renewal. This means that man is not material to be manipulated but the principle and the process of self-transformation. Life is nothing else than "to live," and to live is to spend and to change, which includes the choice of a direction in which to change. The seeming constant "life" is really a performative. Man *is* self-change, not a substance.

From this humanness can be drawn two guidelines: Human self-transformation ought to be a continuous self-*transformation* (not self-destruction), and such transformation ought to be a *self*-transformation (not self-alienation).

(1) Teleologically speaking, human self-*transformation* must be such that it facilitates further transformation. Since man's nature is self-change, any change that results in a stunting of further change is self-defeating, a destruction of human dignity; and therefore it is unethical. Disease is stunting; so is any irresponsible behavior that brings about disease.

One's duty to oneself, then, is to promote further changes, and conversely, to prevent a future stoppage of self-change. Brainwashing, genetic designing of man for *specific* purposes (the breeding of legless, prehensile and muscular dwarfs for space travel), creating cyborgs, are all unethical. For though the victims' biological functionings continue, such genetic manipulation kills the human potentials for self-change, narrowing the range of future choices.

(2) Ontologically speaking, human transformation is good when it is *self*-transformation, not only of the self but for the self, if not always by the self. Parents raise their children, not primarily for parental satisfaction but for the sake of the children themselves. Analogously, physicians serve as agents for the health of their clients.

By contrast, a manipulation of material occurs when a person is the subject of purposes he has not endorsed. Again, brain washing, genetic designing of men for specific purposes, even babies produced in hatcheries, are all unethical manipulations because they are executed for purposes alien to the victims. Any agent of change in another person has done evil if he acts without the person's informed consent.

Similarly a person acting for himself indulges in irresponsible self-manipulation when he disregards his own inner nisus. He alienates himself from himself in his self-manipulation for purposes other than his own self-fulfillment. Such actions are no less than frivolity or fanaticism.

Man's action upon himself, however, is a legitimate self-assertion and -creation when the act fulfills his decision for himself, that is, expresses his responsibility for himself. A deliberate decision to incorporate into oneself a mechanical device (either for therapeutic or for eugenic purposes) is ethical when the decision is made self-responsibly. Such decisions include the use of biomedical devices such as the heart pacer, the kidney machine, the mechanical limbs, of many sorts. Thus, ethical judgment depends upon whether the change effected was meant for self-integration or -alienation, self-furtherance or -destruction.

So far some positive implications of technological error have been explored. One

cannot, however, brush aside the negativity of error, which is, after all, what is meant by error; it is something to be averted, though due to our human nature, we can not completely avert it. Our biotechnical self-transformation intended for self-integration and -furtherance may turn out to be a disaster. We cannot morally afford to commit biomedical errors, yet we cannot avoid them entirely.

In this context, it is important to remember that risks are inherent in the human freedom of self-transformation. Such freedom should include the freedom to learn from misfortune. Errors committed unintentionally, once fully studied, can become important knowledge by which humanity can guide itself in a safer and more reasonable manner. Those misfortunes are now rendered significant. Thalidomide victims will, if they allow their case histories to be studied, have reasons to feel proud that their lives spent (and what life is not spent?) in unforeseen miseries are at least partially "redeemed" in human dignity.

There is, however, a world of difference in significance (if not in frequency) between the above *retrospective* exploration of biomedical errors committed unintentionally and intentional experiments on human miseries.[5] Retrospective investigation is a conscientious redemptive act in the face of inevitable occasional errors. Experimentation is, by contrast, an unethical utilization of humans as guinea pigs, by purposely inducing biomedical disasters so as to observe their process and extent, usually without the victims' prior informed consent.

In the final analysis, biomedical experience is a ruthless exploration into what maximum humanness can mean, in all its physio-psychological aspects. The exploration is ethically fruitful so far as it is faithful to whatever has been disclosed as genuinely *human*. It is fidelity to the importance of being human that keeps biomedical exploration on the right track. As soon as biotechnics abstracts the human body from humanness, the purpose of biotechnics is thwarted and human dignity violated. By contrast, humanness is preserved and enhanced when human values are respected in all the stages of biomedical progress.

Even human errors can contribute to human dignity since the freedom to risk error in conscious planning for the future is a uniquely human characteristic.

Notes

[1] Nature has a convenient remedy called genetic mutation. Yet to rely on natural mutation for our genetic salvation is to admit the futility of our genetic maneuver. Moreover, it is self-defeating to rely for our remedy on something natural (which has been with us without our genetic endeavors), that cancels the fruits of our labor. There is something strange about safe-guarding our deliberate and systematic efforts by natural randomness which nullifies them.

[2] Leon Kass, "The New Biology: What Price Relieving Man's Estate?", in *Science,* Vol. 174 (19 November, 1971), pp. 785f.

[3] Rene Descartes, "Meditations on First Philosophy," meditations 3 and 4; I consulted Norman Kemp Smith, *Descartes' Philosophical Writings,* The Modern Library, Random House, 1958, etc., pp. 193ff.

Josiah Royce, *The Religious Aspect of Philosophy* (1885), Harper Torchbook 1958, pp. 384ff. (reprinted in *Josiah Royce: Basic Writings,* Vol. 1, University of Chicago Press, 1969, pp. 321ff.) *The World and the Individual,* Vols. 1 and 2 (1899), Dover, 1959, is his later expansion of this seminal idea.

Paul Ricoeur, *Freedom and Nature,* Northwestern University Press, 1966; *Fallible Man,* Henry Regnery, 1965; *The Symbolism of Evil,* Beacon Press, 1967.

[4] Jack Bemporad, "From Biology to Spirit: The Artistry of Human Life," in *The Journal of Medicine and Philosophy,* June, 1978, pp. 74ff.

Marjorie Grene, *The Knower and the Known,* Basic Books, 1966, pp. 172f.

[5] Such as the ghastly Tuskegee syphilis study in Alabama in 1930 on black farmers. For this experiment and for others similar to it, see Richard M. Restak, *Premeditated Man,* Penguin Books, 1973, etc., pp. 111ff., 119ff.

THE GRIGNON HOTEL AT BUTTE DES MORTS, WISCONSIN: AN ESSAY IN HISTORIC PRESERVATION[a]

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One of the older buildings in Winnebago County, Wisconsin, the hotel constructed by Augustin Grignon at the village of Butte des Morts is an attractive subject for an essay in historic interpretation. The builder was a person representing the French presence in historic Wisconsin at its best. Born at Green Bay in 1780, Grignon was a grandson of the colorful Charles Langlade and a subject of the British Empire. As an adult, he occupied a prominent branch on "the wide-spreading tree of the Grignons"; and after the United States barred outsiders from its Indian trade, he abjured "all allegiance . . . to every foreign prince . . . particularly to the king of the United Kingdoms of Great Britain & Ireland . . ." to become an American citizen on July 27, 1820.[1] Recognizing Grignon's grasp of early times in Wisconsin, Lyman C. Draper believed that an interview which he obtained from "The Capt." in 1857 would be regarded by future historians as "the most valuable individual narrative ever contributed to the State Historical Society of Wisconsin."[2]

When he died in 1860, Grignon left a legacy of interests in a variety of far-ranging pursuits. He had been an entrepreneur in the Indian trade of Wisconsin. He had pioneered at farming in the Lower Fox River Valley. He had acquired widespread holdings in land. And he had been a community founder and promoter. In that role, he had striven to enlarge the importance of Butte des Morts which he platted in 1848.[3] The hotel he built there not only figured in the development of the village, but also was a potential means of keeping Grignon afloat financially as settlers from outside Wisconsin shouldered their way into the affairs of the region.

Built in the simple Greek revival architectural style popular in America between 1830 and 1850, the Grignon Hotel stands at its original location on the southeast corner of the intersection where Main and Washington streets meet in Butte des Morts. Once, the hotel looked southward over a broad marsh through which flowed the Upper Fox River and across which passed the trail from Portage to Green Bay. After the damming of the Lower Fox, however, the waters of Big Lake Butte des Morts rose, so that today a mere city block separates the hotel from the north shoreline of the lake.[4]

Although the Grignon Hotel has endured more than 130 years of weather and wind, its original appearance is largely unaltered. Admittedly, the building has suffered wear and tear, and it has undergone both interior and exterior changes. For example, a central staircase which extended upward to the second floor from a point facing the main entry on the first floor has been replaced by narrow steps ascending along the interior of the front wall. At the rear of the hotel, an outside stairway built to allow guests independent access to the second floor sleeping rooms has disappeared and with it, an entry door at the top of the stairs. Some items of hardware remain as do window panes which may be the original ones as they are of poor quality glass badly marred by cords and

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[a] Published with the permission of the Winnebago County Archeological and Historical Society. For certain suggestions concerning subject matter, the writer is indebted to Mrs. Lynn Webster and Mr. Dean Sandeman of Oshkosh, Wisconsin.

seeds. Other original features of the interior construction are the door-like shutters covering the windows. (One writer has claimed that these devices shut off light from the rooms and thereby dampened the urge of a red man to put an arrow through a lighted window.) A bar—or counter—also remains which reputedly served a first-floor tavern. On the second floor, there are chimneys for stoves used to heat the rooms during the chill of Wisconsin winters. A large third-floor room whose precise purpose has been the topic of some speculation appears to have experienced little, if any, alteration. A door between the stairs from the second to the third floor contains a peep-hole which can be opened and closed by a small shutter. On the east side of the building there is an attached apartment presumably intended as living quarters for the hotel manager; but none of the detached structures which once served the establishment and its guests remain.[5]

Whatever the condition of the Grignon Hotel at the time of this writing, in the day when it was constructed the building stood in surroundings that could only have pleased the eye. An early picture demonstrating that condition, is a sketch of the Grand Butte des Morts with its "bold shores" drawn by Captain Henry Whiting in 1819. Marching with the Fifth Regiment from Fort Howard to Prairie du Chien when he captured the view, Whiting estimated that "about ten lodges" of Menominees dotted the bluff where one day Augustin Grignon would build his hotel. But in Whiting's time, the Butte served the red men either by affording the living a place to camp, or by furnishing the dead a place to sleep through the ages.[6]

A year before Whiting sketched the site of the future village, Augustin Grignon and Jacques Porlier had built a trading post where a stream now called Daggett's Creek emptied—in the words of Porlier's son Louis—into the "upper end of Lake Butte des Morts, two miles below the present village of that name." According to Louis Porlier, Grignon brought his family to that post in 1840. Porlier's word has the ring of authority; in 1840, he became Grignon's business manager, and in 1841, he married Grignon's daughter, Sophia.[7] Writing in observation of America's Centennial, reporter Reuben Gold Thwaites of the *Oshkosh City Times* also fixed 1840 as the year marking Grignon's permanent residence in the Butte des Morts neighborhood.[8] And, in 1839 a surveyor of the area not only referred in his field notes to Grignon's house and improvements, but also mapped farm land belonging to Grignon.[9] The 1840 federal census was the first to show Grignon to be living in Winnebago County. At that time, the sixty-year-old Grignon headed a household of four females and seven males.[10]

Having established his family on the soil of Winnebago County and having improved his land, Grignon seems to have anticipated a busy life as a farmer. In November, 1842, he contracted with one Thomas Evans to have a new barn built. The agreement called for the barn to be finished by July 31, 1843; the building was to measure 30′ by 50′, and it was to be of pine lumber. The contract stipulated, too, that Grignon was to pay Evans $450 of which $300 was to be due at the "Monomonee" [*sic*] payment in the fall of 1843; should that source not allow Grignon sufficient funds to settle in full, the balance was to be paid in livestock at the going cash price.[11] Completing the circle in 1876, Reuben Gold Thwaites wrote that in the winter of 1842 Evans "worked up his crops at the Stockbridge mill"; then, from what appears to be an omission in newsprint, Thwaites went on to remark, "and used most of the boards in building a barn for Augustin Grignon."[12]

Although Grignon had settled down to follow a rustic existence which—according to the census of 1860—depended on twenty-two acres of improved land and fifty acres that were not,[13] in 1840 he made two entries

of land which are of especial concern to this discussion. One parcel lay in Section 30, Township 19, North, Range 16 East in the Green Bay Land District. It was the site of Grignon's farm home until his death. When the federal government opened former Menominee lands lying north and west of the Fox River for sale in 1840, Grignon entered another 205.50 acres in Section 24, Township 19 North, Range 15 East. It was on this land that Grignon platted the village of Butte des Morts where stands the hotel, which he built on lots one and two in block twelve of the young settlement.[14]

Being in his late sixties did not deter Augustin Grignon from promoting the fortunes of Butte des Morts. It has long been reported that Grignon tried to have the county seat of Winnebago County, which had been created in 1840, located there permanently. As an inducement, in December, 1845, he deeded to the County a plot containing 90,000 square feet of land—about 2¼ acres—for a courthouse site, even though the village was not to be platted until 1848. The County accepted the gift and obligation; but there is a curiosity about it as the deed—and related documents to follow—located the parcel in Section 24, Township 19 North, Range 16 East.[15] In other words, Grignon's proposed courthouse location lay six miles due east from the spot where it might be needed. But no matter, the business of the County came to be conducted at Oshkosh despite the fact that Grignon had donated a site for the county courthouse and that Butte des Morts had been selected as the county seat in 1845.[16] To the Oshkoshites, it was fitting that county affairs be so handled; to Augustin Grignon it was another matter. In 1849 he served public notice in the *Oshkosh True Democrat* of his intention to seek legislative approval for the purpose of locating the county seat permanently at Butte des Morts. Moreover, he intended to request the lawmakers at Madison to approve either his establishing a ferry or building a bridge across the Fox, and he wanted their approval for him to construct a plank road to a ridge of timber near the farmstead of his nephew Robert.[17]

Butte des Morts possessed some points favoring its becoming the seat of justice in Winnebago County. One was its position on the historic trail between Portage and Green Bay. Another, making its selection "eminently proper," was its central location in Winnebago County.[18] In response to Grignon's plans, the *Oshkosh True Democrat* noted that the rapidly growing village of Oshkosh was really the business center of the County; besides, the Indian country north and west of the Fox and the Wolf Rivers was not yet settled. In addition, Oshkosh was to be the location of a new jail costing $500 to which sum the Oshkoshites were to contribute $200. To the *Democrat,* it seemed hardly fair to have the taxpayers of Oshkosh pay so much toward the construction of the jail only to have the county seat moved to Butte des Morts.[19]

Despite the contentions of the *Democrat,* the legislative wheels began to turn. That Grignon's hope to move the county seat enjoyed strong support can be substantiated by the fact that one petition sympathetic to the change went to Madison with 800 signatures.[20] Next, on January 30, 1850, the lower house of the legislature received a bill having the purpose of authorizing the electors of the County "to vote on the removal of the County Seat." The first version of the bill provided for an election to be held in November, 1850, plus a fifty-dollar fine for anyone who offered, gave, or promised to any elector either money or property in return for voting "for or against such removal." The same penalty was applicable to a voter who yielded to such temptation. A substitute bill provided that the citizens were to make their choice at the yearly meeting of their towns on the first Tuesday of April, 1850; it dropped the clause concerning the fine of fifty dollars. The substitute bill re-

ceived legislative approval, and on February 9, 1850, Governor Dewey signed it into law.[21]

Although Butte des Morts had some points in its favor for becoming the County seat, that does not mean that Oshkosh was without advantages for the electorate to consider. Oshkosh was on the main line of communication between Milwaukee and Green Bay; indeed, the *Democrat* was soon to proclaim that the telegraph was coming to Oshkosh. In addition, Oshkosh was where the people were; the census of 1850 showed that it outnumbered Butte des Morts by a ratio of fourteen to one.[22] It was hardly surprising, therefore, that when the voters cast their ballots they favored Oshkosh by a comfortable margin.[23] In December, 1852, the Winnebago County Board returned to Grignon his gift of land for a county courthouse.[24]

Thus it was that Augustin Grignon's hope to give Butte des Morts a brighter then ordinary place in the sun suffered eclipse. But the grandson of Charles Langlade was no quitter. In 1853, he organized a company to build a plank road to run from Butte des Morts to Ripon, and besides, platted an addition to Butte des Morts lying on the north side of the town.[25] Had the county seat been located in Butte des Morts, his hotel would have looked out on the courthouse square and doubtlessly would have given its owner a position of prestige as well as profit.

Meanwhile, in 1849 the United States government had taken a step related to Grignon's building the hotel. On June 15 of that year, it established a post office at Butte des

Fig. 1. Line drawing of the Grignon Hotel at Butte des Morts. Artist, C. F. Norris, Oshkosh, Wisconsin. Courtesy of the Winnebago County Archeological and Historical Society.

With deep regret the writer reports the death of Charles F. Norris on November 19, 1981. He was a man of great talent devoted to serving others.

Morts with Grignon as postmaster. The new post office was a "special" office; that is, it received mail only once a week because Butte des Morts did not lie on a direct mail route.[26] Moreover, by terms of the law in effect, the income from the postmastership could have been only modest as the compensation of the postmasters was geared to the postage on pieces of mail handled.[27] Hence, Grignon soon relinquished the position. Grignon's successor was Finley F. Hamilton, a man of affairs both at Butte des Morts and in the county of Winnebago.[28] *A History of Northern Wisconsin* published in 1881 made the following remark about the time when the hotel went up:

> In 1849, a post office was established and Augustin Grignon appointed Postmaster. The Postmaster, not content with the 'emoluments of his position,' put up a house which he called a hotel. F. F. Hamilton opened a general store in the first frame building erected in the village, which saw the light of day also *during that year.*[29] (Italics mine.)

Although others have suggested various dates for building the hotel, the writer has discovered no evidence so sure as the above statement relative to its construction. Oddly enough, accounts concerning Grignon and early Butte des Morts left by Thwaites, Draper, and Porlier are silent on the subject; nor has diligent search in papers associated with the Grignons discovered a date when the hotel was built. The nomination for enrolling the structure on the National Register of Historic Places stated simply that it was built in 1852, while Harry Ellsworth Cole in his *Stagecoach and Tavern Tales of the Old Northwest* wrote that it "was erected about 1848." On the other hand, the *History* of 1881 not only gave a time for building the hotel but also related it to a contemporary venture in construction. Furthermore, the *History* provided a reason for Grignon's erecting the building in connection with his disappointment over the financial returns from the postmastership at Butte des Morts.[30] The earliest association of the hotel with Grignon's name to come to the writer's attention was in a legal instrument negotiated by Grignon in early January, 1852. The document referred to the building as "Grignon's Tavern."[31]

Louis Porlier and Mrs. Ebenezer Childs (Grignon's daughter Margaret) managed the hotel until 1855 when they leased it to one Thomas B. Petford, a native of England. Petford may have been in the hotel business before 1855 as the census of 1850 gave his occupation as landlord, and showed him as heading a household of ten persons, four of whom were not members of his family.[32] An advertisement appearing over Petford's name in the *Oshkosh Courier* of August 16, 1854, invited the public to attend an "Opening Ball" to be held in the St. Charles Hotel at Butte des Morts. That Petford operated the Grignon establishment during the time indicated can be substantiated by a rent receipt acknowledging that Petford had paid Grignon "fourty [*sic*] three Dollars and Seventy five Cents being in full for the Rent of the Tavern House up to February 16/56."[33]

Evidence suggests that Butte des Morts may have had more hotels—or at least buildings called by that name—than that of Augustin Grignon. While visiting the village in January, 1851, editor Charles D. Robinson of the *Green Bay Advocate* reported stopping at a hotel owned by a man named Bell.[34] Moreover, on August 15 of that year, the *Oshkosh True Democrat* reported that "Mr. Jones, from . . . , New York," was erecting "a very large building" intended to be a hotel. "It is a fine structure," stated the *Democrat,* "and is most conveniently planned." Mr. Jones also had something to say about the "fine structure." In January, 1852, he invited the "young bloods of the county" to visit his cotillion hall where, in parties of twelve, they could dance and dine for a dollar a couple.[35] Just a week before Jones' advertisement appeared, the *Democrat* mentioned a party to be held at Church's Hotel

in the village.[36] Surely, it appears that for a hamlet numbering only 102 souls in 1850, Butte des Morts was performing well in providing overnight facilities for the public.

Whatever the number of hotels at Butte des Morts, a report concerning that of Augustin Grignon alleges that a destructive fire caused it to be rebuilt. But when George Overton, local historian of Butte des Morts, remarked that just before the Civil War "fire completely destroyed the Grignon establishment," he also stated, "Mr. Grignon did not rebuild but put in a stock of goods in a building near his . . . [farm] residence." However, the fire reported to have destroyed the old hotel could not have done so; it is likely that a mercantile concern which Grignon operated "on the east side of Main street, north of Washington street" was the building destroyed.[37] A recent analysis of the soil on which the building stands has shown no indication of any fire.[38] Therefore, it can only be concluded that the report of the hotel's having been reduced to ashes is faulty. The same statement cannot be made, however, of the fact that Grignon rendered his connection with the building somewhat uncertain when, in 1852 he put it in hock and did not redeem it by the time of his death in 1860.

Why did Grignon turn to borrowing in 1852? Did he borrow because of the decline in the local Indian trade after 1848 when the Menominees left the neighborhood around Butte des Morts for the reservation?[39] Was he attempting to raise funds for his plank road plan? Did he wish to defray any unsettled costs related to building the hotel? Had his failure to receive compensation long due him from the Indian trade entangled Grignon in a financial morass from which he could not extricate himself? Or, had time run out for the fur traders of the area?

With regard to the last two questions, there are some observations to be made. According to the terms of the Menominee Treaty of 1836, Grignon had received $10,000 in settlement for credit extended members of that nation; in 1837, however, he received only $1759 under the terms of a treaty applying to credit allowed the Winnebago.[40] Grignon tried to collect more after the settlement as he entered a claim amounting to $20,000 for goods which he had supplied the Winnebago year after year without adequate repayment, according to depositions of old associates in the Indian trade.[41] Describing as "erroneous" the "impression that the old fur traders waxed very rich," Louis Porlier once pictured the "universal credit" they granted the red men as being most uncertain because the system contained numerous risks which could spell disaster to a man in Grignon's position.[42] A document that leaves little doubt as to the hazards of the fur trade by the 1840's is a letter written by Ramsay Crooks of the American Fur Company to John Lawe at Green Bay. Writing on April 3, 1843, that in a bygone day the traders could "provide bountifully and run some risks," Crooks told Lawe:

> The winter has been unusually mild all over Europe, and fears have been entertained that Furs would consequently sell badly this spring. . . . Beaver has fallen about a dollar per pound, compared with the sales 12 months ago. This is caused principally by the introduction into England of the French *silk* Hat, which looks nearly, or quite as well, as those made of Beaver, and unfortunately last almost as long, while they are sold for much less money.[43]

Equally gloomy were Crooks' comments concerning prices being paid for American muskrat skins in Europe as a result of the Hudson's Bay Company's unloading 500,000 rat pelts on the markets there.[44]

Even so, a generation later Reuben Gold Thwaites wrote that "the glory of Butte des Morts" was its annual catch of muskrats.[45] And although the natural habitat of muskrats was destroyed in 1905 when the bog in Lake Butte des Morts began to disintegrate, George Overton claimed that the "sales of

fall rats alone at Butte des Morts totaled more in 1935 than the entire year's business done by Augustin Grignon in 1816 [*sic*]."[46] Ergo, it would seem that in Grignon's day, the fur trade, as then conducted, had become an unreliable source of income: even the American Fur Company—whose papers disclose that on occasion the skins of dogs, groundhogs, and house cats were in the shipments overseas—was forced to suspend payments in 1842.[47]

Whatever Grignon's reasons for turning to the money lenders, on January 14, 1852, he mortgaged the hotel property to one Francis B. Webster of Oshkosh. The sum Grignon obtained was $800; the interest he paid was 12 percent per annum.[48] When the census of 1850 was taken, Webster told the enumerator that he was a liquor dealer by occupation; but when he died in 1860, *The Oshkosh Courier* complimented Webster as having been "a shrewd and successful financial operator."[49] Whether or not the compliment was deserved, Grignon continued to borrow so that by July, 1854, he was obligated for well over six thousand dollars with relatively short due dates.[50] The upshot of it all was that he was unable to clear the slate, and litigation over payments in arrears occurred before he died intestate on October 2, 1860.[51]

Although the census of 1860 showed Grignon to be the owner of real estate worth $20,000 and personal property worth $800,[52] Mrs. Ebenezer Childs stated that her father's finances were largely encumbered. On the ground that Louis Porlier best knew Grignon's business affairs, Mrs. Childs petitioned that he become executor.[53] It followed that in December, 1860, Porlier received the responsibility of settling with the creditors of his late father-in-law.[54] In 1861, the value of all Grignon's worldly goods stood at $15,424.18; and, as Mrs. Childs had stated, her father's debts were nearly as great. But if Augustin Grignon's estate were obligated beyond redemption's cure, the final expenses connected with his journey through life were modest; his funeral costs totaled only $62.00. Forty dollars of that sum went for teams and drivers to Kaukauna and return plus entertaining friends of the family. Burial clothes took five dollars as did the services of a priest. It cost eleven dollars for a coffin and one dollar more to dig a grave.[55]

Pursuing his duty as executor of Grignon's estate, Louis Porlier decided that because of Grignon's heavy indebtedness, all of the property would have to go on the auction block to satisfy his creditors' claims. The courts so ordered on September 16, 1861. Of greatest interest to this discussion, the valuation of the hotel property was fixed at $1,000.[56] A settlement over the hotel did not become final, however, because—among other reasons—a Grignon grandson and heir was serving in the Twenty-First Wisconsin Regiment and so enjoyed immunity from civil actions.[57] But in due course, by sheriff's sale in September, 1866, the hotel went to Gabriel Bouck, an Oshkosh attorney.[58] Bouck retained the tavern property for only a few weeks, and, in November, 1866, sold it for $500 to Louise McCord and Julia Jenney both of whom bore the Grignon name before marriage. Like Gabriel Bouck, Jenney and McCord soon disposed of the hotel. In 1869, they sold it for $450 to Peter C. Peterson, a Norwegian immigrant who arrived at Butte des Morts in the 1850's and had begun to keep a store in the hotel after the expiration of the Petford lease, presumably in 1859.[59] An associate in the venture was Tomms Tonneson, another migrant from Norway. Except for a brief period, 1863-1865, which he spent at Virginia City, Nevada, Peterson kept the store until his death on May 28, 1900.[60]

Like Augustin Grignon, Peter Peterson died intestate. His son Percival became administrator of the estate; in 1901, settlement provided for the real property to go to him and his sister Frances. By land contract, Peterson sold the property to John J. Boe,

aged thirty-one and born in Norway. In 1902, Boe married Peter Peterson's fifty-three-year-old widow Bertha, and in 1911 obtained full ownership of the hotel. Boe operated the store in it until his death in 1952. Under the terms of Boe's will, the hotel went to his stepdaughter, Mrs. Frances Donkle.[61] In 1953, she sold the hotel to Emma Ann Strauss (now Mrs. George Nevitt of Oshkosh). After operating an antique store in the building for some years, Mrs. Nevitt gave the old Grignon Hotel to the Winnebago County Archeological and Historical Society. The structure is presently undergoing extensive restoration.

There is a postscript to the story of Augustin Grignon. Until 1941, he and ten members of his family lay in unmarked graves near Butte des Morts. In that year, under the direction of Arthur Kannenberg, archaeologist of the Oshkosh Public Museum, the bones of all were disinterred preparatory to being placed in a crypt at the Grignon Mansion near Kaukauna, Wisconsin. The transfer did not take place however, with the result that for about twenty years the undertaker to whom the bones were consigned kept them in storage. At long last, on October 12, 1961, the remains were buried in an unmarked plot of the Holy Cross Cemetery at Kaukauna. As an associated curiosity, it was alleged that according to family accounts, Augustin's skeleton was identifiable by a gold Cross and chain suspended from the neck. The tale appears, however, to have been confused with a Cross painted in yellow on the lid of his coffin. Indeed, no artifacts were present with Grignon's remains except a button presumed—because of its location among the bones—to have been from his trousers.[62]

Whatever the changes in the ownership of the Grignon Hotel, this paper has attempted to identify its history with that of Augustin Grignon and his times. True, Grignon owned the hotel for a scant eleven years, but during his ownership economic and social institutions in the Fox River Valley had begun to change rapidly and profoundly. In that era Grignon and his kind were finding it increasingly difficult to accommodate their ways to those of a new breed of Wisconsinites who had little regard for the men who had once bargained over furs with the Indians. In essence, the hotel stands as a testimonial to its builder's efforts to bridge the gap between a way of life that had room for persons like himself and a newer way that did not.

Documentation

[1] Mrs. John H. Kinzie, *Wau-Bun The Early Day in the Northwest* (1948 reprint, Menasha, Wisconsin), p. 48 identifies the Grignon family as stated. For the document assigning American citizenship to Grignon, see State Historical Society of Wisconsin, Division of Archives and Manuscripts, Grignon, Lawe, and Porlier Papers, 1820-1822, LXI, pp. 13 and 14, Territory of Michigan, County Court of Michilimackinac, action of July 27, 1820, taken in accordance with "An Act to establish an uniform rule of naturalization. . . ." Hereafter, materials used from the Archives and Manuscripts Division will be cited as A.M.D., S.H.S.W. See also Reuben Gold Thwaites, editor, *Collections of the Statte Historical Society of Wisconsin* (Madison, 1911), XX, pp. 120-121. Cited subsequently as *Collections*. The law closing American Indian trade to non-citizens is available in Richard Peters, Esq., editor, *The Public Statutes at Large of the United States of America, . . .* (Boston, 1848), III, pp. 332-333. Cited subsequently as *U.S. Statutes.*

[2] *Collections,* III, p. 195; IV, p. 102. Draper's interview with Grignon is in *ibid.*, III, pp. 197-295.

[3] For the plat of Butte des Morts, see County of Winnebago, Oshkosh, Wisconsin, Registrar of Deeds, Plat Book #1, pp. 10-11.

[4] Nomination Form, National Register of Historic Places Inventory, Offices of the National Register of Historic Places, Washington, D.C. Cited subsequently as Nomination, National Register.

[5] Information in this paragraph is derived from *ibid.*: and also Martha Wohlford, "Butte des Morts Has Its Place in History of State," in *Oshkosh Daily Northwestern,* July 1, 1969. Hereafter, the *Oshkosh Daily Northwestern* will be cited as *Northwestern.*

[6] A description of the Grand Butte des Morts is available in Winnebago County Courthouse, Zoning Office, Commission of Public Lands Interior

East Field Notes, CLV, p. 70, Township 19 North, Range 16E, D. Giddings, Assistant Surveyor, June 29, 1839. Cited subsequently as Surveyor's Field Notes. See also Journal of the March of the 5th Regiment in June, 1819, from Green Bay to Prairie du Chien, kept by Captain Henry Whiting, General Services Administration, The National Archives, 1949, microfilm in A.M.D., S.H.S.W. In 1887, Louis B. Porlier indicated that the name Butte des Morts was based on the place being "a higher point of land" than customary in the area and that it was "a principal burying place" for Sacs, Fox, and Menominees. See "Narrative by Louis B. Porlier," in *Collections,* XV, pp. 439-444. In 1857, Augustin Grignon stated that certain burial mounds at the Grand Butte des Morts were "ordinary burial places" not connected with any military contest. See Grignon's "Seventy-two years' Recollections in Wisconsin" in *Collections,* III, p. 293. Concerning the burials at Little Butte des Morts (sometimes confused with the Grand Butte) see an essay entitled "Little Butte des Morts, its former appearance," by Charles V. Donaldson, A.M.D., S.H.S.W. Donaldson wrote in 1905 from memories extending back to 1848 or 1849.

[7] *Collections,* XV, pp. 439 and 445-446. Daggett's Creek was formerly called Overton's Creek. For data concerning Porlier's marriage, I am indebted to John Ebert, Archivist, Catholic Diocese, Green Bay. Porlier and Sophia Grignon were married at St. John's Church, Little Chute, Wisconsin.

[8] Beginning on April 29, 1876, Thwaites contributed to the *Oshkosh City Times* a series of articles on the history of Winnebago County in relation to the Centennial observances. Cited subsequently as Thwaites, *Times.*

[9] Surveyor's Field Notes, 1839, maps and pp. 57 and 68.

[10] United States Census, Manuscript, County of Winnebago, 1840, p. 128. The total population of the county in 1840 was 132; hence, the Augustin Grignon household amounted to 6.6 percent of the tally. Hereafter, all census reports of this class will be cited as U.S. Manuscript Census with the appropriate year.

[11] See A.M.D., S.H.S.W., Contract of Grignon and Evans, November 10, 1842, in Grignon, Lawe, Porlier Papers, B, LXV, p. 49.

[12] Thwaites, *Times,* April 29, 1876.

[13] U.S. Manuscript Census, 1850, Winnebago County, Town of Oshkosh, Agriculture, p. 228c.

[14] Concerning Grignon's land entries, see John L. Homer, Statement of Certification, September 1, 1843, in Grignon, Lawe, Porlier Papers, B, LXV, p. 51. See also the National Archives, National Archives and Records Services, General Services Administration (Washington, 1951), Record Group 49, Records of the General Land Office, Local Tract Books Wisconsin, XLV, pp. 169, 176-177, Certificates 2399 and 2455, in A.M.D., S.H.S.W. Cited subsequently as Local Tract Book. Grignon purchased these lands under terms of an "Act Making Further Provision for the Sale of the Public Lands," approved on April 24, 1820. For precise definition of lots and acreages, the writer has used Joseph H. Osborne, compiler and publisher, Sectional Map of the County of Winnebago, State of Wisconsin (Oshkosh, 1855). Descriptions of land under Certificates 2399 and 2455 are also available on microfilm of Book M, pp. 105-106 and 107, Register of Deeds Office, County of Winnebago. Original documents are in storage with the Winnebago County Highway Commission, Oshkosh, Wisconsin.

[15] Grignon made his offer on July 16, 1845; the County Board approved and ordered the land to be surveyed. See A.M.D., S.H.S.W., Winnebago Small Series 1, Clerk, Board Proceedings, 1843-1847, July 16, 31, and Dec. 2, 1845. The survey was done by S. L. Brooks, county surveyor; it locates the site in "Sec. 24 of Township 19, North of Range 16 East." These documents are in the University of Wisconsin-Oshkosh Area Research Center of the State Historical Society of Wisconsin. Cited subsequently as Clerk, Board Proceedings. See also Augustin Grignon Deed to Winnebago County, Wis., December 8, 1845; in Book A, Deeds, pp. 120-121, in the Office of the Register of Deeds, County of Winnebago. The location of the tract in the deed corresponds with Brooks' Survey.

[16] See Charles D. Goff, "War for the Courthouse," in James J. Metz, editor, *Prairie, Pines, and People, Winnebago County in a New Perspective* (Menasha, 1976), pp. 149-154. Cited subsequently as Goff, "War."

[17] Issue of November 23, 1849. Cited subsequently as *Oshkosh Democrat.*

[18] See "Petition of Burr S. Craft and 800 other citizens of Winnebago Co. asking the legislature to pass an act fixing upon the Village of Butte des Morts as a point to be voted upon by the people of the county in reference to the removal and permanent location of the County Seat of said County" in Secretary of State Election and Records, Petitions 1836—1850-1851, A.M.D., S.H.S.W.

[19] *Oshkosh Democrat,* December 7, 1849.

[20] A.M.D., S.H.S.W., "Petition of Burr S. Craft. . . ."

[21] A.M.D., S.H.S.W., Secretary of State Elections and Records Legislative Bills 1836—Assembly Bills 1849-51 no.194(a) A Bill to authorize the Electors of Winnebago Co. to vote on the removal of the

County Seat cites the action taken in the legislature. For the text of the law authorizing the vote, see *Acts and Resolves passed by the Legislature of Wisconsin* (Madison, 1850), p. 138. Cited subsequently as *Wisconsin Laws* with appropriate date and whether general or private and local.

[22] Issues of August 16 and September 27, 1850. The census enumeration of 1850 was then in process.

[23] On April 10, 1850, the *Milwaukee Sentinel* reported that of 1,111 votes cast, the majority in favor of making Oshkosh the permanent county seat was 279; *The Green Bay Advocate* gave the figure as 253. See also Goff, "War."

[24] *Oshkosh Democrat,* January 30, 1852.

[25] An act to incorporate the plank road company was approved early in 1853. See *Wisconsin Laws, Private and Local,* 1853, pp. 155-160. Grignon already had under construction a plank road across the low lying land before Butte des Morts. See *Oshkosh Democrat,* February 21, 1851. The plat of Grignon's addition of 1853 is available in Winnebago County Plat Book #1, p. 52.

[26] *The Milwaukee Sentinel* reported Grignon's appointment on August 10, 1849. Eli Bowen, *The United States Post Office Guide, . . .* (New York, MDCCCLI), p. 71 defines "special" status. Cited subsequently as Bowen, *Post Office Guide.*

[27] For rules defining salaries of postmasters for the period, see *U.S. Statutes,* LX, pp. 147-148, and 202.

[28] Hamilton built a warehouse and dock at Butte des Morts in 1851; see *Oshkosh Democrat,* June 27, 1851. He also served as county treasurer from 1848 to 1849.

[29] Bowen, *Post Office Guide,* p. 149, lists F. F. Hamilton as postmaster at Butte des Morts in 1851, as does *Table of Post Offices in the United States on the First Day of January, 1851, . . .* (Washington, 1851), p. 36. For Grignon's decision to build the hotel, see *History of Northern Wisconsin . . .* (Chicago, 1881), p. 1191. Cited subsequently as *Northern Wisconsin.*

[30] Nomination, National Register; Harry Ellsworth Cole, *Stagecoach and Tavern Tales of the Old Northwest* (Cleveland, 1930), p. 173. Cole quoted entries from "account books kept by the landlords" during 1854 and 1855 showing that "there must have been lively times at Butte des Morts . . ." (See pp. 234-235). Unfortunately these ledgers could not be located. *Northern Wisconsin,* p. 1191.

[31] County of Winnebago, Mortgages, Book N, pp. 14-15. These records are on microfilm: the originals are in storage with the Winnebago County Highway Commission. Cited subsequently as Winnebago County, Mortgages.

[32] *Northwestern,* August 10, 1936; U.S. Manuscript Census, 1850, Winnebago County, p. 162.

[33] This receipt is in the Harry Ellsworth Cole Papers, A.D.M., S.H.S.W.

[34] *Green Bay Advocate,* January 23, 1851.

[35] *Oshkosh Democrat,* January 23, 1852.

[36] *Ibid.,* January 16, 1852.

[37] *Northwestern,* August 10, 1936.

[38] Statement of Daniel M. Seurer, c. February 1, 1981; and verbal communication from Robert Hruska, Oshkosh Public Museum, March 17, 1981.

[39] For Porlier's remarks concerning the Indian trade after 1848, see *Collections,* XV, p. 447.

[40] Charles J. Kappler, *Indian Affairs Laws and Treaties* (Washington, 1904), II, pp. 466 and 499. See also Louise Phelps Kellogg, "The Menominee Treaty of the Cedars, 1836," *Transactions of the Wisconsin Academy of Sciences, Arts and Letters* (1931), XXVI, pp. 127-135. A.D.M., S.H.S.W., Louise Phelps Kellogg Papers, Notes and Transcriptions re Indian Treaties, 1794-1836; transcriptions and translations re social and military Wisconsin, 1805-1848, Box 48, Winnebago Tribe of Indians to Augustin Grignon, Dr., and Baird to Dear Sir [Augustin Grignon], November 28, 1838. Cited subsequently as Kellogg Papers.

[41] For an example, see Affidavit of Francis Lousignon given with "the assistance of a sworn interpreter" on June 22, 1839, in Grignon, Lawe, Porlier Papers, B, LXV, pp. 5-6.

[42] "Narrative by Louis B. Porlier," *Collections,* XV, pp. 441-442.

[43] Kellogg Papers.

[44] *Ibid.*

[45] Thwaites, *Times,* January 27, 1877.

[46] *Northwestern,* August 10, 1936.

[47] Papers of the American Fur Company, shipment from Detroit Department, November 22, 1838; and Shipments to London 1838 August 30; see also Grace Lee Nute, "The Papers of the American Fur Company: A Brief Estimate of Their Significance," in *The American Historical Review* (New York, 1927), XXXII, p. 538.

[48] Winnebago County, Mortgages, Book N, p. 15, Augustin Grignon Mort. to Franc. B. Webster.

[49] U.S. Manuscript Census, 1850, Winnebago County, p. 63; and *Oshkosh Courier,* January 27, 1860.

[50] In addition to the mortgage for $800 dated January 1, 1852, Grignon borrowed $1025 in February, 1852; see Winnebago County, Mortgages, Book N, p. 17; in July, 1852, he borrowed $2475.68, *ibid.,* pp. 403, 404; in 1854, he borrowed

$2188, Book T, p. 320. The Abstract of Title to the hotel property outlines Grignon's record of borrowing: cited subsequently as Abstract.

[51] See Winnebago County Circuit Court, Judgement Rolls, #1657, September term, 1859.

[52] U.S. Manuscript Census, Winnebago County, 1860, p. 161.

[53] Winnebago County, Probate Court, Documents 36 and 4, Augustin Grignon Estate, on microfilm; the original documents are in the possession of the Harry M. Schmitt Abstract Company of Oshkosh. They include Mrs. Child's petition. Cited subsequently as Grignon Estate Papers. A copy of Mrs. Child's petition is also available in Charles A. Grignon Papers, A.M.D., S.H.S.W. It was addressed by Mrs. Child "To the Honorable R. P. Hodges County Judge of Winnebago County, Wisconsin."

[54] Porlier received his appointment on December 3, 1860. See Abstract, sheet number 5; and Grignon Estate Papers.

[55] Grignon Estate Papers.

[56] *Ibid.*

[57] William Frances Raney, *Wisconsin A Story of Progress* (Appleton, Wisconsin, Perrin Press, 1963), p. 163.

[58] Abstract, sheet number 8.

[59] Abstract, sheet number 11. In 1860, Julia Jennie (Jenne or Jenney) lived with her husband in the home of Louisa Grignon, Town of Winneconne, U.S. Manuscript Census, 1860, p. 375. In 1870, Louisa McCord lived at Winneconne Village, see *ibid.*, 1870, II, p. 382. See also *Northwestern,* August 19, 1936.

[60] U.S. Manuscript Census, 1860, Winnebago County, pp. 362 and 129; *Northern Wisconsin,* p. 1191; *Northwestern,* July 1, 1967.

[61] *Northwestern,* August 10, 1936; See also, Abstract, sheet number 29.

[62] "Bones of Early Trader in Valley Are Removed from Unmarked Grave," in *Northwestern,* October 26, 1940; and "Century Old Bones of Grignon Pioneers Reburied Today," *Appleton Post-Crescent,* October 12, 1961. For a convenient reference to the story of the Cross, see *Northwestern,* October 29, 1940, quoting Arthur Kannenberg. The Oshkosh Public Museum's Report of the Excavations of Augustin Grignon, November 2, 1940, details the disinterment operation and the identification of Grignon's remains.

THE SAPROLITE AT THE PRECAMBRIAN-CAMBRIAN CONTACT, IRVINE PARK, CHIPPEWA FALLS, WISCONSIN

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Abstract

The contact between metamorphosed Precambrian rocks and Cambrian sandstones in west-central Wisconsin is a sharp angular unconformity. Weathering of trondhjemite gneiss during the late Precambrian and possibly early Cambrian developed a saprolite that is exposed at Irvine Park, Chippewa Falls, Wisconsin. The saprolite is mainly kaolinite, quartz and chlorite, its minerology suggests that weathering occurred in a tropical climate that developed in the Wisconsin area as the North American continent drifted southward across the paleoequator in the late Precambrian. Weathered materials from the saprolite became part of the detrital material deposited in the basal unit of the upper Cambrian Mt. Simon Formation.

INTRODUCTION

In the upper Midwest the contact between metamorphosed Precambrian basement rocks and upper Cambrian sandstone is a sharp angular unconformity. The erosional surface at the top of the Precambrian rocks is an irregular surface that truncates the typically steeply-dipping structural grain of the basement. The basal upper Cambrian sedimentary rocks are subhorizontal conglomeratic to fine-grained sandstones and in west-central Wisconsin are the Mt. Simon Formation. Often at the contact is a clay-rich zone for which the time of formation and origin are questioned. This contact is exposed at several localities in west-central Wisconsin including Irvine Park, in southern Chippewa County, Big Falls County Park in north-central Eau Claire County, the Neillsville area in Clark County and south of Ladysmith in Rusk County.

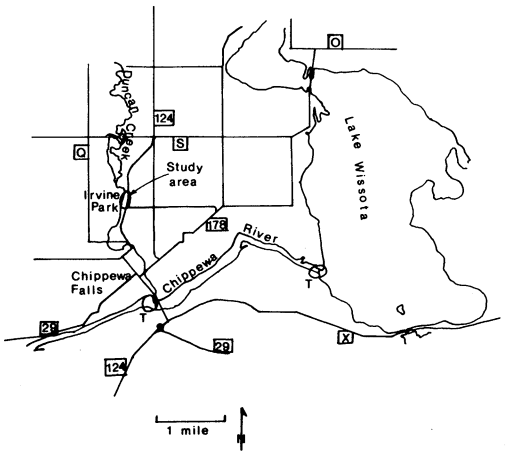

Fig. 1. Map of the Irvine Park study area. T indicates the location of outcrops of trondhjemitic rock at Wissota dam and the dam in Chippewa Falls.

The Precambrian-Cambrian contact and the basal Mt. Simon Formation were studied the Irvine Park (Fig. 1) where they are exposed in the east bank of Duncan Creek. A rock fall during the spring of 1979 provided an excellent unweathered outcrop which instigated this study. The elevations of Precambrian exposures in the immediate area suggest that the Precambrian outcrop at Irvine Park is a topographic high in the basement surface. A zone, at least 2 m and possibly 3.5 m thick, of gray-green, clay-rich material occurs immediately below the contact of the basal Mt. Simon Formation. Ap-

proximately 13 m of sandstone are exposed at the site; the lower 5 m and the Precambrian contact are exposed in an unweathered outcrop.

This study was undertaken to 1) determine the mineralogy of the Precambrian basement and the clay-rich zone, as well as the heavy mineral suite of the lower part of the Mt. Simon Formation; and 2) determine the mode and time of formation of the clay-rich zone.

Previous Work

The Precambrian rocks of west-central Wisconsin are strongly deformed amphibolite gneisses and schists, and quartzo-feldspathic gneisses that have been intruded by granitic to tonalitic intrusives. The time of plutonic emplacement relative to regional deformation and metamorphism during a complicated geologic history is reflected in the textures and structures of the intrusives (Myers, 1976, Cummings and Myers, 1978, Cummings, 1975). The amphibolites are considered Archean while the intrusives are of differing ages. Many were intruded during the Proterozoic I Penokean orogeny, *circa* 1850 m.y. (Van Schmus, 1976, 1980).

The lower Paleozoic Mt. Simon Formation was deposited during the Dresbachian stage (late Cambrian). The formation increases in thickness to the south from 100 feet thick in the Chippewa Falls, Wisconsin, area to approximately 800 feet thick in southern Wisconsin (Asthana, 1969). Outcrops of the Mt. Simon Formation occur for at least 50 miles north of Chippewa Falls (e.g. outcrops at Conrath and Ladysmith, Wisconsin). The northernmost outcrops apparently represent the original northern extent of the formation. However, Asthana (1969), on the basis of lithologic characteristics and mineralogical composition, suggested that the Mt. Simon Formation was correlative with the Jacobsville Formation of northern Michigan, part of the Bayfield Group of northern Wisconsin, and the Hinckley-Fond du Lac Formations of Minnesota. Drill core data from central Minnesota indicates that the Mt. Simon Formation is stratigraphically above the Hinckley-Fond du Lac Formation, which, with the Bayfield Group and Jacobsville Formation are believed to be upper Precambrian Formations (Tryhorn and Ojakangas, 1972). However, the absence of fossils in the postulated upper Precambrian sandstones and the lower unit of the Mt. Simon Formation leaves the age question unsettled.

The Mt. Simon Formation is divided into 3 units: the lower of conglomerate to pebbly sandstone, the middle of coarse to medium-grained sandstone and the upper of coarse to very fine-grained sandstone. Fossil fragments and trace fossils are present especially in the upper unit and indicate marine deposition. Trace fossils are the only evidence that the lower and middle Mt. Simon Formation are marine deposits.

The upper Cambrian section in the Midcontinent Region has traditionally been interpreted as sediment deposited during repeated marine encroachments onto the Wisconsin dome. Asthana (1969) interpreted the Mt. Simon Formation as the lowermost formation in a transgressive sequence. The overlying Eau Claire Formation, a fine-grained sandstone to shale, represents the near shore environment.

Byers (1978), citing a lack of recognizable "quiet water" offshore environments, lack of fossil diversity, and exposure indicators, argued that the basal sandstones of the Cambrian sequence were best interpreted as subtidal shelf or tidal-channel deposits. The Eau Claire and Mt. Simon sequence was considered pro-gradational. Driese (1979b), basing his arguements on sedimentary structures and paleontologic evidence, interpreted the Mt. Simon Formation 'as largely pro-gradational, shoaling- and fining-upward tidal sequence." The same sedimentation pattern continued during deposition of the Eau Claire Formation.

The sandstones exposed at Irvine Park are part of the lower and middle units of the Mt. Simon Formation (Driese, 1979a).

Method of Study

Phe Precambrian trondhjemite and clay-rich zone were sampled to represent the gradation from fresh to altered rock. The trondhjemite was studied in thin section and chemically stained to indicate feldspar types. The intensely altered trondhjemite was disaggregated in water and sieved. The coarser fractions were studied under a binocular microscope, the clay fraction was x-rayed and the heavy mineral suite was separated from the fine sand fraction and studied under a petrographic microscope.

Two stratigraphic sections of the Mt. Simon Formation were measured from the basal contact and samples representing the main lithologies were fragmented and sieved. Histograms and cumulative percent curves were constructed from sieve analyses. A Franz-Isodynamic separator was used to separate the heavy minerals from the fine sand fraction. The suites were mounted and studied under a petrographic microscope.

Description of Units

The basement rock at Irvine Park is medium grained, weakly foliated, reddish-pink trondhjemite. The minerals of the trondhjemite are plagioclase, quartz, and biotite. Zircon and ilmenite are accessory. Similar trondhjemite rocks crop out at dams on the Chippewa River at Lake Wissota and Chip-

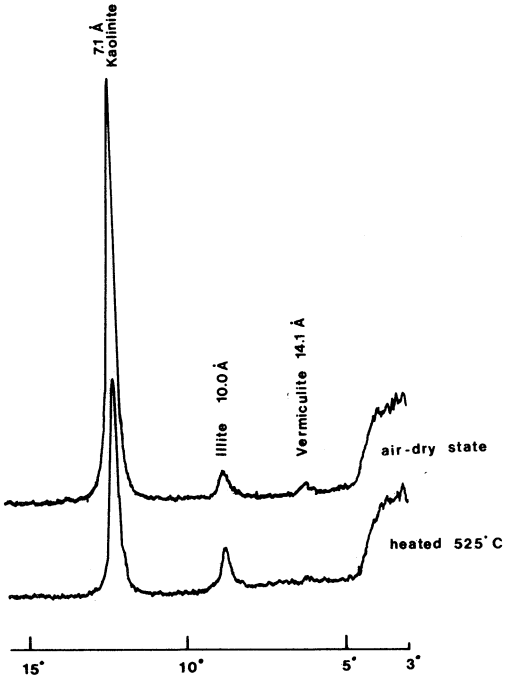

Fig. 2. X-ray diffraction pattern for clays from the Precambrian regolith at Irvine Park. Analyses were provided by S. W. Bailey, University of Wisconsin-Madison.

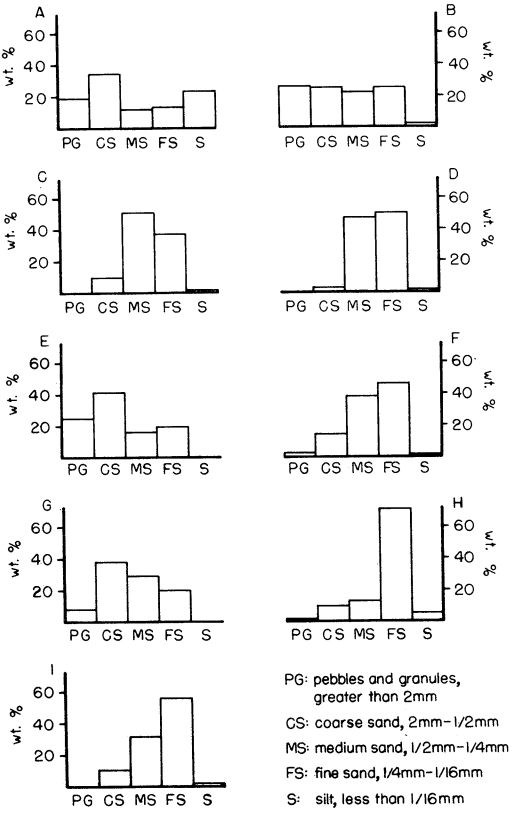

Fig. 3. Histograms of the Mt. Simon Formation and weathered trondhjemite at Irvine Park. A) Weathered trondhjemite, B) Subunit 1, sample 1, C) Subunit 1, sample 3, D) Subunit 2, sample 4, E) Subunit 3, sample 6, F) Subunit 3, sample 7, G) Subunit 4, sample 15, H) Subunit 4, sample 19, I) Subunit 5, sample 18.

pewa Falls (Fig. 1), but the relation among the outcrops is not certain.

The fresh trondhjemite becomes increasingly altered to clay minerals as the contact with the overlying sandstone is approached. At the contact the minerals of the altered rock are chiefly quartz, clay minerals and chlorite. Strongly altered plagioclase, ilmenite and zircon are accessory minerals. Biotite in the trondhjemite apparently is altered to chlorite and plagioclase mainly to clay minerals. Clay minerals separated from the zone were analyzed by x-ray diffraction: 80-90% of the clay is kaolinite while the remaining 10-20% is illite and vermiculite (Fig. 2). The altered trondhjemite is soft and upon drying can be disaggregated and sieved (Fig. 3). Examination of the various size fractions indicate that grains greater than 1.0 mm are composites of quartz and plagioclase. The composite grains are as small as 0.59 mm but are absent in finer size fractions. Although the alteration of the trondhjemite is extreme, metamorphic textures of gniess are preserved in the clay-rich zone to the contact; a paleosol has not been observed.

Locally the altered material has been exposed to recent weathering and is maroon-red rather than the usual gray-green. The color of the clay-rich zone results primarily from the chlorite. Upon weathering hematite becomes concentrated as red spots in the chlorite producing the maroon-red color of the zone.

The lower unit and lower 3 m of the middle unit of the Mt. Simon Formation are exposed at Irvine Park. The lower unit is divided into 4 subunits (Fig. 4). The subunits are generally similar to the sequences defined at the park by Driese (1979a). The reader is directed to the work of Driese who provides a thorough and extensive description of the lithologic units. This report presents information obtained from recent slumps that was not available to earlier authors.

The lowermost subunit contains interbedded and cross-bedded conglomerate, conglomeratic sandstone and fine to medium sandstone (Fig. 3, Table 1). The subunit unconformably overlies the irregular surface at the top of the clay-rich zone. Quartz clasts up to 7 cm long occur immediately above the basal contact. These clasts represent vein quartz that has weathered from the Precambrian basement. Sandstones at the contact, which are generally conglomeratic, are locally fine-grained and greenish clay occurs locally on cross-bed surfaces and discontinuous thin partings on the bedding planes. Cross-beds are poorly developed. The composition of the heavy mineral suites of two samples from the subunit was determined (Table 2). In sample 10, immediately above the contact, 20-30% of the heavy

TABLE 1. Mean diameters and sorting coefficients for the Mt. Simon Formation and regolith at Irvine Park, Chippewa Falls, Wisconsin. Units are listed in order of decreasing stratigraphic position.

Mt. Simon Formation	*Mean Diameter (mm)*	*Sorting Coefficient*	*Sample Number*
Subunit 5—			
Middle Unit	0.25	2.30	18
Subunit 4—			
Lower Unit	0.39	2.27	17
	0.55	3.93	16
	0.20	1.81	19
	0.64	4.54	15
Subunit 3	0.30	2.26	7
	0.24	2.18	20
	1.30	2.77	6
Subunit 2	0.27	1.32	5
	0.30	1.79	21
	0.28	1.27	4
Subunit 1	0.35	1.51	3
	0.73	3.58	1
	0.66	2.96	9
	0.83	3.21	10
Regolith			
Altered trondhjemite	0.85	21.25	8

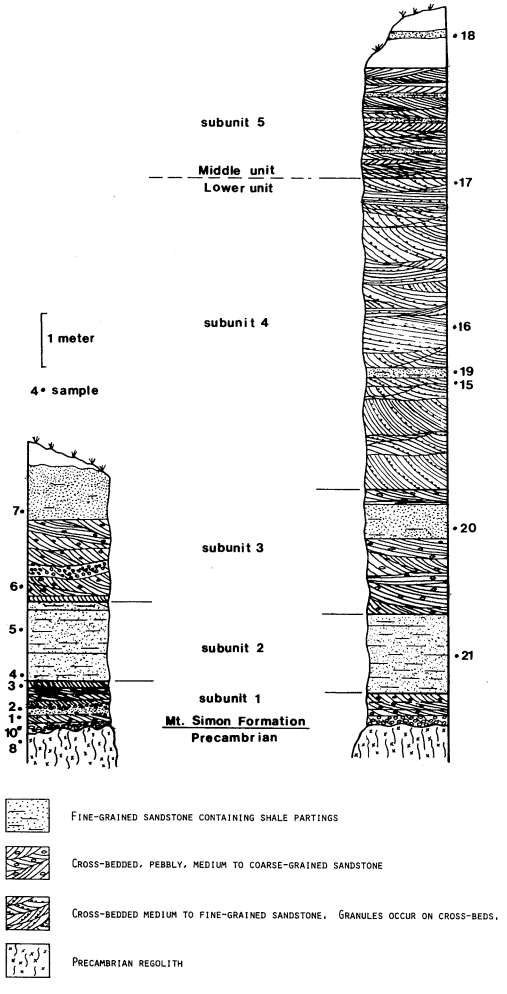

Fig. 4. Stratigraphic columns for the Mt. Simon Formation at Irvine Park, Chippewa Falls, Wisconsin. The left column (no. 1 in text) was prepared from an area of recent rock falls.

mineral suite is green chlorite, however, in sample 1, 0.5 m above the contact, chlorite is present in trace amounts. Altered grains of plagioclase are common to both samples.

The second subunit is well-sorted fine to medium sandstone (Fig. 3, Table 1) with parting lineation and low angle cross-lamination present. The top of the subunit in column 1 (Fig. 4) is marked by a mudstone bed up to 10 cm thick. The bed extends laterally only 5 m because at both ends it is erosionally truncated by a prominent cross-bedded bed 15 cm thick that defines the base of the third subunit. The top of the mudstone bed contains polygonal cracks believed to be dessication cracks, suggesting subaerial exposure of the bed before it was partially eroded. The top of the second subunit is also the top of an upward fining sequence from the bottom of subunit 1 at the basal contact of the formation (Table 1).

The base of the third subunit is marked by prominent through-set cross-bedding. Clasts of shale from the top of the underlying mudstone bed occur in the lowest beds of the third subunit in the area of column 1 (Fig. 4). The base of the subunit is much coarser and more poorly sorted (Table 1) than underlying subunit 2. The subunit contains medium to coarse-grained sand and granules which commonly occur on cross-bed surfaces. Interbedding of fine-grained and medium to coarse-grained sandstones is a common feature of subunits 3 and 4 (Table 1).

TABLE 2. Heavy minerals from the Precambrian regolith and the Mt. Simon Formation at Irvine Park, Chippewa Falls, Wisconsin. Minerals are listed in order of decreasing relative abundance.

Regolith	*Minerals are Mt. Simon Formation*		
Sample 8	Subunit 1	Subunit 1	Subunit 4
chlorite (green)	Sample 10	Sample 1	Sample 17
ilmenite	ilmenite	ilmenite	ilmenite
zircon	tourmaline	tourmaline	tourmaline
tourmaline	epidote	epidote	zircon
	chlorite (green)	zircon	garnet
	zircon	garnet	epidote
	garnet		chlorite (red-green)

The fourth subunit is characterized by large-scale tabular cross beds. Granules of quartz occur on cross-bed surfaces in medium to coarse-grained sandstone. In general this subunit has the greatest variability in sorting. Small amounts of reddish-green chlorite flakes occur in the heavy mineral suite of sample 17 (Table 2), approximately 9.5 m above the basal contact. Tourmaline, zircon and ilmenite are also present. The uppermost subunit defines a receding slope underlain by medium to fine-grained friable sandstone. The sandstone is locally finely cross-laminated. The fifth subunit of this study is the lowermost exposure of the middle unit of the Mt. Simon Formation.

Interpretation

This study is concerned with the time of formation and origin of the clay-rich zone at the Precambrian-Cambrian contact. The angular unconformity between the Precambrian basement and the Mt. Simon Formation represents a time gap of several hundred million years in the geologic record of west-central Wisconsin. During this time the clay-rich layer at the contact developed either 1) by sedimentation, 2) by *in situ* chemical weathering of the basement during the late Precambrian or 3) by ground-water leaching after deposition of the Mt. Simon Formation.

We believe that the upward gradation from fresh trondhjemite to clay-rich material which preserves relic gneissic fabric precludes formation of the deposits by sedimentation during the late Precambrian.

Ground water seepage along the Precambrian-Cambrian contact is commonly observed in west-central Wisconsin. As water percolates down through the sandstone and migrates laterally, seeps develop along valleys that have been cut into the Precambrian basement. Such interaction between ground water and the basement rock could have leached and altered the Precambrian material after the Mt. Simon Formation was deposited. The fabric of the basement rock would be preserved under these conditions. Examples of saprolitization occurring beneath cover have been described by Carroll (1969). The saprolite develops if water percolates down through the overlying material and the covering material protects the developing saprolite from erosion.

Saprolites formed by Pre-Cretaceous weathering and characterized by excellent preservation of primary structures in Precambrian gneiss are recorded in the Minnesota River Valley (Goldich, 1938). Actually two extended periods of weathering are recorded in the Paleozoic-Mesozoic stratigraphy of Minnesota. The older occurs between the Precambrian basement and the Cambrian Mt. Simon Formation; the younger developed prior to deposition of the Cretaceous system. The clay-rich zone at Irvine Park is in the same relative stratigraphic position as the older saprolites in Minnesota, suggesting a similar origin.

If weathering in the late Precambrian formed the clay-rich zone, one would expect weathering products to occur in the Mt. Simon Formation. Two approaches to the problem were pursued: 1) comparison of the grain sizes of materials collected from the clay-rich zone and from the Mt. Simon Formation, 2) comparison of the heavy mineral suites of the materials.

The clay and silt sizes prominent in the clay-rich zone are not present or are present in small amounts in the sandstone (Fig. 3). Also the composite grains commonly observed in the sand-sized fractions from the clay-rich zone are not observed in the sandstone. However, the silt size fractions of both units contain altered plagioclase grains. The silt and clay size fractions from the clay zone were apparently winnowed from the sediment and the composite grains of plagioclase and quartz were destroyed during deposition of the sandstone. However, the altered plagioclase grains suggest a link between the two units.

The composition of the heavy mineral suites from the sandstone is more diverse

than from the clay zone (Table 2). Garnet and epidote in the sandstone are possibly derived from locally occurring garnet amphibolites. Zircon, ilmenite and tourmaline are found in all suites. Zircons from the clay zone are zoned as are zircons from the basal sandstone, but the zircons occur in a coarser size-fraction (0.125 – 0.250 mm fraction) in the clay zone than in the sandstone (most occur in 0.062 – 0.125 mm, a few in 0.125 – 0.250 mm fractions). The difference in size does not allow a clear determination of local provenance for zircon in the sandstone but such a suggestion is not negated.

The best diagnostic mineral in the heavy mineral suites is chlorite. Chlorite is the primary heavy mineral in the clay zone (sample 8), occurring as thin, pale to medium green flakes of uniform color. Chlorite of the same physical appearance comprises 20-30% of the heavy mineral suite in sample 10 immediately above the contact. Chlorite flakes are rare 0.5 m above the contact and are present in small amounts in sample 17 approximately 9.5 m above the contact. The chlorites from sample 17 are more reddish-green than in sample 10, possibly indicating post-depositional oxidation. The chlorite flakes in the basal Mt. Simon Formation strongly suggest that the clay-rich zone provided weathered sediment to the Mt. Simon Formation and that the clay-rich zone is a saprolite that formed before the deposition of the Mt. Simon Formation.

The excellent unweathered exposures of the basal Mt. Simon Formation that were developed for a brief time at Irvine Park contain discontinuous clay partings and clay occurs interstitially to sand grains on cross-beds and bedding planes. These features are not visible on weathered outcrop surfaces. Such features occur mainly in the lower two subunits of the Mt. Simon Formation. The clays may have been derived from the clay zone, however available data does not confirm this interpretation.

If the clay zone developed by weathering during the late Precambrian, what were the conditions of weathering? The formation of clay minerals is a function of temperature, precipitation, topography, drainage and parent material (Loughnan, 1969). Kaolinite, illite and vermiculite are the clay minerals at the top of the weathering profile at Irvine Park. Kaolinite, the main clay mineral, can be formed by weathering of any aluminum silicate material by leaching of K^+, Na^+, Ca^{2+}, Mg^{2+}, and Fe^{2+} provided H^+ is added. The general conditions require precipitation greater than evaporation, permeable rock, percolating fresh water and oxidation of Fe^{2+} (Keller, 1970). The associated illite and vermiculite can be derived from weathering of micas and chlorite under the same conditions. The clay minerals from the regolith in the Minnesota River Valley indicate illite is the main clay deeper in the regolith and kaolinite is the main clay in the upper regolith (Morey, 1972). The sampling at Irvine Park was confined to the upper 0.2 m of the regolith so a similar pattern is not documented.

Paleomagnetic data indicate that western Wisconsin was equatorial during the late Precambrian. The paleoequator passed through Central Wisconsin in the Eocambrian (700 m.y. Dott and Batten, 1971) and by the late Cambrian Wisconsin was approximately 15° south latitude (Irving, 1964). Equatorial climates include humid tropical or tropical savanna; either would meet the requirements to produce kaolin-rich clay deposits such as those found in the saprolites of this period.

The weathering of the Precambrian rocks in west-central Wisconsin during the late Precambrian occurred under a humid tropical climate as the mid-continent region drifted southward from the equator. (Reconstructions based on the present configuration of the continents show the paleoequator north and south during the Precambrian so that the North American continent appears to have migrated from east to west during the Cambrian.) The tropical weathering conditions formed saprolites from Wisconsin into

central and western Minnesota. The extent of the saprolites formed during the same weathering period in the mid-continent region is not known.

Conclusions

The exposures of the Precambrian-Cambrian contact and the lower unit of the Mt. Simon Formation at Irvine Park suggest the following conclusions.

1) The Precambrian trondhjemite was weathered to form a kaolinite-rich saprolite prior to deposition of the Mt. Simon Formation. Clastic materials from a saprolite were deposited in the basal Mt. Simon Formation.

2) Weathering to form a saprolite was controlled by a humid tropical climate that developed as the mid-continent region drifted southward during the late Precambrian.

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VERBAL NONVERBAL COMMUNICATIONS AND RELATED DEVELOPMENTS IN THE DRUM DANCE RELIGION

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The Native American Drum Dance religion probably originated among the Sioux, according to my Menominie informants, and was brought to the Menominies by the Chippewas. It has been practiced among the Menominies for at least three generations and perhaps much longer. It centers on a sacred drum, or drums, which carry the petitioners' prayers to God. The present followers of the Drum Dance religion constitute a very small group with a principal center of population in Zoar, Wisconsin. This settlement is the northernmost of the three major communities located on the Menominie Reservation in the northeastern part of the state.

The greater portion of this religious community is made up of people who prefer to retain a more traditional life style than do the Menominie of the other two communities, Neopit and Keshena. Possibly as a result, this northern community has remained quite isolated, maintaining its detachment from the outside world to the extent of refusing to have telephones within the settlement.[1] Because of such isolationist practices, the people of Zoar are regarded by the other two Menominie communities as backward and pagan.[2]

The purpose of this paper is to examine closely those current internal and external factors that are important to both the success and future of the ritual process of the Drum Dance religion among the people of Zoar. I shall concentrate on the various forms and levels of communication within the ceremony as they are experienced by an apprentice ceremonial leader. Finally, I shall speculate on the direction that this native religion may take in the near future.

Ideally the people of Zoar would prefer to keep religious membership within a single tribe. However, there are too few of their own people to carry out ritual acts related to the specific Drums that form the focal point of their religious ceremony: For them to have a full service, they must rely on help from followers of the same religion who belong to other tribes. Therefore Chippewa, Potowatomie, and Winnebago attend Menominie ceremonies, and in turn, the Menominie reciprocate by helping any of the other groups with their ceremonies in the northwestern part of the state. Furthermore, Kansas Potowatomie and Kickapoo adherents of the same religion (with slight variants) make special trips to Wisconsin to serve as supporters for the Wisconsin groups. These Wisconsin people and religious groups from the Plains and Southwest also invite Canadian Indians, as well as Wisconsin Indians from other religions, to their major seasonal ceremonies. One sees the greatest mixture of people from different tribes when a specific rite is to be conducted at a ceremony such as the installation (initiation) of a member who will be assigned to a vacant station on a specific Dream Drum. The other major occasion calling for a confluence of members from different tribes is the death of one of the main ceremonial members.

Thus the religious ceremonies held by the Drum Dance people have become intertribal, creating the necessity for intergroup relations as well as for contact with outside

tribal groups and native religions. However, it is important to realize that even though all these people practice the same native religion, each group retains certain nuances particular to its life style and world view.

The oral tradition, is basic to the structure of the ritual process. The oral aspect of the Drum Dance ceremony is thus significantly affected when a mixed tribal ceremony takes place, for traditional oral presentations have a tendency to create both a communications barrier and animosity between local people and visiting members of a different tribe who do not speak or understand one another's language. The lack of a common language is not troublesome when a ceremonial leader prays in his native tongue. The acceptance of this practice lies in the old Indian belief that it is very important for one to pray in his own language because the Creator gave all peoples on this earth their own language so they might address him very specifically in their prayers. Therefore, members of all Indian religious societies recognize that each tribe must pray in its native tongue.

Problems arise, however, when leaders deliver advisory speeches (as opposed to prayers) in their native language. Although almost all of the participants understand English, anyone who delivered a speech or prayers in that language would be reprimanded by older traditionalists (a good example of the power of tradition).

The rigors of comprehending and adjusting to levels of communication, and to various other nuances that occur in such a complex ceremony, can best be viewed by following the instruction of an apprentice ceremonial leader. One of his first lessons is to learn the prescribed order in which speeches are presented in the ritual process, such as the designated points in the ceremonial structure when chiefs are expected to speak. The prescribed times for such speeches are as follows: 1) When the Drum Chief calls upon either one of the sub-chiefs, or when another Drum Chief whom he knows presents an eloquent and spontaneous speech to the group; 2) when a chief assistant is called upon by the main Drum Chief to speak to the congregation (each can expect to be called on at any time during the ritual); and 3) when the Chief, the assistants, or any other member of the congregation requests the floor for the purpose of addressing either a religious or secular issue. These impromptu speeches may be directed to the whole congregation or only to specific members within that ceremony. There are occasions when a ceremonial leader will arise to rebuke an inappropriate ritual act or some deviant behavior which has occurred within the prescribed ritual. When something of that kind occurs the ceremonial leader will not call attention to the deviant act at the time it takes place. In accordance wih prescribed ritual order, he will wait until the appropriate time to do so—one of the times when Chiefs are expected to speak. Furthermore, instead of addressing the person or persons who broke the ritual, the ceremonial leader will direct his reprimand to the entire congregation. This tactic achieves its point but does not directly embarrass the offender. It is also important to note the prescribed manner in which the floor is obtained by ceremonial leaders. In lieu of a verbal request, the speaker simply rises, steps out toward the middle of the floor, and begins his address. The apprentice as well as the congregation is well aware of the meaning of this act, for upon seeing this movement they know that the individual has an important statement to convey to the membership. In other words, the speaker utilizes both body language and group cultural space as a mechanism to show that he has something important to say to the congregation. The members in turn recognize the meaning of this particular ritualistic act. Should it happen that a member does not respond to

this symbolic act, it is the duty of one of the sub-chiefs, the one closest to the individual, to call tactfully for his attention.

As the apprentice becomes better acquainted with the ceremony, he acquires the ability to discern when an orator is presenting a religious prayer rather than a secular speech. The interaction between the speaker and the participants, as well as within the group, is different in each case. When a speaker is praying or addressing the congregation with regard to religious matters, movement within the congregation is stilled. Mothers and fathers, relatives, and friends do their best to quiet a crying baby. If this is not possible, someone will take the child out of the ceremonial area. In addition, the caretaker who is seated by the eastern entrance, which is his ceremonial station, sees to it that any young child, adolescent, or adult who may be moving around or talking, restrains himself. These restrictive measures are instituted so that the congregation may hear what the orator is saying. The attention given to the speakers is very noticeable, for the congregation becomes a captive audience. Body movements and behavior are so contained when someone is praying that there is almost a dead silence, unlike the atmosphere during a secular speech. A deep reverence is felt among the communicants during the time a religious prayer is offered.

All the speeches in a Drum Dance ceremony are related to religious matters, but there is a distinct difference evident between those of a very sacred nature, and those which lean more toward secular, everyday life. During the latter babies are allowed to cry, and the children, even though they are discouraged from doing so, are permitted to move about a bit. In this atmosphere, communicants may, if necessary, speak to each other even during a speech.

The apprentice ceremonial leader must learn that two types of orators are sanctioned within the Drum Dance religion. One memorizes his material and the other is a spontaneous orator. The communicants differentiate clearly between the two types. For example, those speakers who memorize the sayings and teachings of old ceremonial leaders are considered "long-winded." Because they have memorized what should be said during each particular occasion of the rituals, they are thought of as men who speak from the head. More highly revered speakers "speak from their heart and not their head." They do not memorize their prayers. When these religious leaders recite the teachings of the older people they do so in their own words while maintaining the general sense of what the old people have said. Such orators adapt the teachings and prayers of the older generation to meet current problems. As part of his education the apprentice learns that members of his religious society feel that the man who speaks from the heart is not only more sincere, but, in a sense, is holier, because he is inspired by the needs of the congregation and by his helpers such as the Thunderbirds.

The problems of communication become acute for an initiate who does not understand the language of a particular native speaker, either because he has not learned his own native tongue or because he is from a different tribe. He may overcome this handicap by learning to read and understand the gestures of the native speaker as well as the responding proximic behavior of the comcunicants and older ceremonial leaders. The apprentice learns to recognize the symbolic signs such as body language and the various sounds that are used by the congregation to sanction or disapprove of a ritual act. He is also expected to realize the importance of dance in the ritual.

Part of this instruction is carried out by participating in the religious dances which form a significant part of the ritual. He must recognize the meaning of symbols which announce an upcoming event in the ceremony. For example, if there is going to be a Belt Dance he must learn to recognize the signs

which will announce its occurrence: the Belt Dance Song must be played four times on the second night of the four-day ceremony. If the Song is not sung four times there will be no Belt Dance on Saturday, the third day. Members of the congregation also recognize this symbolic language. They rely on and thus listen for such signs as the Belt Song. No one announces or asks if there will be a Belt Dance. The songs carry this message. The apprentice must also know when it is appropriate only for men to dance and when women are permitted to dance, as in a secular ceremony. He must learn that, with few exceptions, only men may dance during the first three days and nights of a four-day-and-night major seasonal religious ceremony. Women are allowed to dance only when their song is sung during a religious ceremony or during a Squaw Dance or a Chief's Dance. During the sacred Belt Dance which takes place on the third day he sees that great caution is taken that no child runs loose or falls for such an event might prestate a future tragedy.

The apprentice must also recognize the symbolic meaning of a feather which falls from a sacred Belt (there are generally two Eagle feather Belts in a Belt Dance). Feathers used in the Drum Dance ceremony are considered sacred; they are also symbols of power. In earlier times in most Indian societies, as today among the more traditional groups, different feathers signified different powers, such as those obtained through spiritual contemplation in a vision quest. Warriors were the only ones who could wear eagle feathers. Only a warrior had the power to pick up a power object such as a feather. This belief and practice is still maintained in the Drum Dance religion. Thus, only a war veteran or the close male relative of a deceased war veteran can pick up a fallen feather. For an apprentice to learn all of these rules and regulations he must be present and participate actively in the ritual process of both sacred and secular ceremonies.

After the apprentice learns the basic structure of the ritual he begins to achieve a higher level of awareness. He functions within a nonverbal communication system which binds the orator and the group.[3] He comes to realize that there are some aspects of the Drum Dance ceremony that are so spiritually related to his education that they can be apprehended only in a state of total immersion. He must let the ritual speak to him and for him, must lose his own sense of immediate identity in an essentially mystical unity with the group.

The complexity of the communications problems experienced by the apprentice is difficult for non-Indians to understand. The closest analogy in Western society may be the traditional Roman Catholic ritual (prior to the 1960's) that members of an American congregation might not understand because the Mass was conducted in Latin. In this situation, however, Catholics could rely upon written translations, for they had hand missals designed to aid them in following the liturgy. Within the oral tradition of the Drum Dance religion, however, there is no missal. In these ceremonies the people basically rely on their faith, their knowledge of the order of the ritual process and the body language of the speaker.[4] These people adhere so tenaciously to their traditional ways that, unlike the members of the inter-tribal Native American Church who use English to convey an advisory message or to relate the subject of a prayer, the people of the Drum Dance religion cling to their native speech. This is not to say that communicants in the Drum Dance religion never converse with each other in English after a ceremony. However, when they speak English they carefully refrain from discussing religious experiences connected with their ceremonies, making a point of keeping their conversation within a social context.

After being intensely involved in an electrifying religious experience which lasts four days and four nights the initiate inevitably

feels a sense of anticlimax when the ceremony ends. Half a dozen ceremonial apprentices have described their emotional state in interviews.[5] To his dismay, he realizes that he has lost sight of many of the significant rites which had taken place within the ritual. Not only does he experience a sense of emptiness and exhaustion, but he also finds himself questioning what he had, in reality, learned from his first experiences as a ceremonial apprentice. He also recognizes the possibility that perhaps he is just temporarily disillusioned because of the overwhelming effect of what he has experienced. He further rationalizes that, by going through such a traumatic experience, he actually may have learned more than he consciously realized during particular periods in the ceremony. As he sums up these experiences he is aware that he has been deeply affected by all the energy forces released in the ceremony, especially those rites that rely on subtle means of non-verbal communication. He realizes that the role of an apprentice is much more psychologically taxing than being a member of the congregation. To add to his state of confusion and frustration, the priestly elder who had been working with him throughout the ceremony asks him if he has learned anything. After hesitating for a moment or two while rhetorically asking himself "What can I say?" he confesses that he feels he is not really sure that he can say what he has actually perceived in his first experience as novice ceremonial leader. At the same time he assures his teacher that he has undergone an intense metaphysical and physical experience. Finally, he summarizes his total experience in one dramatic statement: that both physically and mentally he experienced the feeling of being in a vacuum—he had a sense of abandonment and helplessness—even though he was among his own people.

After hearing the apprentice speak of his first experiences, members of the veteran priestly class lift his depressed spirits simply by smiling and saying that the next time will be better. By this they mean that the more the apprentice participates in the ceremony, the more he will know when specific rites should take place during the ritual process and the more acutely he will perceive all the nuances inherent in them. The communication medium is participation and experience.

After several years of learning his new role, the apprentice assistant leader realizes the significance of being keenly in tune with the physical behavior of the communicants. In time, he learns the importance of being aware of the congregation's kinesics as a vital element interrelated with the oral communication process.[6] He knows what is taking place between the speaker as narrator and actor as well as what simultaneous symbolic interactions and metaphysical phenomenon are taking place for narrator, audience, and other ceremonial assistants.

There are indications, however, that the education of an apprentice may be made slightly easier in the future. In the past few years, a number of older orators have responded in an interesting way to the language problem. They have begun to break with the old tradition of presenting their speeches entirely in an Indian language. To reach out to the younger members of the tribes these orators are moving toward the use of English as a *lingua franca.* They preface speeches they deliver in their native tongue by using one or two explanatory phrases in English. A few older members of the Drum Dance religion have stated that they realize the reason so many of their younger members, the below-thirty age group, do not speak an Indian language is because many of them are sons and daughters of tribally mixed marriages. In such cases the parents who speak their own tribal language as well as English but do not understand each other's language use English in the home. Ironically, in this situation most of the children do not learn either of the Indian languages and thus grow up knowing

only English. To further complicate the problem, some of the younger members are offspring of an Indian and a non-Indian parent. Such children usually hear only English spoken in their homes. Other youths are not able to learn an Indian language because they live in cities where Indian languages are seldom spoken in the schools or in the working milieu of the parents. In few cases does an adolescent in his late teens, and out of school, have the opportunity to live and work in a rural Indian atmosphere and thus, in time, learn the Indian language of a particular community.[7]

From a traditional point of view the older people would prefer to have their prayers and speeches presented in an Indian language. However, as a result of the environmental and sociocultural factors involved, the majority of native orators may one day use English, even for their ceremonial speeches, thus significantly altering current practice.

In addition to changes designed to solve the language problem, other changes can be noted in those impromptu religious speeches that are presented by orators who "speak from the heart." These leaders, as well as members of the lay congregation, are moving away from the older custom of preaching and responding to a way of life related to an older tradition. This does not mean that they do not respect the customs of the older members of the church, but rather that, as younger religious leaders, they realize that they must communicate with God according to the current needs of their religious society. They realize that the older church people led a more placid and stable way of life in which there were fewer stressful encounters with either whites or Indian people of different tribes. These leaders are also aware that their young people face totally different encounters in Western-oriented society: young people often find themselves in a world of rapid change that has created a different set of needs than those expected in the old days. There are leaders in the Drum Dance religion who would like to maintain and revitalize some of the older traditional ways of life, although they must use discretion in stressing such things in prayers that must also be relevant to the younger generation. They know that what their elders taught often is no longer directly applicable to everyday life. In response to such internal and external pressures, their speeches have become more complex, and are often more eloquent than earlier narratives. Such orations deal with sociocultural factors—for example, change within the group—as well as providing church members with spiritual support to aid them in their adaptation to the pressures of the dominant Anglo-American society. Modifications of the ceremony are also made to accommodate people of different tribal backgrounds who may have different world views. All these factors will have a significant effect upon the communication process in the Drum Dance religion as it is now practiced among the people of Zoar.

Notations

[1] This is not to say that they do not have any contact with the outside world, for I do not know of any Indian reservation in the Northern Hemisphere which has not been exposed to and affected by the ways of Western society. The Zoar community, in fact, is comparable to those communities which make up the major populated sections of the Hopi Reservation.

[2] This particular point of inter-group reference may be the result of the influence and impact that Christianity has had upon the people in the southernmost Menominie settlements. It is safe to state that the greater portion of the population within Neopit and Keshena have acquired the beliefs and values of the Western world of Christianity. In contrast it is important to note that the Zoar people, even though being exposed to great pressures from the outside world, from their counterparts, continue to maintain and practice many of the old traditional ways of life.

[3] See Edward T. Hall's *The Hidden Dimension* for a discussion of proximic behavior.

[4] The repetition of the ritual reaffirms their faith and helps to maintain the religious values within

the society. For further reference to a major study on this type of phenomenon, see Victor Turner's *Ritual Process.*

[5] Wallace Pyawasit, 60, Potowatomie-Menomonie
Johnson Awonahopay, 63, Potowatomie-Menomonie
Jerry Hawpetoss, 27, Potowatomie-Menomonie
Littie Dixon, 41, Cherokee
Irene Mack, 65, Menomonie
Max Dixon, 43, Menomonie
Kevin Dixon, 20, Menomonie-Cherokee

Wallace Pyawasit and Johnson Awonahopay are ceremonial leaders, Jerry Hawpetoss and Max Dixon are sub-leaders, and the others are apprentices. It is important to note that there is no set age at which a person becomes a ritual apprentice. These interviews were done in 1976-77.

[6] See Ray Birdwhistell's *Kinesics and Context; Essays on Body Motion Communication* for the kinesics theory.

[7] It is important to note that this language problem is now being addressed by the University of Wisconsin at Oshkosh, Green Bay, and Milwaukee as well as Northland College in Ashland, Wisconsin. These institutions offer Indian language programs which are geared to help older native speakers learn how to teach their native language. In turn, it is expected that these people will obtain positions in public schools which have Indian students and teach these young people the language of their heritage. It is too early to predict whether or not these programs will affect the direction the ceremonial speeches will take in the Drum Dance religion in comparison to their current presentation in a native language.

IS THE *CHRISTOS PASCHON* THE PROTOTYPE OF CHRISTIAN RELIGIOUS DRAMA?

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In his *Essai sur les Moers et L'Espirit des Nations,* Voltaire states his belief that Christian religious drama was originated by Gregorio Nazianzeno, the 4th century bishop who served briefly as patriarch of Constantinople.[1] Since the only drama attributed to Gregorio Nazianzeno is the *Christos Paschon,* we may conclude that Voltaire based his remarks on his familiarity with this play, which has come down to us through a 12th century manuscript.

The *Christos Paschon* is of great interest for a wide variety of reasons, not the least of which is that it is the earliest known complete dramatization of the passion of Christ. It is composed in the form of a cento, a style of poetic composition popular in the fourth and fifth centuries. This poetic form has repulsed many later critics because it has appeared to them to be based on plagiarism. The form requires the composer to select his lines from well-known works of poetry or drama and re-work them into a separate, self-contained poetic composition. In the case of the *Christos Paschon,* more than 80 percent of the lines are recognizably derived from a wide variety of Euripides' plays. It should be noted that this was a perfectly acceptable and respectable poetic form that came into being around the 4th century A.D. and continued in use for some centuries thereafter. Once the play is translated into the vernacular, the resemblance of its lines to those of Euripides vanishes and the play stands forth as a strikingly original dramatization of the passion of Christ.

Although Gregorio Nazianzeno is the author to whom the play is most frequently attributed, it has also been attributed to a variety of subsequent sources, some as late as the 12th century. Even if the latest attribution is accepted, the *Christos Paschon* remains the earliest example of a complete dramatization of the passion of Christ. If the earliest attribution is accepted, then it is clearly the earliest example of a Christian liturgical drama.

André Tuilier consulted twenty five extant manuscripts of the play in thirteen different libraries in Europe and Asia Minor.[2] While his main effort is devoted to establishing the authenticity of the authorship of Gregorio Nazianzeno, his scholarship indicates that the manuscripts were circulating in the west as early as the twelfth century and perhaps earlier.[3] In a recent paper "Grégoire de Nazianze, La Passion du Christ, Tragédie," which includes a fully annotated publication of the Greek text with a French translation, Tuilier concludes that the play is very probably the work of the 4th century patriarch, Gregorio Nazianzeno, who lived from 330 to 390 A.D.[4] In another article containing an excellent thematic analysis of the play, Sandro Sticca also concludes that the play should be attributed to Gregorio Nazianzeno.[5] Professor Sticca pays particular attention to the theological intent of the author, which he thinks parallels the theological interests of Gregorio. In "Liturgical Drama in Byzantine Literature," Theodore Bogdanos, while recognizing the persuasiveness of Professor Sticca's arguments, nevertheless believes that the play is a literary exercise of the eleventh or twelfth centuries.[6] Professor Bogdanos' opinion seems to be based on his extreme distaste for the form of the cento. In an earlier article, "La datation et l'attribution du *Christos Paschon* et l'art du centon," Tuilier clearly established the historical fact

that the cento was an art form that flourished in the 4th and 5th centuries.[7]

The early date of the play is further supported by Vénétia Cottas who presents a fascinating argument that the *Christos Paschon* served as a direct inspiration for most of the iconographic works dealing with the passion of Christ from as early as the fifth century A.D.[8] While admitting that she is unable to present direct testimony on this point, she nevertheless presents numerous persuasive examples of art works whose details coincide meticulously with the scenic details set forth in the dialogue and action of the *Christos Paschon*.

Regardless of the fact that over eighty percent of its lines may be shown to have been adapted from various sources in Euripides and elsewhere, an objective examination of the work reveals that it is a self-contained dramatization of the passion of Christ presented through the perspective of his mother, Mary. Tuilier aptly refers to the play as.

> ". . . la tragédie Chrétienne par excellence. Ce drame imite les Anciens pour le fond et pour la forme. Tout en reprenant les expressions mêmes du grand Tragique, l'auteur utilize les thèmes et la mis en scene du théâtre grèc.[9]

The play's dramaturgy is wrought with great technical skill, and its thematic development presents considerable insight into the human condition. It assumes the fundamental dignity of man and womankind, emphasizes free will and responsibility in the area of moral choices, and assumes the existence of a supernatural force that is concerned with human affairs. It then proceeds to dramatize the conflict between its tragic heroine and the problem of evil in the universe. The pattern of action thus presented is tragic in form.

The text of the play, as translated by Tuilier, commences with a thirty line prologue. The author states his intent to dramatize the passion of Christ after the manner of Euripides, and outlines his theme of the redemption of humanity through the sacrifice of Christ. The action starts with a monologue by Theotokos, the virgin mother of Christ, who explains that she is abroad in the night to witness the passion of her son. She is shortly joined by a chorus of holy women, and, together, they witness the approach of an armed crowd that is cursing and beating Christ. A messenger enters and describes the betrayal of Christ by Judas and the condemnation of Christ to death. They follow the mob to Calvary, where Christ speaks to her from the cross, entrusting John to her care and consoling her in moving terms. From this point on, Mary assumes the additional role of the mother of humanity. Christ grants her pleas for the forgiveness of Peter and the descendants of those who are tormenting him. After his death, John, who is also referred to as the Theologian, predicts his resurrection. The chorus then divides itself into two parts to interpret and discuss the preceeding events. Their dialogue is interrupted by the episode of the centurion Longinus and his miraculous conversion. Joseph of Aramithea and Nicodemus then arrive to recover Christ's body. They lower it into the arms of Mary, who gives voice to a particularly poignant lamentation over the body of her son. This scene is felt by Vénétia Cottas, the author of *L'influence du drame Christos Paschon sur l'art chrétienne d'Orient* to have served as the initial inspiration for many subsequent depictions in the graphic arts of Mary mourning over the body of her son.[10] Joseph then announces the death of Judas, and the chorus gloats in a manner strongly reminiscent of the Bacchae exulting over the death of Pentheus. Joseph and Nicodemus then carry the body to the tomb, and all of the characters repair to John's house to rest for the night. In his role as Theologian, John explains the Christian mysteries and describes the harrowing of Hell to Joseph and Nicodemus. In the morning, a messenger arrives to report that a guard has been placed over the tomb of Christ. This persuades them to remain in the house until Easter

morning. That night the Virgin asks for a volunteer to reconnoiter the tomb and Mary Magdalene agrees to do it. The Virgin then decides to accompany her and (from lines 2020 through 2097) the visit of the Marys to Christ's tomb on Easter morning is acted out. Christ appears to them and instructs them to inform the disciples of the good news. On their way to do so, they are stopped by a messenger who relates the dialogue he has just overheard between the tomb guards and the Temple priests after the resurrection. The priests have bribed the guards to hide the truth. As the messenger repeats the words of one of the guards, his speech gradually assumes the characteristics of that guard until he actually becomes the guard. At this point, he is joined by the High Priests and Pilate and they proceed to act out the scene that the messenger has been describing. The dramaturgic intent of the author seems clearly to have been to insert a flashback scene into his play at this point. It is probably the earliest example of the use of a flashback scene in dramatic literature. At the end of this scene, the messenger reassumes his initial characterization, and the focus of the scene returns to Mary, the chorus and Mary Magdalene, with no sign of a break in the continuous action of these scene. Presumably, Pilate, the High Priests and the other guards leave the stage as the flashback ends.

The characters then return to John's house, where Christ again appears and instructs the disciples to preach his word throughout the world. The play concludes with a prayer or *exodos* celebrating the dual nature of Mary, both as Mother of God and as the mother of humanity.

While it cannot be denied that there has been a great deal of controversy concerning the authorship of the *Christos Paschon,* the latest, most meticulous scholarship appears to indicate that it is the work of Gregorio Nazianzeno. It would therefore seem to be an authentic drama of the 4th century A.D.

In "Il *Christus Patiens:* Rassegna Delle Attribuzioni," Francesco Trisoglio presents an exhaustive review of research concerning the play.[11] It is by far the best bibliographical study of the problem to date. While he does not seem to clearly state his own opinion concerning the attribution of the play, the latest research covered by his study seems to favor the authorship of Gregorio Nazianzeno, lending further credence to its standing as a 4th century A.D. drama.

While there is no evidence that it directly inspired a Latin liturgical drama, the mere existence of *Christos Paschon* lends considerable support to Voltaire's assertion that Christian Greek religious drama influenced the origins of medieval Italian and French religious drama. If the latest scholarship dating the play from the 4th century A.D. is accepted, then it is undoubtedly our earliest example of Christian drama.

Notations

[1] Voltaire, *Essai sur les Moers et L'Esprit des Nations,* in *Oeuvres Complètes,* tome 17 (L'Imprimérie de la Société Littéraire-Typographic, 1785), pp. 376-7.

[2] Tuilier, André, "Grégoire de Nazianze, La Passion du Christ," *Sources Chrétienne,* tome 149 (1969), pp. 75-116.

[3] *Loc. Cit.*

[4] Tuilier, André, "Grégoire de Nazianze, La Passion du Christ, Tragédie, Introduction, Texte, Traduction, Notes et Index," *Sources Chrétienne,* tome 149 (1969), p. 116. Eds du cerf, Paris.

[5] Sticca, Sandro, "The *Christos Paschon* and the Byzantine Theater," Comparative Drama, Spring, 1974, pp. 28-41.

[6] Bogdanos, Theodore, "Liturgical Drama in Byzantine Literature," *Comparative Drama,* 1976-77, p. 208.

[7] Tuilier, André, "La datation et l'attribution du *Christos Paschon* et l'art du centon." *Actes du VI^e^ Congrès International d'études byzantines* (Paris: 1948), tome I (1950), pp. 403-9.

[8] Cottas, Venetia, *L'influence du drame "Christos Paschon" sur* l'art chrétien d'orient (Paris: Librairie Orientaliste Paul Guenthner, 1931), pp. 110-13.

[9] Tuilier, André, "Gréboire de Nazianze, La Passion du Christ," p. 19.

[10] *Ibid.,* pp. 36-42.

[11] Trisoglio, Francesco. "Il Christus Patiens: Rassegna delle attribuzioni," *Rivista di Studi Classici,* 22: 351-423.

FINNEGANS WAKE AND THE LINGUISTIC RENAISSANCE

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In James Joyce's *Finnegans Wake,* there is a passage in which Shaun the Post describes the interior of his brother's house. Because his brother, Shem the Penman, is a writer, it isn't surprising to find that Shem's house is cluttered with literary debris which has collected like dust-balls and cobwebs over the years:

> You brag of your brass castle or your tyled house in ballyfermont? Niggs, niggs and niggs again. For this was a stinksome inkenstink, quite puzzonal to the wrottel. Smatterafact, Angles aftanon browsing there thought not Edam reeked more rare. My wud! The warped flooring of the lair and the sound-conducting walls thereof, to say nothing of the uprights and imposts, were persianly literatured with burst loveletters, telltale stories, stickyback snaps, doubtful eggshells, bouchers, flints, borers, puffers, amygdaloid almonds, rindless raisins, alphybettyformed verbage, vivlical viasses, ompiter dictas . . . once current puns, quashed quotatoes, messes of mottage, unquestionable issue papers (*FW* 183).[1]

Besides an impression of general clutter, the last thing we get from this description is a clear picture of Shem's room. It is as if such a picture were irrelevant. The words are so busy calling our attention to themselves that the things they refer to get lost. Shem's room is buried in "messes of mottage"; it is hidden beneath the very "alphybettyformed verbage" which should reveal it. The words themselves have more being and substance than the things they refer to. Moreover, though this is one of the clearer passages in *Finnegans Wake,* in order to puzzle it out, we will need either some knowledge of half a dozen languages or else own half a dozen dictionaries.

We might well ask, what ever happened to the straightforward story with a straightforward narrative? Why this apparent linguistic anarchy which Joyce himself calls the "abnihilisation of the etym?" What happened in the period between Jane Austin's genteel descriptions of drawing rooms and this seemingly chaotic version of a description?

To begin to answer these questions, I will first examine briefly the so-called 19th century discovery of language; then, I will outline the way in which much of 20th century literature embodies three ideas emerging from the linguistic renaissance: first, that words are objective, concrete entities; second, that words are "rooted" in the past and connect us with the order and culture of our ancestors; and third, that languages are interrelated. I will concentrate on Joyce's last work, *Finnegans Wake,* which is in many ways a paradigm for the linguistic concerns of many of the writers of the 20th century.

During the 17th century the works of Descartes and Locke shifted attention to the nature of mind and thought, and thus eventually to language, the medium of thought. Language became the subject of a renaissance of scientific and philosophical inquiry which inevitably influenced literature, though not overtly until the end of the 19th century when writers began to scrutinize their artistic medium with a new intensity, making it part of their message. Thus, one of the characteristics of 20th century modernism is its linguistic self-consciousness, its unprecedented, heightened awareness of language.

This awareness, it is true, is in some degree an innate part of the genius of every poet; but by the 20th century, it had become an overtly conscious part.

When the philologists Rasmus Rask and Franz Bopp in the first decades of the 19th century led the way into the uncharted land of languages, the only equipment they took with them was the scientific method. The purpose of their expedition, and of the more refined ones conducted later, was to gather phonological and morphological specimens from several Indo-European languages, and, by comparative analysis, inductively to derive laws of linguistic change. For the first time with any real depth or consistency, language was being treated as an observable phenomenon. Words and their sound patterns were empirical entities that could be studied.

By the turn of the 19th century, after decades of scientific philology, the impact of which was popularly felt in the monumental and scholarly *Oxford English Dictionary,* the writer as never before was aware of his medium as a medium, with its own ontology. Words were now no longer simply transparent signifiers, but were seen to participate more directly in reality; they were objects in a world of objects. This insight was exploited not only by Joyce, but by Pound, Eliot and others, and forms a foundation for the poetic theory and works of William Carlos Williams, the Objectivist and later Projectivist poets, as well as the group of artists writing in what David Hayman calls the wake of the *Wake.*

Joyce's work in this regard is paradigmatic. To his fictional protagonists, words first have an objective and empirical identity. The boy in the story "Sisters" is fascinated by the words "paralysis," "gnomon," and "simony," which "had always sounded strangely in" his ears (*D* 9). Stephen Dedalus, whom Joyce called a "gentleman wordsharper," also makes various lexical discoveries, including as a child the word "suck" whose "sound was ugly" (*P* 11). When we come to *Finnegans Wake,* however, like Stephen and the boy in the story, we, the readers, are the protagonists and discoverers of linguistic artifacts in the rubble heap of the book. When, for example, in the beginning we are confronted by a thunderword, we cannot help but marvel at the ridiculous thing snaking across the page as if it were alive, having a separate, unlikely existence of its own:

> The fall (bababadalgharaghtakamminarronnkonnbronntonnerronntuonnthunntrovarrhounawnskawntoohoohoordenenthurnuk!) of a once wallstrait oldparr is retaled early in bed and later on life down through all christian minstrelsy (*FW* 3).[2]

It is a word gone beserk, an impossible word which insists on its individuality as an aural and visual entity and on its right to exist as a thing, a sound-image which has meaning.

In *Finnegans Wake* the thunderword is the primordial sound of the Fall of God into his creation, of the fall of Finnegan, the hod carrier, off his ladder, and of humpty dumpty off the wall, events which initiate new cosmic and historical cycles. It is also the primal linguistic stuff of prelapsarian Babel, the divine first substance, Logos. Not only does its strange sound as a word draw attention to its substance and essence, but its visual, printed form is a necessary part of its being. Indeed, *Finnegans Wake* and many other "verbivocovisual" modern works need to be read with the eyes as well as with the ears.

The tendency in modern literature to treat words as objects is probably grounded as much in the technology of printing as it is in the scientific method of philology; in fact, taking a cue from Marshal McLuhan, it could be argued that the phonetic alphabet and the printing press necessarily had to be invented before the linguistic renaissance could develop. Print makes language an ob-

ject, giving it a visual presence which the artist can exploit. To appreciate much of modern literature, particularly poetry, we as readers must be "abcedminded" (*FW* 18.17) without being absent minded. We must be attuned to the visual puns and to the physical appearance of the word on the page, as well as to the music of the text. The "alphybettyform" of each thunderword, for example, consists of 100 letters except for the tenth thunderword which has 101 letters, making 1001 letters in all. Letters are the building blocks, the atoms of this linguistic universe, and the total number of them in the thunderwords is symbolic of birth and renewal, for the one thousand and first letter is the beginning of a new millenium, of a new cosmic cycle.

Philology, in addition to enhancing the modern writer's ontological awareness of words, gave him an awareness of the history and interrelatedness of languages. Comparative and historical linguistics discovered that the genealogy of a word or family of words could frequently be traced to a single source or an a-priori root-word. Through metaphorical process and ordered phonetic change which could be stated in terms of laws, the root metamorphosed into various forms at various times in its descent to the present. Language, as Hugh Kenner has observed, was discovered to be

> a complex coherent organism that is no more the sum of its constituent words than a rhinoceros is the sum of its constituent cells, an organism that can maintain its identity as it grows and evolves in time, that can remember, that can anticipate, that can mutate. Latin is not a dead language; everyone in Paris speaks it, everyone in Rome, everyone in Madrid. The poetic of our time grows from this discovery.[3]

Or as the *Wake* puts it: "the sibspeeches of all mankind have foliated . . . from the root of some funner's stotter" (*FW* 96).

Though such a discovery seems rather commonplace today, when Joyce was a young man studying Skeat's *Etymological Dictionary,* it was a vision which had many implications for literature. Because language could be seen as something organic rooted in and growing out of the past, it was testimony to the continuity of human experience. At a time when science and Darwinism seemed to be cutting man away from God and meaningful existence, language was reconnecting him with his past, creating order and meaning for the present.

The language of *Finnegans Wake,* which Shaun calls "root language," is the artistic embodiment of this second philological insight. It is constructed (though that is too static an image) out of the bricks of etymological root-words. With the Greek word "Bronton" (see note 2) embedded in the thunderword, for example, Joyce is connecting with the ancient world where the Thunderer, Zeus, ruled myth and religion.

Moreover, some of the techniques which Joyce uses to derive the *Wake*'s "root language" or "ur sprogue" are analogous to many of the theoretical processes which occur in the evolution of language. To give one example, Joyce plays with the phonetic law that describes one of the developments of the Celtic languages from proto-Indo-European, namely, the shift from /p/ to /k/, as seen, for example, in the cognate forms for "foot" which are in Latin *pes,* Greek *pous,* and Gaelic *cos.*[4] Hence, the *Wake* word, "quotatoes." A more involved example is Shaun's attempt to convert Roman Catholics into proper Irish Catholics by calling them "roman pathoricks" (*FW* 27.02). Shaun's word also demonstrates Joyce's use of the linguistic phenomenon of L/R interchange. That is, he takes "Roman Catholics," applies the P/K shift to derive "Roman Patholics," to which he then applies the L/R interchange rule to arrive at "roman pathoricks."

Finally, if the word is a thread extending into the past, binding the past to the present, it is also a part of a fabric woven and inter-

woven with the threads of many other words or many other languages. That is, the philologist's comparative method revealed that all Indo-European languages are interrelated. No language is an island. This awareness recovered for the modern artist some of the lost social and metaphysical coherence he was desperately seeking. Men are united by virtue of their language. In part for this reason, many 20th century writers, particularly Pound, Joyce and Eliot, freely use foreign words and phrases. Pound in the *Cantos,* for example, borrowed freely from Greek, Latin, French, Provencal, Spanish, Italian, as well as Arabic, Chinese and Egyptian Hieroglyphic languages. One shrinks from making an inventory for *Finnegans Wake* where such languages as Swahili and Polynesian have been identified. The thunderword, for example, is made up of many foreign words, as well as roots which mean noise and thunder (see note 2). It is an attempt at universality, at connecting all men and nations in a timeless moment.

I have tried here to sketch some of the ideas of the linguistic renaissance which affected one of the more obvious works of linguistic experimentation, a work whose major theme, as Hugh Kenner noted, is language itself. In this sense, *Finnegans Wake* can provide a key to the further linguistic study of modern literature, as well as to the concept of modernism in literature.

Notations

[1] References to Joyce's works will be cited parenthetically using the editions and abbreviations noted below:

James Joyce, *Dubliners* (New York: Viking Press, 1967). Abbreviated as *D.*

———, *Finnegans Wake* (New York: Viking Press, 1939). Abbreviated as *FW.*

———, *A Portrait of the Artist as a Young Man* (New York: Viking Press, 1964). Abbreviated as *P.*

[2] A partial gloss of the thunderword:

-gharaghtak-	Gaelic: gaireachtach = boisterous
-bronnto-	Greek: to thunder
-bronnton-	Greek: Thunderer, epithet for Zeus
-ton-	Latin: tono = to thunder
-tonner-	French: tonner = to thunder
	German: Donner = thunder
-skawn-	Gaelic: scan = crack
-thurnuk-	Gaelic: tornach = thunder

[3] Hugh Kenner, *The Pound Era* (Berkeley: University of California Press, 1971), p. 96.

[4] See Brenden O'Heir, *A Gaelic Lexicon of "Finnegans Wake"* (London: Oxford University Press, 1970), pp. 198-208, for a discussion of the P/K shift.

SNOW CRYSTALLOGRAPHY AND STRENGTH
An Index of the Effectiveness of Roof Insulation

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Abstract

Crystallographic and strength profiles taken in the mid-winter snowpack on a residence-laboratory roof in south central Wisconsin show a close correlation with the internal thermal regimen and ceiling architecture of the building. These relationships suggest the feasability of using these two snowpack parameters as a field index of the effectiveness of insulation.

INTRODUCTION

On a cold winter day, melting snow on the roof of a heated building is an obvious indication of poor insulation and excessive heat loss. More subtly, a roof supporting a snowpack with a basal ice layer indicates greater heat loss than one with no basal ice. In this case the capillarity and low temperature of the snow was capable of "blotting-up" and refreezing the small amount of melt water which had been released.

Today, with increased emphasis on home insulation there is a corresponding increase in survival of snow on the roof, often without formation of basal ice. However, even with roof temperatures less than 0°C the heat flow seems to be sufficient to metamorphose the snow, modifying both its crystal structure and its mechanical properties. The degree of metamorphosis is proportional to the heat flow.

This paper describes how, with the use of simple equipment, the crystallinity and strength of snow on a roof can be examined to quickly give an index of relative heat loss.

Swiss avalanche researchers were the first to describe the relationship of the thermal regimen to the crystallography and strength of snow on the ground (Bader *et al.*, 1939). La Chapelle (1969) noted that two kinds of recrystallization take place in snow on the ground at temperatures less than 0°C. *Equi-temperature metamorphism* produces fine granular snow which becomes well bonded (sintered) and stronger as time passes. *Temperature gradient metamorphism* interferes with the sintering process and over time produces beautiful, coarse, euhedral crystals called *depth hoar*. Thus there is the general association of weakness with depth hoar development.

A temperature gradient in the snowpack implies the flow of heat through the pack. The normal source for this heat is energy stored in the ground during the summer and gradually released in winter. At any given moment, the thermal gradient in snow is a function of the temperature difference between the ground-snow interface and the snow-air interface distributed over the depth of the snowpack. The steeper the gradient, the greater the heat flow, the more complete the metamorphism, and the more perfect the euhedral development of depth hoar crystals.

Since the ground is the heat source and the oldest snow is nearest the ground, the crystal development of the basal snow provides the clearest index of heat flow.

Regarding snow strength, Bradley *et al.* (1978) showed that while gradient metamorphism causes snow to lose strength with time, the weakest snow is actually associated with partially developed (subhedral) depth

hoar a few centimeters above the base, and that in the last phase of crystal perfection there is a slight gain in strength. This study demonstrates that the same holds true for snow on the roof and hence snow strength again can be used as an index of heat flow.

The winter of 1978-79 in southern Wisconsin produced heavy snow loads. Roof collapse was common. This winter was also a time of protracted cold. From December 30 until mid-February the temperature never rose above freezing on the Leopold Memorial Reserve near Baraboo, Wisconsin. The diurnal temperature typically ranged from about −25° to −15°C. By February, the bottom half of the 50 cm. of accumulated snow on the ground was composed largely of depth hoar, so weak that the pack tended to collapse under the load imposed by a skier.

On January 19, we decided to unload snow from the roof of the Reserve Study Center. Spontaneous collapse of a small area of the roof snowpack occurred as the first shovel was inserted. The Center is well insulated even by modern standards but this evidence of extreme fragility indicated significant heat flow from the roof. In addition, as the roof snow seemed even weaker than the snow on the ground, a different thermal regimen was indicated although the nature of the difference was not immediately clear. A search for heat loss indices was conducted over the next two days as 23 metric tons of snow were shoveled from the roof.

Methods

The degree of gradient metamorphism in the snowpack was determined using two kinds of vertical profiles: 1. crystal perfection of the depth hoar; 2. snow strength (See Fig. 1).

Crystal perfection was observed with a hand lens (10×) on samples taken at 5 cm-intervals from a vertical cut face of the pack. Special attention was given to weak zones near the base. Three categories were selected: *Anhedral,* irregular grains but no crystal faces visible. *Subhedral,* scattered crystal faces visible. *Euhedral,* crystal facets clearly dominant in the entire sample.

Snow strength was observed in two ways. The first is qualitative. Immediately after cutting the vertical face the surface of the cut was brushed lightly with a whisk broom which etches the weaker layers leaving the stronger layers as ridges. By giving approximately equal treatment to the entire face the relief produced by the whisk broom is a fairly reliable measure of the relative strength of the various layers.

A snow resistometer was used to obtain a more quantitative measure of strength. The instrument consists of a metal probe with a conical point. The probe is pushed vertically into the snowpack. A sensitive displacement dial mounted in the spring handle records the force per unit area of the cone (N/m^2) necessary to achieve penetration. The instrument has an accuracy in excess of 0.5 N/m^2.

Using preliminary vertical measurements from the whisk broom profile as a guide for the resistometer I obtained spot strength measurements of preselected zones in the snowpack. The mean of four probes represent each point plotted. The points were then connected on a line sketched from the whisk broom profile. The plotted profiles also show those particular layers that were seen to collapse on the pit face when disturbed by the shovel or by pressure deliberately applied to the upper snow surface.

The decision to study the roof snowpack was made too late for a proper investigation of the actual thermal history of the pack. Still, the imprint of that history was sufficiently clear for a qualitative comparison of four roof areas each of which had had a different thermal regimen. For additional comparisons profiles of snow on the lawn and one from snow on the unheated woodshed where gradient metamorphism should have been minimal were included.

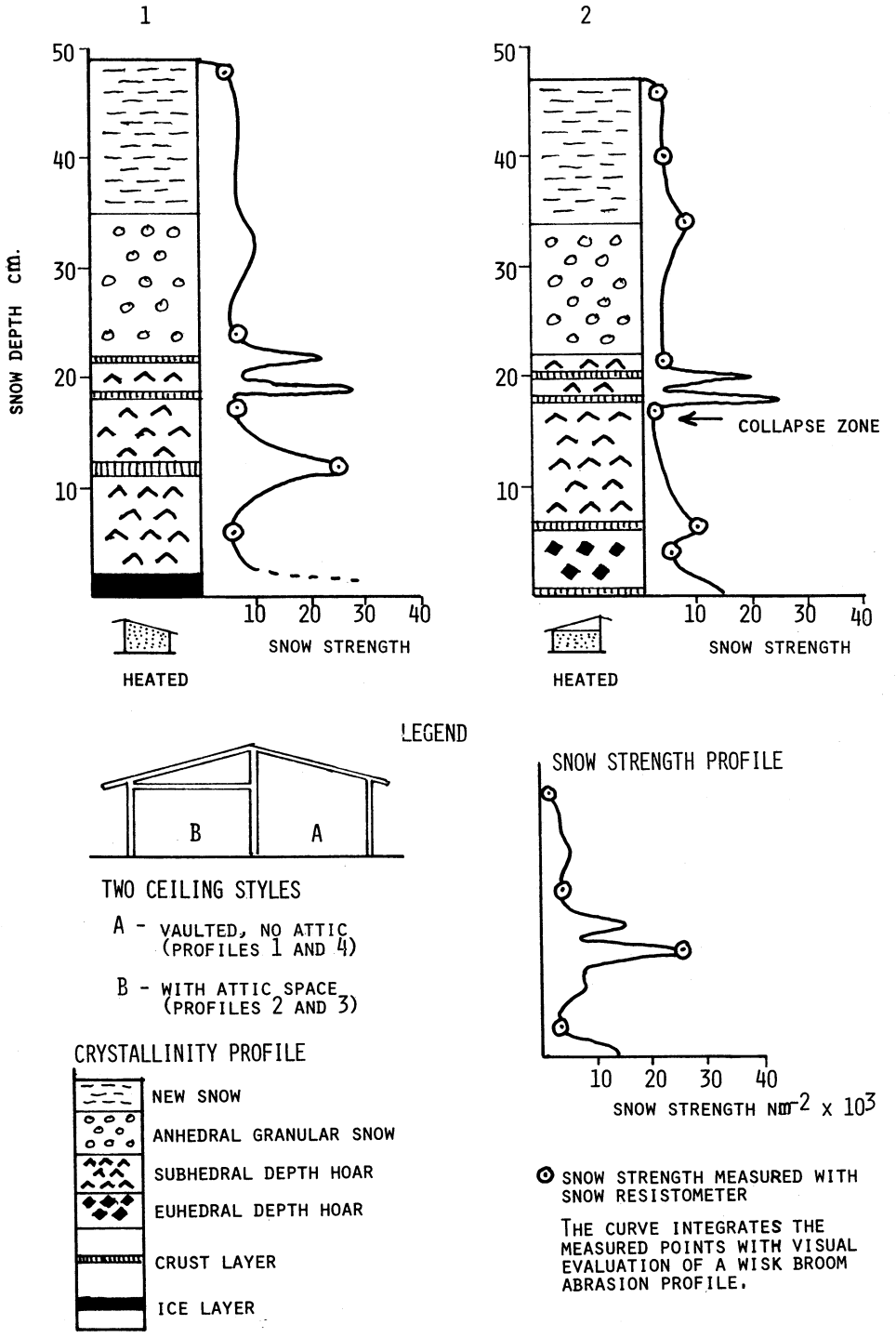
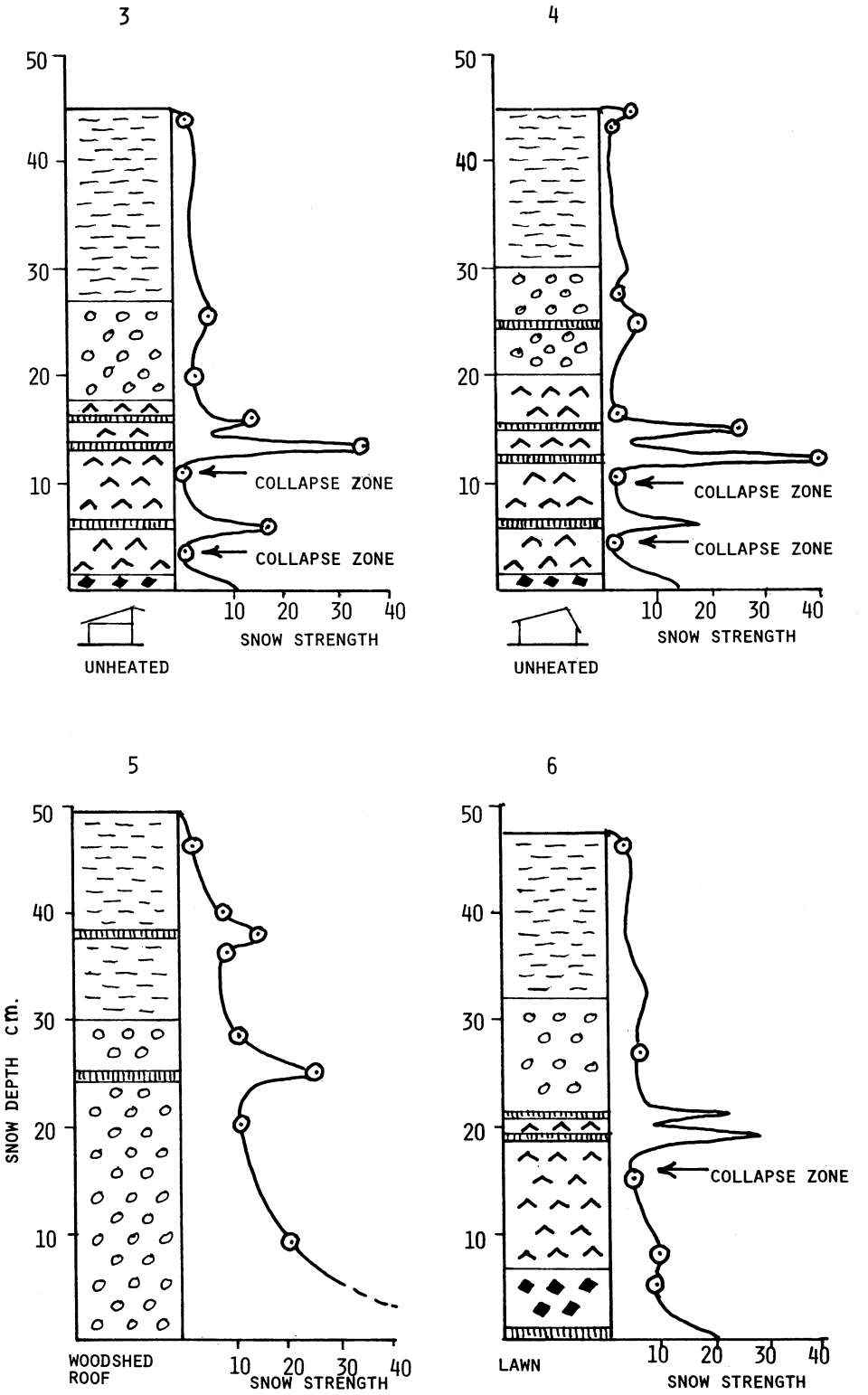


Fig. 1. Crystallinity and strength profiles of snow on the roof of the study center, Leopold Memorial Reserve, obtained January 19-20, 1979.


3
4
5
6
50
40
30
20
10
SNOW DEPTH cm.
COLLAPSE ZONE
COLLAPSE ZONE
COLLAPSE ZONE
COLLAPSE ZONE
COLLAPSE ZONE
10 20 30 40
SNOW STRENGTH
UNHEATED
UNHEATED
WOODSHED ROOF
LAWN

Temperature readings reported in the study were obtained mainly during the period of shovelling and hence only suggest the thermal regimens influencing the snow metamorphism.

The living room roof, alone of the four areas, faces south. The others face north. But, since outside air temperatures had not approached melting point all winter and since light penetration into snow is low, it seems safe to assume that this difference was unimportant. The profiles tend to confirm that assumption (Fig. 1).

Observations

Six pairs of profiles were prepared, one pair each for the four roof areas of the Center, and one pair each for the woodshed and lawn (Fig. 1). Except for the lawn profile the profiles are arranged in order of decreasing thermal gradient.

Profile 1 was taken over the living room where internal temperatures at shoulder height were held between 12°C and 18°C. Temperatures measured at the peak of the high (3.5 m) vaulted ceiling were 4 or 5 degrees higher. The ceiling-roof consists of 5 cm. styrofoam insulation sandwiched between wood with a total thickness of about 15 cm.

Profile 2 was taken over the hallway which has the same internal temperature as the living room (12° to 18°) but has a low ceiling and is separated from the roof by an attic space. Both the ceiling and the roof are well insulated but the attic area has a restricted opening into the unheated garage and remains cold in winter. Attic temperatures were not taken.

Profile 3 taken in the snow over the shop, represents an area architectually similar to the hallway #2 but unheated. Temperature readings in the shop remained near 10°C during the cold weather, a result of leakage from the heated area.

Profile 4 was obtained over the unheated garage where the architecture is similar to the living room. Near the vaulted ceiling the temperature was 0°C when the outside temperature was −15°C.

Profile 5 represents snow conditions on the woodshed. Metamorphism of this pack must have been about as close to equitemperature as one would find in nature. The snow was subjected mainly to the diurnal flux of air temperature. Probably, heat flow from the ground through the wood-pile to the roof was negligible.

Profile 6 represents the lawn conditions. This profile provides a basis for estimating the prevailing thermal gradient. The fact that the ground beneath the snow was unfrozen but the basal snow was unmelted suggests a steady ground-snow interface temperature approximating 0°C. Most of the metamorphism would have occurred during periods of low air temperature. The mean nightly temperature during the winter approximated −25°C. Assuming a 50 cm. snow pack, this temperature gives a mean gradient of 0.5°C/cm. But even this value probably represents the minimum because much of the metamorphism of the basal snow would have taken place when the pack was thinner and the gradient steeper.

Comparison of profiles 1 through 4 show a progressive change in crystallinity and strength to match the progressive drop in temperature gradient. In Profile 1 the roof temperature was high enough to melt the basal snow preventing the development of euhedral depth hoar and producing basal ice. In Profile 2 a lower roof temperature resulted in a thick layer of euhedral depth hoar; Profile 2 shows a closely similarity to Profile 6 and hence probably had a very similar thermal history including a roof temperature close to 0°C.

Profiles 3 and 4 developed under still lower roof temperatures and had little euhedral development. Both show a broad zone of subhedral crystals and such fragility that under the overlying snow load it was virtually impossible to insert the shovel without

initiating snowpack collapse. As expected Profile 5, with minor perturbations, shows increasing strength with depth—the expected equitemperature profile.

Conclusions

It seems clear that a correlation exists between the strength and crystallinity of snow on the roof and the heat loss from the house under study.

A thoroughly quantitative study of heat loss through a roof and its effect on snow would require an imposing array of instruments to measure the pertinent variables involving roof, snow and weather throughout the course of the winter. However it is evident that an observer with handlens, whiskbroom and shovel could tell, with a brief examination of the basal snow, which areas of a roof were losing the most heat and which the least.

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DOUGHBOYS AND HOME FOLKS
Observations from Rusk County, Wisconsin, at the Opening of World War I

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A verse from a marching song found in the papers of a Rusk County, Wisconsin, soldier read:

> Goodbye maw, goodbye paw,
> Goodbye mule with your old he-haw.
> I don't know what this war's about,
> But you bet by gosh I'll soon find out.
> And Oh! my sweetheart don't you fear
> I'll bring you a king for a souvenir.
> I'll get you a Turk and the Kaiser too,
> And that's about all one fellow can do.[1]

More than six decades have passed since the United States plunged into the Great War in 1917. But perhaps no conflict of this century has had a greater impact on the American people. This article examines the initial effects of World War I on a portion of northern Wisconsin—Rusk County and vicinity—and upon its young men who shouldered arms in defense of their country.

Both those who left and those who remained at home found that their cultural isolation, security, and attendant parochialism came under attack; rural values and beliefs were subjected to severe stress. Individualism was subordinated to uniformity, while the presumed moral superiority of the countryside was confronted with the reality of twentieth-century American urban life.

A location in upper Wisconsin was selected because most of what has been written about Wisconsin in the Great War concentrates upon the activities of the more urbanized and politically active southern part of the state. In addition, if tensions existed between the two halves of the state because of political and economic disparities, as they apparently did, it would be interesting to know how they manifested themselves in the general war effort.

The Rusk County area, with Ladysmith as the county seat, was typical of northern Wisconsin in the period. It was sparsely populated, and depended upon marginal agriculture, the railroad, light industry and wood products for its survival. When war broke out, the county threw itself energetically into the war effort, contributing more than her share of men to the military.[2]

As part of the research for this article, thirty-eight local veterans cooperated by completing questionnaires and/or granting personal interviews. The questions were designed to elicit information regarding family background, educational attainment, social position of the individual, occupations both before and after the war, military experiences, and personal prejudices and attitudes. This sampling is not large enough to render precise measurements of attitudes, but suggests their general magnitude. Also, secondary sources have been utilized, as have local newspapers and hitherto untapped personal correspondence from the period.

The news which had electrified Europe in June of 1914, that the heir to the Austro-Hungarian throne had been assassinated, initially registered only a tingle in the northern Wisconsin papers. But within weeks, foreign affairs had become a ubiquitous topic of conversation. As great armies swung into action, northern Wisconsinites settled down to enjoy the spectacle. "A new history of Europe is being written," observed one editor; "We will publish a thrilling chapter

every week."[3] Movie theaters capitalized on the moment; for example, in Ladysmith the theater screened on consecutive weekends in September 1914 "War is Hell," "Napoleon," "Faithful unto Death," and "The Last Volunteer."

Inevitably, some Rusk County area residents identified with one or another of the belligerents. Many inhabitants of the region were foreign-born, some of German extraction. The concentration of German-Americans in this area was lower than in the southern part of the state, but there were some Teutonic communities with strong feelings about the war.[4] More than balancing these, however, were settlements of French, Italians, and Belgians, which, in the opinion of one veteran, gave the area a pro-Allied bias. Veteran E. A. Preston of Ladysmith recalled that pacifism was the most prominent sentiment in this hometown, while another veteran, Private Allen Cooper, remembered the district around the village of Dallas in neighboring Barron County as isolationist, albeit "certain folks wanted to get us involved in the fracas." A similar view was expressed by Private Henry Plagge from adjacent Chippewa County.[5]

Although public sentiment might have been gauged somewhat differently by the interviewees, a common belief seems to have existed until the eleventh hour that our involvement in Europe was unlikely.[6] However, by February 1917, Washington and Berlin were clearly on a collision course, and the *Rusk County Journal,* among others, now dismissed those who said war was impossible, adding:

> While the American people should pray that war may be averted, they should get busy at once and prepare for the emergency that looms up close.[7]

By 12 March 1917, President Wilson had ordered the arming of U.S. ships. On April 2, the President delivered a stirring message to Congress requesting a declaration of war against Germany, which Congress granted on April 6.

The citizens of the Badger State found themselves in a rather uncomfortable position. Wisconsin had a large (42%) and vocal minority of German-Americans, which led to the nickname "the 58% State."[8] Because of this, neighboring states and even the War Department feared that Wisconsin might have to be subdued in case of hostilities.[9]

Then, too, there were the anti-war activities of Wisconsin's Senator Robert M. LaFollette, or "Von LaFollette," as he was labeled by the *Cincinnati Post.*[10] His actions outraged many in the Rusk County area, for, as one local weekly editorialized,

> On account of the attitude of the senior U.S. Senator from this State, Robert M. LaFollette, on the armed neutrality bill, which measure he led to destruction by his filibustering methods, . . . Wisconsin is in the limelight, scorned and humiliated by every American newspaper and citizen. . . . He . . . sets an example that will be quickly taken up by the belligerents who will not be slow to sow the seeds of discord among American citizens.[11]

When the President's war message came to the floor of the House of Representatives, nine of Wisconsin's eleven members voted nay, the exceptions being Irvine Lenroot and David Classon, both representing northern Wisconsin.[12]

To dispel suspicion of its patriotism Wisconsin quickly swung into action. On April 12, the first State Council of Defense in the nation was established, soon followed by branches in every county; a thousand Four Minute Men toured the state, rallying support, and funds were solicited for the Red Cross, YMCA, and Liberty Loans.[13] Victory gardens sprang up in vacant lots and school children were organized to tend them. The capstone was Wisconsin's gift to the nation of statewide "wheatless" and "meatless" days.

Madison's war mobilization efforts met with mounting approbation in Rusk County and its environs. Patriotic meetings were held monthly in rural schoolhouses; all boys ages twelve to twenty in Sawyer County were mobilized for farm labor; loyalty was taught in the schools, when necessary to the exclusion of normal courses of study; and "go to work or go to jail" was becoming the motto of the area. Conservation and rationing were accepted as necessary. The mood of the people was expressed in the following verse, entitled "Hooverizing":

> My Tuesdays are meatless, my Wednesdays are wheatless,
> I'm getting more eatless each day.
> My home it is heatless, my bed it is sheetless,
> They're all sent to the YMCA.
> The barrooms are treatless; my coffee is sweetless,
> Each day I get poorer and wiser.
> My stockings are feetless, my trousers are seatless,
> My God, I do hate the Kaiser![14]

The economic and financial contributions demanded of the area were hotly debated. What was needed was not an exodus, but an inflow, of capital if this raw new country were going to be able to clear land and increase food production for the war effort.[15] Instead, the Liberty Loan drives, among others, drained liquid assets from the region. The total subscription for Liberty Loans in Wisconsin was $333,633,800; Rusk County contributed $510,300, a sum which represented less than half the average per capita contribution in the state. Yet the sacrifice was heavy, and, when the newspapers were asked to publish the statement, "No man is too poor to do his bit by subscribing," the editor of the *Rusk County Journal* expostulated:

> We object . . . to publish[ing] stuff that contains such a damnable lie as the foregoing. It is safe to say that more than half the men of the country are too poor to buy a Liberty Bond.[16]

Nevertheless, Rusk County did its best by contributing not only to the Liberty Loans, but also the Red Cross ($4,922), and to savings stamps ($101,000).[17]

The dark side of the war effort throughout the nation and in the Rusk County area was the mounting hysteria, more violent than in the Civil War or in World War II.[18] The situation was exacerbated by the Espionage Act of October 1917 and the Sedition Act of May 1918 (under which, for example, refusal to purchase a Liberty Bond or the use of imprudent language could lead to a maximum sentence of twenty years in prison and a $20,000 fine).[19] Vigilante groups bent on patriotic missions were organized, and the word "slacker" reverberated in civilian and army life. Sauerkraut and German measles were rechristened, respectively, liberty cabbage and liberty measles. A final indignity proffered by the American Defense Society was their suggestion that all Germans not well known locally be considered potential spies.

Those German-Americans and aliens living in the Rusk County area found themselves uncomfortably conspicuous. In the best of times, provincial people have difficulty understanding dual loyalty.[20] It was no accident, therefore, that with the arrival of hostilities, xenophobic tendencies increased. Even before the President's war message, concern about the presence of foreigners was voiced in the local press. On 9 March 1917, the editor of the *Ladysmith News-Budget* reviewed a film entitled "Fall of a Nation," in which a European army invaded the U.S. with the assistance of foreign immigrants. "This," declared the editor, "provides an awful warning." On 12 April, the *Rice Lake Chronotype* advised the alien to "obey the laws and keep your mouth shut." And within months he was further

told that "the day will come when foreign [language] newspapers will not be tolerated."[21] All things alien obviously were suspect, but not even naturalization could satisfy the zealots, as this editorial suggests:

> On reading over the list of applications [for citizenship] one cannot escape the thought there ought to be some legal way to Americanize some of the names to some extent while Americanizing their citizenship.[22]

The plight of the aliens worsened in June when their true numbers became known through the registration of all men eligible for the draft.

The situation for German-Americans was particularly sensitive. A portion of a song which one Ladysmith soldier kept among his papers illustrates the dilemma of many:

> I am a Deutscher man
> But I'll fight for Uncle Sam
> And I want you to know
> Where ever I go
> I'll do the best I can.[23]

Recruits with Teutonic names were given pamphlets with titles such as "American Loyalty" which argued that Prussianism, not the German people, was the foe, and that the nation was on a crusade to rescue Germany.[24] However, treason stalked the Northwoods, often appearing in isolated German communities whose inhabitants, deemed insufficiently patriotic, might be labeled Kaiserites or worse.[25] Several area residents were arrested for sedition, while the *Phillips Bee* reported that a "nest of disloyal Americans" infested their town.[26] An organization calling itself "The Loyalty Legion" was soon established in the Rusk County area, welcomed as an ally in the unmasking of treason. The editor of the *Rusk County Journal* approved, arguing

> . . . that patriotic societies with or without name be organized where there may not be any today, to oppose treason and line up traitors where ever they may be found. Before the year 1918 is closed there ought to be thousands of disloyal or semi disloyal men put into stockades until the war is over.[27]

Against this general background, it might be well to turn to the Northwoodsmen who took up arms in their country's behalf.

The first in Wisconsin to be summoned to the colors in April 1917 were the National Guard, veterans of the Mexican imbroglio of 1916, who were dispatched to protect ore docks, railroad bridges and other strategic points. A second brigade of three regiments was immediately planned, with Camp Douglas selected as its rallying point. Men ages eighteen to thirty-five were encouraged to enlist, and to fire the blood frequent allusions were made to the State's glorious heritage from the Civil War. For example, Lieutenant Maloney of Rusk County wrote, "Recovery of the American spirit, the aggressive liberty loving and self sacrificing spirit of . . . the Boys of '61 have been the source of our greatest national pride."[28]

Initially, volunteers had been few, and as one recruitment officer observed later:

> Like the generality of Americans, the people of Rusk County were slow to realize the possibility of war. No great war having been experienced during this generation, they could not bring themselves to believe that war was a possibility. The young men felt that joining the troop would tie them down to useless drill.[29]

Recruitment techniques in the Rusk County area included speeches, public meetings and automobile cavalcades.

After the commencement of hostilities, many men had left the area to join the Allied armies, and their letters home, published in local papers, were filled with war experiences that evidently stimulated enlistment. Positions in the cavalry and aviation corps offered high drama and consequently were

most alluring.[30] "Some unthinking recruits," editorialized the *Ladysmith News-Budget,* considered the plan for national defense "as only a means of recreation and excitement."[31] Romantic illusion was maintained through provocative war movies and literature. Today the novels and poetry of the period seem maudlin, but their effects should not be ignored.

A powerful attraction for volunteers in Ladysmith was the opportunity to enlist in a cavalry troop, with all its attendant dash and excitement. War arrived at an auspicious season for enlistment in the Northwoods, for, as one veteran recalled, the "river pigs" and "cruisers" were at slack time, allowing logging crews to volunteer en masse. That veteran also reported that some men of German descent even volunteered with the understanding, which was honored, that they would not have to fire at the enemy, as did also an army cook who said he had "ein fodder 'n' two bridders" in the ranks of the Kaiser.[32]

Nationwide volunteerism proved inadequate for the country's needs. It was obvious, therefore, that conscription was the only solution. On 18 May 1917 the Selective Service Act was passed; and 5 June 1917, designated "Duty Day," saw the uneventful registration of eligible men ages twenty-one to thirty-one. Overall, enlistment in Rusk County was excellent, with the result that the impact of the Selective Service Act was minimized, since volunteers were counted as substitutes for draftees.[33]

Eventually the northern twenty-nine counties of Wisconsin contributed approximately thirty-four percent of the State's total draft, although they held only a quarter of the State's population. Thus, some northern communities found themselves short of manpower. In Cumberland (Barron County), for example, 78 of the 120 registered men were taken on the first round.[34] One young lady writing in the summer of 1917 complained, "How about the Ladysmith Girls—they can't find a fellow here if they wanted to for they're like hen's teeth—scarce."[35] Her lamenting finally prompted this rejoinder from her doughboy fiancé:

> I suppose the girls are organizing a football team to take the place of men that would play if they weren't in the army. You know that all over the country the women are learning to do things that were formerly proformed [sic] by men and Ladysmith don't want to be behind the times.[36]

Some men, much to their dismay, were rejected as volunteers but were later drafted.[37]

Rivalries among Wisconsin recruits divided them in several ways. First, the cavalry troops had the conviction that they were unquestionably superior to the infantrymen. This resulted in clashes such as the general melée reported by a Ladysmith trooper in August 1917 at Camp Douglas, after which some commanding officers were punished along with their men for their reluctance in quelling the disturbance.[38]

Another cleavage separated the volunteer and the draftee. The motto of the Wisconsin National Guard was "Come in out of the draft," showing disdain toward conscription. The enlisted men at camp might be curious to know who back home had been drafted, but, as Private William Bretag of Ladysmith wrote, "We're not proud of them."[39] A poem which was circulated among the northern Wisconsin men, evidently describing their feelings, read in part:

> Why didn't I wait to be drafted,
> And led to the train by a band,
> And put in a claim for exemption?
> Oh, why did I hold up my hand?
> Why didn't I wait for the banquets,
> Why didn't I wait to be cheered?
> For the drafted men got all the credit,
> While I merely volunteered.[40]

One sympathetic editor in Ladysmith suggested that there be no fanfare when the draftees departed.[41] Often this tension was channeled into athletic activities; as one

Rusk County man wrote after a football game, "I knew all the time that the volunteers could beat drafts any day."[42]

The words "slacker" and "draftee" were synonymous in the minds of some; as one enlistee grumbled,

> Speaking of slackers, they seem to fare pretty well. . . . All the drafted men have overcoats and winter clothes while we [volunteers] still wear our summer issue.

In another letter he reported that

> They say the officers can't do anything with them [the draftees]. They won't obey orders at all and if they are put on guard they go to sleep.[43]

Obviously not all drafted men fit this description, but the reality of the situation was not as important as the perception of it.

It has been suggested that the bastions of super-patriotism in Wisconsin lay in the small towns.[44] Communities in the isolated northern portion of the state were naturally more cohesive than their larger urban counterparts in the south. Troops were recruited at the county level and local sentiment favored having hometown men serve together. Initially every effort was made to maintain parochial entities, such as local cavalry troops, within the armed forces. This sentiment was extended to other units of the armed forces as well, such as the Fourth Wisconsin Infantry Regiment, which was to be recruited only from the upper part of the State.[45] There were many advantages to hometown units; parents formed permanent organizations, auxiliaries were established to make comforts for the boys; community-wide drives successfully gathered quantities of small luxuries which were sent to their own fighting units; and employers promised publicly to rehire the veterans.

In Ladysmith, for example, support for the cavalry troop was considerable. Here, the Campfire Girls and other civic groups raised a mess fund of $1500 for Troop K prior to its departure for Camp Douglas.[46] A large crowd, complete with band, was at the Ladysmith depot at 5:20 a.m. on 27 July 1917 to bid farewell to Troop K. Their trip was punctuated by a stop at Weyerhaeuser, where the men detrained to parade *ad hoc* through the streets, and a long festive layover at Eau Claire while that city bid farewell to its recruits. Five hundred dollars had been allocated from the Rusk County treasury to buy uniforms for the cavalry.[47] These were a luxury no other unit at Camp Douglas possessed, which prompted the remark, "When we first came they called us the Millionaire Lumberjacks because we wore leather putees and our uniforms looked good."[48]

From the start, a moral influence was exercised over the boys from Rusk County. The war effort was characterized as a religious crusade and after academicians the clergymen were the most outspoken hawks in the country.[49] "Clean Christian living" in the camps was the desire of the home folks, an ideal supported by the federal government as well as the State of Wisconsin.[50] For Northwoodsmen this meant availability of nightly Bible classes, sending home of signed temperance pledge cards, and mandatory church attendance on Sundays.[51] The ubiquitous YMCA and like organizations fostered rectitude and promoted such events as a "Night to Write to Mother," while Wisconsin's Governor Philipp imposed a 'dry zone' around Camp Douglas. When Troop K was transferred to Camp McArthur, near Waco, Texas, there was concern back home that the innocents from the north would be led astray, a fear not completely allayed even when the city fathers of Waco made assurances they would keep the boys moral at the cost of closing saloons and driving out disreputable individuals.[52]

For many doughboys, the gilt of army life began to tarnish almost immediately. Homesickness was rampant; one newcomer at Camp Douglas said of the well-wishers at the send-off, "Some of them made so much

fuss it made it pretty hard for the boys and I was glad when we got away."[53] A couple of the stalwarts complained bitterly about the hardness of the beds and the absence of pillows.[54] Setting the matter of discipline aside for the moment, the raw recruit found his illusions sorely tested by reality. The widely applauded bravado of a Washburn County swain, who declared upon enlistment, "Now I don't give a damn just so long as they bury me on German soil," illustrated the misconception that the only way one could die in the army was valiantly, at the front.[55] But there were many inglorious ways of forfeiting one's life without ever seeing the enemy. Accidents on the practice range were common—even the hospital at Camp McArthur was shelled by novice gunners.[56] More disheartening were the deaths by disease which ravaged the camps. Many of the men were quarantined with mumps at Camp Douglas in the summer of 1917, but this was nothing compared to the pneumonia, rheumatism, and tuberculosis which struck them down in Texas.[57] Yet the following year brought an even greater disaster, the influenza epidemic. There were also occasional instances of maltreatment by officers. A Ladysmith private risked chastisement by writing home that he had heard that a major at Kelly Field in Texas had so mistreated his men that eight had cut their throats, many had deserted, and still others had perished by freezing.[58]

The sobering of one Northwoods volunteer might represent the experiences of many of his companions. After the heady days of departure with Troop K, Private William Bretag underwent a change of heart. In October 1917, his only desire was to go to Europe, have it out and survive. While at Camp McArthur, Bretag and his companions saw ruined French equipment on display at the Cotton Palace in Waco, but instead of eliciting sympathy the sight depressed them, for it graphically illustrated the firepower of the foe. In early November Bretag wrote that it was "barbarous and against the law of men and God" to shoot down such fine troops and horses as those in the American Army.[59]

Of course, all presentiments were as nothing compared to the reality of the trenches, but here the censor reigned supreme and all that the home folks received were vague statements in letters defaced by razor blades and ink. Within a few months after U.S. entry into the war, the flow of information to the media from the doughboys began to dwindle as the recruits were warned not to write the "inside dope" and the government ordered that military personnel could not act as correspondents for newspapers.[60] The results were predictable. Private Bretag wrote from Waco:

> I just read an article . . . out of a Milwaukee paper describeing [sic] this hospital we are in, was sure great. It stated we had the best of cooks which is a very good joke.[61]

For the Northwoodsman, military life meant a sharp circumscription of his freedom. The propaganda mills had long ground out the message that Prussian obedience and discipline were anathema to the American spirit, but after April 1917, as one Barron County doughboy reported, the boys were taught that obedience was the highest virtue.[62] "Rigid discipline was required in everything, even games," which dazed the newcomers; as one of them wrote after four days at camp,

> Lots of the boys would leave right now if they had a chance but nothing doing. . . . New rules new regulations and everything done under a system.[63]

By reading the correspondence of Rusk County veterans, one can see that they felt enmeshed in regulations. Topics of complaint included: drill; lack of leisure time; not being allowed to wear homemade sweaters because not all the men had them; being given a week of fatigue duty for failing to request a pass from a high enough officer; a month of hard labor and the guardhouse for partici-

pating in a friendly scrap; and a week's confinement to troop street for staying out too late. Where possible there was resistance, but never victory; Private Bretag recounted that

> some of the fellows has been in the habit of covering up there [sic] dirty clothes with clean ones and the major looked them over this a.m. The result is that some of them have something coming.[64]

In some respects the doughboys could breathe easier after they left Wisconsin. Beneath the parental gaze of Governor Philipp and the folks back home, Camp Douglas had been so tightly sealed that not even the newsboys could enter. "While we are well fed and not over worked," wrote a Rusk County volunteer, "we have some idea of what a prison camp would be."[65] This feeling of incarceration was not entirely accounted for by the three-mile *cordon sanitaire* encompassing the camp, nor yet by the discipline or the quarantines due to infectious diseases. State planning had been weak. There was little training, no ammunition, much boredom, and, for a short time, half rations.[66] To be fair, not all men found the experience unpleasant, for as Private Bretag said after cataloging some new regulations, "It may seem very foolish . . . and it seems very queer to us . . . yet I can't say I don't like it [army life]."[67]

Although the country more thoroughly understood the importance of discipline once the nation was involved in the war, the American Expeditionary Force never matched European standards of military nicety, and even the *Stars and Stripes* made jests on this topic.[68] Many veterans would argue that in their youth discipline, both in school and on the job, had been harsh, yet the difference was that the army regimentation was not merely a restricting, but a standardizing process out of which the mass man of the century would appear.

In many cases the attitude of recruits toward discipline was determined by the relationship between the officers and their men. With the outbreak of hostilities, the National Guard was mobilized and expanded preparatory to being placed under federal authority. The Adjutant General of the State recommended, and the Governor approved, the commissioning of many new captains and lieutenants who were then summoned to Milwaukee for a few weeks of training. This accomplished, the captains were free to appoint other officers who in turn were sent downstate for training.[69]

Interviews with Northwoods veterans, most of whom came from low socio-economic backgrounds, suggests that there was some discontentment over this selection process. Officers were drawn from the wealthier, better educated segment of society, which in the small communities of the area meant the "uptown people" or businessmen, and from the larger urban centers. Undoubtedly, local politics were another ingredient in selection and promotion.[70] Nevertheless, at the time, ill will was concealed, leaving an esprit based upon their shared background. Commanders of contingents from small northern Wisconsin towns might view themselves as *in loco parentis;* Captain A. H. Hadden wrote home from Camp Douglas to his local paper in this vein: "If the boys do not write home, let me know of it. They do not need to tell me when home folks do not write."[71]

As units arrived at Camp Douglas, Wisconsin, questions arose as to whether the new officers were qualified to fulfill their duties. Several were demoted, but all too often the replacement officers were from the southern part of the state. This caused some irritation. As one veteran recalled, "It is true that we suffered some from being an 'Upstate Troop'—our officers replaced by Milwaukee men."[72]

This situation altered again when the Wisconsinites passed into the jurisdiction of the regular army. Once again, locally-appointed

officers were scrutinized for fitness, and some enlisted men who were successful in passing written examinations were raised to the rank of second lieutenant by the division commander. These officers were trained in the evening after drill and were called "ninety day wonders" by the men.

Transfers and demotions were to continue. "Some of these new sergeants," wrote Private Bretag, "just can't find a hat big enough for their heads and they try to show their authority like young roosters learning to crow."[73] Higher officers were not immune from dismissal, as this letter showed:

> We are going to loose [sic] our captian [sic] again. Every captian [sic] in our three artillery regiments are going to be changed. They say its because the old captians are to [sic] well acquainted with the men and are apt to show partiality. I guess there is a good deal in that.[74]

To the folks back in Rusk County the tidings of demotion, forced retirement, and even court-martial of their heroes caused cries of indignation. Widespread dissatisfaction was expressed in the press:

> This is being done by regular officers, to whom a man from Hicks Corners, Milwaukee or Frisco looks all the same. The idea of local patriotism is a foreign subject—he only wishes to create a fighting machine and men are only so much blood and iron.[75]

In general, the uprooting of the average recruit from the Rusk County area and his arrival at training camp was a memorable experience. Of those veterans interviewed, over one-third left Wisconsin for the first time when they joined the Army, while ten percent left their counties for the first time. Most Rusk County doughboys had traveled by train before their enlistment, which was not true for many recruits.[76] Railways were very important in the north and had been used in immigration; among the veterans questioned in this study, the average year for a first train trip was 1907, when most of them were still children.

Automobile travel, on the other hand, was another matter. Maintainance of both vehicles and roads in the north was a major expense, a problem which hindered the state in meeting its quota of experienced drivers for the military.[77] In the Rusk County area, 1921 was the average year of purchase of the first car among those veterans questioned.

America in these years revealed a growing disdain for rural society, for the drabness of village and small town life, and for the 'hick,' clumsy and stupid, who was equated with the farmer. "Much of the contempt of rural life," suggested one writer, "represented a larger revolution against . . . Puritan moralism."[78]

One out of four veterans questioned recalled some incident of anti-rural prejudice in the army, and in turn one discerns a certain deference by Northwoodsmen toward urban society. The highest ranking officer of Rusk County, a captain and successful lawyer, reported that he was

> over-awed when he considere[ed] that he [was] superior in rank to some of Chicago's finest lawyers, bankers, and preachers. At first . . . he almost hesitated at commanding a bank president or preacher to clear up cigarette or cigar butts.

Or again, when Troop K from Ladysmith arrived at Camp Douglas in their new uniforms which the County had purchased, one man wrote, "We looked so good in our nice clothes that we were mistaken for the Milwaukee ('A')."[79]

To loggers, farmers, and semi- and unskilled workers in Rusk County, school attendance was far less important than earning a livelihood. An eighth grade education was the norm, and a high school diploma was a rarity. One sergeant from Bruce, Wisconsin, recalled that only five out of a company of 150 were high school graduates. It was believed that the urban environment held more

ducational possibilities; thus one Northoodsman, after acting as scribe for a ranger, wrote home, "It certainly is a ame that a young fellow coming right om the city . . . hasn't any better educaon than he has." At camp the recruits were ven written examinations, and Wednesdays, aturdays and Sundays were partially set ide for the "training of backward indiiduals."[80] Book drives back home helped establishing libraries at the camp YMCAs; owever, one soldier observed that they were efinitely underutilized. While on duty, some en were given an opportunity for selfnprovement. For example, a company of ational Guard from Barron County, staoned in Superior to protect the ore docks, ould take courses in such subjects as hipology, military cartography, shorthand, and yping, though fewer than half of them ever id so.[81]

To be at a disadvantage vis-à-vis the city wellers was one thing, but to be considered npatriotic by them was an outrage. A statenent by Mr. E. D. Hurlbert, president of ne Merchant's Loan and Trust Company of Chicago, which was circulated in the Rusk County area, said, "Farmers will not buy Liberty Loans, pay taxes, sell their produce r fight."[82] Thus, when a Four Minute Man rrived to preach patriotism in Ladysmith, he response was quite peppery, as in this ditorial from the *Rusk County Journal:*

> The small caliber flunky, Julian S. Nolan, of Chicago, was sent to tell us lumberjacks what patriotism is. . . . Now, we don't care a darn for Nolan—a nobody coming from a town that is full of them.[83]

Local pride rested not only on patriotic efforts, past and present, but also upon the virtues of Northwoods fighting men. Chief among these were strength and physical endurance. Although labor shortages were acute, rural editors chuckled over the proposal that soft city kids should be organized as farm workers, and crowed when the attempt failed. And compared to agricultural work, a doughboy's life was a perpetual vacation, at least Stateside. "Drill five hours and up at 7:00," wrote Private Bretag, "we are sure having it easy now and I sure hope it continues." Ten days later he declared, "Oh yes, I am getting heavier then [sic] I was. I always do when I quit hard work."[84] Another private, Orville Shannon, spelled out his contentment in this manner:

> Well army life is sure easy. All we have to do is drill every day and eat three times a day and sleep all night; now if you can[,] find an easier job than this for $30 per month and no chance to get fired.[85]

Over all, the most important impact upon the Rusk County area doughboy was the socialization and acculturation he experienced. With the exception of the veterans who had been wounded, most interviewees in this study declared that the war had not changed their lives greatly. However, after further investigation, it was evident that their understanding of the world had indeed changed.

From their first stop at Camp Douglas, Wisconsin, and from the federal training facilities across the nation, the recruits sent home a torrent of memorabilia and photographs, mostly of the men themselves in their new woolen uniforms, and of such exotica as skylines of Hoboken and Abilene. They also penned tales of army cookery to weaken the stomach and stories to illustrate that everything Uncle Sam bought was the cheapest. But above all, there was a shock from the new turn life had taken; as Private Allen Cooper of Barron County wrote, "I can't make myself believe I am away down in Georgia in the Army with U.S.A. on my collar."[86]

The men of the Rusk County area were thrown into contact with a broader spectrum of society than existed back home. For the first time, many of them had contact with large numbers of Blacks. Five draft calls in Wisconsin had produced only twenty-five

Negroes; thus they were at first photographed along with other sights of interest.[87] But social intercourse was impossible, as the military instructed soldiers to steer clear of Negro neighborhoods in the light of potential racial conflicts. There was, however, some opportunity to become better acquainted with Wisconsin Indians who had volunteered and at many camps a Continental flavor was supplied by the presence of numerous Allied officers.

A high mark in the peripatetic lives of the men—dwelt upon in letters to the home folks—was the arrival at one of the major training facilities. These camps, compared to Camp Douglas, were well constructed and had electric lights, an item considered to be "real class" by Rusk County men.[88] But after the novelty of their new surroundings had worn thin, homesickness revealed itself. For example, a Barron County man said he "would not trade the west end of Cedar Lake for Texas and Arizona, sagebrush, coyotes and sand 6 inches deep."[89] From Private Cooper at Camp Greenleaf, Georgia, came the similar comment, "If I had ten acres of Wisconsin I wouldn't trade it for the whole d--n state [of Georgia]," while Private Bretag wrote from Texas, "Im getting tired of the sameness of the landscape and long for the big timber. We don't have grand refreshing days as you have in Wisconsin."[90]

A natural reaction of the country boys was to appraise the agricultural potential of other states; some states given high marks were Oregon and Missouri, but Mississippi and Texas soil were rated poor.[91] They were delighted with their first views of cotton fields and outraged at scorpions, and discovered the discomforts of adjusting to different climatic conditions.

Southern ways were both pleasing and exasperating to the Wisconsinites. "They talk as lazy as they act," wrote one man, and as for the languid southern belles, his verdict was that they had "no get up and dust."[92] A Rusk County editor who visited the local volunteers at Waco, Texas, sent back a similar appraisal:

> Here was another characteristic feature of the South. 'Do It Now' signs would have little sale here. Southerners are forward looking, always ready to chance on tomorrow.[93]

But a different view was stated by one engineer: "After making this trip of the entire South, I have an altogether different view of it. . . . They sure are great on hospitality."[94]

In general, the men of the Rusk County area had experienced an exciting cultural awakening. Discoveries of all sorts were made, as Private Orville Shannon, stationed in Oregon, indicated:

> When you speak about the nice garden I get the rambles. . . . I sure do like fresh garden truck but we have something out here that almost holds it level and that is fresh salmon.[95]

A popular song in the post-war era was "How Ya Gonna Keep 'Em Down on the Farm after They've Seen Paree?" There is no doubt that the flight from rural America was a reality, but was it stimulated by the sight of Paris or by the stateside equivalents? Some men of Troop K were impressed with the size of New Orleans, the beauty of Atlanta and Washington, D.C., and the historical qualities of Nashville, and there were even a few who resettled abroad or in some newly-discovered community in America after the war. Twenty percent of the veterans questioned for this study stated they were favorably impressed by the cities they visited, while thirty-six percent felt they had not had enough opportunity to judge, since many of the troop trains bypassed the big cities and the officers at camps kept the men on a short lead. About seventy-five percent of these veterans reported they had intended to return home to stay after the war, as opposed to ten percent who had not. In fact, over fifty percent returned to their home communities to remain for stays averaging sixteen years.[96]

Those who left their hometowns after a short stay cited economic conditions as the primary motive for departure. Perhaps one laconic Rusk County man spoke for most when he wrote, "Me for the farm when I'm thru here."[97]

In conclusion, what emerges is the picture of an area which initially remained aloof from the problems of war, but which mobilized energetically when hostilities were declared. This potent spirit of patriotism with its admixture of parochialism often manifested itself in animosity toward the State's capitol, and in strong community support for the local doughboys, even including attempts to exert moral influence over them at camp.

Of interest, too, are the antagonisms which developed under pressure of the times, such as those of volunteers against draftees, '100% patriots' against things foreign, and rural versus urban society. Finally, although the training period for the average individual may have been relatively brief, and in retrospect seemed of less consequence than battlefield experience, it was of great importance in the cultural shaping of the raw recruits from the Northwoods.

The experience of Rusk County illustrates how the discipline resulting from the national crisis touched both the doughboys and the homefolks, and contributed to the shaping of the new mass man of the twentieth century.

NOTES

[1] Marching song included in a letter from Private William Bretag, Camp McArthur, Waco, Texas, 2 November 1917, to Miss Eva Ross of Ladysmith, Wisconsin. In personal correspondence collection of Mrs. Eva Ross Bretag, Ladysmith, Wisconsin (hereafter shown as Bretag Correspondence).

[2] Lieutenant Gerald C. Maloney, *Rusk County in the World War* (Ladysmith, Wisconsin: The Rusk County Journal, 1920), p. 19. Maloney pointed out that 1 out of 25 Americans, as a national average, were in the armed forces, while in Wisconsin the ratio was 1 in 22, and in Rusk County it was 1 in 20.

[3] *Ladysmith News-Budget,* 28 August 1914, p. 1.

[4] Edward Fitzpatrick, *Wisconsin* (Milwaukee: Bruce Publishing Co., 1928), p. 253. For example, in neighboring Barron County the *Barron County* Shield ran a weekly column entitled "In the Fatherland: Interesting Bits of News from the Great German Empire," which was discontinued when the U.S. became involved.

[5] Questionnaire from Clarence E. Soderberg, of Barron, Wisconsin, December 1978; questionnaire and correspondence from E. A. Preston, of White Bear Lake, Minnesota, 7 and 15 December 1978; questionnaire and correspondence from Allen W. Cooper of Hillsdale, Wisconsin, 1978; questionnaire from Henry A. Plagge, of Holcombe, Wisconsin, 15 October 1978.

[6] George Kolar recalled that, on the other hand, some National Guardsmen who were called up in June 1916 for service on the Mexican border privately believed that they were actually being trained for European duty, a very unpopular idea. From conversations and tape recordings of George Kolar, of Ladysmith, Wisconsin, 12 November 1978.

[7] *Rusk County Journal,* 9 February 1917, p. 4. The *Barron County Shield* concurred (8 February 1917, p. 8).

[8] Karen Falk, "Public Opinion in Wisconsin During World War I," *Wisconsin Magazine of History* 25 (June 1942): 390.

[9] Russel Austin, *The Wisconsin Story* (Milwaukee: Milwaukee Journal Co., 1964), p. 298.

[10] David Thelen, *Robert M. LaFollette* (Boston: Little, Brown, 1976), p. 134.

[11] *Sawyer County Record,* 15 March 1917, p. 2.

[12] Richard N. Current, *Wisconsin: A History* (New York: W. W. Norton, 1977), pp. 211-12.

[13] Falk, "Public Opinion," p. 399; *Wisconsin Blue Book for 1919* (Democrat Printing Co., 1919), p. 417.

[14] *Rusk County Journal,* 11 January 1918, p. 1.

[15] This point of view was stated by the manager of the Wisconsin Development Association (*Ladysmith News-Budget,* 17 April 1917, p. 5).

[16] *Rusk County Journal,* 8 June 1917, p. 4.

[17] Drawn from tables in *Wisconsin Blue Book for 1919,* pp. 420, 431-32.

[18] Henry May, *End of American Innocence* (Chicago: Quadrangle Books, 1967), pp. 387-88.

[19] Oscar Barck and Nelson Blake, *Since 1900: A History of the U.S. in Our Time* (New York: Macmillan, 1965), pp. 231-32. Most of those convicted under these laws were Socialists and IWW members. About ninety-two persons were arrested

in northern Wisconsin on slight provocation indeed [Robert Nesbit, *Wisconsin* (Madison: University of Wisconsin Press, 1973), p. 447].

[20] H. C. Peterson, *Propaganda for War* (Norman: University of Oklahoma, 1939), p. 173.

[21] *Ladysmith News-Budget,* 2 March 1917, p. 2, and also 9 March 1917, p. 1; *Rice Lake Chronotype,* 12 April 1917, p. 4; *Ladysmith News-Budget,* 26 October 1917, p. 2.

[22] *Ladysmith News-Budget,* 16 February 1917, p. 2.

[23] Bretag Correspondence.

[24] Citizens of German Descent, "American Loyalty" (Washington, D.C.: War Information Service, 1917), pp. 5-8. Preserved among the papers of Henry Plagge.

[25] The Germans of Tony, Wisconsin, received this appellation, according to one interviewee, Mrs. Alice Reimert, of Ladysmith, Wisconsin, 30 December 1978. Elsewhere people were allegedly arrested because they persisted in speaking their native tongue (questionnaire from Henry Plagge, Holcombe, Wisconsin, 15 October 1978). This phenomenon recurred throughout the United States [Robert Billigmeier, *Americans from Germany* (Belmont, Cal.: Wadsworth Press, 1974), p. 143].

[26] *Barron County Shield,* 12 April 1917, p. 4; *Phillips Bee,* quoted in the *Rusk County Journal,* 25 January 1918, p. 4.

[27] *Rusk County Journal,* 25 January 1918, p. 4.

[28] Maloney, *Rusk County,* p. 3.

[29] *Ibid.,* p. 5.

[30] May (*End of American Innocence,* p. 371) suggests that the middle class felt an instinctive dislike for kings and aristocrats, thus their enlistment.

[31] *Ladysmith News-Budget,* 17 April 1917, p. 5.

[32] Questionnaire from E. A. Preston. The Northwoods was a prime recruiting ground for engineering and forestry regiments.

[33] In all, seven of the twenty-nine northern counties of Wisconsin were passed over in the first draft since their quotas had been filled by volunteers; *Ladysmith News-Budget,* 27 July 1917, p. 2. Price County was conspicuous with 200 volunteers [R. B. Pixley, *Wisconsin in the World War* (Milwaukee: S. E. Tate, 1919), p. 106].

[34] *Ladysmith News-Budget,* 27 July 1917, p. 3.

[35] Miss Eva Ross to William Bretag, 16 August 1917, in Bretag Correspondence.

[36] William Bretag to Miss Eva Ross, 21 November 1917, in Bretag Correspondence.

[37] Maloney, *Rusk County,* p. 19.

[38] William Bretag to Miss Eva Ross, 18 August 1917, in Bretag Correspondence.

[39] Ibid., 25 September 1917.

[40] "Only a Volunteer," in Bretag Correspondence.

[41] *Ladysmith News-Budget,* 5 October 1917, p. 2.

[42] William Bretag to Miss Eva Ross, 12 November 1917, in Bretag Correspondence.

[43] Ibid., 19 November 1917 and 2 November 1917.

[44] Nesbit, *Wisconsin,* p. 447.

[45] In fact, not enough men could be found, so that companies from the south had to be included (Pixley, *Wisconsin,* pp. 21-22).

[46] William Bretag to Miss Eva Ross, 23 November 1917.

[47] Maloney, *Rusk County,* p. 6.

[48] William Bretag to Miss Eva Ross, 1 August 1917. Unhappily, the County had purchased shoddy merchandise and in short order they were rechristened "the Sears and Roebuck troop."

[49] Charles Genthe, *American War Narratives 1917-1918* (New York: David Lewis, 1969), p. 30.

[50] Frank Friedel, *Over There* (Toronto: Little, Brown and Co., 1964), p. 27.

[51] William Bretag to Miss Eva Ross, 7 November 1917, in Bretag Correspondence.

[52] *Ladysmith News-Budget,* 28 September 1917, p. 4.

[53] William Bretag to Miss Eva Ross, 29 July 1917, in Bretag Correspondence.

[54] *Ibid.,* 7 August 1917.

[55] *Sawyer County Record,* 7 June 1917, p. 3.

[56] William Bretag to Miss Eva Ross, 23 November 1917, in Bretag Correspondence.

[57] *Ibid.,* 15 August 1917, 19 October 1917, and 10 January 1918.

[58] *Ibid.,* 24 January 1918.

[59] *Ibid.,* 17 October 1917 and 7 November 1917.

[60] *Ibid.,* 14 September 1917; *Ladysmith News-Budget,* 7 September 1917, p. 2.

[61] William Bretag to Miss Eva Ross, 12 October 1917. Some interesting anecdotes on the science of military medicine of the period can be found in these letters.

[62] Genthe, *Narratives,* p. 36; Private Allen Cooper to his parents, 27 October 1918, in Cooper Correspondence in Mr. Cooper's possession.

[63] Joint War Historical Commissions of Michigan and Wisconsin, *The 32nd Division in the World War: 1917 to 1919* (Madison, 1920), p. 31; William Bretag to Miss Eva Ross, 1 August 1917, in Bretag Correspondence.

[64] *Ibid.,* 19 October 1917; 23 October 1917; 19 November 1917; 18 August 1917, 1 December 1917.

[65] Maloney, *Rusk County,* p. 119, letter of E. W. Richardson.

[66] William Bretag to Miss Eva Ross, 1 August 1917, in Bretag Correspondence.

[67] William Bretag to Miss Eva Ross, 1 August 1917, in Bretag Correspondence.

[68] Genthe, *Narratives,* p. 87; Preston Slossen, *The Great Crusade and After* (New York: Macmillan, 1930), p. 47.

[69] *Ladysmith News-Budget,* 22 June 1917, p. 1.

[70] Questionnaires from Albert A. Johnson (Cameron, Wisconsin), George Kolar, and Allen Cooper. Approximately one in four of those questioned could be said to have harbored some resentment over the process of officer selection. The impact of local politics was asserted, for example, by Jim Carlson, of Cumberland, Wisconsin, in his questionnaire in December 1978.

[71] *Ladysmith News-Budget,* 17 August 1917, p. 1.

[72] From correspondence with E. A. Preston, December 1978. Also, William Bretag to Miss Eva Ross, 28 September 1917, in Bretag Correspondence, relates the arrival of Milwaukee officers in their unit.

[73] William Bretag to Miss Eva Ross, 31 December 1917, in Bretag Correspondence.

[74] *Ibid.*

[75] *Ladysmith News-Budget,* 5 October 1917, pp. 1-2.

[76] Slossen, *Great Crusade,* p. 36.

[77] *Rusk County Journal,* 25 January 1918, p. 1. In 1917 there were 160,000 registered vehicles in Wisconsin (*Ladysmith News-Budget,* 5 October 1917, p. 2).

[78] Howard P. Chudacoff, *The Evolution of American Urban Society* (Englewood Cliffs: Prentice-Hall, 1975), p. 180.

[79] *Ladysmith News-Budget,* 5 October 1917, p. 4; 5 August 1917, p. 1.

[80] Conversation with Sergeant Ralph D. Jenkins, of Bruce, Wisconsin, in November 1978; William Bretag to Miss Eva Ross, 25 September 1917, in Bretag Correspondence; *ibid.,* 10 September 1917 and 28 September 1917.

[81] *Rice Lake Chronotype,* 26 April 1917, p. 7.

[82] *Ladysmith News-Budget,* 26 October 1917, p. 2.

[83] *Rusk County Journal,* 7 December 1917, p. 4.

[84] William Bretag to Miss Eva Ross, 25 October 1917 and 4 November 1917, in Bretag Correspondence.

[85] Orville Shannon at Fort Stevens, Oregon, to his sister Mrs. Joyce Matthews, 11 April 1918, in correspondence collection of Mrs. Joyce Matthews of Ladysmith, Wisconsin.

[86] Allen Cooper to parents, 18 September 1918, in Cooper Correspondence.

[87] *Wisconsin Blue Book for 1919,* p. 340.

[88] William Bretag to Miss Eva Ross, 14 September 1917, in Bretag Correspondence.

[89] *Barron County Shield,* 16 August 1917, p. 1.

[90] Allen Cooper to parents, 24 September 1918, in Cooper Correspondence; William Bretag to Miss Eva Ross, 5 November 1917, in Bretag Correspondence.

[91] Eldon Shannon at Camp Shelby, Mississippi, to his sister Mrs. Joyce Matthews, 16 November 1918, in Matthews Correspondence; William Bretag to Miss Eva Ross, 31 October 1917, in Bretag Correspondence.

[92] *Ibid.,* 31 October 1917 and 19 November 1917.

[93] *Rusk County Journal,* 8 February 1918, p. 3.

[94] *Ladysmith News-Budget,* 27 August 1917, p. 6.

[95] Orville Shannon at Fort Stevens, Oregon, to his sister Mrs. Joyce Matthews, 15 July 1918, in Matthews Correspondence.

[96] A fuller study which included American veterans of both World Wars indicated that only twenty-five percent of returning veterans moved away from their home counties [Peter Karsten, *Soldiers and Society* (Westport, Conn.: Greenwood Press, 1978), p. 32].

[97] Maloney, *Rusk County,* p. 120.

ARTS SUPPORT GOES PUBLIC IN WISCONSIN

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The State of Wisconsin holds the distinction of being the last state in the Union to achieve a statutory agency for the arts. Yet, it was one of the earliest states to explore the concept of a state council. Why the delay?

Is this a classic case of "the first shall be last"? Was it due to ineptitude, mismanagement, apathy? Is the delay an example of the ability of Wisconsin citizens to discuss everything into a comatose condition? Was it lack of political acumen?

Some of these and none of them. We shall leave the finger pointing for future historians and attempt in this paper only to chronicle briefly the long, tortuous and often heartbreaking efforts of many dedicated men and women who worked for nearly two decades to make recognition of the arts a legitimate concern of the state.

From papers of the period and recollections of those involved, come the patterns of interest in developing an organized citizen support for the arts.[1] In 1953, Extension Arts Professor Robert E. Gard was in England examining the activities of the British Arts Council. He returned to discuss the idea with Extension Dean Lorenz H. Adolfson, who appointed a committee chaired by Extension English Professor George B. Rodman to explore the concept.

ORIGIN OF THE WISCONSIN ARTS FOUNDATION AND COUNCIL

On December 3, 1956, representatives of a variety of cultural organizations met in Madison to review the need for a statewide council for the arts, to determine what purposes it could serve beyond those of the Extension Division, to decide how best to organize, and who should be invited to membership. As a result, the Wisconsin Arts Foundation and Council was incorporated on May 2, 1957. The word "foundation" was included in the hope that a capital fund might eventually be established on behalf of the arts.

People instrumental in these early developments included Robert Gard, who was elected president in January 1958, Robert Schacht, S. Janice Kee, Helen Lyman, William W. Cary, LaVahn Maesch, David H. Stevens (newly retired head of the Rockefeller Foundation arts and humanities division), Mrs. B. C. Ziegler, Eli Tash, James Schwalbach, Walter Meives, George Foster, Elmer Winter, Al P. Nelson, Edward H. Dwight, William Feldstein, Mrs. Mary John, Mrs. Lela Smith and G. Ellis Burcaw.[2]

Other groups in the state, beyond the original organizers, became interested. Movements to create state arts councils were gaining momentum throughout the country as a result of the successful community councils that had been functioning for 25 years or more. In New York, the state legislature was in the process of discussing a state arts council. Canada had already passed the Canada Council Act.

In 1959, Gard took a year's leave of absence and Mrs. Bernard Ziegler, vice president, headed the organization until the membership meeting in November 1959 at which William W. Cary, public relations director of the Northwestern Mutual Insurance Company, was chosen president. Mrs. Ziegler obtained the services of counsel for drafting by-laws and obtaining tax exempt status under Internal Revenue rulings. Cary began a Quarterly Arts Calendar which for more than a decade faithfully listed cultural activities over the entire state.

The group established a pattern of arts seminar meetings around Wisconsin. For example, in 1959, the annual meeting was held in Appleton where contralto Maureen Forrester was appearing in a concert at Lawrence College. The membership also heard an address by University of Wisconsin graduate Charles C. Mark, then executive secretary of the Winston-Salem, North Carolina, Arts Council.

The annual meeting in November 1962 was held at the Johnson Foundation headquarters at Wingspread in conjunction with a conference entitled "Common Threads in Contemporary Art." This national assembly on the arts was initiated by the Extension Division with Professor Edward L. Kamarck chairing the faculty planning committee, and was one of the first such interdisciplinary meetings in the country.

By 1963, the idea that the federal government should become involved in support of the arts was encouraged by the report of August Heckscher to President John F. Kennedy, entitled "The Arts and the National Government."

A month after the Heckscher report the *New York Times* published a national study about arts development around the nation. Sometimes when the *New York Times* looks beyond the Hudson, it becomes nearsighted. Wisconsin, it claimed, was "a cultural dust bowl" because the state had been laggard in developing a state-wide planning effort for the arts.[3]

Of course the judgment entirely overlooked the pioneering impact on national cultural patterns from the University of Wisconsin's long and innovative support of activities such as the artist-in-residence and radio station WHA, the "oldest station in the nation," which had filled the air waves for years with "Music of the Masters" and "Chapter A Day." It took no account of the rich cultural growth from ethnic roots which has never been allowed to wither in Wisconsin.

Not having a Rockefeller up the Hudson to help develop our cultural potential, Wisconsin had no official state arts council—but neither did many other states. Wisconsin was not a cultural desert; it just needed watering.

Governor's Council on the Arts

Governor John Reynolds may have been somewhat annoyed by the *New York Times* statement which was widely quoted. Perhaps, and more probably, given the nature of political pressures, someone influential in the arts reached the governor, and said loudly, "Do something!"

Reynolds acted. In the fall of 1963 apparently without reference to the existence of the Wisconsin Arts Foundation and Council, he created a Governor's Council on the Arts to "call attention to public events and exhibitions in the performing arts, issue a bimonthly digest of current cultural events and displays, to serve as liaison for public and private organizations concerned with the arts and to issue awards to citizens who have attained distinction in the arts."[4]

Dean Adolph A. Suppan of the University of Wisconsin-Milwaukee was appointed chairman by the Governor. Suddenly, there were two organizations in Wisconsin struggling to further the cause of the arts, statewide.

Without funding the Governor's Council had difficulty being effective but at the May meeting at Wingspread it established several committees, including one on awards, as directed by the Governor. Dr. Abraham Melamed of Milwaukee chaired the committee. The Governor's Council also urged support for the bill to establish a National Council on the Arts which had just passed the United States Senate and was pending in the House.

Governor's Awards

By September 9, 1964, the Governor's Awards Committee reported nominations for recognition in six categories: the arts in gen-

eral, the visual arts, music, drama, literary arts, dance, and, in addition, a special citation and award. Governor Reynolds agreed to host a dinner at the Governor's Mansion on October 8 when the announcement of the arts awards to citizens was to be made. The dinner was given as scheduled, although the Governor was unable to attend. The citations represent the first major notice by the State of the contributions of the arts to Wisconsin society.

All of this activity and public notice was not well received by the Wisconsin Arts Foundation and Council. On September 28, 1963, meeting at Janesville, the Board instructed George Richard, Secretary, to write to Governor Reynolds. He said "since it seemed clear your advice on planning the Governor's Council did not provide you with a thorough background on the related developments in the arts area, our board of directors and arts committee thought it advisable to let you know something about . . . the Wisconsin Arts Council"[5]

Bewildered by the Governor's Arts Council, the WAFC discussed the possibility of formal liaison with the "political group." They agreed, however that nothing should be done until the Governor's Council had longer experience and had formulated its goals and objectives more explicitly.

Mrs. Carl T. Wilson, director of the Door County Festival, was a member of both the WAFC and the Governor's Council. In March 1964, at Mount Mary College, Milwaukee, she told the WAFC board that her first impression was that the Governor's Council was to concentrate on promotion of Wisconsin arts activities outside the state. WAFC members foresaw conflicts between the two groups with confusion inevitable in the public mind.

The WAFC also had internal problems. At another Wingspread meeting in November 1964, persistent absenteeism on the part of Board members and continuing resignations prompted a resolution that directors would be expected to attend at least fifty percent of the Board meetings.

Times changed. A new election brought Warren P. Knowles to the Governor's post. He abandoned the idea of an appointed Governor's Council on the Arts and instead requested the WAFC Board to recommend nominees for eight governor-appointed board members to their organization. The WAFC changed its by-laws making the Governor an ex-officio director of the corporation with power to appoint eight directors.

WAFC Designated Federal Agency

On April 2, 1965, Governor Knowles designated the Wisconsin Arts Foundation and Council as the official state coordinating group for the arts.[6] This was a tremendous step forward, but there was still no tax money to implement the challenge.

Once again the Johnson Foundation stepped in with help and offered $5,000 for support of a "summit conference" at Wingspread to be attended by art delegates from seven regions of the state. The conference was in part a response to the passage of federal legislation which had created the National Endowment for the Arts. It was also conceived as an effort to involve the whole state in determining goals for long-term art growth. The University Extension assumed responsibility for organization and promotion of the effort. William Cary and Edward Kamarck chaired the program and eight regional meetings were held before the culminating conference at Wingspread, entitled "Project: Wisconsin and The Arts" on November 20, 1965. The session in Madison was recorded by Lee Sherman Dreyfus.

At the Wingspread meeting, nearly 80 state and national leaders assembled. Among the speakers were Julius Bloom, Executive Director of Carnegie Hall, who gave the keynote address on "Our Cultural Economy," and Ralph Burgard, Executive Secre-

tary of the Arts Councils of America. The proceedings were published in a handsome booklet.

Throughout 1965 the WAFC was busy. It decided to continue the Governor's Awards and developed a "Festival Planning Booklet." In cooperation with the State Free Library Commission a bibliography was prepared called "The Arts Are For All," which recommended basic art study materials for every public library. The Wisconsin Federation of Women's Clubs undertook to see that all state public libraries would receive them.

In February 1966, President Cary attended meetings in Chicago, sponsored by the National Endowment for the Arts, and reported "WAFC is doing about as much as any state council, excluding four or five which have state appropriations." He also found that a $25,000 "study grant" from the Arts Endowment would be available to Wisconsin.[7] The Johnson Foundation again helped with "seed money" to implement the use of the federal funds.

In July 1966, WAFC Vice President George Richard became executive director with responsibility for directing the study. The funds were to support a staff and office for nine to twelve months. The state study group was divided into three task forces as follows: Task Force I—to explore the advisability of forming a state arts agency, Task Force II—to explore creation of a statewide cultural inventory; Task Force III—to explore the Wingspread conference recommendations pertaining to the arts in education. Eleven statewide meetings were arranged between September 17 and October 15. By the November annual meeting a plan was outlined with legislative as well as gubernatorial blessing to support the formation of a state arts agency.

Program suggestions arising from the study included forming pilot touring companies in the performing arts, encouraging greater communication in the arts, establishing more local arts councils and local arts festival workshops, and continuing the work of Task Force III on educational needs in the arts. An appropriate budget was proposed: office —$50,000, calendar and information services — $30,000, regional assistance — $30,000, pilot touring projects—$100,000.

Task Force I reviewed three possible options for the WAFC organization: To continue WAFC with legislative support; To reorganize WAFC into a state agency; To form a new agency. On November 5, 1966, Charles McCallum reported that the task force he chaired recommended the third option, formation of a new non-membership organization with a board appointed by the Governor. Presumably, legislators would not support a membership organization and the chance of obtaining legislative approval was better for a standard state agency than for a hybrid.

Meantime, there was some progress on the state level.

Senate Bill 30 was introduced in the 1967 Wisconsin Legislature, at the request of Governor Knowles, by Senators Jerris Leonard of Milwaukee and Fred Risser of Madison, and Assemblywoman Esther Doughty of Horicon. The bill called for the establishment of a fifteen member state arts commission to be called the Wisconsin State Arts Council. The Council was to establish public policy on encouragement of the arts in Wisconsin and the bill provided specific safeguards for freedom of artistic expression.

The measure provided for a state appropriation of $25,000 for each year of the 1967-69 biennium—the minimum necessary to establish an administrative office to: 1. Act as an information exchange agency for state arts groups and individual artists. 2. Make available for arts activities (sponsored by organizations and institutions in Wisconsin) up to $50,000 a year in grants from the National Endowment for the Arts. 3. Help

arts organizations in Wisconsin to obtain private contributions and other federal aid. 4. Work with federal, state and local agencies and private organizations and institutions in strengthening the arts, and education in the arts, in Wisconsin.

Senate Bill 30 was referred to the Legislature's Joint Committee on Finance, chaired by Republican Senator Walter G. Hollander of Rosendale and Republican Assemblyman Byron Wackett of Watertown.

Hope for passage of the bill ran high, not only because of the intrinsic value of the legislation but because broadly based support for the concept of state involvement in the arts had been expressed in the 1965 and 1966 regional meetings. There was also the implicit understanding that if state action were not taken to establish an adequately financed administrative framework, the state might lose opportunities for obtaining federal funds.

There were still problems. In March 1967 the WAFC Board passed a motion to approve all actions taken during the preceeding 12 months at meetings at which a quorum was not present. The need for this action suggests why, despite all the meetings and the effort expended in the sixties, the WAFC was never quite able to succeed in its mission.

By August 1967, the Johnson Foundation grant was running out and money to support the necessary administration and WAFC funds were gone. The Board decided to write the membership for emergency assistance. Also, at the August meeting, a new need for arts development support appeared. Requests for help came from some several "inner city" groups—perhaps a reflection of the turmoil in the American cities which had erupted during the hot summer of 1967.

There was considerable gloom at the November annual meeting. The year which had begun so well was ending in disappointment. About $1,800 remained in the treasury. The Legislature had recessed without taking action to establish a statutory arts agency. The WAFC Board faced the need to raise administrative funds to allocate the federal grants; this need put WAFC in direct competition with the very groups it was trying to help. The newsletter headline was "Gray Day for the Arts in Wisconsin" and the text stated that only Mississippi, Delaware and American Samoa were as "behindhand" as Wisconsin in setting up state-supported arts programs. Nevertheless, continuing efforts by the WAFC to provide service were documented in a series of printed reports from the Wisconsin Arts Resources Study committee.

In 1968, the agency continued to function, receiving and dispensing federal funds and attempting to raise private money for administrative needs. Funding became so acute for the office that at the July 1968 meeting at Spring Green, the position of the Executive Director George Richard was reduced to half time. Young Audiences of Wisconsin utilized the other half of his time for their administrative needs and agreed to share their Milwaukee Headquarters with WAFC.

Nine months later William Boyd, representing attorney Harry Franke, reported that the financially conservative attitude in the State Assembly would now make the establishment of a state agency very difficult. George Richard resigned as director.

Summer was dismal. The Board had a balance of $4,100 and on the federal level the National Endowment for the Arts was also without funds, because Congressional action for the current fiscal year was delayed, The Arts Endowment was able to allocate only $20,000, of a potential $39,000, available to Wisconsin for project grants.

At this point, Oscar Louik, the WAFC Treasurer, volunteered to serve as Executive Director for the coming year for a salary of $6,000, half of which he would raise himself. On the recommendation of a special committee, he developed a state-wide arts resources and information service to coordi-

nate and publish information and give administrative counseling to arts groups.

At the November annual meeting, Louik brought good news. A legislative measure establishing a statutory arts council, without state funding, had been introduced in the Senate. Within a month, there was gloom again. The *Milwaukee Journal* reported:

> The Joint Finance committee added new luster to its negative reputation Thursday when it tabled a bill that would have permanently designated the Wisconsin Arts Foundation and Council the official state body to coordinate the use of federal funds to support a variety of fine arts programs. The reason given for the committee's tabling action was that the bill might open the doors to the use of state funds to support the arts. And what's wrong with that? The nation has experienced a growing awareness in the last decade that fine arts should be officially supported. President Nixon has just called on Congress to double—to $40,000,000— federal support of the arts through the National Foundation on the Arts and Humanities. It is this body that has distributed money to the Wisconsin council.
>
> Legislative action is needed to give some fine arts body permanent designation as the state's representative. The bill now tabled is the minimum that should be done in this area. The Joint Finance committee should reconsider its moves.[8]

On February 21, 1970, because of continuing confusion, Louik recommended that the word "foundation" be dropped from the organization's name. Audrey Baird of Milwaukee moved that the name be officially changed to Wisconsin Arts Council. At a July meeting the change was approved. A quarterly publication, "Wisconsin Arts Fare," was established to provide visibility for the arts around the state.

At the 1970 annual meeting President William Cary announced his wish to retire, and a search committee was established under Charles McCallum of Milwaukee. Cary continued for some months, assisted by Vice President Donovan Riley of Milwaukee. The search committee recommended adding a Chairman of The Board and a Second Vice President to the list of officers.

WAC Again Becomes an Official Agency

At the March 1971 meeting the history of the on-going Governor's Awards in the Arts was clarified; the by-laws of the WAC were amended, and Oscar Louik reported that the incoming Democratic governor, Patrick W. Lucey, had on January 25, 1971, once again designated the WAC as the official arts body for the state.

At the annual meeting on November 13, 1971, Donovan Riley of Milwaukee was elected president and Gerald A. Bartell of Madison Chairman of the Board. Bartell at once put his years of media experience to work to create broader public recognition for the WAC through use of television spot announcements. Subsequently these short 15 and 30 second spots were seen throughout the state. They emphasized that "The Arts Are For Everyone. Support. Enjoy." There were other activities: Lee Sherman Dreyfus became chairman of the Arts Committee; the Wisconsin Graphics project with portfolios of ten prints by state artists was made available for sale;[9] the by-laws were again revised. A new category of members was established for long-time board members, and Robert Gard, Lloyd Schultz, Fannie Taylor, Mrs. Edward Weiler, and Mrs. Carl T. Wilson were named emeritus board members.

Once again the Governor appointed a committee—this time a Governor's Study Committee on the Arts with Dean Adolph A. Suppan, University of Wisconsin-Milwaukee, as chairman, to review the role of the State Arts Council.[10]

A special conference at Wingspread on September 29, 1972, brought Governor Lucey to make the Governor's Arts Awards in person. One of these awards was made,

appropriately, to William W. Cary for his long and dedicated support. Keynote speaker for the conference was Frank Stanton, vice-chairman of the Columbia Broadcasting System. Notables from the state and from the National Endowment for the Arts attended.

At the November annual meeting the Board authorized a formal request from Chairman of the Board Bartell, and William C. Kidd, State Secretary for Business Development, to Governor Lucey as follows in "considering your 1973-75 budget for the State of Wisconsin or special legislation for the 1973 Legislature you include and endorse the following: Creation of a statutory state arts council. Appropriation of state funds to such a council, the amount of money not to exceed $150,000 the first year of the biennium and $200,000 the second year." The money thus requested was intended to match federal support to Wisconsin from the Arts Endowment, and the message to the Governor again emphasized that Wisconsin, alone among the fifty states of the Union, had no statutory arts agency.

In 1973, the efforts to garner support continued briskly. Executive Director Oscar Louik resigned, however,[11] blasting the Governor's Study Committee on the Arts for: recommending a combined arts and humanities commission, its incomplete records of what were intended to be public hearings around the state, its lack of understanding of the relationship between the state arts agencies and the National Endowment for the Arts, and its injecting the arts council staff into the political arena.

Throughout the summer of 1973 there was considerable activity back and forth between the council offices and the Governor's office by the Wisconsin Arts Council executives, and ultimately the suggestion of the Governor's study committee did not prevail. The arts and humanities were allowed to retain their separate status.

The next crisis arose from the possibility that the Governor might make a line-item veto because modifications were made during the legislative process. A letter was sent to "Friends of the Arts in Wisconsin" alerting them to the possibility and suggesting that the "Friends" inform Gerald Bartell and Donovan Riley of their support for positive action by the Governor.

Wisconsin Arts Board

Then suddenly, the long years of effort were rewarded. On August 2, 1973 the Governor signed the budget bill. The "endless haggling" over the budget stopped, and with that signature, Section 20 15.53 of the Statutes of Chapter 90, Laws of 1973, became law. "There is created an arts board to consist of 12 members appointed for staggered

Fig. 1. Three individuals were cited for support of the arts at 1980 Governor's Award dinner. Left to right they are, Ralph Goldsmith, publisher of the Boscobel Dial; Mrs. Betty Foster, advocate of cultural projects at the Wausau Hospital Center, and (center) Mrs. William D. Hoard, Jr., chairman and benefactor of the Hoard Museum and its annual art show in Fort Atkinson. They are shown here with Gerald A. Bartell, chairman of the Wisconsin Foundation for the Arts, sponsor of the ceremony for Governor Lee Sherman Dreyfus.

3-year terms from among the citizens of the state who are known for their concern for the arts."

The budget bill provided administrative support in the amount of $94,000 for the biennium, divided $45,200 the first year and $49,100 the second. No state funding was provided for gifts or grants, but specific authorization was given to receive federal grant monies. Provision was made for an executive secretary, and all authority previously given to the Wisconsin Arts Council and Foundation was transferred to the new Wisconsin Arts Board.

Finally, the Wisconsin Arts Board was provided with state funds for gifts and grants as well as for administrative support; the 1979-80 biennium budget for WAB was $1,471,650. Jerrold B. Rouby headed the agency as Executive Director.

The Wisconsin Arts Council, whose various board members struggled for so many years to achieve a statutory agency in our state, reassumed a portion of its original name on December 2, 1977. As the Wisconsin Foundation for the Arts it now continues to act as a citizen membership organization and arts advocate and its most recent activity was to sponsor a new version of the former "Governor's Awards."

In the fall of 1980, the WFA with the help of Governor Lee Sherman Dreyfus reinstituted the Governor's Awards. Recognition of the need for business support of the arts was incorporated in the "Governor's Awards in Support of the Arts," which were given to seven corporate executives and three individuals at a gala dinner at the Governor's mansion on October 9, hosted by Governor and Mrs. Dreyfus (Figs. 1 and 2).[12]

Fig. 2. Recipients of the Governor's Awards in Support of the Arts are cited for corporate support at the Governor's awards dinner, October 9, 1980 (left to right): Herbert V. Kohler, Jr., Robert Hartwig, Donald J. Schuenke, Hal C. Kuehl, Gerald A. Bartell, chairman of the Wisconsin Foundation for the Arts, John S. Sensenbrenner, Jr., Oscar G. Mayer, and James R. Schweiger.

The new version of the Governor's Awards points up the strong support for creative activity that exists throughout the state, much of it fostered by citizen endeavors to form a state agency. Throughout Wisconsin there are flourishing arts groups, many of which did not exist fifteen years ago. The requirement for matching money to obtain support from the public sector, a concept now routinely required on both the federal and state level, has become an important force in opening new opportunities for artists and their organizations. But the most important support for public funding has come from the artists, the arts organizations, the audiences, and the public, all of whom have insisted that the arts must be an integral part of our everyday lives.

NOTES

[1] Gard, R. E., Unpublished letter to the author, April 1979.

[2] "A Brief History of the Wisconsin Arts Foundation and Council," as provided by U.W. Extension, n.d.; and WAFC Minutes of April 12, 1957.

[3] Esterow, Milton, *New York Times,* June 15, 1963.

[4] Wisconsin Blue Book 1964, p. 303. "Governor's Council on the Arts."

Also appointed: Gordon Berchardt, Richard Gregg, Mrs. Harold Groves, Tom Holter, Roland A. Johnson, Sister M. Laudesia, Mrs. John Marshall, Dr. Abraham Melamed, Rudolph Morris, Leslie Paffrath, Jack Rudolph, Sister Mary Remy, Fannie Taylor (Secretary), Sister Thomasita, Mrs. Carl T. Wilson, Elmer Winter, Mrs. Webster Woodmansee, Robert Zigman (Leonard Zubrensky, legal counsel for the Governor, attended *ex officio*).

[5] By-laws and Minutes, Governor's Council on the Arts, F. Taylor Collection, Wisconsin State Historical Library Archives.

[6] Wisconsin Blue Book 1973, p. 346. "The Governor's Council on the Arts, created as a special committee in 1963, and the Wisconsin Arts Foundation and Council, a private statewide organization representing all of the arts, were merged in April 1965. Among its 200 members, the Wisconsin Arts Council includes some 50 organizations—art centers, colleges, merged organizations—to effectively explore and develop ways of increasing cultural opportunities and resources in Wisconsin. In 1971 the council was designated as the official state body through which the public interest in the arts and culture should be maintained, encouraged, and disseminated in Wisconsin" (Senate Joint Resolution 22).

The governor appoints 8 public directors. There are also 15 elected directors.

[7] "A Review of Art Activities in Wisconsin," National Endowment for the Arts Fact Sheet, April 1966.

[8] *The Milwaukee Journal* Dec. 19, 1969.

[9] A "pre-publication" offer for $500 was made to museums on March 12, 1971. Artists represented in the portfolio were: Robert Burkert, Warrington Colescott, Jack Damer, Raymond Gloeckler, Victor Kord, Dean Meeker, Frances Meyers, Marko Spalatin, Arthur Thrall and William Weege.

[10] Wisconsin Blue Book 1973, p. 347. Study Committee on the Arts in the State of Wisconsin and the Wisconsin Arts Council. Members Adolph A. Suppan, chairman, Mrs. Marion Baumann, Mrs. Ralph Brandon, Tom Evans, John Gauthier, Tom Harris, Edward Kamarck, Michael Kazar, Charles Krause, Mrs. Mary Lewis, Roger Mitchell, Don Reitz, Don Rintz, O. Vernon Schaffer, Ray Taylor, Mrs. Mary Alice Wimmer. Committee created February 1972 "to review the state of the arts in Wisconsin and the role of the Wisconsin Arts Council . . . what programs can the arts council undertake to increase the number of citizen participants in all of the creative arts? How can it best recognize and encourage promising individual artists in Wisconsin? How can minority projects be best assisted by the Arts council? The final report of the study committee was issued in January 1973."

[11] *The Milwaukee Journal,* February 23, 1973.

[12] *Wisconsin State Journal,* October 12, 1980.

[13] GOVERNOR'S AWARDS IN THE ARTS

1964

Mrs. H. L. Bradley, River Hills
Edna Ferber, New York
Lynn Fontanne and Alfred Lunt, Genesee Depot
Margaret H'Doubler, Sister Bay
Robert Osborn, Conn.
Peninsula Music Festival, Door County
Edward Steichen, Conn.
University of Wisconsin-Madison
University of Wisconsin-Milwaukee
Robert von Neumann, Milwaukee
Father John Walsh, Milwaukee
Thornton Wilder, Conn.
Wisconsin Painters and Sculptors
Frank Lloyd Wright (posthumous)

1965
August Derleth, Sauk City
Georgia O'Keefe, Taos, N.M.
Ralph Votapek, N.Y.
Johnson Foundation, Racine
Elsa Ulbricht, Milwaukee
Milwaukee Symphony Orchestra
Marine National Exchange Bank, Milwaukee
Wisconsin Federation of Music Clubs

1967
Robert E. Gard, Madison
Thor Johnston, Evanston, Ill.
Charlotte Partridge, Mequon
Wm. P. Wenzler & Assoc. Milwaukee
Milwaukee Repertory Theater
Milwaukee Art Center
Schlitz Brewing Co., Milwaukee

1968
Fine Arts Quartet, Milwaukee
Roland Johnson, Madison
Pabst Brewing Co., Milwaukee
Sr. Thomasita, Milwaukee
Sr. Mary Remy, Milwaukee
John Anello, Milwaukee
Aldo Leopold (posthumous)

1969
Warrington Colescott, Madison
Aaron Bohrod, Madison
James S. Watrous, Madison
Mrs. Ronald A. Dougan, Beloit
Phillip Sealy, Appleton
Peninsula Arts Association, Door County
Wisconsin Ballet Company, Madison

1970
Emmett Sarig, Madison
Edna Meudt, Dodgeville
Donald Reitz, Spring Green
Edward A. Boerner, Milwaukee
Mrs. Carl T. Wilson, Milwaukee
Marie A. Endres, Madison
Gunnar Johansen, Madison

1971
Madison Art Center
James R. Schwalbach, Madison
Richard W. E. Perrin, Milwaukee
O. V. Shaffer
Milwaukee Inner City Arts Council

1972
G. Lloyd Schultz, Lake Mills
Clair Richardson, Milwaukee
Mrs. Elmer J. Einum, Rice Lake
William W. Cary, Milwaukee
Frank Italiano, La Crosse
Ruth Mary Fox, Madison
Ruth Milofsky, Milwaukee

GOVERNOR'S AWARDS IN SUPPORT OF THE ARTS

1980
(Corporate citations)
John S. Sensenbrenner, Jr., president of Kimberly-Clark Foundation, Neenah
Donald J. Schuenke, president of Northwestern Mutual Life Insurance Co., Milwaukee
Oscar G. Mayer, Oscar Mayer & Co., Madison
Hal C. Kuehl, president of First Wisconsin Corp., Milwaukee
James R. Schweiger, president of Schweiger Industries, Jefferson
Herbert V. Kohler, Jr., chairman of the board of Kohler Co., Kohler
Robert Hartwig, president of Hartwig Manufacturing Co., Wausau
(Individual citations)
Robert Goldsmith, Boscobel
Mrs. Betty Foster, Wausau
Mrs. William D. Hoard, Jr., Fort Atkinson

VEGETATION CHANGE ON THE GOGEBIC IRON RANGE (IRON COUNTY, WISCONSIN) FROM THE 1860s TO THE PRESENT

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Abstract

This study documents the impact of iron mining activity and associated settlement on the vegetation of a portion of the Gogebic Iron Range in Wisconsin. Land cover was determined and vegetation maps prepared for three different periods: 1) The 1860s representing pre-mining conditions, 2) The 1930s representing peak development, and 3) The 1970s representing declining human activity. Importance Values and size class distributions were calculated for the major tree species of the 1860s and 1970s based on Feberal Land Office Survey data and field sampling.

At the time of initial settlement the dominant upland vegetation was mesic forest with sugar maple (*Acer saccharum*), hemlock (*Tsuga canadensis*), and yellow birch (*Betula lutea*) as major components. Much of this forest was cleared for mining timber and to create farmland around the mining communities. With the cessation of mining, the area is gradually returning to mesic forest. The forest of the 1970s appears younger and more diverse than that of the 1860s with greater dominance of sugar maple and lower importance of hemlock and yellow birch. Human activities have altered both the present condition and future composition of the forest to an extent that evidence of this disturbance will not disappear in the near future.

INTRODUCTION

Iron County is located in north-central Wisconsin, where it borders Lake Superior and the western end of the upper peninsula of Michigan (Fig. 1). The Gogebic Range extends across the northern portion of Iron County, from Ashland County on the southwest into Michigan on the northeast.

The Gogebic Range is best known for its iron deposits which were mined heavily from the mid 1880s until operations ceased in the mid 1960s. Permanent settlement began with the development of the first mines. By 1920, the mines on the Range were shipping approximately 6 million tons of ore per year (Mladenoff 1979). The population of Iron County reached over 10,000 persons in the 1930s, but by the 1970s had declined to 6500 inhabitants, fewer than in 1900.

Our purpose was to document the impact of the characteristic "boom and bust" cycle of mining activity on the vegetation of the Gogebic Range. To do this the land cover was analyzed during three periods which represent different parts of the cycle: the 1860s, 1934, and the 1970s. By comparing the plant communities of these three eras, the extent and duration of the impact of mining and its associated activities were traced.

GEOLOGY, SOILS AND CLIMATE

Two parallel ridge systems comprise the Gogebic Range (Fig. 1). The southern Iron Range is composed of resistant quartzite, granite and the iron formation. The northern Gabbro-Trap Range is composed of highly faulted and eroded Keweenawan lava flows of basalt and gabbro. Between them lies a lower central valley of less resistant slate

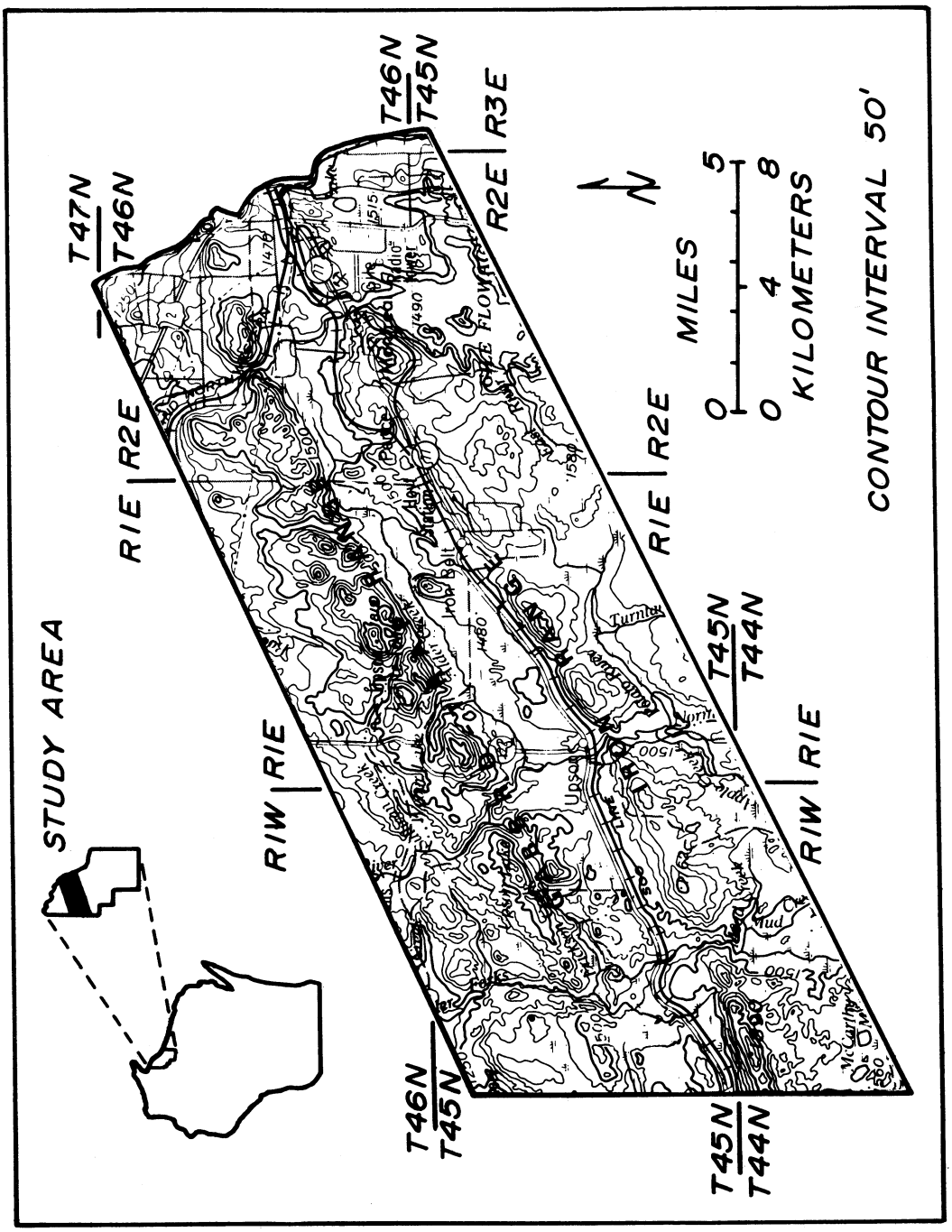

Fig. 1. Topographic map of study area and location in Iron County, Wisconsin.

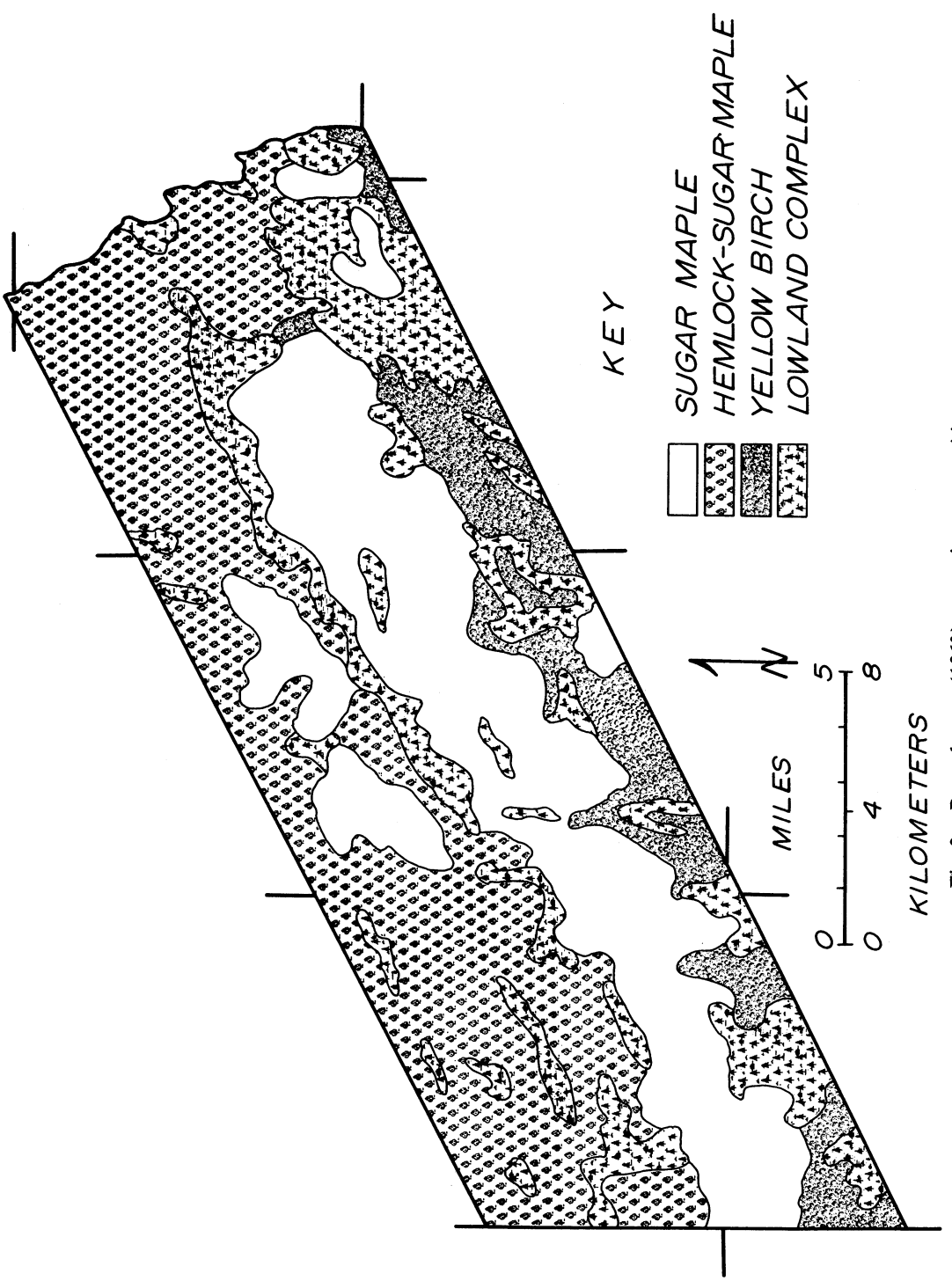

Fig. 2. Presettlement (1860) vegetation communities.

rock. All formations dip sharply to the northwest. The ridges reach an elevation of 520 to 580 meters (1700 to 1900 feet) above sea level, or approximately 365 meters (1200 feet) above Lake Superior. The low points, approximately 335 meters (1100 feet) in elevation, occur in the central valley and to the north of the Range, and give a local relief of about 245 meters (800 feet) (Martin 1965).

Soils in the study area are derived from glacial materials, primarily ground moraine with reddish-brown till. Soil types vary from Orthods (Podzols) to Inceptisols (Low Humic Gley and Brown Forest Soils) (Hole 1976).

In general, the climate of the Gogebic Range study area is typical of northern Wisconsin and is characterized as temperate humid continental, with cool, short summers and cold winters. Locally, however, the mesoclimate is influenced by the proximity of Lake Superior, and more distinctively, the steep elevational gradient from the Lake to the Range. The prevailing movement of weather systems over Lake Superior results in a narrow band of slightly moderated temperature and significantly increased precipitation along the Gogebic Range, when compared with more interior locations. The average annual precipitation of 91 cm. (36 in.) and, in particular, the mean annual snowfall of 391 cm. (154 in.) are substantially greater than in other portions of the state. Adjacent Wisconsin stations report average annual precipitation of 76 to 81 cm. (30 to 32 in.). Ashland, Wisconsin, 56 kilometers (35 miles) west, has an average annual snowfall of 152 cm. (60 in.). The average annual temperature in the study area is 5°C (41.5°F) (Waite 1960, Strommen 1974).

The Vegetation of the 1860s

The presettlement vegetation of the study area was reconstructed and mapped using the field notes of the Federal Government Land Survey. The purpose of the Survey was to delineate township and section lines and to note the general condition of the land in terms of agricultural and timber production potential (Bourdo 1956). Different portions of the study area were surveyed at various times from 1856 to 1867 by using two different procedures. On the exterior township lines, the section and quarter section corners were marked by recording the distance from each corner to the closest tree in each compass quadrant. To identify these "witness" trees, the species and trunk diameters were noted. At corners on the interior lines only two witness trees were used.

These survey data were used to generate a plant community map following techniques similar to those employed by Kline and Cottam (1979). The township and section lines on the study site were mapped at a scale of 1:24,000. On this map species-keyed letter codes and colored symbols were placed in the appropriate location for each witness tree. The map was overlayed onto a topographic map for interpolation.

Areas on the map determined by visual inspection to be reasonably homogeneous for species were delineated and designated as communities. Two major vegetation groups were so delineated: the Lowland Complex and the Upland Communities. Three upland communities were identified and named for their dominants: Yellow Birch (*Betula lutea*) Forest, Sugar Maple (*Acer saccharum*) Forest, and Hemlock-Sugar Maple (*Tsuga canadensis-A. saccharum*) Forest (Fig. 2, Table 1).

Table 1. Area of presettlement (1860) vegetation communities of Gogebic Iron Range

Community	*Percentage of area*	*Hectares (Acres)*
Hemlock-Sugar Maple	34.6	10,762 (26,573)
Sugar Maple	27.0	8,398 (20,736)
Yellow Birch	5.6	1,742 (4,300)
Lowland communities	30.8	9,580 (23,654)

Lowland Complex

The Lowland Complex made up 31 percent of the study area and occurred primarily along the streams of the central valley and in the area south of the Iron Range, and in scattered locations among the ridges of the Gabbro-Trap Range. The largest single expanse was south of the Iron Range at the eastern end of the study area. Conifer swamps of white cedar (*Thuja occidentalis*), spruce (*Picea* spp.), tamarack (*Larix laricina*), and yellow birch predominated.

Based on historical records and the scale of the surveys used in this study, the Lowland Complex received less impact than the Upland Communities (Mladenoff 1979). Nor did the Lowland Complex change as significantly in composition. Consequently, the Lowland Complex will not be considered further here.

Upland Communities

The three upland communities were mesic forests (Curtis 1959), and were dominated by sugar maple, hemlock, and yellow birch in different proportions. The development of much of the Lakes States forest, of which this was a part, has been postulated to result from climatic shifts in the mid-sixteenth century (Graham 1941, Potzger 1946). Judging by growth tables for northern hardwood species (Gates and Nichols 1930), the largest hemlocks recorded in the Land Survey notes may date to that period.

To describe the structure of each community, an Importance Value (I.V.) (Curtis 1959) based on relative density, frequency, and dominance was calculated for each species of witness tree located within it (Cottam 1949, Ward 1956), and a species-size distribution graph was prepared.

Yellow Birch Forest: The Yellow Birch Forest occupied approximately 6 percent of the study area (Table 1), and occurred primarily in the uplands south of the Iron Range (Fig. 2). In general this area is lower than its surroundings (Fig. 1), and thus is a cold air sink subject to advection frost at any time of year. The southwestern exposure also makes it subject to periodic disturbance from windthrow and also from fire, especially during extremely dry years.

Yellow birch was by far the leading dominant in the community with an Importance Value of 34.1 (Table 2). The largest individuals in the forest were yellow birch and this species also had the highest density. Although common in many northern Wisconsin stands, yellow birch does not often reach such a position of dominance (Brown and Curtis 1952, Winget *et al.* 1965). The reported heavier precipitation for this portion of the state may partially explain this anomaly. Hemlock and sugar maple were second in importance with I.V.'s of 18.8 and 17.2 respectively. In addition, balsam fir (*Abies balsamea*), white cedar (*Thuja occidentalis*), and white spruce (*Picea glauca*) were prominent members of this community.

The size class distribution (Fig. 3) indi-

TABLE 2. Importance values for species in the presettlement forest communities. Values > 1.0.

Community	*Acer saccharum*	*Tsuga canadensis*	*Betula lutea*	*Tilia americana*	*Ostrya virginiana*	*Quercus rubra*	*Acer rubrum*	*Abies balsamea*	*Thuja occidentalis*	*Prunus serotina*	*Picea glauca*
Hemlock-Sugar maple	30.4	33.5	18.6	4.3	1.8	—	1.8	4.1	2.8	—	—
Sugar maple	52.9	11.8	19.9	4.2	1.5	1.2	2.0	3.2	1.5	—	—
Yellow birch	17.2	18.8	34.1	1.2	2.5	—	—	14.6	6.1	1.2	3.3

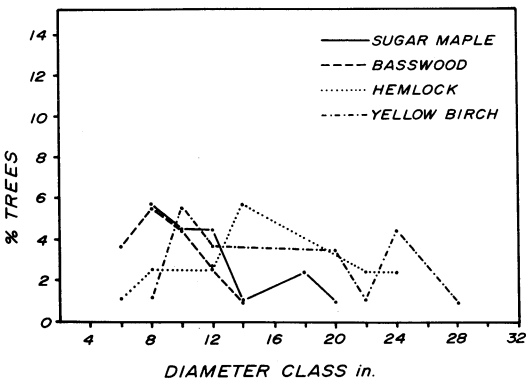

Fig. 3. Size class distribution of major tree species in the presettlement Yellow Birch Forest.

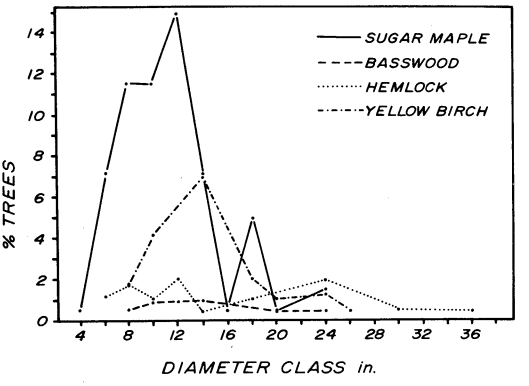

Fig. 4. Size class distribution of major tree species in the presettlement Sugar Maple Forest.

cates that yellow birch and hemlock were evenly represented across the range of diameter classes, evidence that these species were reproducing in the area. However, the distributional patterns of these species were different from that which might normally be assumed—i.e., having many individuals in smaller size classes and progressively fewer in the larger sizes. The skewed distribution curves found here could have been the result of size bias by the surveyors, or it could be hypothesized that it was a composite picture of an area which had experienced a history of periodic disturbance (Loucks 1970). If this hypothesis were correct, the Yellow Birch Forest would have been a mosaic of even-aged stands of trees with each "pocket" dating from a small-scale perturbation. Yellow birch tends to reproduce well under conditions following fire as do balsam fir, white cedar, and white spruce (Fowells 1965). It is also possible that the mosaic was one of diverse micro-climates as well as of disturbance. The scale of the land survey vis-a-vis that of the units of the mosaic makes it difficult to investigate these theories.

Sugar Maple Forest: The sugar maple community was centered along the Iron Range and made up approximately 27 percent of the study area (Table 1). A small area also occurred in the center of the Gabbro-Trap Range. Sugar maple was by far the leading dominant with an Importance Value of 52.9, twice as high as that of the second leading dominant, yellow birch (19.9), and four times that of hemlock (11.8) (Table 2).

The dominance of sugar maple resulted from its extreme abundance in the lower size classes (Fig. 4), although it also was represented in larger size classes. Yellow birch followed a similar pattern, but individuals were much less numerous (43 vs. 152). Hemlock was represented in small numbers across all size classes, being greatly exceeded in the smaller sizes ($<16''$) by sugar maple; neither yellow birch nor sugar maple approached its presence in larger sizes ($>20''$).

The high ridges of the Iron Range provided an environment which was not as cold as that of the Yellow Birch community. In addition, the area was protected somewhat from fire by the surrounding wetlands and the steep topography. These conditions were excellent for sugar maple and hemlock, and also for the basswood (*Tilia americana*) and and red oak (*Quercus rubra*) which were scattered throughout this area; the environment was less favorable for yellow birch (Fowells 1965).

Hemlock-Sugar Maple Forest: This community occupied the largest portion of the

study site (35 percent) (Table 1) and was centered along the Gabbro-Trap Range (Fig. 2). Hemlock (I.V. 33.5) and sugar maple (I.V. 30.4) were codominant (Table 2). Yellow birch (I.V. 18.6) played a lesser role; also present were basswood, ironwood (*Ostrya virginiana*), red maple (*Acer rubrum*), balsam fir, and white cedar. Sugar maple, hemlock, and yellow birch all had similar size class distributions, with many stems in the smaller size classes and few in the larger sizes (Fig. 5)—an indication that all three species were reproducing in the area. Hemlock present were as large as 142 cm. (48 in.) in diameter; there were no maples or birch larger than 71 cm. (28 in.).

Because of its rugged topography the Gabbro-Trap Range provided a wide variety of habitats. The system of small ridges and intervening small valleys allowed maple, birch and hemlock to reach a more equal development than in either of the other two communities; the warmer slopes favored the sugar maple, and the cooler, more moist coves provided optimal conditions for hemlock and yellow birch (Stearns 1949, Fowells 1965).

The Vegetation in 1934

The vegetation of the study area as it appeared during the period of peak development was reconstructed by using the Land Economic Inventory for Iron County (Bordner 1934). The Inventory was compiled by field workers who traversed each quarter mile of land and noted vegetation communities and the current human land usage. From this detailed survey, a map was constructed (Fig. 6).

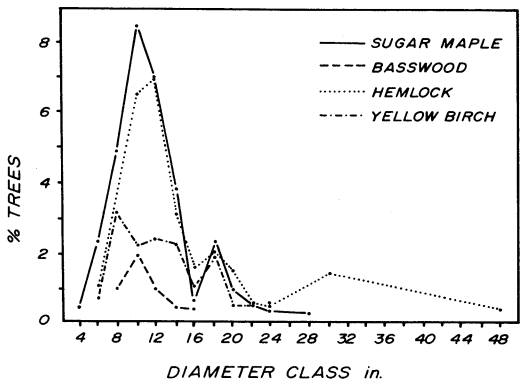

Fig. 5. Size class distribution of major tree species in the presettlement Hemlock-Sugar Maple Forest.

Lowland communities, here identified as Woody Lowland and Marsh and Lakes, still occupied approximately the same proportion of the study area as they did in the 1860s (Tables 1 and 3). The upland forests, however, had been reduced to about 75 percent of their former extent by clearing for farmland and dwellings; those areas which remained forested had been greatly changed in composition.

Because the categories used in the Bordner Survey were different from those used to interpret the Federal Land Survey, it is difficult to make exact comparisons between the eras; nevertheless several trends are evident. The Mixed Hardwoods and Conifers of the Bordner Survey were equivalent to the upland mesic forest types of the 1860s. In 1934, these communities made up only 20 percent of the area. In addition, their structure had changed significantly because of logging for timber for building and for extensive use in the mines (Mladenoff 1979). Whereas the presettlement forests had an average tree diameter of 30 cm. (12 in.), most of the trees recorded in 1934 were between 2.5 and 15 cm. (1 and 6 in.).

Another type of upland forest, Hardwoods and Conifers with Aspen (*Populus* spp.), occupied 21.5 percent of the 1934 land cover. This type occurred along the Iron Range and across the western portions of the Gabbro-Trap Range. Aspen was not recorded as a witness tree in the 1860s survey of the area and its importance in 1934 was probably a result of recent logging and fire. Aspen as a community type also occurred in 1934 in the most recently logged areas.

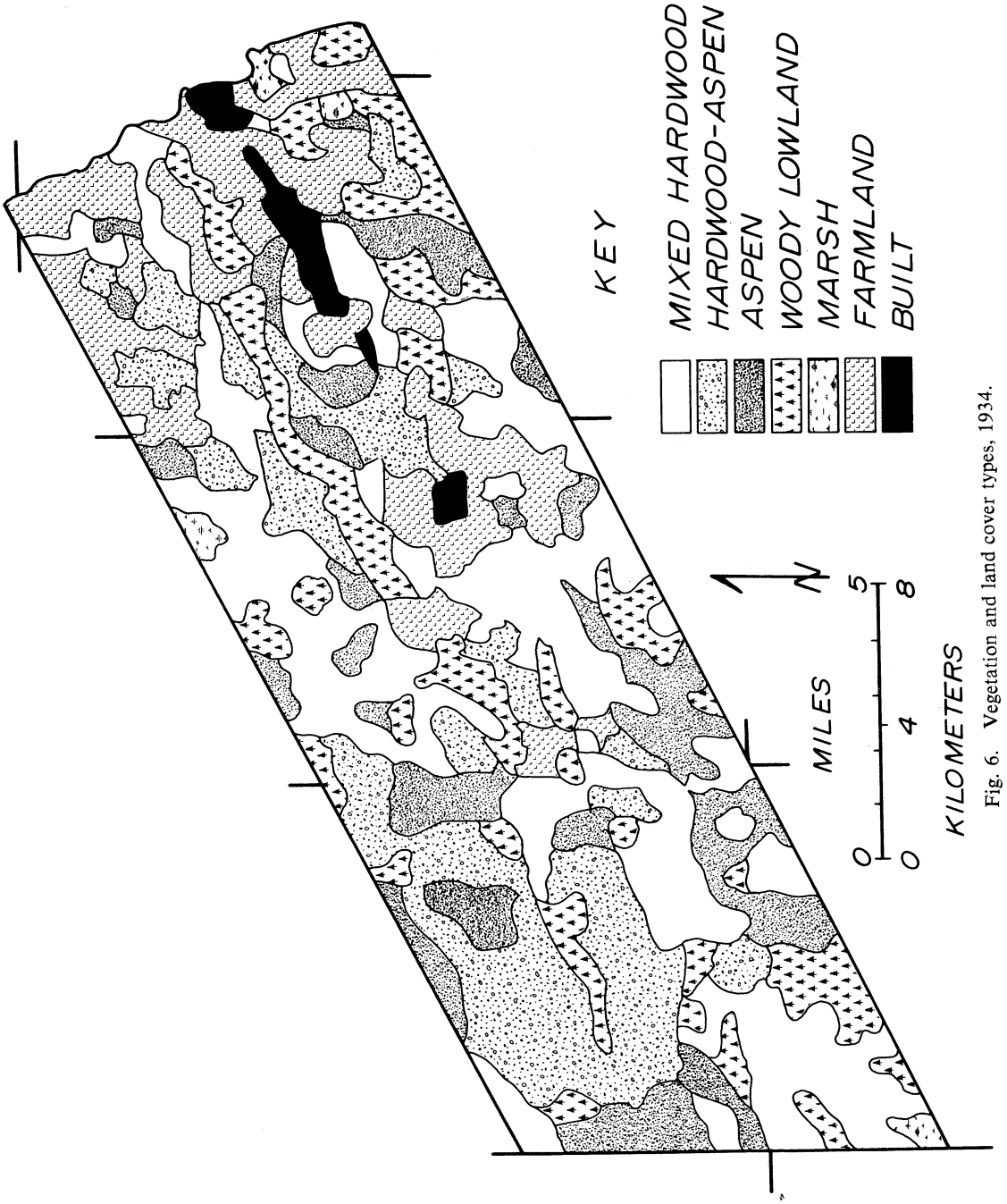

Fig. 6. Vegetation and land cover types, 1934.

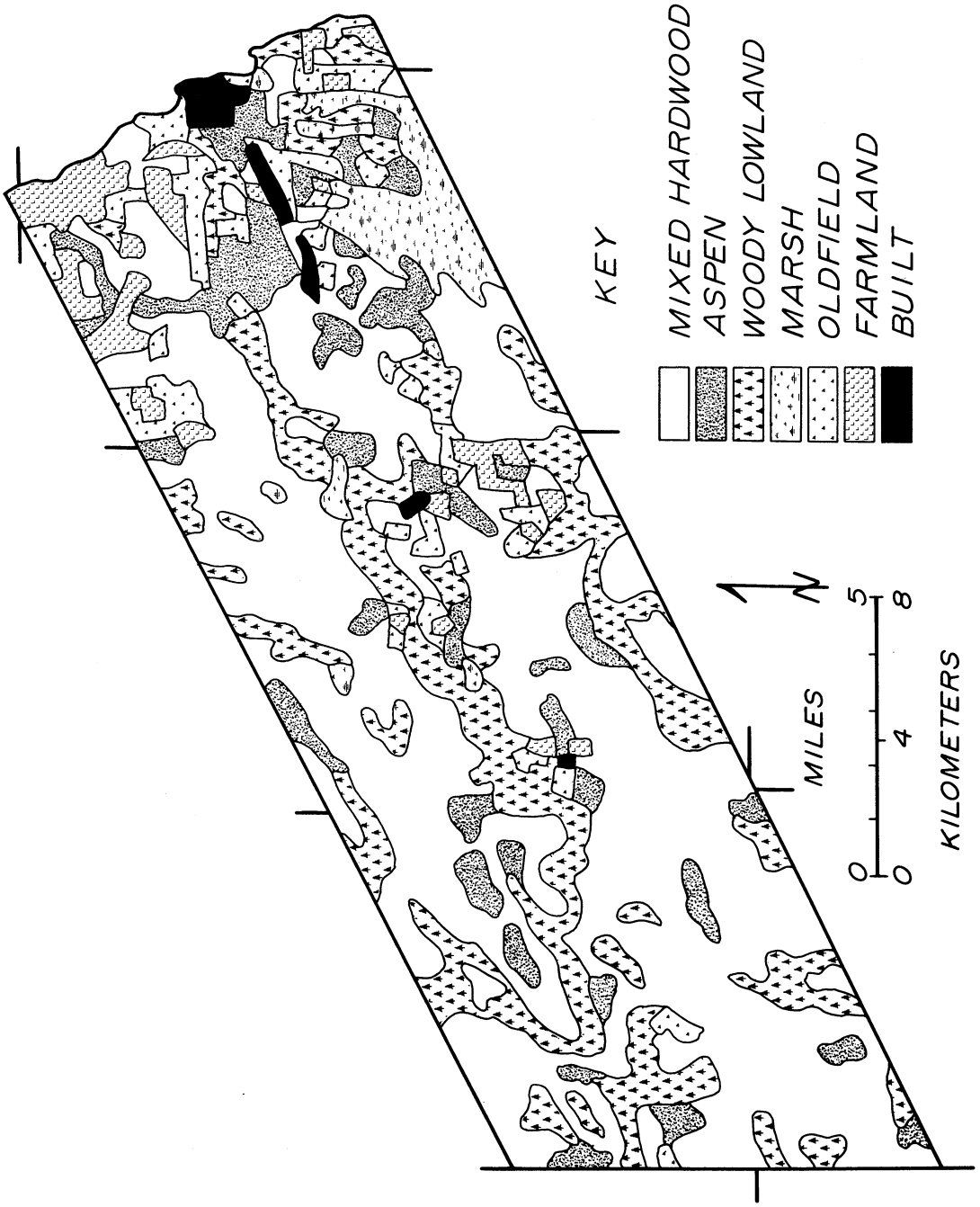

Fig. 7. Vegetation and land cover types, 1973.

TABLE 3. Land cover in the Gogebic Iron Range, 1934.

Land Use	*Percentage of area*	*Hectares (Acres)*
Mixed hardwoods and conifers	20.0	6,221 (15,360)
Hardwoods and conifers with Aspen	21.0	6,687 (16,512)
Aspen	9.2	2,861 (7,065)
Woody lowland	28.1	8.740 (21,580)
Marsh and lakes	.09	28 (69)
Farmland	18.5	5,754 (14,208)
Built	1.9	591 (1,459)

TABLE 4. Land cover in the Gogebic Iron Range, 1973.

Cover Type	*Percentage of area*	*Hectares (Acres)*
Mixed hardwood	52.1	16,205 (40,013)
Aspen	6.4	1,991 (4,915)
Woody lowlands	27.7	8,616 (21,274)
Marsh and lakes	3.7	1,151 (2,841)
Farmland	4.2	1,307 (3,226)
Old field	4.1	1,275 (3,148)
Built	1.9	591 (1,459)

THE VEGETATION OF THE 1970s

The vegetation of the 1970s was documented by constructing a map of land cover types using U.S. Agricultural Stabilization and Conservation Service (ASCS) black and white infrared aerial photographs at a scale of 1:15,460, and by field sampling 15 upland forest stands. The map was based on visual inspection of changes in the pattern shown on the photographs supplemented by ground inspection to verify the classification of the patterns. Sites for the field sampling were chosen by locating random points on U.S. Geological Survey (USGS) topographic maps (scale 1:24,000) and sampling the upland forested area closest to the point. The point-quarter method was used to sample trees in each stand (Cottam and Curtis 1956). This method evolved from the technique used in the Federal Land Survey in recording witness trees at section corners. The sample sites were divided into two groups: those which occurred in the location of presettlement Sugar Maple Forests and those which were located in areas of presettlement Hemlock-Sugar Maple Forests. The data were tabulated for each community in the same manner as that described for the presettlement data.

In 1973 the lowland communities still appear remarkably consistent, occupying approximately 31 percent of the study area (Fig. 7, Table 4). Farmland has decreased greatly since 1934 and wooded areas have increased. The most notable change in the composition of the upland forests is the reduction in the area of aspen and the increase in sugar maple-dominated hardwood. The Mixed Hardwoods community increased from 20 percent in 1934 to 52 percent—seemingly at the expense of aspen dominated communities. The actual presence of aspen (primarily *P. tremuloides,* but including *P. grandidentata*) however, is underestimated to some extent under this classification. In some of the areas where it was listed in 1934 in mixture with hardwoods, by 1973 it had been selectively cut or was dying. In other locations it is present in the stand as scattered large individuals; sugar maple is generally replacing it on the upland sites. A considerable area of the aspen community surrounding the mining towns occupies areas that were pastured in 1934. Areas listed as Old Field in the 1970s are recently abandoned farmlands being invaded by shrubs and aspen.

COMPARISON OF UPLAND FORESTS OF THE 1860s AND 1970s

The vegetation map for the 1970s, an era of declining development, is more similar to that of the 1860s than it is to the 1934 map representing peak development. This is primarily because the upland communities of the presettlement era are still, or are once

TABLE 5. Density, mean basal area, and dominance for presettlement communities and corresponding sample stand averages for 1978.

	Density stems/ha	*Mean basal area (dm^2)*	*Dominance dm^2/ha*
Hemlock-sugar maple			
1860	546	10.2	5,580
1978	923	4.0	3,513
Sugar maple			
1860	548	8.6	4,709
1978	762	6.3	4,403

again, hardwood dominated by sugar maple. The field data were used to determine the extent of changes in structure which may have occurred in these communities and which are not evident in the mapped classifications.

Tree densities and mean tree sizes for the presettlement Sugar Maple and Hemlock-Sugar Maple communities of the 1860s were compared with those in the 1970s (Table 5). In this time span there have been dramatic increases in density. The size of the average tree (basal area measured at breast height) has changed from 10 to 4 dm^2 in the Hemlock-Sugar Maple type, and from 8.6 to 5.9 dm^2 in the Sugar Maple type. These size and density changes are, as noted by Rogers (1959), an expected change in mesic forests which have experienced heavy cutting. The size difference between the two present communities may have resulted in part because the sugar maple type, which is largely along the Iron Range, was cut 20 to 40 years earlier and is thus an older forest. As expected, dominance (dm^2/ha) has also decreased in both areas, with the greatest difference being noted in the Hemlock-Sugar Maple community.

Importance Values of the dominant species were calculated for both periods (Table 6). In both vegetation types the most dramatic change has been the greatly increased value for sugar maple in particular; this increase has apparently been at the expense of hemlock and yellow birch. In the Hemlock-Sugar Maple type, the relative importance of sugar maple has increased from 30.4 to 50.8 (>65%). Hemlock has decreased from an I.V. of 33.5 as a leading dominant to an insignificant 1.5. Yellow birch, which had been the third leading dominant (I.V. of 18.6) has been reduced by 62% (I.V. 7.1). The major increases in I.V.s in this community are in basswood, which has more than tripled, and in red oak, white ash (*Fraxinus americana*) and aspen.

Similar changes have taken place in the Sugar Maple community where sugar maple has increased in I.V. from 52.9 to 68.4. The former second dominant, yellow birch, has

TABLE 6. Importance values for dominants in presettlement communities and corresponding sample stand averages, 1978.

Community	*Year*	*Sugar Maple*	*Hemlock*	*Yellow Birch*	*Basswood*	*Red Oak*	*Elm*	*Red Maple*	*White Ash*	*Balsam Fir*	*White Cedar*	*Aspen*
Hemlock-Sugar Maple	1860	30.4	33.5	18.6	4.3	—	—	—	—	4.1	—	—
	1978	50.8	—	7.1	14.4	5.5	—	—	—	—	—	5.5
Sugar Maple	1860	52.9	11.8	19.9	4.2	—	—	—	—	3.2	—	—
	1978	68.4	—	3.1	16.3	—	5.9	4.1	—	—	—	—
Yellow Birch	1860	17.2	18.8	34.1	—	—	—	—	—	14.6	6.1	—

decreased in I.V. from 19.9 to 3.1; and hemlock again is reduced to insignificance. Major increases again are in basswood, a quadrupling in value, the appearance of American elm (*Ulmus americana*) as the third dominant, and increase in red maple and white ash.

The similarity of change in the two communities is striking. It seems likely that the minor differences result from compositional differences in the original communities rather than the results of differing histories since that time. Sugar maple shows vigorous reproduction with no other species competing closely in the smaller size classes (Figs. 8 and 9). The other important species have increased in the moderately small sizes, but then again drop off. The greater irregularity of the curves representing the Hemlock-Sugar Maple community may be another indication of more recent cutting and disturbance.

In both of these types, the pattern shows near elimination of the codominants of the sugar maple—hemlock and yellow birch—and an increase in a group of less mesic species. Although these species differ somewhat between the two communities, they are generally those species present in the original forest, which would have benefited from and responded to the increased light following cutting of the more sought after dominants (Kline and Cottam 1979). In particular, the marked increase in I.V. of basswood is probably associated with its sprouting ability (Stearns 1951).

During the mining era the mixed hardwood forests were generally selectively cut, to varying degrees, depending largely on the market conditions as well as the age and condition of the various species present in a stand (Frothingham 1915). This was true in particular along the Trap Range where many areas were cut during the erratic and depressed market conditions of the early 1930s (Corrigan 1976).

Hemlock and yellow birch were in greatest demand for lumber (Corrigan 1976) and were both present in the desirable larger size classes. Sugar maple, which was present in smaller sizes, would have been cut less severely. Conditions resulting after large-scale cutting would have been unfavorable to the survival of the remaining hemlock and yellow birch, because of their greater sensitivity to exposure, fire, and drought and their inability to sprout in comparison to sugar maple (Fowells 1965, Godman and Krefting 1960).

The structural and compositional changes from the presettlement condition to the present, particularly the large reduction in mean

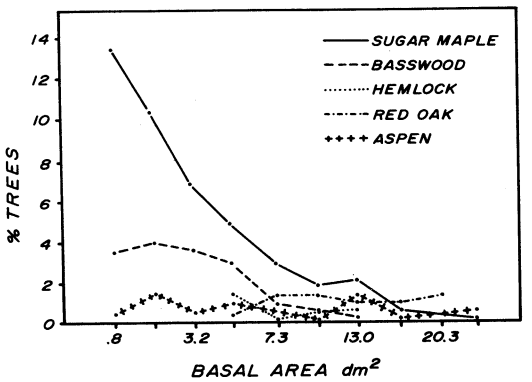

Fig. 8. Size class distribution of major tree species in 1978 in the former Hemlock-Sugar Maple Forest.

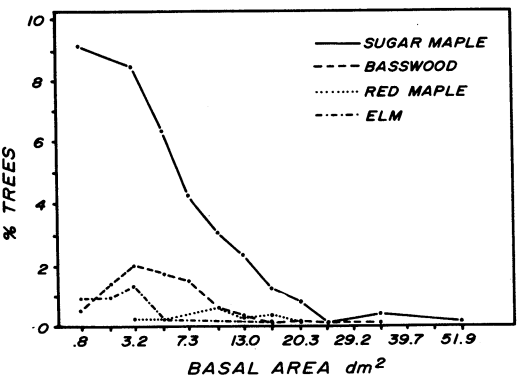

Fig. 9. Size class distribution of major tree species in 1978 in the former Sugar Maple Forest.

basal area, can be attributed to several factors, the massive disturbance which apparently took place in the study area and the ensuing response of the vegetation. Elimination of the trees in the larger size classes is evident from the data (Figs. 8 and 9). This is particularly true of hemlock and yellow birch, which as dominants in the presettlement communities also constituted the largest individuals. Consistent with removal of the large trees is the reduction in dominance in the present forests. Goff and Zedler (1968), in a structural analysis of a large number of stands in the western Great Lakes area, found a high positive correlation between basal area per unit area and mean diameter, particularly in the northern forests. This may explain the reduction noted in mean basal area in the two types of 61% and 27%, respectively, and the corresponding reductions in dominance of 37% and 6.5% (Table 5).

However, the most significant factor in the reduction in mean basal area appears to be the dramatic increase in the smaller size classes. Tree sizes in the presettlement communities suggest relatively mature, mesic forests with stem distribution in all size classes indicating no severe, recent disturbance. Removal of large trees would be necessary for any increase in density and reduction in basal area to occur in this forest. However, the magnitude of change in mean basal area, in particular in the Hemlock-Sugar Maple community, does not appear to be accounted for directly by the elimination of the larger trees. Goff and Zedler (1968) also found a significant negative correlation between density and mean diameter. Correspondingly, the increases in density for the two forest types in the study area are 69% and 39%, respectively; both are of a significantly greater magnitude than the change in dominance, and much more closely in proportion to reductions in mean basal area. A higher peak is also evident in the small size classes in the present forests, and that peak occurs at sizes which are even smaller than those for the presettlement forests. Several less mesic species occur with significant importance values; these species were not present in the presettlement communities. Auclair and Goff (1971), in another study of the western Great Lakes area, found that tree species diversity is greatest for young, successional forests at the midpoint along time and environmental gradients (mesic). They also found that a greater diversity of successional tree species indicates a high density, successional forest. Our data and the assumed site history point to a similar conclusion; that the pronounced structural changes, particularly the large reduction in mean basal area, cannot be attributed primarily to the mere removal of a portion of the larger diameter trees, *per se,* but rather to the severe disturbance and opening of the canopy of the original mesic forest to an extent that resulted in the wide-spread, rapid reproduction with a greater variety of species (Loucks 1970). This resulted in the high diversity forest of today, and more fully accounts for the changes in mean basal area and other structural changes.

Several workers in Wisconsin have cited damage by browsing deer as being the primary cause in the reduction of hemlock reproduction in particular (Beals *et al.* 1960, Swift 1948). Evidence that browsing was an important factor does not seem to be present. Northern Iron County, because of its heavy winter snows and extensive mesic forests, affords less food and traditionally has had a lower deer population than adjacent counties. This can be illustrated by comparing the ratio of deer kill per square mile for Iron County and several adjacent counties (Fig. 10). The yearly data were taken from Bersing (1966). For the entire period from 1912 to the present, Iron County has the lowest ratio, varying from 0.22 to a high, in post logging years, of only 0.96. Adjacent counties have varied over the same period

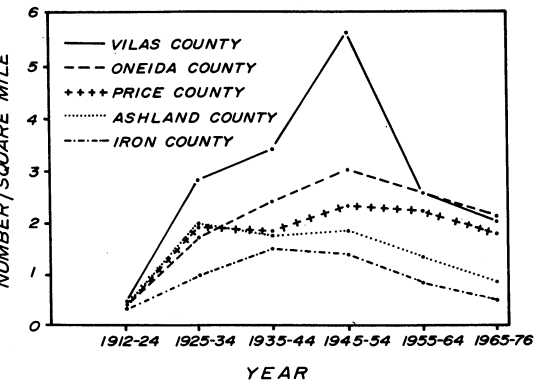

Fig. 10. Average annual deer harvest per square mile for Iron County and adjacent Counties 1912-1976. Data from: Bersing (1966), Wisconsin DNR (1966-76).

from 0.26 to 5.6 and a mean of 2.3 deer taken per square mile. Hunter pressure and weather may also influence the ratio. Hunter pressure, however, does not account for the consistent ratio noted, an opinion shared with Department of Natural Resources foresters in Iron County (Hanson 1979).

If deer are not a major factor, climate and site history must account for a greater part of the vegetation pattern as it appears today and for the direction in which it appears to be moving.

Conclusions

At the time of initial settlement of Iron County, the dominant upland cover was mesic forest with sugar maple, hemlock, and yellow birch as major components. Relative importance of the species varied with local topography, soils, and site history.

From the 1860s to the 1930s, the region underwent rapid development with intensive exploitation of iron ore and forest resources. Development produced mainly secondary regional impacts, *i.e.,* extensive timber cutting and land clearing resulting in the spread of farms around the mining communities. There were of course, intensive site-specific impacts from the mining, such as subsidence and lack of reclamation in and around populated areas, and, not least, the social problems that resulted from this boom and bust economy. However, despite the once dramatic changes in the landscape, the area is generally reverting to mesic forest. This is consistent with the findings of Kline and Cottam (1979) in southwestern Wisconsin where, despite significant impacts, the overriding climatic influence has resulted in re-establishment of vegetation similar to the original forest.

Compositionally, the mesic forests along the Gogebic Range are considerably different today from those in 1860. In terms of tree species with significant importance values, the forests appear to be considerably more diverse. This is, in part, because the forest is now younger; many of the species present today are pioneer species which could not survive and reproduce under the dense shade of the mature maple-hemlock presettlement forest.

The forests along the Gogebic Range have in fact been affected by human activity in such a manner that despite reversion to a mesic forest type, the regional vegetation will not have the same composition which characterized its presettlement condition, even if undisturbed for a considerable time. Climate appears to remain the dominant factor determining vegetation of a region.

The compositional changes described in this paper are not unusual for the mesic forests of northern Wisconsin. However, the timing of disturbance and the driving forces behind it form a unique relationship between the forest and the mining economy. These human activities have altered the present condition and future composition of the forest to an extent that will not be erased on a regional scale in the foreseeable future.

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THERMAL STRATIFICATION OF WISCONSIN LAKES

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Abstract

A model predicting summer temperature stratification in lakes utilizing lake surface area and maximum depth information was developed from vertical profile temperature and dissolved oxygen data collected on approximately 500 Wisconsin lakes. From the model, the number of stratified versus non-stratified lakes (natural and impoundments) was estimated for the 3,000 plus Wisconsin lakes with surface areas 25 acres (10 hectares) or greater. Statewide, about one-half of the lakes are predicted to be non-stratified. Impoundments, which represent about 16 percent of the state's lakes, are about 86 percent non-stratified. Potential uses for the lake stratification model are noted.

INTRODUCTION

Thermal stratification in moderately deep temperate latitude lakes is a well documented phenomenon. Hutchinson (1957) provides a thorough discussion of the contributions of earlier researchers. Thermal stratification results from density differences in lake water of varying temperatures (Birge, 1916). After the winter ice melts, water temperatures increase above the point of maximum density of 4°C until maximum Wisconsin lake surface temperatures, generally between 21°-27°C (Wisconsin DNR, Bureau of Research lake data files), are reached by mid-summer. The wind provides energy during the spring to circulate the warming surface waters throughout the entire water column (spring overturn) maintaining homoiothermal (uniform) lake temperatures. As water temperatures increase above 4°C, water density decreases, with each successive degree of rising water temperature resulting in a greater decrease in water density. Consequently, more wind energy is required to completely circulate the warmer lake surface waters with the cooler, more dense bottom waters.

In deeper lakes, as surface temperatures increase on calm, warm spring days, the density differences between surface and bottom waters become too great for the wind to maintain complete homoiothermy. Thermal stratification results with the establishment of an *epilimnion* (upper warm water, freely circulating), *hypolimnion* (deep, cold, relatively undisturbed water), and a zone of steep thermal gradient called the *metalimnion* (or *thermocline*). These regions exist throughout the summer months until fall, when the lake surface water cools sufficiently to again equalize water density differences between top and bottom, thereby initiating fall overturn.

Shallow lakes exhibit complete mixing regularly throughout the summer as the wind provides enough energy to destabilize the minor density differences that develop between the surface and bottom as a result of surface warming on hot, calm summer days. Certain lakes have sufficient depth to allow for temporary thermal stratification, which persists until major weather systems with high winds again cause complete mixing. These weather systems occur frequently enough during the summer months in Wisconsin (Stauffer, 1974) that these weakly stratified lakes can be considered as non-stratified. Stratified lakes do not exhibit

complete mixing during the summer, although metalimnetic deepening, as a result of these strong weather fronts, does occur (Stauffer, 1974).

Rigorous mathematical expressions have been developed to describe the heat flux processes of lakes that ultimately result in thermal stratification (see Hutchinson, 1957). Calculations based on various physical lake characteristics can describe the *stability* of a lake, or the amount of work needed to cause a lake to destratify to a uniform temperature. Lake depth is an important variable in the calculation. However, the lake depth required before thermal stratification develops varies greatly between individual lakes as a function of lake surface area, basin orientation relative to prevailing winds, lake depth-volume relations, protection by surrounding topography and vegetation, and other factors (Wetzel, 1975).

Few generalizations about stratification have been attempted for diverse groups of lakes. Hutchinson (1957) noted that the eddy diffusivity (related to the process of turbulent mixing) is greatest in the wind-swept epilimnion of large, exposed lakes. Consequently, lakes of similar maximum depths may be either stratified or non-stratified, depending on their surface area.

Ragotzkie (1978), using data from Wisconsin and central Canadian lakes, developed one of the first simple lake stratification models. Lake fetch (F) was used to predict the depth of the summer thermocline (D_{th}) for lakes having fetches from 0.1 to over 20 km:

$$D_{th} = 4\sqrt{F}$$

Summer stratification of a lake has a tremendous impact on the chemical constituent concentrations of each lake and a great influence on the lake's biological community structure. Although Wisconsin lakes are very diverse in their geochemical characteristics (Poff, 1961) and watershed nutrient loadings, particularly between northern and southern Wisconsin, they are also greatly affected by thermal stratification (Lillie and Mason, in press). In general, southern Wisconsin lakes are more fertile, and those that stratify usually exhibit dissolved oxygen depletion throughout the hypolimnion as a result of respiration and bacterial decomposition of organic matter. The lack of oxygen in the colder hypolimnion precludes the survival of cold-water-adapted fish such as trout since surface water temperatures are high where dissolved oxygen concentrations are adequate. Other aquatic life such as bottom feeding insects and zooplankton are restricted from the anoxic hypolimnion except for brief periods when certain species migrate into the hypolimnion. Northern Wisconsin lakes are generally less fertile and therefore in many cases do not undergo complete hypolimnetic oxygen depletion. Cold-water-adapted fish do well in the hypolimnion of these lakes during the summer months when surface waters are too warm.

The lack of oxygen in the hypolimnion of fertile lakes causes the hypolimnetic lake sediments to release such dissolved constituents as inorganic phosphorus, ammonia, and hydrogen sulfide into the overlying water throughout the summer stratification period (Mortimer, 1941-1942). In shallow, fertile lakes a significant amount of dissolved nutrients released from the lake sediments during periods of brief stratification can be transported by subsequent mixing to the surface waters where high levels of algal production are maintained.

Resuspension of sediments is another important effect of lake mixing. Shallow lakes continually resuspend nutrient rich sediments that contribute to increased nutrient concentrations for algal growth.

The combined result of sediment resuspension and frequent stratification followed by lake mixing in shallow lakes results in potentially high rates of internal nutrient recycling during the summer months. As a result, surface waters of non-stratified lakes

in Wisconsin generally show a net increase in total phosphorus concentration from spring to summer, while deep stratified lakes usually exhibit a net decrease in total phosphorus concentration (Lillie and Mason, in press. Thermal stratification effectively creates a temporary nutrient barrier between the epilimnion and the hypolimnion, while nutrients are being removed from the epilimnion by sedimenting algae. The importance of this barrier varies between lakes as a function of lake basin morphometry.

The classification and inventory of lakes in relation to their trophic status has been emphasized increasingly in recent years by state and federal agencies. Since thermal stratification can significantly affect lake water quality and concomitant recreational potential of a lake, a model capable of predicting stratification in Wisconsin lakes from limited data could provide useful information for the classification process.

Methods

Data used in this report came from two sources: (1) vertical profile temperature and dissolved oxygen data on approximately 500 lakes 25 acres (10 hectares) or greater in surface area, collected by the Wisconsin DNR, Bureau of Research; and (2) lake surface area and maximum depth information on Wisconsin lakes 25 acres or greater (data compiled by DNR Bureau of Fish Management). The lake inventory data was subdivided into natural lakes and impoundments.

Decisions about the establishment of thermal stratification are based on inspection of the temperature and dissolved oxygen vertical profiles. Three main types of tem-

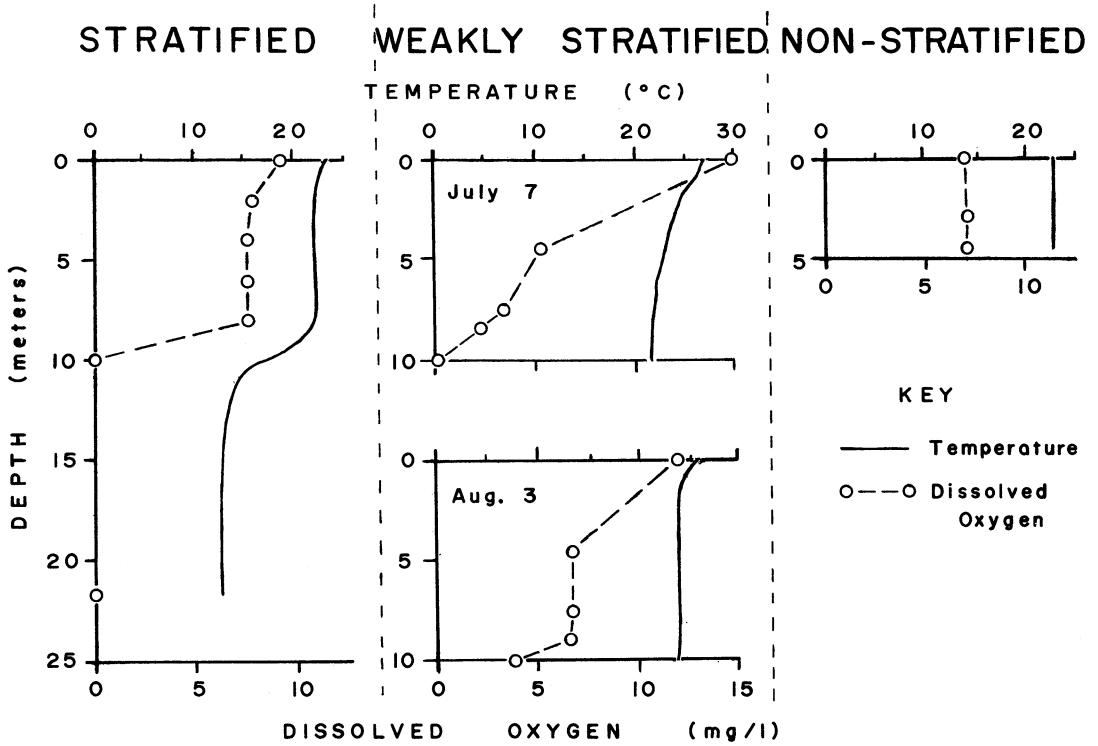

Fig. 1. Temperature stratification patterns found in Wisconsin lakes. (Stratified = Lake Monona, Dane Co., Aug. 1, 1978; Weakly Stratified = Lake Waubesa, Dane Co., July 7 and Aug. 3, 1976; Non-stratified = Round Lake, Chippewa Co., July 15, 1975).

perature profiles are found in Wisconsin lakes (Fig. 1). The stratified lake has a distinct epilimnion, metalimnion, and hypolimnion. The hypolimnion in the example is completely anoxic, indicating the absence of mixing with the epilimnion. The non-stratified lake is homoiothermal; dissolved oxygen concentrations demonstrate well-mixed conditions.

The weakly-stratified lake (Fig. 1) demonstrates the difficulty in deciding whether or not the lake is capable of developing permanent stratification throughout the summer season (late June, July, and August). On July 7, the lake appears to be stratified and dissolved oxygen depleted near the lake bottom. However, on August 3, the temperature gradient is not as steep (with bottom temperatures being more than 2°C higher) and dissolved oxygen concentrations are higher in deeper waters, indicating that some recent mixing has occurred. The July 7 data provides a clue to the lake's ability to destratify; bottom water temperatures are almost 22°C. Any cooling and/or mixing of the lake's surface waters as a result of a weather front would reduce the density differences between the top and bottom waters sufficiently to allow complete vertical mixing.

Consequently, any lakes with mid-summer bottom water temperatures above 20°C were generally considered to be weakly stratified and were combined with the more obvious non-stratified lakes for the purposes of this study. For the few lakes where stratification or lack of it was even more difficult to determine, the authors assigned lakes to the appropriate category based on their judgment about the influence of other factors affecting stratification, such as lake shape and surrounding topography.

Results and Discussion

Lake surface area and maximum depth information were plotted for all natural lakes that could be classified as either stratified or non-stratified based on interpretation of the temperature and dissolved oxygen vertical profile information (Fig. 2). A generally linear separation between the stratified and non-stratified lakes resulted from a logarithmic presentation of lake area. Those lakes

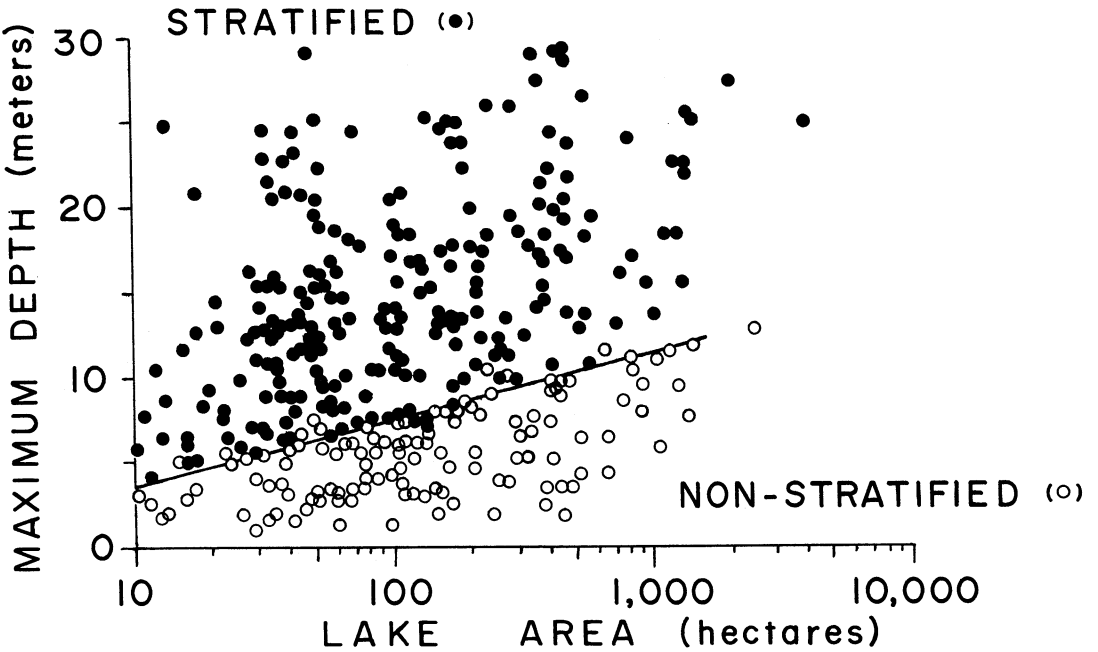

Fig. 2. Lake stratification model for Wisconsin lakes.

lying close to the stratification/non-stratification interface (Fig. 2) represented borderline cases, with stratified lakes having less stability when in close proximity to the interface. Many of the non-stratified lakes near the interface were weakly stratified.

Impoundments plotted in this same manner showed somewhat similar results, however a few anomalies were noted. In some cases stable temperature stratification occured in small, relatively shallow depressions near the spillways of dams where there was no circulation and warmer surface waters were passing over the spillway. A number of impoundments (and a few natural lakes) receive large river discharges in relation to their volume and thereby experience a physical flushing which precludes the establishment of thermal stratification. Lack of stratification in Wisconsin impoundments with high flushing rates was found in depths up to 22 meters. Because of these abnormal stratification characteristics impoundments were excluded from the development of the final stratification model (Fig. 2). However, the model should be applicable to most impoundments.

Color, caused by dissolved humic substances, is one important variable affecting the depth of thermocline development in all lakes. The increased absorptive capacity of colored water restricts penetration of radiant energy. Consequently, colored lakes frequently have shallower epilimnions and narrower thermoclines than clear-water lakes (Wisconsin DNR, Bureau of Research lake data files).

Because of the linear separation between stratified and non-stratified lakes, a simple mathematical model was developed to predict lake stratification based on maximum depth and lake area:

$$\frac{\text{Maximum Depth (meters)} - 0.1}{\text{Log}_{10}\text{ Lake Area (hectares)}} > 3.8 - \text{Lake should be stratified}$$

This model allowed for the prediction of the number of stratified versus non-stratified lakes for Wisconsin from surface water inventory data. As the model was based only on lakes with surface areas 25 acres (10 hectares) or greater and because smaller lakes may be heavily influenced by surrounding topography, the model was only applied to the 3,000 plus Wisconsin lakes in this size range. Impoundments and also lakes with high color were included in the data set. The number of poor predictions was relatively small.

Since the mathematical expression was developed using a data set from Wisconsin lakes, application of the model to other areas of the country may result in inaccurate stratification predictions because of differences in basin configuration, climate, or other factors. However, lakes in the upper Midwest should be reliably predicted by the model.

The lake stratification model, when compared to the model developed by Ragotzkie (1978), produced corresponding results.

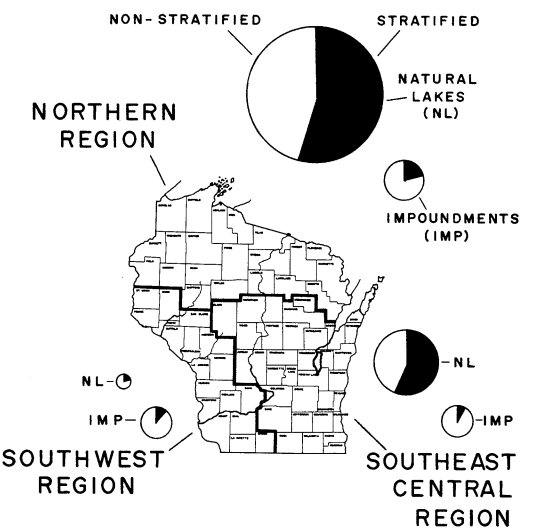

Fig. 3. Regional stratification characteristics of Wisconsin natural lakes and impoundments. (Number of lakes proportional to area of circle; Stratified lakes = solid area, Non-stratified lakes = open area).

His equation predicted the top of the thermocline, whereas the line drawn in Figure 2 would correspond approximately to the bottom of the thermocline. Consequently, Ragotzkie's equation for lakes between 10 and 20,000 hectares (after fetch was converted to circular lake area) when plotted was somewhat parallel to our line in Figure 2, but at shallower depths for corresponding lake areas. As lake area increased, the two models predicted a more extensive thermocline; this is consistent with observational data on Wisconsin lakes (Wisconsin DNR, Bureau of Research lake data files).

For identification of lake stratification characteristics Wisconsin is divided into three regions (Fig. 3). The southwest region generally coincides with the Western Upland Geographical Province of Martin (1965), part of which includes the Driftless or unglaciated area. The topography is highly dissected with few natural lakes present. The northern region includes a majority of the state's lakes; these are characterized by low alkalinity (Lillie and Mason, in press) as a result of the igneous bedrock geology (Hanson, 1971; Poff, 1961). The southeast central area of the state generally has lakes of higher alkalinity and poorer water quality than northern lakes; this is particularly true in the southern part of the southeast central region (Lillie and Mason, in press). Separation of the state into distinct regions based on county lines is arbitrary, but lake inventory information was available on a county basis. The bedrock and surficial geology each indicate much more complex regional distinctions.

Natural lakes and impoundments are unevenly distributed throughout the three state regions (Fig. 3). Approximately 75 percent of Wisconsin's 3,000 plus lakes of 25 acres (10 hectares) or greater surface area are located in the northern region of the state. The southeast central region has roughly 20 percent of Wisconsin lakes in this size range, and the remaining 5 percent are located in the southwest region. Impoundments comprise less than 16 percent of the total number of Wisconsin lakes 25 acres or greater. The number of impoundments is similar in all three regions. Most lakes in the northern region are natural; impoundments represent only about 8 percent of the total number. Impoundments constitute about 75 percent of all lakes found in the southwest region. There are few natural lakes in southwestern Wisconsin since that area was not covered by the Wisconsonian ice (Martin, 1965).

Slightly more than one-half of Wisconsin's lakes with surface areas of 25 acres or greater are predicted by the lake stratification model to be non-stratified throughout the summer (Fig. 3). About 26 percent of the impoundments are predicted to be non-stratified, compared to only 45 percent of the natural lakes.

Impoundments are 80, 93, and 84 percent non-stratified in the northern, southeast central and southwest regions, respectively. The high percentage of non-stratified impoundments is not surprising since they represent shallow lakes on dammed rivers. Natural lakes are predicted to be 55 and 58 percent stratified in the northern and southeast central regions, but only 22 percent stratified in the unglaciated southwestern region.

Striking water quality differences have been noted between stratified and non-stratified lakes. From data collected on approximately 500 lakes throughout the state, average summer secchi disc (water transparency) readings were 2.8 and 1.5 meters for stratified and non-stratified lakes, respectively (Wisconsin DNR, Bureau of Research, unpublished data). Differences in water transparency were related to greater concentrations of chlorophyll (algal biomass) and higher turbidity in nonstratified lakes.

The lake stratification model has potentially important applications for the classification of Wisconsin lakes. The combined effect of generally poorer water quality in non-stratified lakes resulting from greater

efficiencies in internal nutrient recycling, coupled with the large number of non-stratified lakes in Wisconsin, necessitates careful selection of lakes as candidates for limited non-point pollution control efforts. Lakes that are chosen for programs designed to restrict nutrient inputs, which are often expensive, should possess characteristics that would indicate a high probability of water quality response (improvement or long-term protection), thereby ensuring a high benefit to cost ratio. Temperature stratification would seem to be a very important characteristic in lake selection.

The thermal stratification model has other potential uses in water resource management activities. The model may be useful for the initial selection of lakes capable of supporting cold water fisheries, particularly in northern regions where hypolimnetic dissolved oxygen concentrations are likely to be adequate. The model can also serve as a guide to lake managers conducting dredging projects. By predicting lake depths needed for the development of thermal stratification, dredging can be planned to reduce internal nutrient recycling in fertile lakes. The stratification model could also be used in the design of impoundments for the above reasons or to maximize sediment trap efficiency.

Other more theoretical uses of the temperature stratification model may have management implications. The sediments contain a history of the lake's development, and lakes of certain depths may have accumulated sufficient bottom sediments over time to convert the lake from stratified to non-stratified. Probable trophic changes in the lake may be deduced by interpretation of differences in the physical and chemical sediment characteristics. Differences in the biological remains present, above and below the sediment depth where the lake should no longer be stratified, also provide clues. Such interpretation might allow the prediction of projected water quality changes in stratified lakes that are currently experiencing a high rate of in-filling and sediment deposition.

Finally, a stratification model similar to the one presented here may be developed to predict the depth of the epilimnetic/metalimnetic boundary. This depth could be used to calculate the lake bottom area exposed to wind mixing, thus providing an index of potential internal nutrient recycling, as well as information useful for calculating total lake sedimentation rates. This model, coupled with other lake morphometric data, may also help to refine existing lake eutrophication models that relate external phosphorus loadings to in-lake water quality.

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ECOLOGICAL RELATIONSHIPS OF RUFFED GROUSE IN SOUTHWESTERN WISCONSIN[1]

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Abstract

Ruffed grouse (*Bonasa umbellus*) were studied in southwestern Wisconsin from 1976 through 1978. Eighty-six of 87 activity centers were situated on slopes of less than 25 degrees. Spring densities of territorial males were 8.8 and 11.4 birds per 100 wooded ha in 1976 and 1977, respectively. Unusually warm springs allowed most females to nest prior to the peak of drumming. Brood break-up began in mid-August and dispersal reached maximum intensity in late September. Mean and maximum dispersal distances were 2.2 and 7.4 km respectively. Females had red tails proportionally more often than did males. Less than five percent of the 216 reward bands were returned indicating light hunting pressure. Territorial males had an annual survival rate of 53 percent.

The ruffed grouse is one of the most intensively studied upland game birds in North America. However, there remain large areas within this species' broad range from which there is little information. The unglaciated region of southwestern Wisconsin is such an area. This study was designed to provide greater insight into the ecology and harvest of ruffed grouse in southwestern Wisconsin.

The Driftless Area, as this region is known, also extends into northeastern Iowa and southwestern Minnesota and is typified by dendritic drainage patterns and steep slopes. Nearly all of the land is in small, privately owned farms. The creek bottoms and many ridgetops have been cleared for crops or pasture.

Five areas located in northeastern Iowa County, approximately 50 km west of the city of Madison, were studied. These areas totaled 889 ha of which 589 ha were forested. The woodlands are dominated by oak (*Quercus spp.*) and closely resemble the southern xeric forests described by Curtis (1959). Porath and Vohs (1972) reported on ruffed grouse research from forests of a similar nature in northeastern Iowa. Maximum relief on the study areas is 105 m.

METHODS

Field work began on 25 March, 1976 and continued through 15 May 1978. Observations were discontinued between 15 October and 20 March each year.

Drumming sites were located by systematically searching the wooded portions of the study areas. One or more drumming logs within 100 m of each other used by an individual territorial male were considered to delineate an activity center (Gullion 1967). I did not rely on hearing drumming to locate display sites, but looked for accumulations of droppings on logs or rocks. Other clues such as dense shrub-layer vegetation, leaf-free spots adjacent to logs, and worn areas on logs aided in location of potential drumming sites. The presence of droppings was considered the only conclusive proof of re-

[1] Research supported by the College of Agricultural and Life Sciences, University of Wisconsin, Madison, the Wisconsin Department of Natural Resources, and the U.S. Fish and Wildlife Service.

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cent activity. This method minimized the possibility of missing silent, but territorial cocks as identified by Dorney *et al.* (1958). Single logs showing only slight use (less than five droppings) that were greater than 100 m from other drumming logs were not considered activity centers, but were classified as light-use logs. The designation of activity centers and light-use logs was substantiated through trapping and banding.

Ocular estimates were made of the species composition of thickets that could make drumming logs essentially "predator proof" (Gullion and Marshall 1968:132). Data were taken only at the primary log (most used) of any given activity center. All woody vegetation within approximately 5 m of the stage (the point of drumming) was classed by occurrence and composition (percentage of stems present). These values were combined to obtain an index to the relative importance of various species in providing protection from predation.

Mirror traps (Tanner and Bowers 1948) were used to capture territorial males on drumming logs during the spring. For this purpose, single-door National live traps were fitted with mirrors and covered so that the interior was completely darkened once the trap was sprung. Two nesting females were caught with a lift net of sufficiently large mesh to allow the eggs to slip through and remain in the nest bowl. Between 5 August and 15 October of 1976 and 1977, grouse were captured in lily-pad traps (Dorney and Mattison 1956) with 37 m leads and small funnel traps at each end. All birds were marked with color-coded combinations of aluminum leg bands (Gullion et al. 1962), one of which was inscribed with a $5 reward notice and the return address.

Sex and age were determined for all grouse using plumage characteristics. Techniques reported by Bump *et al.* (1947:84-90, 98) and Hale *et al.* (1954) were used for sex and age discrimination. Feather measurements were helpful, but apparently vary geographically (Dorney and Holzer 1957, Davis 1969). However, the ratio of the calamus diameter of primaries 8 and 9 (Rodgers 1979) provided excellent age separation. A sexing criterion based on the number of whitish dots on the rump feathers (Roussel and Ouellet 1975) was also used and has the added advantage of being applicable to juveniles that had not completed growth of adult tail feathers. Juveniles were further examined for progression of the primary molt. The use of several techniques assured reliable sex and age determination.

Color phase was determined by examining all rectrices during the handling of each bird. Each grouse was categorized as being red, gray, or intermediate.

Timing of hatch was approximated principally by using the primary molt progression to backdate juveniles trapped in late summer (Bump *et al.* 1947). Estimates of nest initiation were calculated by assuming 17 days for a hen to lay an average clutch of 11 eggs and a 24 day incubation period (Bump *et al.* 1947). This information was supplemented with known dates from three nests.

Results and Discussion

Eighty-seven activity centers and 24 light-use logs were located during the springs of 1976 and 1977. Nine of these activity centers were found off the study areas. Light-use logs probably represented trial sites of males seeking to establish a territory. This apparent testing of logs for suitability has been noted by Gullion (1967:98-99). Frank (1947:308) also made reference to such sites, and similarly, did not consider them to be part of an established territory. Alternatively, some light-use logs may have been challenge sites used by males to engage in temporary drumming duals with other males (Gullion 1967:90). Light-use logs were typically in poorer habitat than activity centers.

Drumming Site Characteristics

Activity centers were most commonly located on or near ridgetops. This may indicate a preference for relatively level drumming sites. Only one activity center was found on a slope of greater than 25 degrees. Boag and Sumanik (1969) and Porath and Vohs (1972) found no drumming logs on slopes exceeding 22 degrees and 45% (24 degrees) respectively. Taylor (1976) suggested that the drumming ritual may be difficult to perform on logs sloping more than 20 degrees. He found that, in Tennessee, 71% of the drumming logs had an incline of less than ten degrees. The only activity center that I found on a hillside of greater than 25 degrees was composed of two logs which had fallen parallel to the contour and, consequently, were level. The tendency for trees to fall downhill might severely limit the potential of steep hillsides as drumming sites. Thus, an apparent preference for ridgetops may result since these areas constitute a major portion of the relatively level wooded terrain in this region. Activity centers were found below ridgetops on slopes of less than 25 degrees. Vegetational differences may also have some bearing on selection of ridgetops as drumming sites, however, this possibility was not quantified.

Male ruffed grouse might be encouraged to increase use of steep slopes for activity centers by providing sufficiently level drumming stages. This could be accomplished without significant expense when logging by leaving waste logs roughly parallel to the contour. Such a practice probably would not increase populations, since ruffed grouse are promiscuous (Brander 1967). However, it could be aesthetically valuable by distributing drumming grouse onto tracts of land which have little woodland other than that on steep slopes.

Several workers have indicated that male ruffed grouse select drumming logs which have a relatively high density of stems surrounding them (e.g. Gullion and Marshall 1968, Boag and Sumanik 1969). Observations made during this study appeared to substantiate these results. Gullion and Marshall suggested that this high stem density provides protection from avian predators. Subjective estimates made at the primary logs of 51 activity centers indicate that prickly ash (*Zanthoxylum americanum*), hazelnut (*Corylus americana*), and grey dogwood (*Cornus racemosa*) contribute most to high stem densities around southwestern Wisconsin drumming logs (Table 1).

Prickly ash probably furnishes the best

TABLE 1. Woody species that contribute to high stem density and may provide protection from avian predation. Relative percentage of stems obtained from ocular estimates at 51 primary drumming logs in southwestern Wisconsin.

	A *Occurrence* %	*B* *Composition*[1] %	*(A × B)/100* *Species Importance Index*
Prickly ash (*Zanthoxulum americanum*)	49.0	56.0	27.4
Hazelnut (*Corylus americana*)	47.1	26.7	12.6
Grey dogwood (*Cornus racemosa*)	29.4	33.7	9.9
Black cherry (*Prunus serotina*)	45.1	18.4	8.3
Riverbank grape (*Vitus riparia*)	25.5	31.2	8.0
White oak (*Quercus alba*)	41.2	15.5	6.4
Missouri gooseberry (*Ribes missouriense*)	33.3	12.8	4.3
Shagbark hickory (*Carya ovata*)	37.3	8.7	3.2

[1] Proportion of stems within 5 m of stage where species is present.

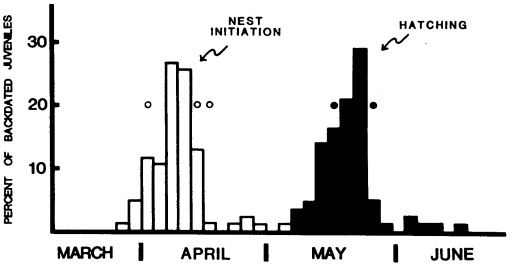

Fig. 1. Ruffed grouse nesting chronology for southwestern Wisconsin, 1976 and 1977. Bars represent 3-day units of pooled data derived by backdating juvenile grouse based on progression of the primary molt. Circles indicate actual nests.

protection against predators because it grows in dense thickets approximately 2 m in height and is armed with sharp thorns. Furthermore, little herbaceous vegetation grows within these thickets, thus affording the grouse a nearly unobstructed view of the area around it. Such a view would facilitate early detection of ground predators (Boag and Sumanik 1969, Gullion 1970). Small trees and shrubs and the riverbank grape (*Vitus riparia*) provide the greatest degree of protection around drumming logs in this region.

Nesting Phenology

No significant difference between hatching dates from 1976 and 1977 was detected by a t-test, consequently, all data were pooled. Approximately 80% of the 86 juveniles examined were estimated to have hatched between 12 May and 24 May (Fig. 1). Similar nesting synchrony has previously been reported by Hale and Wendt (1951) and Cringan (1970). Hale and Wendt suggested that a sharp hatching peak was indicative of high success of the first nests. They related this to warm, dry spring weather. The springs of 1976 and 1977 both began unusually early and were substantially warmer, but not drier, than normal in southern Wisconsin (U.S. Department of Commerce 1976, 1977).

The early spring probably influenced the onset of mating and nest initiation. Most nests were begun in the first and second weeks of April. This is roughly two weeks earlier than was reported for 1966 and 1967 in northeastern Iowa, only 110 km to the west of my study areas (Porath and Vohs 1972).

Intensive roadside drumming counts, conducted on a transect which passes through the study areas (Rodgers 1981), indicated that peak drumming (approximately 15 April) occurred after most females had initiated nesting. The peak of copulation is often concurrent with the peak of drumming (Brander 1967, Porath and Vohs 1972, Archibald 1976). This, apparently, was not the case in 1976 and 1977, particularly if copulation occurred three to seven days prior to nest initiation (Bump *et al.* 1947:471). These results are not incompatible with those of other researchers, but may represent the first time that both nesting and drumming data could be collected under such unusually favorable spring conditions.

Several workers have indicated that the timing of nesting in tetraonids is flexible and dependent on temperature (e.g. Neave and Wright 1969, Zwickel 1977). Conversely, there is increasing evidence which suggests that the peak of ruffed grouse drumming is more strongly determined by photoperiod than by temperature (Gullion 1966, Rodgers 1981). It does not appear to be mandatory that peak copulation coincide with the peak of male display, but rather that the level of display only be adequate for the females to locate males successfully. Zwickel (1977: 191) states that, in blue grouse (*Dendragapus obscurus*), "the breeding period of males has likely been selected to cover the entire receptive period of females, including annual, geographical, and age-class variations." This conclusion is probably also applicable to ruffed grouse.

Movements

Lily-pad trapping commenced too late in the summer to yield substantial information

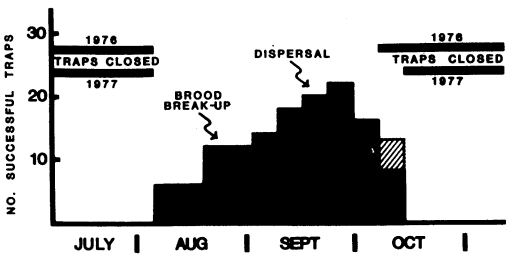

Fig. 2. Lily-pad trap success as an index to movement in the juvenile cohort of a southwestern Wisconsin ruffed grouse population. Bars represent 7-day intervals of pooled lily-pad trapping data from 1976 and 1977. Arrows indicate general periods of brood break-up and dispersal. Hatched area represents the projected 2-year level.

on brood movements. However, limited data from trapping and sporadic contacts with broods corroborate observations on brood movements made by Porath and Vohs (1972) in northeastern Iowa.

Timing of brood break-up and dispersal was estimated by comparing success in lily-pad traps during different periods. A trap was considered successful if it captured one or more ruffed grouse, thus individual and multiple captures were weighted equally. Consequently, a plot of total successful traps per day (Fig. 2) illustrates the timing of brood break-up and dispersal since these periods are characterized by the presence of solitary juveniles (Godfrey and Marshall 1969). Because captures in these traps depend on ground movements of the target species, dispersal was further emphasized by the relatively high level of movement within the juvenile cohort during this period.

Brood break-up apparently began in mid-August. Recapture data appear to confirm conclusions by Godfrey and Marshall (1969: 615) that juveniles wandered as individuals within their previous brood ranges at that time. I recorded 16 recaptures of solitary juveniles within 200 m of the previous capture between 16 August and 15 September; only six such recaptures occurred in the following month. Capture of a solitary juvenile is not an indication of brood break-up, however, an increase in the relative frequency of such captures could be indicative. Dispersal probably began the second week of September and peaked near the end of that month. Recaptures of juveniles at greater than 400 m from the original capture sites also suggested this timing. One such recapture was recorded on 6 September and four others occurred between 24 September and 7 October. These data tend to support the assertion of Godfrey and Marshall that brood break-up and dispersal are distinct and temporally separate events for any given individual, although they overlap at the population level (Rusch and Keith 1971).

No significant differences were detected in the sex ratio of juveniles captured in four one-week intervals between 10 September and 7 October (χ^2), indicating no differential timing of dispersal between the sexes.

Linear distances between observations were similar to those reported by other workers (e.g. Chambers and Sharp 1958, Hale and Dorney 1963) for adult males and juveniles. No useful movement data were obtained for adult females.

Adult males appeared to be the most sedentary cohort. These birds were trapped up to 200 m from their respective activity centers during the fall, although one adult male was shot 685 m from his activity center in mid-winter. Movement by this cohort is generally believed to be highly restricted during the spring drumming period. One drumming male was, however, recaptured on a log 335 m from the original capture site only three days after banding in April, 1976. These captures were each in mirror traps suggesting that this bird defended both sites. This situation is similar to the "expanded occupancy" noted by Gullion (1967:91) in low density populations. Drumming counts conducted in the spring of 1976 were among the lowest recorded for this area in 26 years (Hale, Unpublished data; Rodgers 1981). In 1977 after an apparent population increase, this bird defended only one of

these sites. The other was occupied by a first year male.

Dispersal distances were determined for eight juveniles from which bands were returned and for two juvenile males recaptured on drumming logs. Data obtained via recaptures in lily-pad traps were not considered to represent completed dispersal movements since these traps may have interrupted ongoing dispersal movements. Mean dispersal distance was 2.2 km with a maximum of 7.4 km obtained for one female. In this limited sample, a t-test indicated no difference in dispersal distances between male and female juveniles.

In the disjunct woodlands of southwestern Wisconsin, movements of the magnitude noted above necessitate the traverse of relatively large open areas. Godfrey and Marshall (1969) have indicated that dispersing juveniles tend to avoid extensive open habitats, however, recaptures and band returns obtained in this study indicate that many juveniles crossed open areas as much as 300 m wide. Crossing large open habitats could increase the vulnerability of dispersing juveniles to predation.

Coloration

Records of adult plumage coloration were obtained for 205 birds. Color variation between birds was most pronounced in the rectrices. No birds with gray contour feathers were observed. Although tail color was categorized for convenience, I found no justification for considering this population to be comprised of distinct color morphs and, therefore, prefer a continuum concept. Porath and Vohs (1972) classified 71% of their northeastern Iowa ruffed grouse as red. If the group of birds which I classed as intermediate was evenly divided into the red or gray categories, again, 71% of the population would be classed as red. The dominance of oak in the woodlands of southwestern Wisconsin results in a reddish-brown leaf litter against which red coloration is probably more cryptic than gray.

TABLE 2. Tail color of southwestern Wisconsin ruffed grouse by sex and age.

	Red	*Intermediate*	*Gray*	*Total*
Sex[1]				
Male	65	49	26	140
Female	51	10	4	65
Age				
Adult	22	10	10	42
Juvenile	94	49	20	163
Total	116	59	30	205

[1] Color differs significantly ($P < 0.001$) between sexes.

A higher proportion of females than males possessed red tails (χ^2, $P < 0.001$, Table 2). This substantiates findings by Bezdek (1944) with central Wisconsin ruffed grouse. In contrast, Porath and Vohs (1972) found no differences in color between sexes, however, they examined only 58 birds. Bezdek suggested that this characteristic might be sex linked, but did not rule out other possibilities. Differential selection between sexes appears to be an unlikely cause since these differences were again significant ($P < 0.02$) in juveniles of only four to five months of age. Juveniles of this age were either acquiring or had just recently acquired adult plumage, thus allowing little time for a selective process to operate. No differences between adult and juvenile coloration were detected. The greater tendency toward red coloration in females is, therefore, either sex-linked or hormonally influenced.

Population Statistics

Spring densities of territorial males were 8.8 and 11.4 birds per 100 wooded ha in 1976 and 1977, respectively. These figures compare favorably with densities of 5.5 to 8.7 reported by Gullion (1966) in Minnesota between 1959 and 1965. They are

higher than densities found on the northern Wisconsin areas studied by Dorney *et al.* (1958). While I have no direct census information for all cohorts, drumming counts as well as information obtained from hunters indicated that populations were lower than normal through the spring of 1976. On the basis of the densities observed, I agree with the assertion of Porath and Vohs (1972) that the Driftless Area lies within the optimal range of ruffed grouse although it is on the fringe of the current range of the species.

A sex ratio of 1.3 males per female was obtained for 163 juveniles captured in lily-pad traps. Deviation from the expected 1:1 ratio was not significant (χ^2), however, significance was approached ($P < 0.08$). Dorney (1963) found a similar sex ratio of 1.2 males per female in a sample of 508 juveniles shot in southwestern Wisconsin. This was a significant deviation ($P < 0.05$) from a 1:1 ratio. It is unlikely that this skewed ratio resulted from procedural error since Dorney (1963) found nearly even ratios in other regions of Wisconsin using identical techniques. Reports on sex ratios of juvenile ruffed grouse from other localities are about evenly divided between those with even sex ratios and those skewed in favor of males (Davis and Stoll 1973). The cause of an unbalanced sex ratio within juveniles of four to five months of age remains unclear.

Since drumming ruffed grouse generally utilize only one activity center throughout their lives, annual survival of banded territorial males can be easily determined. In this study, a drumming male was assumed dead if, in a subsequent year, his activity center was not occupied or if another bird was captured at that activity center. These assumptions are not flawless. Gullion (1967) has recorded instances in which established males shifted activity centers. As a result, the following survival estimates must be regarded as minimal.

Of 36 territorial males whose fates were determined, 19 (53%) were known to be alive the following spring. This value compares favorably to 44% survival in northern Wisconsin (Dorney and Kabat 1960), 47% at Cloquet, Minnesota (Gullion and Marshall 1968), and 36% at Rochester, Alberta (Rusch, personal comm.). My data represent only two years compared to three, seven, and eight for the northern Wisconsin, Minnesota, and Alberta figures, respectively. Study of survival over a more extended period may produce a somewhat different value. Nevertheless, survival of territorial males in Southwestern Wisconsin is, at least, comparable to that in other regions. Although Porath and Vohs (1972) suggested a high turnover within this cohort, their suggestion was based on only five banded adult males.

Hunting pressure evidently was light; bands from only ten birds were returned in the two years of the study. This represents a crude return rate of under 5% and is lower than any previously reported rate. Unreported kills should have been reduced by the $5 reward. This apparent low harvest occurred despite close proximity to the Madison metropolitan area (population 300,000).

There are at least three factors contributing to this low rate. As Dorney (1963) pointed out, the rugged terrain automatically limits hunting pressure in the Driftless Area. Steep slopes and dense and often thorny undergrowth undoubtedly discourage many hunters. Second, the region is not well suited for road hunting, a practice common in northern Wisconsin where approximately 32% of the ruffed grouse harvest was taken along roads (Dorney 1963). The corresponding figure for southwestern Wisconsin was only 5%; there roads usually follow the valley bottoms or major ridgetops, most of which have been cleared for agriculture. Third, almost all land in southwestern Wisconsin is in small privately owned farms, a

fact that probably further limits ruffed grouse harvest. Virtually all land in the vicinity of my study areas is posted against hunting or trespassing. Access is limited for hunters lacking personal contact with landowners.

Nine of ten band returns were from birds shot on or after 29 December. The ruffed grouse hunting season in the Driftless Area counties extended through 31 January, a full month longer than in the remainder of Wisconsin. The extended season appears to be effective in increasing the harvest. Without the additional month, the grouse harvest in southwestern Wisconsin might drop to a fraction of its current low level.

Management Implications

The ruffed grouse population in southwestern Wisconsin appears generally capable of sustaining increased hunting pressure. This conclusion contrasts with recent information from east-central Wisconsin which suggests a potential for over-harvest of ruffed grouse on public wildlife lands (DeStefano and Rusch, pers comm). Over-harvest in southwestern Wisconsin is unlikely for several reasons: 1) posting reduces access to private land; 2) the rugged terrain limits hunting pressure on both public and private lands; and, 3) the ratio of population to public land in southwestern Wisconsin is only about one-fourth that of east-central Wisconsin (Carley 1962). Individual public holdings in southwestern Wisconsin are comparatively small. Thus, ingress of birds would probably compensate for losses should an unusually heavy ruffed grouse harvest occur on a given public area. I believe the extended season, overall, is an excellent management practice for the Driftless Area.

A larger ruffed grouse harvest in southwestern Wisconsin could probably be obtained by shifting the entire season back about two weeks. A delayed opening in the southwest might attract many Wisconsin hunters. The present statewide opening brings few grouse hunters to the southwest; many hunters travel north to better known grouse coverts. A two week extension of the closing would provide quality hunting at a time when relatively few outdoor activities are available to sportsmen. There would be no interference with spring breeding. With this later opening, a greater proportion of the season would occur after leaf-fall, which is relatively late in the southwest.

Evaluation of ruffed grouse harvest, particularly on public lands, and of public reaction should precede and follow any regulation changes.

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HELMINTH AND ARTHROPOD PARASITES OF SOME DOMESTIC ANIMALS IN WISCONSIN

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Abstract

Nineteen species of intestinal helminths (cestodes and nematodes) and 15 species of arthropod ectoparasites (fleas, ticks, botflies, chewing lice, and mites) are reported from six species of domestic animals (dog, *Canis Familiaries;* cat, *Felis catus;* chicken, *Gallus domesticus;* turkey, *Meleagris gallopavo;* pig, *Sus scrofa;* and horse *Equus caballus*) in southeastern Wisconsin. Most are first state records. Data on frequency and intensity of infection are discussed in relation to results from similar surveys elsewhere.

INTRODUCTION

Surveys of parasites of domestic animals, particularly those of dogs, are common in the literature. Surveys of helminth parasites of dogs are usually based on fecal examination (Burrows and Lillis, 1960; Jaskoski, 1971; Loenbenberg and Waitz, 1977; and Mann and Bjotvedt, 1965), and less commonly on autopsy material (McGuire, 1964 and Palmieri, Thurman and Andersen, 1978). Helminths of cats from the Midwest were surveyed by Christie, Dubey and Pappas (1976), Cross and Allen (1958), and Power (1971). Surveys of helminths from the other domestic animals examined in this study are not uncommon except that those from turkeys dealt primarily with wild turkeys rather than with the domestic form, e.g., Hon, Forrester and Williams (1978), Jackson, Andrews and Ridgeway (1977), and Pence and Bickel (1977).

The present study was undertaken to account for the parasites of these animals because such published information is not known in Wisconsin except for the arthropod ectoparasite surveys by Amin (1973, 1976a, b).

MATERIALS AND METHODS

This report is based on material collected from Racine and Kenosha counties in southeastern Wisconsin, during the autumn (September-November) of five years for dogs, three years for horses, two years for cats, chickens, turkeys and one year for pigs between 1972 and 1977. Dogs and cats were obtained from the Racine Humane Society and other mammals were obtained from various Racine and Kenosha farms and stables. Eggs of intestinal helminths of horses were screened through fecal examination. In other hosts, the entire alimentary tract of freshly killed animals was examined for helminths. All helminth and arthropod parasites were routinely processed and permanently mounted for identification.

Specimens

Representative specimens are deposited in the Milwaukee Public Museum; museum accession members are listed in tables 1 and 2. Additional arthropod ectoparasites from wild mammals (Amin, 1976a, b) are deposited in the same museum; numbers are available from the author.

RESULTS AND DISCUSSION

Survey results are summarized in Tables 1 and 2. Ectoparasitic species of dogs and cats were previously reported from smaller collections by Amin (1973, 1976a, b). All other parasites appear to represent first records for Wisconsin. Almost all these para-

TABLE 1. Intestinal helminths from domestic animals in southeastern Wisconsin.

Host		Parasite						
Species Number examined	Number infected (%)	Species	Group[a]	Number recovered	Sex ratio m:f	Mean Parasites/ host	Location[b]	Museum number
Dog 74	1(1.4)	*Mesocestoides* sp.	C	1	—	1.0	SI	IZ326a
	2(2.7)	*Taenia pisiformis*	C	22	—	11.0	SI	IZ326b
	3(4.0)	*Dipylidium caninum*	C	9	—	3.0	SI	IZ326c
	12(16.2)	*Ancylostoma canium*	N	205	1:2.42	17.1	SI	IZ326g
	8(10.8)	*Toxocara canis*	N	53	1:0.77	6.6	SI	IZ326h
	7(9.5)	*Toxocaris leonina*	N	141	1:1.88	20.1	SI	IZ326i
	4(5.4)	*Trichuris vulpis*	N	339	?	84.7	C	IZ326j
Cat 23	5(21.7)	*Hydatigera taeniaeformis*	C	12	—	2.4	SI	IZ326d
	3(13.0)	*Dipylidium caninum*	C	117	—	39.0	SI	IZ326e
	2(8.7)	*D. sexcoronatus*	C	24	—	12.0	SI	IZ326f
	10(43.5)	*Toxocara cati*	N	87	1:1.74	8.7	S,SI	IZ326k
	3(13.0)	*Toxocaris leonina*	N	13	1:0.3	4.3	S,SI	IZ326l
	1(4.4)	*Ancylostoma tubaeforme*	N	12	1:5.00	12.0	SI	IZ327a
Chicken 26	16(61.5)	*Heterakis gallinarum*	N	454	1:1.29	28.4	C	IZ327b
	18(69.2)	*Ascaridia galli*	N	118	1:1.36	6.5	SI	IZ327c
	1(3.8)	*Ascaridia* sp.	N	1	1:0	1.0	SI	IZ327d
Turkey 41	5(12.2)	*Ascaridia galli*	N	17	?	3.2	SI	IZ327e
Pig 5	1(20.0)	*Ascaris suum*	N	1	0:1.00	1.0	SI	IZ327f
	1(20.0)	*Oesophagostomum brevicaudum*	N	23	1:2.83	23.0	CC	IZ327g
Horse 14	14(100.0)	*Strongylus* sp.	N	27-211 eggs/fecal smear (3 smears/horse)	—		GI	
	uncommon	*Parascaris* sp.	N	only 7 eggs found	—		GI	

[a] C = cestodes; N = nematodes

[b] SI = small intestine; C = cecum; CC = colon and cecum; S = stomach; GI = gastrointestinal tract

sites are widely distributed in North America and many must have been recovered by other investigators elsewhere in the state. However, a literature search failed to reveal such published accounts.

Dog parasites. Seven helminth species were recovered from dogs in this study. Dogs were more frequently and heavily infected with nematodes; 16.2% were infected with *Ancylostoma canium* (Ercolani, 1859). A mean value of 85 *Trichuris vulpis* (Fröhlich, 1789) per infected dog was calculated. This latter figure was exceptionally high due to the infection of one dog with 339 *T. vulpis*. Infection with cesodes was lower. The *Mesocestoides* specimen belonged to either *M. latus* Mueller, 1927 or *M. corti* Hoeppli, 1925. The highest intensity of cestode infection was with *Taenia pisiformis* Bloch, 1780, the larvae of which were commonly found in the body cavity of many local cottontail rabbits, *Sylvilagus foridanus*.

The prevalence of helminth infections in Racine-Kenosha dogs appears to be intermediate between that of well cared for dogs (Jaskoski, 1971) and of those examined from the dog pound in the city of Chicago (Cross and Allen, 1958). Prevalences are

TABLE 2. Arthropod parasites from domestic animals in southeastern Wisconsin.

Host			Parasite					
Species	Number examined[a]	Number infected (%)	Species	Group[b]	Number recovered	Sex ratio m:f (nymphs)	Mean Parasites/ host	Museum[c] number
Dog	47	1(2.1)	*Cediopsylla simplex*	F	1	0:1.00	1.0	
	47	11(23.4)	*Ctenocephalides canis*	F	141	1:2.81	12.8	
	47	28(59.6)	*C. f. felis*	F	202	1:3.21	7.2	
	47	1(2.1)	*Pulex irritans*	F	1	0:1.00	1.0	
	17	1(5.9)	*Dermacentor variabilis*	T	1	0:1.00	1.0	IZ327h
	17	1(5.9)	*Ixodes scapularis*	T	1	0:1.00	1.0	IZ327i
	17	2(11.8)	*Rhipicephalus sanguineus*	T	2	0:2.00	2.0	IZ327j
	17	1(5.9)	*Cuterebra* sp.	BF	1	larva	1.0	
Cat	52	1(1.9)	*Cediopsylla simplex*	F	1	1:0	1.0	
	52	16(30.8)	*Ctenocephalides f. felis*	F	424	1:2.16	26.5	
	52	1(1.9)	*Tamiophila grandis*	F	1	0:1.00	1.0	
	52	1(1.9)	*Orchopeas h. howardii*	F	1	1:0	1.0	
Chicken	45	6(13.3)	*Menopon gallinae*	L	46	1:1.37:(0.50)	7.7	
	45	29(64.4)	*Menacanthus stramineus*	L	338	1:2.21:(0.96)	11.6	
	45	3(6.7)	*Goniodes dissimilis*	L	5	all nymphs	1.7	
Horse	24	5(25.0)	*Gastrophilus* sp.	BF	eggs on hairs		—	
	56	31(55.4)	*Sarcoptes scabiei equi*	M	undetermined ?		?	

[a] When different for same host species indicates separate collections examined independently for parasitic groups noted.

[b] F = fleas; T = ticks; BF = botflies; L = lice; M = mites.

[c] Insects are not given accession numbers.

usually higher in the south, i.e., Vaughn and Jordan (1960) from New Orleans, and lower farther north, i.e., Dorman and Ostrand (1958) from New York, presumably reflecting the harsher and less favorable environment in northern localities (Jaskoski, 1971). The frequency of at least *A. caninum* and *T. vulpis* infections was clearly related to certain climatic factors by Becker et al. (1977).

The sex ratio of all dog helminths, except *Toxocara canis* (Werner, 1782), and all all arthropods obtained in significant numbers was biased in favor of females rather than males.

Ctenocephalides f. felis (Bouché, 1835) was the most common arthropod ectoparasite of dogs. The prevalence of *Ctenocephalides canis* (Curtis, 1826) fluctuated; it was rare in some years (Amin, 1976a) and considerably higher in others and averaged 23.4% with a higher mean per infected dog than *C. f. felis* (Table 2). Infections with ticks were scarce from dogs, as well as from other mammals in southeastern Wisconsin (Amin, 1976b).

Cat parasites. The prevalence of cat helminth parasites was comparable to that reported for cats from Illinois and Kentucky (Power, 1971) but less than that in stray cats from Ohio (Christie et al., 1976) for *Toxocara cati* (Schrank, 1788) Brumpt, 1927 and *Ancylostoma* sp. *Hydatigera taeniaeformis* (Batsch, 1786) and *Dipylidium sexcoronatum* von Ratz, 1900 do not appear to be widely spread elsewhere. Local cats were most frequently and heavily infected with *T. cati* (43.5%) and *Dipylidium cani-*

num (39 worms per infected host), respectively. Only the sex ratio of *Toxocaris leonina* (V. Linstow, 1902), Leiper, 1907 was biased in favor of males.

The most common flea species infesting cats is *C. f. felis*. Accidental infestations with *Cediopsylla simplex* (Baker, 1895), *Tamiophila grandis* (Rothschild, 1902) and *Orchopeas h. howardii* (Baker, 1895) probably result from predatory associations with cottontail rabbits, eastern chipmunk, *Tamias striatus ohionensis* and eastern gray squirrel, *Sciurus carolinensis,* respectively.

Chicken parasites. Chickens were frequently infected (>80%) with *Heterakis gallinarum* (Schrank, 1788) Madsen, 1949 and *Ascardia galli* (Schrank, 1788) and most heavily infected with the first species (28.4 per infected host). These figures are comparable to those for chickens from Manitoba (Hodasi, 1966) and elsewhere in Canada (Stephen, 1976). Infestation with *Menacanthus stramineus* (Nitzsch, 1818) was markedly more frequent and heavier than with *Menopon gallinae* (Linné, 1758). Older chickens were noticeably more heavily infested with *M. stramineus* than younger ones, particularly under crowded conditions. Only five *Goniodes dissimilis* Deny, 1842 nymphs were recovered. No mixed infestation with *M. stramineus* and *M. gallinae* in the same chicken farm was observed.

Domestic turkey parasites. Only light infections with *A. galli* were encountered. The lighter and less prevalent infection of domestic turkey with *A. galli* (this report) compared to the greater diversity of parasitifauna in wild turkey (Hon et al., 1978; Jackson et al., 1977; Pence and Bickel, 1977) are probably related to the rearing conditions of the domestic form in farms. Jackson et al. (1977) speculated that the high incidence of *A. galli* in wild turkeys "may be attributed to domestic fowl contaminating parts of the turkey range with ova passed in feces."

Pig parasites. Only one of five pigs was infected with one *Ascaris suum* Goeze, 1782 and another with 23 *Oesophagostomum brevicaudum* Schwartz and Alicata, 1930. This incidence is low compared to reports elsewhere particularly from southern locations (Stewart and Hale, 1975, and Lindquist, 1975).

Horse parasites. Infections with *Strongylus* sp. [probably *S. vulgaris* (Looss, 1900) Railliet and Henry, 1909] were more common (100%) than with *Parascaris* sp. [probably *P. equorum* (Goeze, 1782) (York and Maplestone, 1926)] as revealed by egg counts in fecal smears. Eggs of the horse botfly *Gastrophilus* sp. [probably *G. intestinalis* (de Geer, 1776)] were recovered from hairs mostly on upper half of forelegs and shoulders. The mite *Sarcoptes scabiei equi* Gerlach, 1857 was common (55.4%) particularly on horses held in holding pens before shipping. The damage caused by *S. vulgaris* to horse intestinal arteries and the role played by other horse parasites were discussed by Georgi (1977).

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THE PHYSICAL AND CHEMICAL LIMNOLOGY OF A WISCONSIN MEROMICTIC LAKE

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Abstract

Numerous physical and chemical parameters of a small central Wisconsin lake were monitored over an 18 month period. Included in these parameters were temperature, light, conductivity, pH, oxygen, sulfide, sulfate, iron, nitrate, nitrite, ammonia, phosphate, dissolved inorganic carbon, and methane. Chlorophyll a and bacteriochlorophyll d were also measured. The lake was determined to be biogenically meromictic. Because of its meromictic state, the lake provides a favorable environment for the development of populations of anaerobic bacteria such as photosynthetic sulfur bacteria and methanogenic bacteria.

INTRODUCTION

Meromictic lakes, since they do not undergo complete vertical turnover, provide permanently anaerobic habitats in the deeper portions. Such lakes provide favorable locations for the study of many limnological and biogeochemical processes related to anaerobiosis such as carbon, nitrogen, and sulfur cycles. Meromictic lakes also provide an extremely favorable environment for the development of diverse and relatively stable populations of anaerobic bacteria.

Hutchinson (1957) describes three types of meromictic lakes: those displaying ectogenic, crenogenic or biogenic meromixis. According to this classification, ectogenic and crenogenic meromictic lakes have a dense, saline layer covered by a less dense freshwater layer. Lakes displaying biogenic meromixis have a dense bottom layer as a result of biological decomposition which releases high concentrations of solutes into the bottom waters. In each type, the different dissolved solute concentrations between the bottom (monimolimnetic) and surface (mixolimnetic) waters creates a density difference which prevents mixing when the lake is isothermal. A chemocline separates the mixolimnion and the monimolimnion. The mixolimnion of meromictic lakes exhibits changes similar to those of a holomictic lake. It may develop thermal stratification and completely mix at some time of the year. The terms epilimnion and hypolimnion are used to describe portions of the mixolimnion, when thermally stratified, in a manner analogous to holomictic lakes.

Several meromictic lakes have been studied with respect to chemical balances and causes of meromictic stability. Many meromictic lakes have been shown to remain stratified as a result of dense saline bottom water (Matsuyma, 1973; Takahashi et al., 1968). Walker (1974) has used stability calculations to compare several saline meromictic lakes in Washington. In most of the lakes studied, the meromictic stability has decreased with time. In biogenic meromictic lakes, additional factors besides density aid in preventing mixing. Weimer and Lee (1973) concluded that the morphometry of the lake basin and topography of the surrounding watershed were major factors in maintaining meromixis in Lake Mary, Wisconsin. Similarly, Culver (1975) concluded that lack of wind action was necessary to maintain meromixis in Hall Lake, Washington.

The discovery in central Wisconsin of Knaack Lake, a sharply stratified meromictic lake, allowed the authors to conduct detailed studies of physical and chemical changes in such a lake over a two year period. In addition, this paper provides necessary field background for subsequent studies on microbial activities in the lake.

Materials and Methods

Study Areas. Knaack Lake is located in northern Waupaca county approximately 8 miles south of the town of Marion, Wisconsin. The lake and surrounding farm lands are owned by Mr. Carl Knaack. Douglas Caldwell, who first studied this lake in 1972 and 1973, referred to it as Hirsch Lake (Caldwell, 1977). The lake lies in the northwest corner of section 22, R. 13 E., T.25 N.

The lake has a surface area of approximately 1.1 hectare and a maximum depth of 22.0 m. The water is yellow-brown in color, a result of high levels of dissolved humic and tannic compounds. The lake is bounded on three sides by farm fields while a peat bog extends from the northeast shore a distance of about 0.3 k. A dense stand of hardwood, hemlock, and pine lies between the fields and the lake shielding it from the predominant northwestly winds. A hill to the northwest of the lake contributes additional shielding. No wind speed measurements have been made, however the authors have never observed waves in excess of 5 cm at the lake surface. There are no visible inflows or outflows to or from the lake, thus the major source of water input appears to be groundwater seepage and rainwater.

Lake Morphometry. During the winter the depth of the water was measured along six transects across the lake. Holes were drilled through the ice at 10 m intervals along each transect and measurements were made using a weighted hand line marked at 0.5 m intervals. The depth readings were then transferred to an enlarged copy of the USGS topographic map (7.5 minute series, Marion Quadrangle), and bathymetric contours drawn.

Sampling Techniques and Field Measurements. Initially, water samples were collected using a horizontal Van Dorn water sampler (Wildco Wildlife Supply Co., Saginaw, Michigan). Beginning in December 1976, water samples were collected using a peristaltic pump (Horizon Ecology Co.). Water was pumped through 3/16 inch inside diameter latex tubing weighted at one end. The weighted end was attached to a chain which was used to regulate sampling depth. The chain prevented stretching of the tubing, and the system allowed accurate sampling at narrow intervals, and minimized exposure of the anoxic water to oxygen. Unless otherwise stated, samples were collected from a station located over the deepest area of the lake. Water was sampled through holes in the ice during the winter and from a canoe when the lake was ice free.

Seepage meters following Lee's (1977) design were placed around the perimeter of Knaack Lake. Rates of groundwater seepage into the lake were estimated by collecting the water which flowed from the meters into plastic bags. The volumes of water collected were measured and seepage times noted. Rates were calculated as ml flow/m^2/min.

Temperature and oxygen were measured *in situ* with a combination temperature-oxygen probe (Yellow Springs Instruments Co.). Conductivity was measured *in situ* with a combination salinity-conductivity-temperature probe (Yellow Springs Instruments Co.). pH measurements were made in the laboratory on water samples collected in glass stoppered BOD bottles using a Corning Model-12 pH meter. A 30 cm diameter Secchi disk was used to estimate water transparency and a Li-Cor model-185 quantum meter combined with an underwater silicon photodiode quantum sensor (Lambda Instruments Corp., Lincoln, Nebraska) was used to measure light extinction in the lake. To determine the underwater spectral dis-

tribution of light in the lake, water samples were brought to the laboratory, filtered, and the optical characteristics of the water were determined following James and Birge (1938). Ten cm glass cuvettes were used with a Beckman DK-2 scanning spectrophotometer.

Chemical Assays. Samples for nutrient assays were collected in polyethylene bottles and placed on ice. Immediately upon returning to the laboratory (ca. 4 hours) the water samples were filtered through Whatman GF/C glass fiber filters and Gelman GN-6 0.45 μm membrane filters. After membrane filtration, the water samples were frozen; soluble phosphate, nitrite, nitrate, and ammonia concentrations were determined at a later date. The glass fiber filters were extracted with 90% acetone and refrigerated overnight before chlorophyll analysis. Chlorophyll a was determined as described by Vollenweider (1969) and bacteriochlorophyll as described by Takahashi and Ichimura (1968). Absorbances were determined in a Beckman DB-G spectrophotometer or a Beckman DK-2 scanning spectrophotometer. Glass fiber filters were found to retain more than 95% of the chlorophyll present in the lake water.

Nitrite and soluble reactive phosphate were determined by the method of Strickland and Parsons (1968). Ammonia was initially determined according to Strickland and Parsons (1968). However, this method gave questionably low values of ammonia in the bottom water. A second method (Strickland and Parsons, 1972) was then used and yielded considerably higher values. Nitrate was initially measured by the method of Mullen and Riley (1955). This method proved satisfactory in other lakes, but resulted in formation of a brown precipitate in the monimolimnetic water samples from Knaack Lake. In these samples the precipitate was filtered out, using a 0.45 μm membrane filter (Gelman), and the absorbance of the colored filtrate was measured. To examine the accuracy of this procedure, nitrate was determined by a second method (Strickland and Parsons, 1968). The methods gave comparable results ($\pm$5%) on the same water sample. Using either method unusually high concentrations of nitrate were detected in the monimolimnetic waters. Water below 15 m, but not the surface water, had values often higher than 200 μg/l when filtered through the Gelman filters. However, nitrate was not detected when the same water samples were analyzed for nitrate before filtration or assayed after filtration through glass fiber filters alone. Gelman GN-6, 0.45 μm membrane filters are composed primarily of esters of cellulose nitrate (>95%). Apparently some compound, present in the monimolimnion, possibly an organic acid, was able to extract nitrate from the filters resulting in false positive values.

Iron was quantified by means of a modification of the assay described in American Public Health Association (Taras *et al.*, 1971). Samples for ferrous and ferric iron were collected anaerobically in glass-stoppered bottles and transported to the laboratory on ice. Ferrous iron was determined by adjusting the pH of the water samples to 4.0 with ammonium acetate buffer, adding a solution of 1,10 phenanthroline monohydrate, and reading the absorbance at 510 nm. Total iron was determined by adding concentrated HCl and a hydroxylamine solution to water samples which were then heated at 100°C for 30 minutes in teflon-capped screw-cap test tubes. After heating, the pH of the sample was adjusted to 4.0, the phenanthroline reagent added, and absorbance read at 510 nm. The ferric iron concentration was calculated by subtracting the ferrous concentration from the total concentration. This method did not distinguish between particulate and soluble ferrous or ferric iron.

Ten ml water samples for sulfate and sulfide analysis were collected in screw-cap test tubes containing 0.5 ml of a 0.2% solution

of zinc acetate in 0.2% acetic acid. Sulfide was determined by the colormetric method of Pachmayr as described by Brock *et al.* (1971) modified in that only 1 ml of the amine reagent and 0.5 ml of the ferric iron reagent were added to the 10 ml water samples. Sulfate was determined by the turbidometric method of Tabatabai (1974). All chemical assays were performed on a Bausch and Lomb Spectronic 20 or Gilford Model 420 spectrophotometer.

During the fall of 1977 Winkler titrations were used for oxygen determination as low levels of oxygen were present in the mixolimnion. Winkler titrations were performed as described in Strickland and Parsons (1972), with the modification that samples were fixed immediately at the lake with the addition of manganous sulfate and alkaline iodide. Since oxygen levels were very low, the thiosulfate titrant was diluted ten fold to attain better sensitivity.

Dissolved methane and dissolved inorganic carbon ($DIC = CO_2 + HCO^-_3 + H_2CO_3$) were measured by modification of the gas stripping technique of Rudd *et al.* (1974). Water (5 ml) was collected by inserting a 10 ml glass syringe (without needle) into the outlet of the sampling pump. The syringe was held pointing downward to prevent any degassing bubbles from escaping. It was fitted with a 23 gauge needle, and the water injected into a 18 by 240 mm butyl rubber stoppered anaerobic tube (Bellco Glass Co.) containing 0.5 ml of 6 N HCl. Upon returning to the laboratory, tubes were assayed for for CH_4 and CO_2 on a Packard 419 gas chromatograph (Nelson and Zeikus, 1974). DIC was calculated using the Bunsen absorption coefficients for dissolved CO_2.

Calculation of Stability. Stability, the minimum amount of work required to mix a chemically stratified lake that is devoid of thermal stratification, was calculated by Schmidt's stability equations (Walker 1974). The density of Knaack Lake was calculated by summing the total dissolved solutes present at a given depth and adding this mass to the density of the water.

Results

Physical Characteristics

Lake Morphometry and Seepage. The physical characteristics of the lake basin and surrounding watershed were mapped (Fig. 1A). Bathymetric contours and position of the seepage meter sites were established and a cross section of the lake along the major axis prepared (Fig. 1B and 1C). The positions of the thermocline, present during the spring, summer, and autumn months, and the chemocline, which is present year-round, are represented by broken lines.

Since there are no visible inflows to the lake, a survey was made to determine the rate of groundwater seepage and the points of maximum seepage. Meters were placed at the deeper stations in the lake by a SCUBA

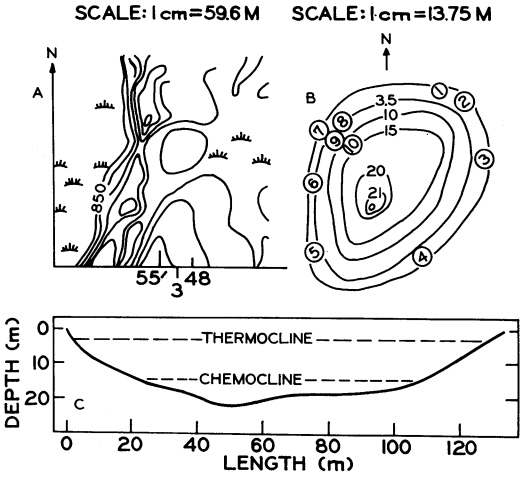

Fig. 1. Morphometry of Knaack Lake and topography of the surrounding watershed. A. Topography of watershed from the Marion county Quadrangle (USGS). B. Bathymetric contours (meters). The sampling station was located over the deepest portion of the lake (22 m). Circled numbers indicate locations of seepage meter sites. C. Cross section of the lake along the major axis. Dashed lines designate the location of the summer thermocline, which separates the epilimnion and hypolimnion, and the chemocline, which separates the mixo- and monimolimnion.

diver. Maximum seepage into the lake was found to occur along the northwest shore (Table 1). These data, collected in the spring of 1977, coincide with visual observations made during the winter. In determination of morphometry of the lake basin many holes were drilled through the ice. At that time, it was observed that the ice near the northwest shore of the lake was 70 to 80% thinner than the ice at any other location on the lake, suggesting larger flows of warmer groundwater.

TABLE 1. Seepage into Knaack Lake.

Station	*Depth (m)*	*Seepage rate (ml/m²/min)*
1	1.2	1.7
2	1.1	6.3
3	1.0	4.8
4	0.9	5.5
5	1.1	0
6	1.2	15.6
7	1.0	32.1
8	1.9	11.1
9	6.0	8.25
10	12.0	4.2

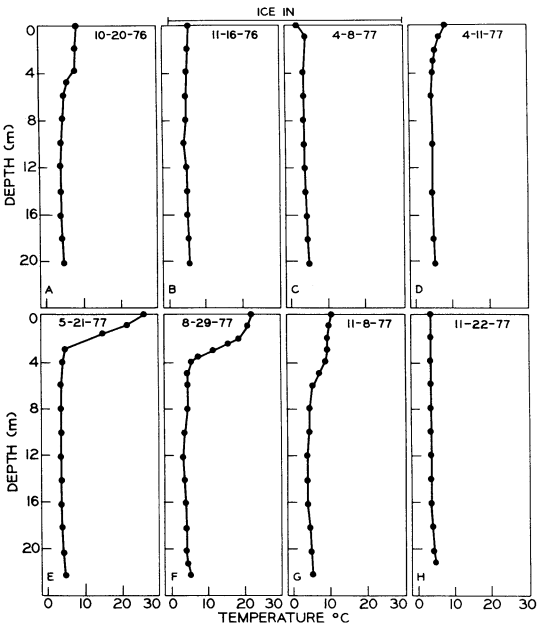

Fig. 2. Temperature profiles in Knaack Lake from 20 October 1976 through 22 November 1977. Profiles just prior to lake freezing (A), during the period of ice cover (B and C), immediately after "ice-out" (D), during the stratification period (E through G), and when the lake was isothermal (H).

Temperature and Oxygen. Temperature profiles were measured throughout the year (20 October 1976) to 22 November 1977) (Fig. 2). After the lake became isothermal in the fall, the surface temperature dropped rapidly until the lake froze. Temperature increased with depth reaching 4°C at 6-8 m. Water temperature from 8 to 15 m was 4°C, while below 15 m the temperature again increased to a maximum of 5°C at the bottom. Temperature profiles remained constant throughout the winter (Figs. 2B and 2C). After "ice-out" in the spring (Fig. 2D) the surface temperature increased rapidly and a sharp thermocline was formed at 1 to 2 m (Fig. 2E). Throughout the year the water below the thermocline remained at 4°C and increased to approximately 5.5°C at the bottom. In the late summer and fall, surface temperatures decreased and the thermocline dropped (Figs. 2F and 2G) until the upper 15 m of the lake became isothermal (Fig. 2H).

In the fall of 1976 oxygen was present down to the thermocline (Fig. 3A). The lake quickly became anaerobic after freezing in the winter of 1976-1977 (Figs. 3B and 3C). However, the measurements were made with an oxygen meter which could not detect small (less than 0.5 mg/l) concentrations. The lake remained anaerobic throughout the winter except for a period in March (Fig. 3D) when an algal bloom formed under the ice and 9 to 10 mg/l oxygen was detected. The lake again became completely anaerobic after the algal bloom disappeared (Fig. 3E). After "ice-out," oxygen (8-12 mg/l) was present above the thermocline and oxygen concentrations in the epilimnion remained fairly constant throughout the summer (Figs. 3F and 3G). As the lake began to mix in the fall, oxygen concentrations in the sur-

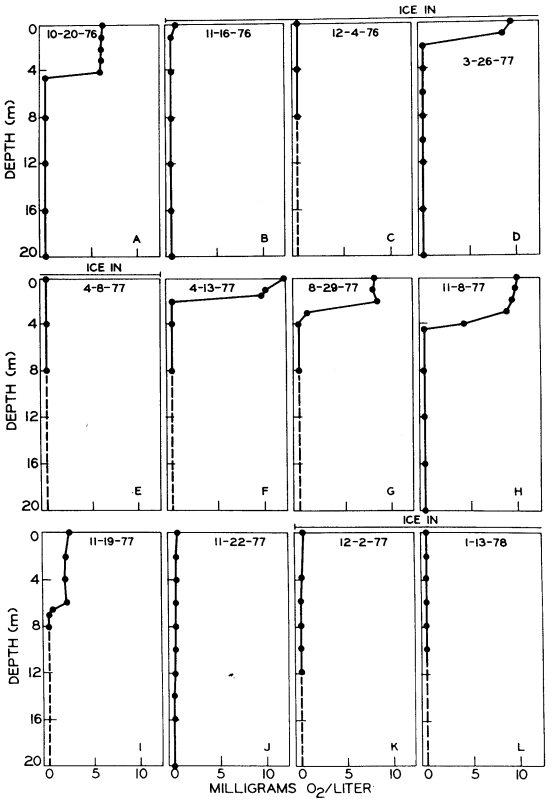

Fig. 3. Oxygen profiles in Knaack Lake from 20 October 1976 through 13 January 1978. Oxygen concentrations during the periods when the lake was stratified (A. F. G. H. and I), when the lake was isothermal (B and J), and when the lake was covered with ice (C, D, E, K, and L).

face waters decreased and oxygen was detected in deeper waters (Figs. 3H and 3I). When the lake became isothermal in the fall (Fig. 3J), oxygen was detected at 12 m at a concentration of 0.4 to 0.8 mg/l. Traces of oxygen were present for several weeks after ice formed (Fig. 3K) but by 1-3-78 oxygen was absent (Fig. 3L).

Conductivity. Conductivity was measured throughout the study period (Fig. 4). Conductivity was low in the surface water and increased at the thermocline (Figs. 4A, 4B and 4C). This increase followed the thermocline down the water column in the fall. Below the chemocline (14 to 15 m) conductivity increased rapidly with depth, reaching 300 to 400 μmhos at the bottom. This corresponded to high concentrations of ammonia, phosphate, and carbonate found in the monimolimnion. When the lake was isothermal in the fall (Fig. 4D), conductivity was nearly constant to 14 m, as a result of mixing of the mixolimnetic waters.

Light. The color of the lake water and the presence of suspended particles results in rapid dissipation of light as it travels through the water column. The transparency of the lake water was estimated with a Secchi disk, as the depth of Secchi disk extinction may be interpreted as 1 to 15 percent transmission of incident light (Wetzel,

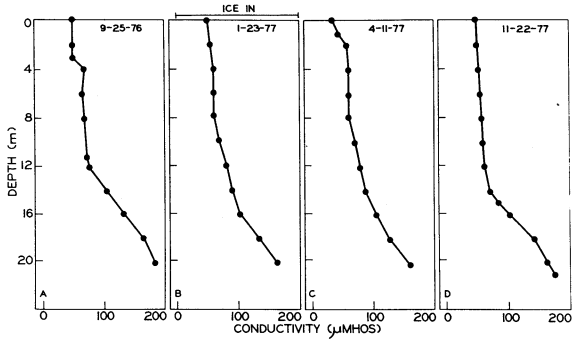

Fig. 4. Conductivity profiles for selected sampling dates. Conductivity when the lake was thermally stratified (A), during ice cover (B), immediately after ice-out (C), and when the lake was isothermal (D).

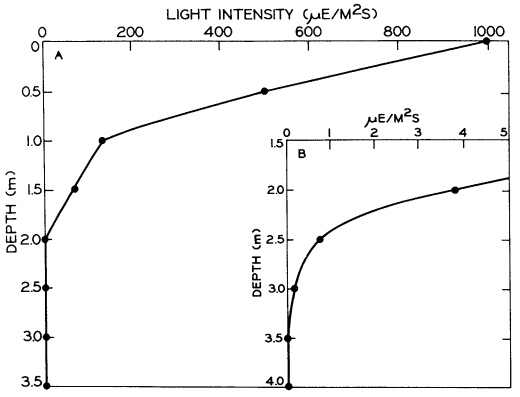

Fig. 5. Light extinction in the Knaack Lake water column from 0 to 4 m (A). Details of light extinction from 2 to 4 m (B).

1975). Depths of Secchi disk transparency ranged from 0.6 to 1.1 m throughout the year. Using the data of Aberg and Rodhe (1942), that relate lake water color and disk transparency as a hyperbolic function, the water of Knaack Lake has an estimated color of 130 Pt units. Light extinction was also measured with a submersible quantum detector. This method of measuring the penetration of light through the water column is more useful, in that it directly measures the quanta of light available for phytoplankton photosynthesis. It is evident that the lake water absorbs light effectively and that below the depth of 4 m no light is present (Fig. 5). Large amounts of dissolved organic compounds impart a yellow-brown color to the water, suggesting that changes in light quality with depth be examined. Extinction coefficients were determined by scanning filtered lake water in a spectrophotometer, and using the formula given by Hutchinson (1957); $T\% = 100e^{-n}$, where n is the extinction coefficient and T is transmission. Using the extinction coefficients it was possible to determine which wavelengths penetrated farthest into the lake. Calculations employed the formula $I_z = I_o e^{-nz}$ where I_z is the light intensity at depth z, I_o is the light intensity at the surface, and n is the calculated extinction coefficient (Hutchinson, 1957). The transmission spectrum for a 0 to 3.5 m integrated water sample was measured in a 10 cm glass cuvette (Fig. 6) and extinction coefficients were calculated for selected wavelengths. Percent transmission is low and extinction is high for wavelengths greater than 725 nm. Maximum transmission occurs at 700 nm and transmission decreases sharply from 640 to 400 nm.

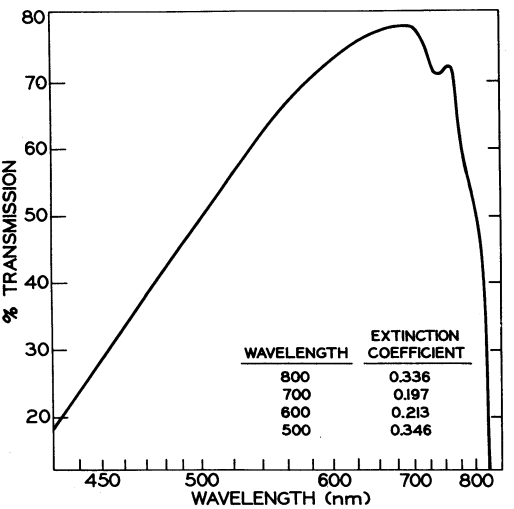

Fig. 6. Transmission spectrum for a filtered, 0 to 3.5 m integrated lake water sample. The integrated sample was prepared by pooling samples collected at 0.5 m intervals with a vertical Van Dorn water sampler to the 3.5 m depth. Extinction coefficients are shown for several wavelengths.

Chemical Parameters

Chemical parameters of Knaack Lake water were determined during an 18 month period in an attempt to characterize the chemistry of the lake over an annual cycle. The chemical parameters monitored were pH, nitrite, nitrate, ammonia, soluble reactive phosphate, sulfide, sulfate, DIC, methane, ferric iron, and ferrous iron.

pH. During the winter (Fig. 7A) pH values were relatively constant with depth throughout most of the water column (5.9 to 6.2). During the months when the lake was ice free, increased pH values were observed in the surface water, although the pH below the thermocline remained constant (Figs.

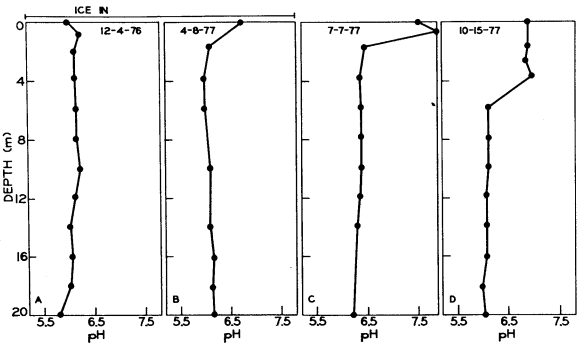

Fig. 7. pH profiles in Knaack Lake during the period of ice cover (A), after ice-out (B), and during summer (C) and autumn (D) stratification periods.

7C and 7D). During mid-summer, the highest pH values were observed in the epilimnion and the pH below the thermocline was slightly higher than observed at other times of the year. The increased pH reached down to 4 m during the fall due to the lower thermocline at this time.

Nitrogen Species. Nitrite and nitrate concentrations in the water column were measured throughout the sampling period. Nitrite concentrations greater than the sensitivity of the assay (10 μg/l) were never observed. Nitrate was not detected below a depth of 2 m, although nitrate was periodically detected in the surface water (Fig. 8). Surface values ranged from less than 10 μg/l to 390 μg/l. Increased groundwater seepage due to rainfall and phytoplankton activity influenced nitrate concentrations. When the lake was ice-free, oxygen was present in the surface water and nitrate, a chemically stable species under aerobic conditions, was often present. On some dates during the ice-free period, dense populations of phytoplankton were observed in the epilimnetic waters and nitrate was not detected in the surface water (7 July 1977 and 23 May 1977). At times, however, pulses of nitrate were observed in the surface water when phytoplankton was present (17 May 1977 and 30 June 1977). These pulses of nitrate occurred after periods of heavy rainfall (the lake received 1.4 in of rain on 16 May 1977 and 1.75 in on 28 June 1977) and it is likely that heavy rainfall significantly accelerated the rate of groundwater seepage resulting in a higher input of nitrate.

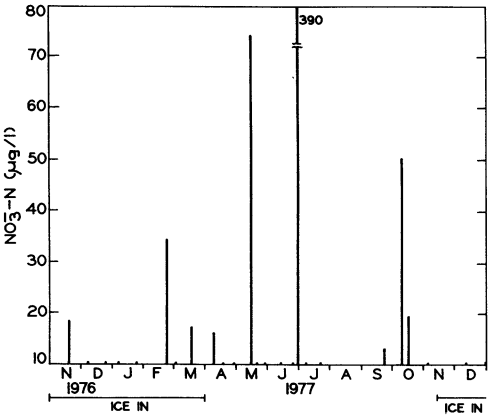

Fig. 8. Nitrate-nitrogen concentrations of the epilimnion (0 to 2 meters) throughout the year. Concentrations generally ranged from undetectable (<10 μg/l) to 75μg NO^-_3-N/l. On 30 June, 1977 nitrate concentrations reached 390 μg/l.

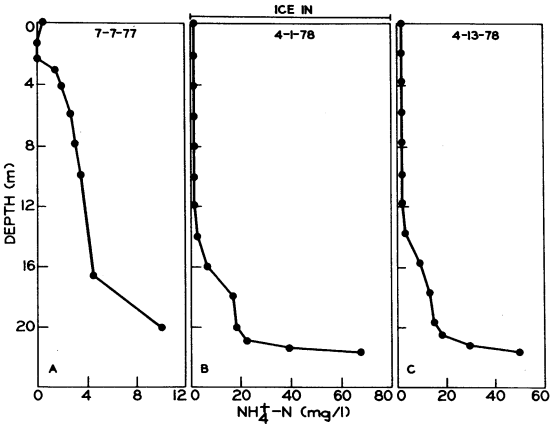

Fig. 9. Ammonia profiles in Knaack Lake during summer stratification (A), during winter ice cover (B) and the spring after ice-out (C). Note that scale of abcissa in A is different from B and C.

Shortly after the lake froze in 1976, oxygen disappeared from the surface water. Nitrate, an energetically favorable electron acceptor for anaerobic respiration in the absence of oxygen, was depleted within three weeks. On several dates during the winter of 1977, nitrate was detected in the surface water. Several of these dates corresponded with the presence of oxygen in the water immediately below the ice. The presence of nitrate on these dates may be a result of increased flow of oxygenated groundwater.

When the lake was thermally stratified, the surface waters contained 0.2 mg/l ammonia and ammonia was not detected at 1 and 2 m (Fig. 9A). At 3 m, ammonia was detected at 1.4 mg/l and increased steadily to a concentration of 3.4 mg/l at 10 m. At 20 m, the ammonia concentration reached 9.0 mg/l. During the winter, ammonia concentrations were relatively low (<2 mg/l)

above 14 m, but rose sharply below this depth and reached a maximum of 68 mg/l at 21.5 m (Fig. 9B). A similar profile was observed after ice left the lake in the spring (Fig. 9C).

Phosphate. During the winter of 1977, phosphate was detected at 70 μg/l from the ice down to 8 m (Fig. 10A). Below this depth phosphate values increased reaching 1300 μg/l at 20 m. During periods when the lake was ice-free, phosphate was generally not detected in the surface water. Occasionally, however phosphate was present at the surface. Fluctuations in phosphate in the surface water were probably a result of increased groundwater seepage following periods of heavy rainfall.

On 22 November 1977, when the lake was isothermal, phosphate concentrations were constant to a depth of 14 m (Fig. 10G). In the unmixed water below this depth, phosphate values increased sharply. During the winter months phosphate increased in the upper 14 m of the lake (Fig. 10H-I). This increase was thought to result from liberation of phosphate from decomposing phytoplankton; marked decreases in chlorophyll a were observed during this period.

Sulfur Species. Sulfate and sulfide concentrations in Knaack Lake were measured throughout the sampling period (Fig. 11). In the fall of 1976 (Fig. 11A) sulfide was absent above the thermocline and was present in concentrations of 0.6 to 0.8 mg/l in the anaerobic portion of the lake. Immediately after ice formed (Fig. 11B) sulfide was absent in the top meter of water; phosphate was low from 2 to 10 m (0.1 to 0.2 mg/l) and was approximately 0.7 mg/l below 12 m. Sulfide in the upper 12 m in-

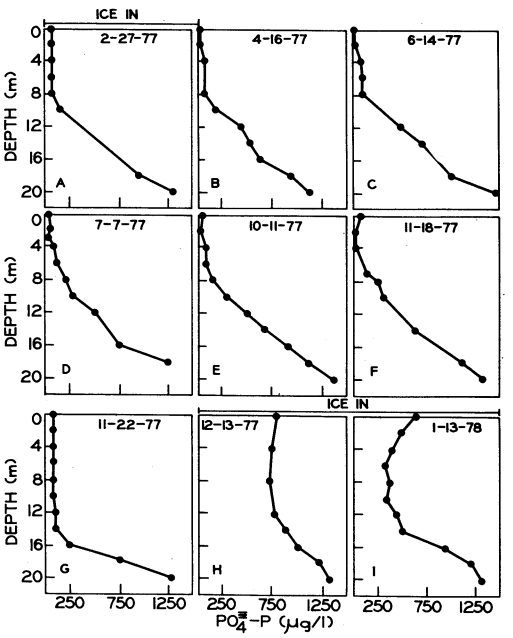

Fig. 10. Phosphate profiles in Knaack Lake throughout the sampling period.

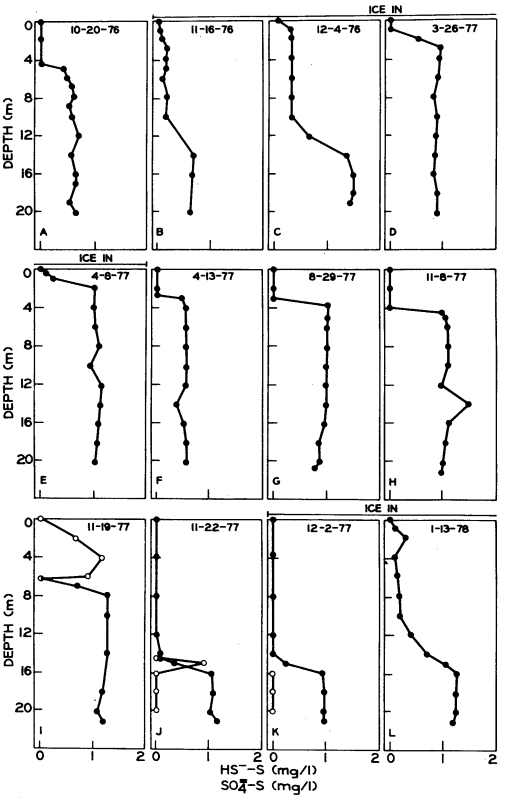

Fig. 11. Sulfate and sulfide profiles in Knaack Lake. Symbols: $SO_4^{\equiv}$-S (○) mg/l; HS^- and H_2S-S (●) mg/l. Note sulfate was only detectable on two sampling dates (J and K).

creased throughout the winter (Figs. 11C and 11E) and was present to the bottom of the ice except during a period when an algal bloom under the ice depleted sulfide, and oxygen was detected immediately below the ice (Fig. 11D). After "ice-out" (10 April 1977) sulfide was absent above the thermocline and was 0.7 to 1.2 mg/l in the anaerobic water (Fig. 11F). As the upper part of the lake began to mix in the fall (Figs. 11H and 11I) the anoxic waters became oxygenated and sulfide depletion occurred. When the lake was isothermal (22 November 1977) sulfide was not detected in the upper 14 m (Fig. 11J). After ice formed (Fig. 11K) sulfide was absent above 14 m but gradually increased in the upper waters throughout the winter (Fig. 11L).

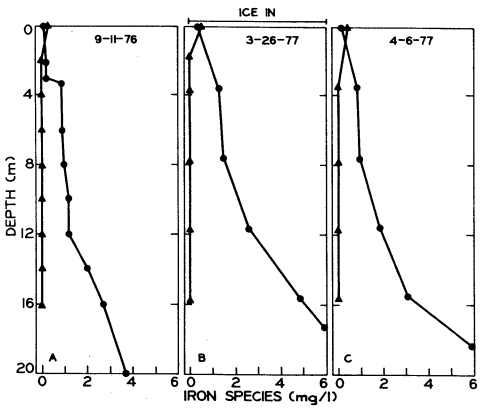

Fig. 12. Profiles of total ferrous and total ferric iron in Knaack Lake. Symbols: Fe^{+3} (▲); and Fe^{+2} (●).

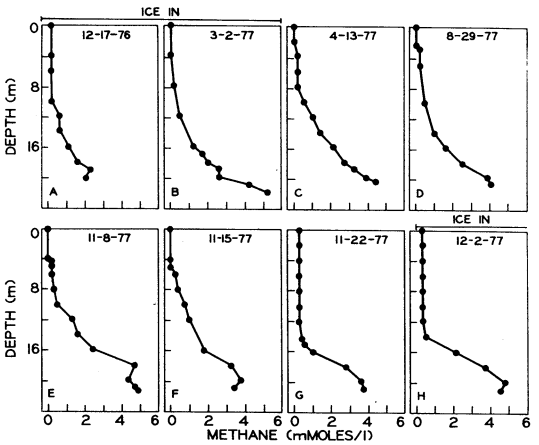

Fig. 13. Profiles of dissolved methane in Knaack Lake from 12-17-76 through 12-2-77.

Sulfate was not detectable in Knaack Lake throughout most of the year. The turbidometric assay for sulfate, however has a lower detection limit, approximatealy 0.5 mg/l SO_4^{-S}, than the colorimetric method for sulfide. Small amounts of sulfate (1-2 mg/l) were detected in the fall of 1977 above the thermocline (Figs. 11I and 11J). This was probably a result of sulfide oxidation as the deeper sulfide containing water was mixed with the shallow oxygenated water.

Iron Species. Ferric iron was detected only in the surface water at concentrations from 0.10 to 0.50 mg/l (Fig. 12). No ferric iron was detected in the anaerobic hypolimnion. In the aerobic epilimnetic waters, ferrous iron concentrations were low 0.1 to 0.38 mg/l), but increased with depth in the anaerobic portions of the lake and concentrations of 4 to 6 mg/l were commonly observed near the bottom.

Ferrous iron concentrations were considerably higher than would be expected from the concentrations of sulfide measured in Knaack Lake. The maximum concentration of sulfide predicted from theoretical calculations was approximately 50 times lower than the actual sulfide concentrations measured in the lake. It is likely that the ferrous iron observed in the bottom water is present as iron chelates of humic acids.

Methane. In Knaack Lake, high concentrations of methane were found in the bottom water throughout the year. After ice formed (Fig. 13A) methane was present in small concentrations in the top 12 m (ca. 100 μmoles/l) and began to increase below 12 m. Methane in the oxygenated surface water probably resulted from mixing of the hypolimnetic waters, which contained methane, with the surface water when the lake was isothermal. Methane concentrations gradually increased throughout the winter (Fig. 13B). When the ice went out in the

spring (Fig. 13C), methane was depleted in the aerobic surface water, presumably because of methane oxidation at the thermocline and evasion into the atmosphere at the surface. As oxygen reached greater depths in the fall of 1977, methane was consumed above the thermocline (Fig. 13D-F). When the lake became isothermal on 11 November 1977, water with large concentrations of dissolved methane above 14 m was mixed with overlying water and a concentration of 200 to 300 μmoles/l methane was found throughout the upper 14 m (Fig. 13G). These concentrations stayed constant after the ice formed. Methane concentrations reached levels as high as 4000 μmoles/l in the bottom water and monimolimnetic waters varied little throughout the year.

Dissolved Inorganic Carbon. Dissolved inorganic carbon (DIC) was measured throughout the lake and was generally at 1000 to 3000 μmoles/l in the surface water and increased to 5000 to 10,000 μmoles/l in the monimolimnion (Fig. 14).

Photosynthetic Bacteria. Photosynthetic bacteria were present in Knaack Lake at all times of the year. Microscopic examination of water samples revealed that the predominant photosynthetic bacteria were green sulfur bacteria of the genera *Chlorobium* and *Pelodictyon*. Bacteriochlorophyll assays of water samples indicated only one type of bacteriochlorophyll, bacteriochlorophyll d (bchl d). The relative distribution of oxygen, sulfide and bchl d were compared for a midsummer sampling date (Fig. 15). Usually bchl d was only detected at depths where sulfide was present and maximum concentrations of bchl d were found at depths where sulfide was first noticed in the water column (Fig. 16A). Occasionally bchl d was observed at depths just above the sulfide containing waters (Fig. 16). Sulfide was present between 2 and 4 m during periods of stratification and generally present up to the ice during the winter. In February and March, 1977, a bloom of photosynthetic algae was present under the ice. The water became oxidized and sulfide was not detected above 2 m. In the fall of 1976 and 1977 the point at which sulfide was first detected dropped to depths of 14 and 15 m respectively. These depths indicate the maximum depth of mixing when the lake was isothermal. During the winter of 1977, bchl d maxima were found at depths of 0.5 to 1.0 m (Fig. 16B). On 10 April, 1977 the ice left Knaack Lake

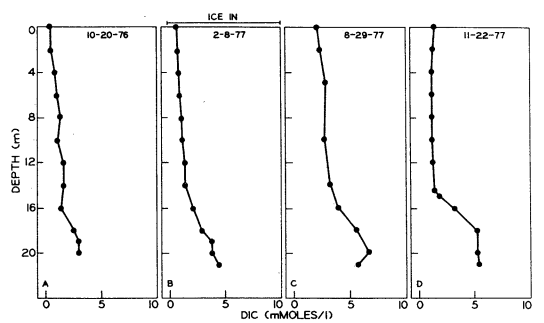

Fig. 14. Profiles of dissolved inorganic carbon (DIC) on selected sampling dates.

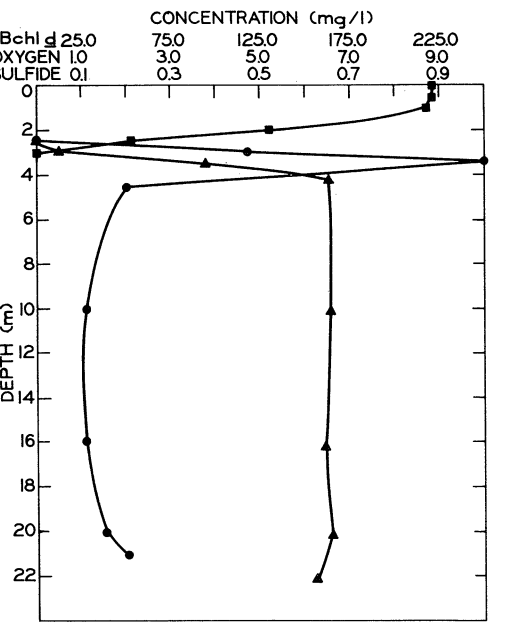

Fig. 15. Distribution of oxygen, sulfide, and bacteriochlorophyll d in Knaack Lake on a midsummer sampling date (7-7-77). Symbols: Bchl d (●); Oxygen (■); and Sulfide (▲).

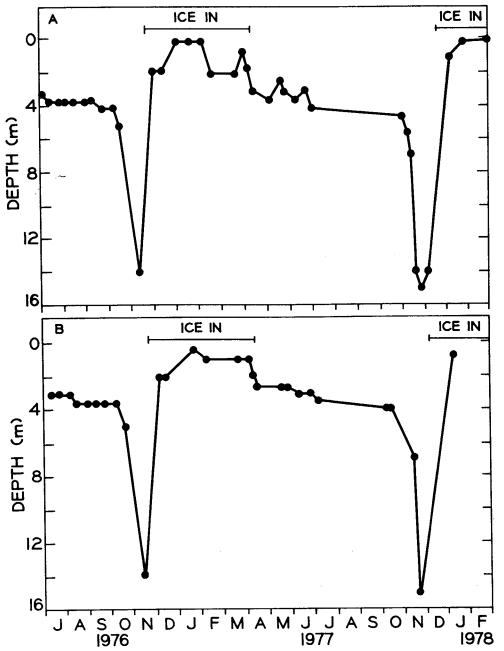

Fig. 16. Variation in depths where Bchl d (A) and Sulfide (B) were first detected in the Knaack Lake water column throughout the sampling period.

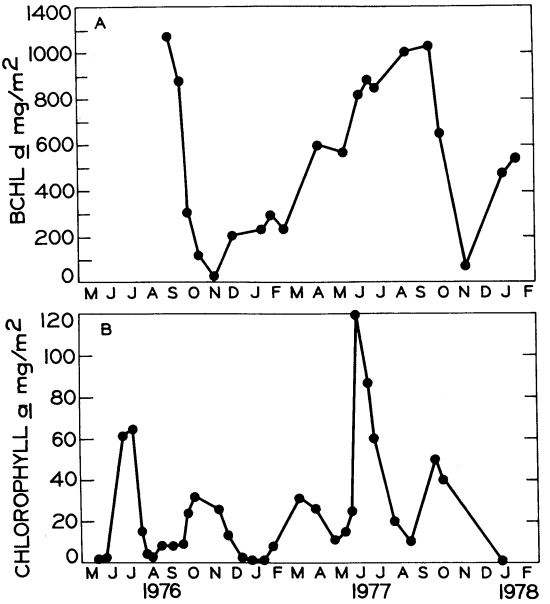

Fig. 17. Integrated Bchl d concentrations (A) and Chlorophyll a concentrations (B) in Knaack Lake throughout the sampling period.

and the surface waters (0 to 2 m) were depleted of sulfide. At this time the bchl d maximum was located at a depth of 2.5 m. By mid-May 1977 the bchl d maximum had migrated to a depth of 3 m. The photosynthetic bacteria remained at depths of 3 to 4 m in the lake from mid-May to mid-October. From 17 October, 1977 to 22 November, 1977 the lake experienced partial mixing. Mixing occurred to approximately 15 meters and not above this depth were sulfide and bchl d present in the water column. By 13 January, 1978 the lake had ice cover and the photosynthetic bacteria were found at a depth of one m.

Integrated bchl d values in Knaack Lake were calculated (Fig. 17A). Concentrations of bchl d exhibit an annual periodicity. After ice forms, the concentrations of bchl d in the lake increased steadily until "ice-out" (10 April 1977) and continued to increase throughout the summer. Maximum concentrations were observed in September at which time concentrations began to decrease. It is thought that this decrease occurred because the thermocline and hence the sulfide containing water became established at a lower depth (4.5 meters). The 4.5 m depth is below the photic zone and, since photosynthetic bacteria require both light and sulfide, the population began to decline. The decrease in bchl d continued through the partial mixing period until the lake became isothermal. After ice covered the lake anoxic conditions became reestablished and bchl d concentrations increased.

Phytoplankton. Chlorophyll a concentration in the epilimnion also seem to exhibit an annual periodicity (Fig. 17B). Peaks occurred in July 1976, October 1976, March 1977, June 1977, and October 1977. The summer chlorophyll peaks were higher than either of the two fall peaks or the winter peak. The predominant photosynthetic organism present in the epilimnion during July 1976 and June 1977 was the filamentous, heterocyst–forming, blue-green alga, *Ana-*

TABLE 2. Meromictic stability of saline and biogenic meromictic lakes.

Lake (location)	*Stability (gm-cm/cm²)*
Soap (Washington)[a]	4,495
Lower Goose (Washington)[a]	720
Blue (Washington)[a]	3,020
Wannacut (Washington)[a]	32,850
Mary (Wisconsin)[b]	1.1
Knack (Wisconsin)	35.8

[a] Data from Walker (1974). All lakes have highly saline monimolimnia; Soap and Lower Goose Lake are thought to be ectogenic.
[b] Data from Weimer and Lee (1973).

baena subcylindrica. The peaks in October 1976 and October 1977 consisted of a mixture of blue-green algae and green algae. *Ceratium, Scenedesmus, Staurastrum, Ankistrodesmus, Coelospherium, Anabaena,* and several types of flagellated unicellular green algae were identified in water samples collected on these dates. These fall blooms disappeared when the lake became isothermal and iced over. In March and April, 1977 a bloom of algae occurred under the ice. This bloom was almost entirely composed of a green flagellated alga.

Meromictic Stability. The density of Knaack Lake at 15 m was estimated by summing the concentrations of the various chemical species measured in the monimolimnetic waters and was calculated to be 1000.455 g/l. Using this value, the stability of Knaack Lake (S) was calculated to 35.8 g-cm/cm² (Table 2). Highly saline meromictic lakes (Soap, Lower Goose, Blue, and Wannacut) have extremely high stability values, while Lake Mary, a biogenic meromictic lake, has a stability value of only 1.1 g-cm/cm².

DISCUSSION

The results presented here show that Knaack Lake is indeed a meromictic lake. A sharp thermocline was established immediately after "ice-out" in the spring and only the upper one to two m of water were mixed. In the fall the thermocline began to drop and partial mixing of the lake occurred to a depth of 14 to 15 m as was evidenced by the uniform profiles of all chemical parameters. Although the turnover was not followed closely in the fall of 1976, chemical data after ice formed indicate that mixing occurred to a depth of approximately 12 to 14 m.

The decreased depth to which the lake mixed in the fall of 1976 probably resulted from the rapid and early freezing. The lake froze two weeks earlier in 1976 following a period of very cold weather. This early freezing and consequent mixing to a shallower depth also affected the water chemistry during the period of ice cover. Sulfide was present to the bottom of the ice immediately after ice formed in 1976 whereas sulfide was not detected in the upper 14 m of water for one month after ice formed in 1977, indicating more thorough mixing in 1977.

Although conductivity increases rapidly with depth in the bottom waters, there is no sharp chemocline dividing the mixolimnion and monimolimnion. Thus, meromixis in Knaack Lake does not appear to be of ectogenic or crenogenic origin. Other factors than salinity must be responsible for maintaining meromixis in Knaack Lake.

Weimer and Lee (1973) have suggested that the major factors allowing meromixis in Lake Mary are biological activity and morphometry of the lake basin. These factors may also be responsible for the meromictic state of Knaack Lake. The concentrations of ammonia, carbonate, phosphate, and methane were extremely high, and (except methane) probably account for the increase in conductivity observed in the monimolimnion. Ammonia, carbonate and methane are all products of biological activity and are relatively stable anaerobically. Thus, biogenic activity is likely a major factor in maintaining meromixis in Knaack Lake. As oxygenated surface water is never mixed with the bottom water, these compounds

accumulate and reach extremely high concentrations in the bottom water resulting in increased density in the monimolimnion.

The morphometry of the Knaack Lake basin and surrounding topography probably has a major effect on maintaining meromixis. The lake is surrounded by dense stands of trees and there is a hill on the northwestern shore of the lake which shields the lake from the prevailing winds. The small surface area and the great depth of the lake, combined with the shelter provided by the surrounding watershed prevent extensive mixing of the lake by wind.

Weimer and Lee (1973) calculated that the density difference between the mixolimnetic and monimolimnetic waters in Lake Mary was not sufficient to prevent mixing of that lake. Using Schmidt's stability equation, they calculated the stability to be only 1.1 g-cm/cm^2. They concluded that the physical characteristics of the lake basin and to a lesser extent biogenic activity were responsible for maintaining meromixis. Biological factors may play a more important role in maintaining meromixis in Knaack Lake than in Lake Mary. Conductivity, ammonia, phosphate, methane and DIC concentrations in Knaack Lake were much higher than values reported in Lake Mary. Furthermore, the stability of Knaack Lake (35.8 g-cm/cm^2) was considerably higher than Lake Mary, although the stability of Knaack Lake was several orders of magnitude less than reported values for saline meromictic lakes (Walker, 1974). It appears unlikely that density difference between the mixolimnetic and monimolimnetic waters alone is sufficient to prevent complete mixing of Knaack Lake.

Based on our results, Knaack Lake can be classified as a biogenic meromictic lake, although the morphometry of the lake basin is also an important factor in maintaining meromixis. Since there is no sharp chemocline dividing the mixo- and monimolimnetic waters, the amount of mixing each fall may depend on seasonal factors such as the date the lake freezes and the magnitude and direction of the predominant winds.

The mixolimnetic waters of Knaack Lake behave as a monomictic lake, mixing completely only in the fall. Nutrient input into the lake appears to result primarily from groundwater seepage along the northwest shore. Increases in groundwater after heavy rainfall result in increased nutrients in the surface water which in turn give rise to phytoplankton blooms. The shallow thermocline during spring and summer provides an environment conducive to blooms of photosynthetic bacteria.

Stagnation of the monimolimnetic waters of the lake gives rise to a permanently anaerobic environment high in dissolved solutes. As sulfate and nitrate are absent in the anaerobic water fermentation and methanogenesis are probably the major biological activities occurring in the monimolimnion. The shallow and sharp thermocline and the permanently anaerobic bottom water of Knaack Lake provide an excellent environment for the examination of many microbiological processes such as bacterial photosynthesis, anaerobic decomposition and methanogenesis. The chemical and physical data presented in this paper have been used as a basis for other studies on the microbial activities in the lake.

Acknowledgments

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FORWARD: COMMON SCHOOLS AND UNCOMMON LEADERS

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Wisconsin's school system, conceived in the northeastern states, was brought into being through the successive labors of six dedicated men. Eleazer Root, Azel P. Ladd, Hiram A. Wright, Alfred C. Barry, Lyman C. Draper, and Josiah L. Pickard came to Wisconsin in the middle of the nineteenth century from New York, New Hampshire, and Maine to serve, each in his turn, as Wisconsin Superintendent of Public Instruction. Each built upon the efforts and achievements of his predecessor, shaping Wisconsin's schools to the philosophy of the Common School Movement that flourished in nineteenth century Massachusetts and Connecticut.

Wisconsin's electorate was already sympathetic with the Common School Movement or it would not have hired these proponents of the movement. But the orientation and energy of these early Superintendents gave direction and thrust to the infant school system. Had any or all of them supported the private tutorial education of the southern states or the sectarian education of the middle Atlantic states, Wisconsin's educational system might have been far different. As it was, these harmonious leaders faced many obstacles.

Teacher preparation, parental apathy, environmental aesthetics, and the search for a responsive and demanding supervisory structure concerned these early educators much as they worry us today. A picture of the conditions and reforms of Wisconsin schools of the time emerges from the thirteen annual reports these first six superintendents were required to file. Each report contained information supplied by clerks of county boards of supervisors. These annual reports provide a record of the recommendations and achievements of each superintendent, as well as a detailed account of the status, problems, and progress of early common schools in Wisconsin.

Territorial statesmen had envisioned a Wisconsin educational system encompassing all levels, elementary through university. The state constitution of 1848 committed land monies and revenues to the support of such a system. Article X, Section 1, specifies the leadership designed to bring the dream to fruition:

> The supervision of public instruction shall be vested in a state superintendent, and such other officers as the legislature shall direct. The state superintendent shall be chosen by the qualified electors of the state, in such manner as the legislature shall provide; his powers, duties and compensation shall be prescribed by law.[1]

Fittingly, the author of Article X was elected the first Wisconsin Superintendent of Public Instruction.

Eleazer Root (1802-1887) was born in the state of New York, earned a law degree from Williams College, and moved to the Wisconsin Territory in 1845, becoming principal of the Prairieville (now Waukesha) Academy. Instrumental in the founding of Carroll College and the University of Wisconsin, he became a professor at Carroll and a member of the first Wisconsin Board of Regents. Root's three year term as state superintendent of the Wisconsin system of common schools began in December 1848.

Delegates to the constitutional convention had voted to adopt the term common schools, defeating the proposal favoring the

name public schools. Unlike Europe, where the word "common" denoted inferiority, in the United States a common school was a tax-supported institution intended to offer equal educational opportunity to all children. Root earnestly discharged his responsibility to advance the schools according to this principle.

Root listed three major personal objectives: (1) to promote in-service training programs for teachers; (2) to promote normal schools, (3) to promote grading, i.e. the classification of students by age and ability. Root's annual reports show a determination to personally evaluate school quality. He traveled throughout the state observing and participating in school functioning for as many as seven months in a single year. Various diaries and personal accounts record the conditions Root encountered.

Most schoolhouses were small log or frame buildings with benches for students and a desk on a platform for the teacher. The rooms were drab. Windows were high to minimize distractions, walls were unpainted and pictureless. Ventilation was lacking; a pot-bellied stove emitted uneven heat, and a water pail with a common dipper often spread disease. Globes, blackboards, and standardized textbooks were lacking, making teaching and learning difficult.

Many teachers were teenagers; most were ill-prepared, and all were hired to "keep" school, i.e., administer firm discipline. Teachers' low salaries were supplemented by "boarding round," with various families in the school district. Daniel Thomas described, in a diary, his many years of boarding round. Apparently meals were usually uninspired and often inadequate; a typical breakfast consisted of bread and water, and he was served turkey only once in twenty years. Uncomfortable beds in cold rooms were common; one particularly miserable attic room drove Thomas to sleep in a trunk for warmth. School days for Thomas began when he built a fire at 8:00 A.M., and ended at 4:00 P.M. on weekdays, noon on Saturdays. One diary entry vividly illustrates teacher status within the community. During a blizzard, Thomas waited at school until a parent arrived to call for the last remaining students. Thomas left the schoolhouse with the children whose father had come in a wagon. The father chose not to invite Thomas to ride; furthermore, he admonished him to walk "a respectable distance" behind the wagon.[2]

Teacher improvement was one of Root's major objectives. During his first year in office he formed teacher institutes in all except five counties in Wisconsin, although he regarded institute lectures and discussions as partial, temporary aids to classroom teachers. He judged normal school training essential to prepare future teachers in the subjects they would teach and in pedagogical skills. Commenting that teaching was a profession not unlike law or medicine, Root encouraged normal school administrators to include theory as well as technique in their curricula. He recommended a free five-month university course for all teachers, legal support for teacher institutes, and retention of teacher certification even though he believed the criteria for certification were inadequate. The following copy of one certificate indicates the characteristics the community desired in a teacher.

> We the subscribers, inspectors of Common Schools for the town of Chili in the county of Monroe do certify that at a meeting of the inspectors called for that purpose, we have examined Miss Eliza Dibble and do believe that she is well qualified in respect to moral character, learning and ability to instruct a common school, in this town, for one year from the date hereof.[3]

His extensive school visits gave Root specific ideas for desirable changes in schoolhouses and their sites. Observing that schools often were built on treeless land, sometimes swampland, at a junction of two roads, Root recommended they be built in a dry, health-

ful, sheltered location on one or more acres of land away from highways and businesses. He specified a need for shade trees and a fence, separate privies and schoolhouse entries for boys and girls, and low windows which could be opened or closed. He preferred buildings with two classrooms which would enable teachers to implement a grading system and eventually eliminate one teacher classrooms with students of varying ages. Large blackboards, maps, charts, pictures, and even useful decorations were advocated, provided they promoted sound morals. Root intended improved common school facilities to increase comfort and practicality as well as to discourage private school enrollment. Always, his emphasis was on the tax-supported education of the public, privileged or poor.

Root requested an expense account and a clerk for the State Superintendent of Public Instruction. He asked that copies of textbooks, samples of school apparatus, and county maps be placed in the office of the superintendent.

Despite public approval of his performance. Root declined to be a candidate for reelection in 1851. In his final month in office, he summarized his recommendations: (1) every township should have primary graded schools taught by female teachers, and higher graded schools equal to high schools and academies; (2) the university should include a non-tuition normal department; (3) county boards of superintendents should conduct institutes and certify teachers; (4) public libraries should exist in every school district supported by public funding; (5) the school fund should be ample and continually increasing; (6) town and county officers, in conjunction with a state officer, should supervise teachers, and strive toward uniformity.

Root's successors restated his recommendations, most of which were eventually enacted. His greatest accomplishments appear to have been the firm establishment of the new office, open communication with teachers and other citizens, and some improvement of teacher competency. After serving as a state assemblyman, Root moved to St. Augustine, Florida in 1853 serving as rector of Trinity Episcopal Church until his death in 1887.

New Hampshire-born Azel P. Ladd (1811-1854), Root's successor (1852-1853), had moved to the Wisconsin Territory in 1842. Some members of the electorate opposed his candidacy for the superintendency because they believed that he, a physician, lacked suitable qualifications. He had, however, shown previous interest in public service by helping to form the Mining Region Teachers' Association in 1848, and by serving as vice president of the State Historical Society of Wisconsin.

Ladd was confident that the common schools would inspire public honor, create a wholesome regard for laws, prevent crime, and infuse kindness. He expressed his faith in this possibility, saying,

> Thus FREE EDUCATION TO ALL may be appropriately inscribed upon the emblem of our State—its present glory, its future hope.[4]

Wealthy parents created an obstacle to public school progress by enrolling their children in private schools, creating by contrast an image of public schools as vulgar and inferior. Responding to parents who expressed fears that their children might acquire habits of vice and vulgarity in common schools, Ladd urged them, as a public duty, to send their children to public institutions so that they might reform, elevate, and purify the schools.

In an attempt to strengthen public schooling, Ladd advocated a tuition-free state system of three divisions: (1) a district school to teach the common and necessary branches of knowledge, (2) a county high school to provide the elements of professional studies and prepare pupils for a business or trade,

(3) a university to equip graduates for an occupation in science or literature. He recommended construction of schoolhouses with two, or even three classrooms to accommodate the separation of pupils into grades.

Ladd observed many schoolhouses, located on wide and shelterless prairies, failing to provide either health or comfort. He condemned overcrowded classrooms with extremes of temperature, impure air and high seats, and without drinking water and teaching apparatus. Ladd advised that no new schoolhouses be built near swamps, marshy river banks, or pools of stagnant water. He recommended shade trees and pleasant playgrounds, a constant supply of fuel and fresh water, windows which opened, high ceilings, low benches, and space to allow movement. Convinced of the value of aesthetics, Ladd remarked, "Beautiful sights create beautiful thoughts, and beautiful thoughts are the germ of pure principles and noble actions."[5]

One of the state superintendent's duties was to recommend textbooks. Ladd devoted many hours to examining textbooks before concluding that Wisconsin's textbooks were inferior, outdated, and deplorable in their diversity. As a remedy, he urged the adoption of uniform textbooks.

Ladd labored to enhance teaching skills. He continued Root's sponsorship of one- to two-week teacher institutes offering professional information during the day and public lectures for the general population at night. Encouraging women, whom he termed "natural guardians of the child," to teach, Ladd catalogues his reasons for asserting their superiority to male teachers: her voice is more inviting, and her language is comprehensible to a child; her affections are stronger than her intellect so her greater concern is for the child's feelings, rather than his intellect; her classroom control is based on kindness, not on fear. Advocating hiring the best, even though the most expensive, teachers available, Ladd cautioned, ". . . no school at all is preferable to one taught by an incompetent and unfaithful teacher."[5]

Ladd was equally interested in the judgment of the men who hired teachers. The town superintendent of schools was charged with responsibility to form school districts, receive and apportion school money among the several districts in the town, and certify teachers. Ladd accused town superintendents of sometimes hiring unqualified relatives, friends, or neighbors. For this reason, he advised the public that the office of town superintendent wielded excessive power.

Clerks of county boards of supervisors were required to submit annual reports to the state superintendent of public instruction for incorporation in the superintendent's comprehensive annual report. Portions of such reports substantiate Ladd's contention that clerks submitted irregular, incomplete, or inaccurate accounts. One clerk reported on a school where classes had been conducted forty-six months during that year. Another described a school which had operated twenty and one-half months over a twelve month period. Furthermore, that community had 327 residents, 436 of whom had attended school that year.[6]

Ladd also attempted to explain the proper relationship of parents to the common schools. He advised parents to display interest in all school affairs, to participate in district school work, and to actively pursue financial aid for schools. He urged parents to visit school frequently and unceremoniously, to associate with the child's teacher and peer group, and to supervise home study. Ladd relied upon community involvement to sustain a successful common school system.

Ladd formed county associations of teachers, as a preliminary step to establishing a state organization. He requested delegates from each county group to attend a meeting in Madison on July 12, 1853. Eight teachers assembled to adopt a constitution, elect officers, and confer with one another for several days. This was a modest beginning for

a group that would wield enormous power in later years. Perhaps Azel Ladd's most enduring contribution to Wisconsin education was the founding of the influential State Teachers Association.

Before his death in 1854, Ladd returned briefly to his career as a physician.

Hiram A. Wright (1823-1855) succeeded Ladd as State Superintendent of Public Instruction (1854-1855). He moved from New York state, where he was born, to Prairie du Chien in 1846, and, in the late 1840's published the only newspaper on the upper Mississippi River. He studied law, was admitted to the bar, then served for two years as Crawford County judge. Wright served in both the Wisconsin Senate and Assembly prior to his election to the highest educational post in the state.

In Wright's annual report of 1854, he, like Ladd, called upon parents to participate actively in common school operations, for he believed that properly directed public sentiment would accomplish what laws could not. He issued a warning:

> So long as the people remain indifferent to the character of their school, so long will their children have to attend indifferent schools.[7]

Reporting that teachers unanimously rated "irregular attendance and want of punctuality" as the greatest deterrent to educational reform, Wright blamed parents for perpetuating this problem. He went on to reproach careless and indifferent parents for deficiencies in moral and intellectual training in the schools. Noting that poor schoolhouses contributed to poor attendance, he proposed that parents work to improve physical accommodations.

Wright was repelled by filthy schoolrooms, cracks in the walls, impure air from poor ventilation, and ill-constructed seats that caused pain and, in some instances, permanent bodily distortion. Wright recommended an annual allowance for the purchase of globes, maps, blocks, blackboards, and numerical frames. A clock was indispensible to his standards of orderliness. Advising optimum use of existing facilities, he made two practical suggestions to teachers: paint the cardinal points of a compass on either the platform holding the teacher's desk or the ceiling; mark the measure of an inch, foot, and yard on the edge of the blackboard.

Pointing to the success of the few union schools in existence, Wright encouraged the establishment, in populous areas, of additional institutions of two or more classrooms. He favored, where feasible, combining several district schools into a union school, for union schools would be economical, provide the best schoolhouses and the best apparatuses. Union schools, Wright believed, would permit proper pupil classification, and maintain order and discipline, while attracting the best teachers.

The problem of diverse textbooks, confronted during Ladd's tenure, continued. Because there were almost as many different textbooks as students, teachers were forced to hold excessive numbers of hurried recitations. For this reason, Wright, too, advocated textbook uniformity. Despite his expressed confidence that qualified teachers were capable of selecting textbooks, he recommended that, because of the large number of unqualified teachers, the state superintendent should make the choices.

Apparently annual district and town reports had not improved, for Wright referred to incomplete and erroneous accounts. As had Ladd, Wright charged district clerks and town superintendents with careless recordkeeping. He faulted some teachers, also, for failing to keep a school register as prescribed by law.

Wright believed that the classroom performance of teachers was critical. He stated, "As the teacher is, so is the school. He teaches by example as well as by precept."[8] Wright contended that if a teacher were boisterous, uncourteous, careless, superfi-

cial, unzealous, severe, or unreliable these qualities would be transmitted to students. The formation of town teachers' associations would provide a forum for sharing ideas: parental involvement might improve teacher performance, and discriminating certification policies would eliminate unsatisfactory teachers.

Having promoted and participated in institutes, Wright was persuaded they, too, would have a salutary effect on classroom performance. In his opinion, institutes could improve methodology and create an environment in which pupils might reason, understanding principles as well as facts; the mental capacity of students might be enlarged and a love of learning instilled.

Wright requested funds for normal schools as well as for institutes. Citing New York, Massachusetts, and Connecticut for maintaining successful normal schools, he emphasized an immediate need for normal schools in Wisconsin.

Again referring to New York, Wright endorsed that state's system of school libraries, proposing the establishment of similar facilities in Wisconsin. In addition to supplying books for children, such libraries could serve the community by offering adult books. Wisconsin law allocated a maximum of ten per cent of the district school fund for the purchase and continuance of a school library. Wright recommended that use of the entire ten per cent for that purpose be made mandatory.

Also at this time, and with Wright's active support, a bill passed authorizing town libraries to buy a copy of *Webster's Unabridged Dictionary* for each common school under their jurisdiction. Wright wanted a dictionary in each Wisconsin common school, for he viewed the book as an aid in discouraging provincialism, and preventing immigrants from corrupting the English language.

Wright's period in office was characterized by a consistent appeal for parental involvement, endorsement of improvements advocated by his predecessors, and provision for a dictionary in each common school. After suffering from ill health throughout his superintendency, Wright died in May of 1855, less than six months into his second term.

Governor Barstow appointed the Reverend Alfred C. Barry (1815-1888) to complete Wright's term. Barry was later elected to two consecutive one-year terms (1856-1857). Born in New York state, he attended private schools to prepare for the Universalist ministry. After moving to Racine in 1846, he founded and edited a temperance magazine, *The Old Oaken Bucket*. He served as the first Superintendent of Schools in Racine from 1849 through 1853.

Seeking specific additional information, Barry submitted a questionnaire to each town superintendent, then incorporated the responses into his annual reports together with letters from other educators in Wisconsin and the East. Moreover, he clarified his educational goals by supporting the common school intended, according to his interpretation, to foster ". . . the development of a free, true, harmonious human soul."[9] He viewed public education as the safeguard of a democratic government, and an instrument for the advancement of mankind.

Barry contended that it was difficult to learn in uncomfortable, inconvenient, unpleasant, unattractive schoolhouses which he labeled "mean, murderous things." A town superintendent placed a value of three cents on one building. Barry speculated,

> This pre-supposes 'three cent' parents. And we have only to suppose farther a *three cent teacher,* and a *three cent school,* to complete a very interesting and prosperous state of things.[10]

To alter these circumstances, Barry like his predecessors recommended that new schoolhouses be built on pleasant sites consisting of a minimum of one acre of land, although he preferred three to five acres. He stipulated that there be two rows of shade

trees, flowers and shrubbery in front of the building, and two playgrounds in the rear. Stressing the desirability of cultivating comfort and health, he recommended high white-painted walls holding maps, charts, and pictures, and a thoroughly ventilated building. To facilitate adoption of his plans, Barry urged each town superintendent to purchase a copy of *School Architecture,* written by Henry Barnard, noted Connecticut educator.

Barry urged the public to endorse a system with a primary school and a high school in each town, an academy in each county, and university for the state, all tuition-free. Opposing small districts, Barry supported formation of union schools, assuring citizens that a two- or three-mile walk would not be a hardship for students. Perhaps to counter parental apathy, he recommended an increase from the then current minimum of three to at least six months of school annually, before a district could receive its share of state aid.

Directing his attention to equipment, Barry quoted numerous town superintendents who approved of the concept of textbook uniformity, and agreed to implement such a plan.

There would be numerous advantages, according to Barry, to the State Superintendent's selecting all textbooks. The often inferior books chosen with haste and partiality by overburdened teachers and town officials would be eliminated by the judicious selections of the state superintendent. Books suitable to each grade level would be the same throughout the state, saving money and time when students or teachers moved across district lines. After telling of the success of a uniform textbook system in other states, Barry mentioned bribery and corruption charges directed toward his office and perhaps in self-defense, carefully documented his reasons for selecting each book on his list.

Barry favored a curriculum which would be pragmatic, promote health and cheerfulness, and achieve a union of moral affections and nature. He recommended study of natural history and natural sciences, botany and zoology, geology and agriculture, anatomy and physiology, citizenship and moral science. In an emotional account of the moral power of music, Barry stressed the importance of music in primary schools. Daily hymns and songs would provide a welcome respite from studies.

Comparing school to a prison, Barry objected strongly to a strict regimen of book learning for small children exposed to six hours of inactivity, impure air, uncomfortable benches, and meaningless memorization. He said,

> . . . the result is seen in the shattered constitution, the ruined health, the enfeebled mind, the perverted moral sense, the nervous excitability of blasted or abused childhood.[11]

To offset these conditions, Barry favored delaying schooling until a child displayed adequate maturity to comprehend subject matter rather than engage in rote memorization. He observed that many great minds, e.g., Newton, Schiller, and Patrick Henry, did not, as youngsters, display intellectual brilliance.

Barry condemned parents, generally, for being apathetic toward education. He also accused parents of frequently keeping their children home from school without a legitimate reason, and not knowing when their own children were tardy. Parents failed to determine whether teachers were fulfilling their duties, whether proper and adequate books were supplied, or whether equipment and environment were satisfactory. Many town superintendents called parental indifference the greatest obstacle to improved schools. In Barry's opinion, the chief educational responsibility lay directly with the parent, while the teacher was intended to be merely a parental agent or surrogate.

Objecting to the popular view of a teacher as a person who simply "keeps" school,

Barry asserted that teachers should stand *in loco parentis.* Parents must accept the responsibility for choosing good teachers. Teachers, for their part, must avoid formal, mechanical instruction forcing students to cram, a process Barry termed "sausage stuffing." Barry urged annual funding of institutes as likely to eradicate unacceptable methodology. He insisted that, in addition, it was imperative for Wisconsin to establish a state normal school to enhance teacher preparation. Barry also urged an increase in teacher salaries, hoping thereby to attract competent, well-educated professionals.

Superior teachers deserved skillful leadership. Agreeing with Ladd's assessment, Barry claimed that incompetent or disinterested town superintendents were unable to give such direction. Therefore Barry made the momentous decision to recommend creation of the office of county superintendent of schools. He was convinced that county superintendents would give rigid but practical certification examinations, speak persuasively to influence public opinion, provide efficient leadership, and assume certain duties performed, at the time, by the state superintendent. Because the state superintendent and his assistant worked fourteen to sixteen hours a day, Barry also asked for additional help in the Department of Public Instruction. The state superintendent heard appeals cases, kept records, spent five months a year inspecting schools, apportioned school money, and prepared the annual report. His assistant was fully occupied handling the extensive correspondence.

In 1856, a private periodical, *The Wisconsin Educational Journal,* was renamed *The Wisconsin Journal of Education,* and according to the title page, became the official organ of the State Teachers' Association and the Department of Public Instruction. Barry, a member of the original nine-man editorial committee, contributed frequent articles and printed his annual report in the journal. He sent a copy of each issue to every town superintendent, and expressed the wish that it could be read by every Wisconsin teacher.

After his service as state superintendent, Barry served as a chaplain during the Civil War, and after the war as a hospital chaplain. He worked, also, in the State Assembly, and was chaplain of the Wisconsin Commandery of the Military Order of the Loyal Legion.

Lyman C. Draper (1815-1891), fifth Wisconsin State Superintendent of Public Instruction (1858-1859), attended public schools in his home state of New York before entering Granville College in Ohio. He became corresponding secretary of the State Historical Society of Wisconsin in 1854, two years after moving to Madison. His work for the society helped to expand its membership, library, and state funding. An early fascination with the West, and extensive travel, led him to a career of writing about the land and its people. Draper was influential in bringing to Wisconsin the notable common school proponent, Henry Barnard, admired by Draper's predecessor.

Draper identified the common school system as the hope of the state. In the following statement, he interpreted the role of the common school as a "leveling agent."

> And such must ever be the legitimate results of the Free School system, placing the high and the low, the rich and the poor, upon a common level—where unconquerable devotion and intrinsic worth, however humble or however poor, alone secure the prize.[12]

Unlike his predecessors, Draper did not dwell upon the responsibility of parents and the general public in advancing the Common School Movement, but, instead, relied upon the state legislature to achieve progress.

To implement educational equality, Draper advised legislators to adopt a free graded system of education from primary schools through the university. He reinforced his arguments for a central graded high school for

each town in Wisconsin by quoting numerous sympathetic educators from other states. As a further means of strengthening education, he, like Barry, recommended extending the school year from three to six months.

To improve administration, he advised replacing the district system with a township board of education to be composed of a superintendent, school treasurer, and school clerk. Draper, expressing popular disapproval of town superintendents, was hopeful that a board of education would prevent continued hiring of inept town superintendents and clerks. He illustrated the incompetence of some of these officials by examples from his correspondence. In one letter a schoolteacher referred to a man responsible for certifying teachers.

> The District Clerk, _____, cannot read or write. . . .[13]

A letter, from a town superintendent, dramatically displays the academic attainments of another school official.

> May 10th 1860
> Mr. Lyman J. Drayper
> Stait Supertendant
> Madison Wis
> my Dear frend i was Electid town supertendant of the town of _____, _____ co. Wisconsin and i would like to have A new School code of Wisconsin and som Annual Reports of the Clerk of School Distric and all most Repctfuley yors
>
> _____
> town Supertendant of Common Schools in the town of _____, _____ co wis[14]

In a further attempt to upgrade administrative procedures, Draper approved Barry's recommendation for creating the office of County Superintendent with the following duties: (1) supervising teachers, (2) certifying teachers, (3) furnishing statistics and information, (4) adjusting controversies.

According to Draper, the first educational duty was to teach children to read, and the second was to provide them with the right books. To fullfill this obligation, school libraries must be a part of the public educational system. Draper contended,

> I think that it may justly be regarded, that this matter of Township School Libraries is emphatically the present great educational want of Wisconsin.[15]

He underscored this interest, by devoting approximately twenty-five per cent of his annual report to a discussion of libraries. School libraries, Draper declared, would provide incentive for the formation of literary associations and debating clubs. With properly selected books, libraries would be valuable to the entire community when school was not in session. Draper proposed that the libraries include books on history, travel, physiology, chemistry, and geology. In addition, books on the theory and art of teaching would be a less expensive method of improving teacher performance than either institutes or normal schools.

Libraries should not be a substitute for institutes, however, for teachers need a formal learning experience, Draper noted, particularly when they are unable to attend a normal school. A successful institute is dependent upon effective instructors and lecturers, for whom the state should provide funding. Crediting Barnard for improving Wisconsin normal schools and teacher institutes, Draper termed Barnard's association with the state normal schools the most important event ever to occur in Wisconsin's educational history.

The growth of normal schools provided increasing opportunities for women to become teachers. Draper encouraged the acceptance and advancement of women in the teaching profession, declaring,

> Females, in consequence of their higher moral instincts, their more refined tastes, together with their more patient and sympathising natures, are fitted in a more emi-

nent degree than the male sex for imparting instruction to the young.[16]

Draper proposed that a teacher's association be formed in every county, city, and township in Wisconsin. Information from each chapter could be incorporated into the annual report of the State Superintendent.

Referring to salaries of comparable officials in other states, Draper recommended a wage increase for the State Superintendent, Assistant State Superintendent, and Clerk. Lamenting the intrusion of politics into the office of superintendent, he proposed a change from a fall election for a two-year term to a spring election for a three-year term. He recommended establishing a state board of education authorized to appoint a superintendent and serve in an advisory capacity to him.

After completing his term as State Superintendent, Draper resumed his writing career, traveling extensively to find materials. His personal collection, combined with the 478 volumes he acquired for the society, formed the nucleus of the Historical Society's manuscript collection of frontier history, one of the largest and most important in the nation.

Josiah L. Pickard (1824-1914), who became, in 1860, the sixth State Superintendent, and the last to hold this office prior to the Civil War, was born in Maine. He graduated from Bowdoin College before moving to Platteville in 1846. A professional educator, he was principal of Platteville Academy for fourteen years, and helped to organize the Wisconsin State Teachers' Association.

A public educational system, for Pickard, was essential to prepare citizens for active participation in a democracy, to prevent people from becoming willing tools of demagogues, and to permit persons to appreciate the blessings of civil liberty. Moreover, education, as a preventative to crime, was more effective and less expensive than corrective measures. In the following statement, Pickard voiced his approval of common school principles.

> The general diffusion of knowledge and of correct moral principles, are therefore absolutely essential to the perpetuity of popular institutions.[17]

Pickard was convinced that only public schools were able to equip Wisconsin citizens for self-government inexpensively and universally.

Pickard divided schools into three levels: primary, intermediate, and high schools. Pickard's goals for primary schools were to further physical and moral development, cultivate a taste for study, and provide a transition from freedom at home to restriction at school. Only female teachers should work at this level, he said, for they have quick perception, patience, kindness, a sympathetic nature, and devotion. Intermediate scholars would encounter more severe restraints, longer tasks, greater emphasis upon books, and more variety in daily work. Pupils must be more self-reliant during this transition period. The high schools were to emphasize mental activity in a curriculum including moral and natural science, history and civics, classics and research.

Pickard praised the effectiveness of the graded system, listing many advantages: (1) a teacher taught fewer branches of knowledge, thus utilizing a talent for special work; (2) supervision was more careful; (3) opportunity for promotion stimulated teacher and pupil; (4) permanent, congenial employment appealed to teachers and a larger number of female teachers were employed; (5) expenses did not increase; (6) pupils remained in a school longer, giving character to the school, while sparing parents the expense of sending the child away from home for an education; (7) the system followed natural development.

Aware of circumstances which might make gradation impossible in some districts, Pick-

ard offered several alternatives: giving the younger children more frequent recesses and an earlier dismissal; devoting half a day to the younger children, who would then leave; or dedicating half a day to the younger and half a day to the older children. Each teacher could select from among the three options.

As *ex officio* member of the fifteen-man Board of Regents, Pickard wanted the university to be intimately connected with common schools. He urged free instruction not only in arts and sciences, but also in professional pedagogical training.

Because many Wisconsin schools still had improper lighting and heating, no ventilation, and no coat closets, because blackboards were placed too high and ceilings built too low, because halls were narrow and seats often the wrong size, Pickard recommended that each school library should have a book of schoolhouse architecture, such as Barnard's, to encourage creating useful and beautiful buildings.

Pickard hoped that a pleasant setting might improve attendance and encourage children to take the initiative in attending school, despite parental indifference. Pickard speculated that some needy parents kept their children home to avoid buying books or clothes, or to encourage them to find jobs to supplement the family income. He estimated that one-fourth of Wisconsin children received instruction only in the "school of the street," where they learned corrupting habits running counter to the moral teaching of the common schools.

Pickard, and the public generally, favored a curriculum broader than the "three r's." He quoted Daniel Webster who said,

> Were the branches taught in public schools to be limited, I would select such as would of themselves deeply interest the pupil, and thus create a thirst for knowledge.[18]

Adopting a more rigid stance on textbooks than on curriculum, Pickard advised legislation to force district board members to adhere to the recommended book list of the State Superintendent. Although he regarded textbook uniformity as essential within a school and desirable in a town and county, he believed state uniformity to be unnecessary, for pupils rarely moved great distances. He restricted the need for textbook uniformity to district schools where frequent teacher turnover would lead to confusion or dissatisfaction if each were to follow personal preference. Because of their greater job stability Pickard believed high school teachers might choose their own textbooks to be used over a period of several years.

The 1859 legislature had passed an act to provide a permanent township school library fund. Pickard approved, citing books as ever-present, direct educational agencies which were often more potent than a living teacher. He observed that people with the lowest incomes most needed a library, but could least afford to support one. Pickard claimed to have found no libraries worthy of the name except where a voluntary local tax was added to state money.

Pickard reported that public interest in education increased wherever he conducted institutes. He viewed these classes, varying in length from three days to two weeks, as vehicles to awaken an interest in culture. Perceiving a need for the preparation of greater numbers of teachers than in past years, he advocated placing the state university at the head of a normal school system consisting of a number of local schools financed with state aid and private contributions. In the meantime, growth of the Wisconsin State Teachers' Association prompted the organization of increasing numbers of local chapters which provided an opportunity for teachers to share professional skills and arouse public interest in schools.

The improvement of teacher preparation made it possible to revise teacher examinations. Pickard recommended that examinations be both written and oral, and that they test knowledge of fundamental princi-

ples rather than continue to ask ambiguous or puzzling questions. He proposed scheduling examinations for a definite date and time, in preference to the impromptu system then in effect.

During his first year in office, Pickard had repeated his predecessors' appeals for a county superintendency to replace town administrators. The perseverence of state superintendents and others was rewarded in 1861 with the passage of a law creating the office of county superintendent of schools. Persons elected to two-year terms assumed responsibility to: (1) examine and license teachers; (2) visit and inspect schools; (3) organize and conduct at least one teacher institute each year; (4) encourage teachers' associations; (5) advise in all questions arising under county school law; (6) advise on pedagogical skills and schoolhouse design; (7) report on the condition and prospects of schools; (8) collect abstracts of clerks' reports for transmission to the State Superintendent. Problems long confronted by the State Superintendents were, at last, on the way to resolution with the enactment of this law.

Innovations of a different nature occurred with the common school system's expansion to include special schools. The Wisconsin Institute for the Education of the Blind opened in Janesville; the Wisconsin Institute for the Education of the Deaf and Dumb opened in Delavan; a State Reform School opened in Waukesha. The Reform School was intended to prevent crime rather than to reform criminals, to be educational rather than penal.

Although this study ends with the beginning of the Civil War, it should be noted that Pickard served during wartime, resigning in 1864 to become Superintendent of Schools for Chicago, a position he held until 1877. He then accepted another prestigious position as president of the State University of Iowa, remaining from 1878 to 1887.

The shared educational roots of these six superintendents gave Wisconsin's educational system a period of uninterrupted progress. The early superintendents were in general agreement. Each superintendent identified the following obstacles to the achievement of quality education: insufficient state funds, inefficient administration, incompetent district and town officials, inferior schoolhouses, lack of textbook uniformity, ill-prepared teachers, poor attendance, and parental indifference.

Consistent with one another in naming probable solutions to these problems, the superintendents recommended, and were eventually granted, creation of an office of County Superintendent of Schools, graded schools, school libraries, institutes and normal schools, and professional associations and publications.

Several trends between 1848 and 1861 reflect the efforts of the state superintendents. Public interest in education grew, uniformity of textbooks was accepted, and the quality of teacher preparation improved. Teacher salaries increased with teachers' increased professionalism. The average male teacher earned $15.22[19] a month in 1849, but $23.01[20] in 1861, while corresponding figures for female teachers were $6.92[21] and $14.62.[22]

Schoolhouse construction changed slightly. In 1849, five per cent of all schoolhouses were brick, three per cent of stone, fifty per cent of logs, and forty-two per cent frame.[23] In 1861, the number of brick schoolhouses remained at five per cent, stone buildings increased to four per cent, log structures decreased to thirty-two per cent, while frame schoolhouses increased markedly to fifty-eight per cent.[24] The number of schools having blackboards grew from fifty-three per cent in 1849[25] to seventy-nine per cent in 1861.[26] Schools with maps numbered twenty-three per cent in 1848,[27] twenty-nine per cent in 1861.[28]

During these years common schools

reached increasing numbers of children. In 1849, forty-six per cent of children between the ages of four and twenty attended schools[29] which were in session an average of 3.93 months that year.[30] In 1861, sixty per cent of the registered children attended classes regularly[31] in schools open an average of six months yearly.[32] These and other statistics serve only as indicators, for their accuracy is questionable because of the ineptitude of many district clerks and town superintendents. Yet it is evident that vast improvements in the Wisconsin school system were wrought between 1848 and 1861. Root, Ladd, Wright, Barry, Draper, and Pickard championed education despite great obstacles. They were uncommon leaders who shaped the common school system of Wisconsin during its formative years.

Notes

[1] "The Wisconsin Constitution," Wisconsin Legislative Reference Bureau, *The Wisconsin Blue Book,* 1968. Madison Document Sales, 1968, p. 307.

[2] State Historical Society of Wisconsin, *Diary of Daniel Thomas,* SC 145.

[3] State Historical Society of Wisconsin, *James T. Lewis Papers,* Wis Mss VY.

[4] Azel P. Ladd, *Annual Report of the State Superintendent of Public Instruction, For the Year 1852* (Madison: Brown and Carpenter, Printers, 1853), p. 24.

[5] Azel P. Ladd, *Annual Report of the State Superintendent of Public Instruction, For the State of Wisconsin, 1853* (Madison: David Atwood, Printer, 1854), p. 31.

[6] *Ibid.,* pp. 6-7.

[7] H. A. Wright, *Annual Report of the State Superintendent of Public Instruction, Of the State of Wisconsin For the Year 1854* (Madison: Beriah Brown, Printer, 1855), p. 20.

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

[9] A. Constantine Barry, *Annual Report of the State Superintendent of Public Instruction of the State of Wisconsin For the Year 1855* (Madison: Calkins & Proudfit, Printers, 1856), p. 30.

[10] A. Constantine Barry, *Annual Report of the State Superintendent of Public Instruction of the State of Wisconsin For the Year 1856* (Madison: Calkins & Proudfit, Printers, 1857), p. 16.

[11] A. Constantine Barry, *Annual Report of the State Superintendent of Public Instruction of the State of Wisconsin, For the Year 1857* (Madison: Atwood & Rublee, Book Printers, 1858), p. 19.

[12] Lyman C. Draper, *Tenth Annual Report on the Condition and Improvement of the Common Schools and Educational Interests of the State of Wisconsin For the Year 1858* (Madison: Atwood and Rublee, Printers, 1858), p. 34.

[13] *Wisconsin Journal of Education,* V (February 1861), p. 264.

[14] Draper, *1858 Report,* p. 179.

[15] *Ibid.,* pp. 87-88.

[16] *Ibid.,* p. 119.

[17] J. L. Pickard, *Thirteenth Annual Report of the Condition and Improvement of the Common Schools and Educational Interests of the State of Wisconsin For the Year 1861* (Madison: Smith and Cullaton, State Printers, Argus Office, 1861), p. 47.

[48] J. L. Pickard, *Twelfth Annual Report on the Condition and Improvement of the Common Schools and Educational Interests of the State of Wisconsin, For the Year 1860* (Madison: James Ross, State Printer, Patriot Office, 1860), p. 7.

[19] Eleazer Root, *Report of the State Superintendent* (December 31, 1849), Appendix A.

[02] Pickard, *1861 Report,* p. 11.

[21] Root, *1849 Report,* Appendix A.

[22] Pickard, *1861 Report,* p. 11.

[23] Root, *1849 Report,* p. 7.

[24] Pickard, *1861 Report,* p. 5.

[25] Root, *1849 Report,* Appendix A.

[26] Pickard, *1861 Report,* p. 5.

[27] Root, *1849 Report,* Appendix A.

[28] Pickard, *1861 Report,* p. 5.

[29] Root, *1849 Report,* Abstract A (no pagination).

[30] *Ibid.,* pp. 5-6.

[31] Pickard, *1861 Report,* pp. 8-9.

[32] *Ibid.,* p. 112.

TRANSFORMATION OF U.S. AGRICULTURE: THE PAST FORTY YEARS[1]

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The United States, with some exceptions, was settled as a nation of small farmers. The peak number of farms, 6.8 million, was reached in the mid-1930's; the average size was 155 acres. By 1979 there were about 2.4 million farms averaging 443 acres. One-half million of these farms received about 80 percent of the cash receipts from farming. The U.S. farm population reached its peak of about 32.5 million people during the depths of the depression in 1933. Today we have less than 4 percent of the labor force employed in on-farm production with a total farm population of less than 9 million people. These figures imply very rapid changes in the structure and organization of U.S. agriculture over the past 40 years. How were these changes brought about and why?

FACTOR ENDOWMENTS AND U.S. AGRICULTURE

U.S. agriculture developed under conditions of plentiful land and a scarcity of labor. Thus the emphasis since the beginning of the nineteenth century has been on output and efficiency per person rather than per acre. To be sure, some people were concerned with breeding better livestock, improving soil treatment, better plant varieties, etc. But the major concern was to extend the capacity of labor through mechanical devices and improved tools and equipment.

Our green revolution came more recently. Hybrid corn was introduced in the late 1920's, but the widespread use of commercial fertilizers and, later, of weed and insect-control chemicals did not occur on a massive scale until after World War II. The abrupt increases in yield based on biological-chemical technology came after 1950. But this technology alone would have had little impact on farm size and population structure. The change in structure was brought about largely by the tractor and related mechanization. The shift from oxen to horses in the nineteenth century, and the horse-drawn implements and equipment that were developed throughout that period, did improve labor efficiency and output per worker. Essentially this permitted a better job of tilling the land or perhaps clearing and putting more land under cultivation *within* the 80- or 160-acre family farm unit—rather than expanding the basic size of the farm. Use of tractors and the development of ever larger power units as well as tillage and harvesting equipment required larger farms to utilize the machinery efficiently.

In the United States, as in countries around the world, land-saving technology was essentially neutral to scale or size. There is nothing mysterious or complex about this. Seeds, fertilizers, insecticides, etc. are divisible inputs and can be applied with equal efficiency on small or large farms. Water for irrigation may involve some scale economies, but these can be captured through water user associations, cooperatively owned

[1] Parts of this paper were included in my "Agriculture Within the U.S. Economy: Integration and Interdependence," in *Farm Structure* Committee Print, 96th Congress, 2nd Session, April, 1980, Committee on Agriculture, Nutrition and Forestry, U.S. Senate. A more comprehensive analysis, including parts of this paper, is my "Rural Development Problems and Policies: The United States' Experience," in Background Papers for the United States Delegation to the World Conference on Agrarian Reform and Rural Development FAO Rome 1979, Agency for International Development, Washington, D.C.

tube-wells, etc. Likewise, machines can be small, machine services can be rented, or machines can be jointly owned. In this way, machine services too can be made divisible. However, the basic factor endowments in U.S. agriculture with plentiful land and scarce labor did not encourage the latter development.

Mechanization and Farm Size Expansion

In the early years of mechanization, joint ownership of certain machines was common. This did not generally include the tractor or the basic tillage machines and implements. Machines that were used only a few days during the year and where timeliness of operation (in relation to weather and season) was not crucial were generally prospects for joint ownership. The joint ownership by 6 to 10 farmers of a grain threshing machine was common, at least in the Midwest, until the 1940's. Many farmers hauled their unthreshed grain (in bundles) and stored it at the farmstead, either in relatively weather-proof stacks or in the large lofts above the stables. In either case, the crop was protected by removing any concern for losing the crop because of a prolonged period of rainy weather. The threshing machine could be moved from farm to farm, and there were few conflicts over whose grain was to be threshed first and whose last. With the shortage of farm labor brought about by World War II, farmers switched increasingly to threshing directly from the field. Now timeliness became critical and conflicts arose among the cooperators in a threshing ring. Everyone wanted to be first to avoid loss should the weather turn bad. Most of the sharing and joint ownership of machines disappeared by the late 1940's.

During the prosperous years of World War II, farmers accumulated savings; later credit became more readily available. The machinery companies shifted from war-time production to domestic production, and new and bigger farm machines (tractors and accompanying equipment) were placed on the market. Thus, in the 1950's, there was a major wave of farm mechanization. From one-fifth to almost two-thirds of the farms sold in the late 1950's, depending upon type of farming, were purchased by adjoining farmers who wished to enlarge their farms to achieve the economies of scale associated with the new machines. This process continued throughout the 1960's, but slowed in the 1970's.

How did the small farms (e.g., 80-acre farms) that continued operation during this period succeed financially? Actually, they continued to be productive on the basis of output per acre. In the late 1950's, analysis of a large number of Wisconsin farms showed that the smaller farms produced the same (or even slightly higher) yields for the major Wisconsin crops as did the larger farms. However, output per worker increased much more rapidly on the larger farms. With increased mechanization and *farm-size expansion,* the difference in output per worker between larger and smaller farms grew wider. To own the machines, and to get bigger machines, a farmer was forced to expand. Farmers who increased their land base received higher incomes—as a general rule. Although their costs increased also, the returns increased faster than costs —*always,* however, with the requirement of an expanded land base; otherwise scale economies were not realized and costs went up faster than returns. Realization of these economies was dependent upon farm enlargement and labor displacement. The net outmigration of people from U.S. farms averaged more than a million per year throughout the 1940's and the 1950's and over one-half million per year throughout the 1960's. Outmigration has declined substantially in the 1970's.

Small farmers could survive and stay in business throughout this period—and some did. They had to settle for a lower income

nd fell behind farmers who were expanding heir operations and even farther behind eople in urban occupations. However, one nust differentiate here between a small armer who was established before 1940 and ne who tried to become established in the 950's. Throughout this period, land values nd taxes were increasing at a fairly rapid ate. Thus a farmer who was established in 940 and who had his mortgage paid off by 960 or before could continue operations, lthough at a reduced return. But, a young amily purchasing a farm at the higher land alues of 1950 (given the subsequent unavorable cost/price relations in farming) vould find it very difficult to make the higher nortgage payments and pay the higher taxes, nd at the same time provide the increasing ncome needed for a growing family. The ate 1940's marked the turning point.

Small farms transferred before 1945 could urvive through the 1950's and 1960's, but hose transferred later were likely to experince financial difficulties and these farms vere again sold and usually combined with neighboring farm. "Small farm" is not a recise term. Even specifying acreage is imrecise since the significant measure is the ize of the business rather than acreage. In he dairy areas of Wisconsin and neighboring tates, the 80-acre farm was considered at he margin of being economically viable in he late 1940's. In cash-grain (corn-soybean) arming areas, the 160-acre farm, and in the nore arid wheat producing areas, the 320cre farm were marginal. Of course, farm nlargement in the cash-grain and wheat reas occurred somewhat earlier and was nore pronounced than in the dairy areas.

In many cases, the sale of small farms reulted from older farm operators selling arms at retirement. In other cases, howver, technological developments drove the mall farmer out of business or required that ie change his type of farming. One such case nvolved small dairy farmers; but the more lramatic case was that of the mechanical cotton picker and the displacement of Southern sharecroppers.

A major technological innovation occurred in the 1950's that made it difficult for small farmers to continue in dairying. Until about 1950, farmers stored milk in 10-gallon cans which were kept in a cooling tank. The cans were picked up each morning and delivered to a processing plant. But beginning with the early 1950's, cans were replaced by the refrigerated bulk tank installed in a special milk-house adjacent to the dairy barn. This was accompanied, or soon followed, by the pipeline milking system through which the milk was pumped directly from the milking machine into this bulk tank. Each morning, or in some cases on alternate mornings, the milk was picked up by a tank truck. It soon became almost impossible for the dairy farmer to operate without this new equipment. The bulk tank and pipeline system involved a major investment and required a larger dairy herd than many farmers had to support it. One alternative was to produce milk for delivery to small local cheese factories, but these were also under economic pressure, and were being consolidated. So this new technology created major pressures for farm-size expansion in Wisconsin dairying.

In the South, the mechanical cotton picker had a profound effect on farm structure and employment. Southern plantation agriculture was transformed after the Civil War, not into a system of small owner-operators, but into a system of sharecroppers. These sharecroppers, many of them Black Americans, held very insecure tenure rights to the land and could easily be displaced. The shift from mules to tractors as the major power source resulted in decline of the sharecropping system and increased reliance on wage labor supplied by resident, former sharecropper families, or by workers living in the neighboring villages and countryside. A further decline in sharecropping and in overall labor use resulted from greater mechanization

of pre-harvest cotton operations and use of chemical weed control. In addition to the mechanization of pre-harvest operations in cotton, other farm tasks were also increasingly mechanized: corn harvesting, oats and soybean combining, hay baling, and the like. But, although cotton was of key significance, all of this mechanization did not affect the unskilled labor required for the cotton harvest. In fact, seasonal harvest labor per acre of cotton increased as a result of increasing yields. With the introduction of the mechanized cotton picker in the 1940's, however, demand for unskilled labor practically disappeared while that for skilled labor increased. The average unskilled labor input per hundred-weight of cotton was 33.5 hours in 1940; it dropped to 11.5 hours by 1950, and to 2.4 hours in 1957. In the same period input of skilled labor increased eight times (0.32 hours in 1940 to 2.50 in 1957). In the first stage of mechanization sharecroppers were being replaced, but they retained an employment opportunity (although at very low pay) in the cotton harvest. In the final stages of mechanization (which included the mechanical cotton picker), this opportunity disappeared leading to a massive outmigration of poorly educated people seeking employment in industrial centers—especially in the large cities of the North (Day 1967).

Aside from a few such dramatic cases, which were extremely costly and disruptive to the people involved, farmers had a choice. They could continue without expanding if they were willing to accept declining relative incomes. The only way that farmers could keep up with family income growth in non-farm occupations was to buy the machines and expand their land base. This could be done only by combining farms and displacing labor.

Sociological Factors in Farm Size Expansion

Another factor weighed heavily on the minds of operators of family-owned farms. Almost every farmer and his wife wanted the farm to remain in the family. Before the 1940's this was not a major problem. The young people (son and wife or daughter and husband) who got the home farm considered themselves favored and fortunate. The problem was not to persuade one of the children to take over the farm; rather, to figure out how to establish the remaining children—since farms were generally not subdivided to provide for all the children. The farm ordinarily passed to the next generation as a unit. All children usually shared in the parents' will, but this sharing was commonly achieved through the estate which included payment for the farm by the child fortunate enough to become the new operator.

Again, however, changes occurred after 1940. Farm children were no longer isolated from urban society; electrification gave access to radio and television. Many farm boys were involved in World War II. Most farm children attended high school after 1940, whereas before many did not. And after World War II, jobs in the cities were relatively plentiful. Young men and women would not stay on the farm if it meant falling behind in income and sacrificing the amenities which they felt urban life could offer. So, if a farmer did not expand his operation and buy the machines, he fell behind in income and his children left the farm and took city jobs.

The change in the structure of opportunities is well illustrated by two studies of family farming in Wisconsin. A study in the 1940's documented the relation between the size of the farm business and the life cycle of the farm family (Long and Parsons 1950). At that time, a Wisconsin dairy farm was a business closely associated with the physical capacity of the farm operator and his family. A young family would build its business (measured in terms of the number of milking cows) until the farmer reached about age 50. At about that time, there were two possibilities. If a son was

available to "work his way into the business," the dairy herd was maintained at the peak size and the son would take over the business when the father reached 60 to 65. Where no sons were available, the herd was gradually reduced and the farmer would sell the farm to a new beginning farmer when he reached 60 to 65. The new family would simply start the cycle over. In the first case, the increased labor (and strength) supplied by a son came at an appropriate time to offset the declining physical capacity of the father. In the latter case, where no sons were available, the waning capacity of the aging farmer resulted in a decline in the business.

Similar studies in the 1960's and 1970's illustrate well the fundamental changes that had occurred. The life-cycle phenomenon and its relation to business size was still pronounced. However, the timing and implications had changed. Farmers without sons at home were able to maintain the size of their business (i.e., the number of milking cows) until they were about 60 years old. Machine technology had reduced dependence on hard, physical labor. Farm wives had become more important in the farm labor force. Furthermore,, it is likely that farm people were healthier and in better physical condition than a generation earlier. Other factors contributed to this greater capacity. Farmers were more knowledgeable about production practices. With the consequent reduction in risks, greater specialization was possible and secondary enterprises could be eliminated. Greater availability of custom machine hire was also a factor. Finally, farmers had achieved coverage under the Social Security system in the 1950's and were less dependent on their children for care and support in old age. Thus, by this time, the parents had achieved greater independence from their children (Dorner and Sandretto 1963; Dorner and Weisblat 1963; Dorner and Marquardt 1979).

Yet, as noted above, the children had also achieved much greater independence from their parents. What these latter studies showed very clearly was that if a farmer was to interest a son in taking over the farm business, he had to expand operations by the time he approached the age of 50. Even though his own increased capacities would permit him to run the business at peak performance ten years longer than his father had, he still had to expand and mechanize further to provide volume sufficient to sustain both himself and his wife and a new (son's or daughter's) family at a constantly rising level.

Prices and Farm Size Expansion

Throughout the 1940's, farm prices were relatively high. Thus a small farmer got a substantial boost (certainly relative to the depressed prices of the 1930's) in his farm income from the higher prices even when his output remained constant. After the first few years of the 1950's, or more precisely, after the Korean War, farm prices fell. They continued to fall, relative to the prices farmers had to pay for production goods, throughout the 1960's and the 1970's. This is evident from changes in the Parity Ratio over these years. The Parity Ratio is a ratio of two indices: Index of Prices Received by Farmers divided by the Index of Prices Paid by Farmers (including in the latter-interest, taxes, and wages). Both indices are on a base of 1910-14 = 100. The ratio is multiplied by 100 and expressed as the percentage that farm prices are of parity. Over the past thirty years, there have been a number of modifications in the formula, especially concerning the base period. These complications do not alter the conclusions. During the 1940's, this percentage averaged 107.4; it fell to an average of 91.7 during the 1950's; fell further to an average of 81.5 during the 1960's; and, despite the high prices during several years, the Parity percentage averaged under 80 during the first six years of the 1970's (Economic Report of the President 1976). In recent years, only

dairy product prices have been held at 80 percent of parity by government purchases. Most other commodity prices were consistently below 80 percent. Thus the terms of trade have shifted against farmers since the prosperous 1940's.

The only way to maintain farm family income was to expand production and to increase efficiency (i.e., lower cost per unit of output). But, maintaining income was hardly sufficient. Average farm family incomes had always been considerably lower than urban family incomes, and urban family incomes were rising sharply throughout this period. Farmers were under pressure from a variety of sources: from the machinery companies introducing and merchandizing new and bigger machines; from a cost-price squeeze; from the prospect of income decline relative to urban workers and other farms that were mechanizing; and finally, from their own hopes and desires for keeping the farm in the family.

So, to repeat and to emphasize, the economies of scale in U.S. agriculture were and are associated with machinery, the machines introduced after 1940 and particularly after World War II. This mechanization made sense under conditions of relatively scarce labor and abundant land. However, it did not always make sense everywhere in the country since mechanization came very rapidly, and the movement of people from the farms was overly rapid—especially in cases such as the adoption of the mechanical cotton picker and the displacement of sharecroppers.

Consequences of Agricultural Commercialization

Commercialization of U.S. agriculture occurred throughout the 19th century, and continued with increasing momentum in the 20th and especially during the past 40 years. More and more functions that once were performed on the farm were shifted to the industrial sector, while some service functions which farmers could not provide on their own developed in the non-farm sectors of the economy.

In the early years, capital was created with farm labor and oxen or horse power—land was cleared, buildings were constructed, fences were built, drainage systems were installed, livestock herds were enlarged, and so forth. Horses and mules were home-grown power sources and they used home-grown fuel in the form of hay and oats. Later, purchases of implements and other hardware increased, but throughout most of the 19th century, major reliance was on farm-produced capital. However, with greater commercialization and purchase of equipment, more credit was needed—especially following the Civil War. On the output side, much processing in the early years took place on the farm but, with some exceptions, these functions were soon shifted off the farm.

Gradually those functions where major economies of scale could be realized disappeared from the farm and into the industrial sector. The farmer was left with the increasingly specialized function of producing raw materials for processing. He purchases large quantities of seed, fertilizer and similar materials, some from other segments of the farm sector, combines them with land, labor, machinery, and livestock under his management, and produces raw materials practically all which are sent to market for further processing, packaging, storing, transporting, refrigeration, wholesaling, and retailing. Indeed, in recent years, there has been an increasing industrialization of some of the raw material producing functions—especially in certain lines of livestock production. Highly specialized broiler production operations, some hog operations, and beef feeding lots with as many as 100,000 head resemble much more a factory assembly line than they do the sequential processes associated with crop production; these last continue to be governed by season and climate and are highly dependent on land area.

Given these major shifts of functions from the farm to the industrial sector, it is somewhat misleading to concentrate only on the less than 4 percent of the U.S. population that are engaged in actual farm work. Over the years people and functions have moved from the farm to the factory—some moving relatively close geographically to the on-farm production, and some far distant. These people and these functions remain part of the larger agribusiness food and fiber system. Perhaps one-fourth to one-third of the entire U.S. labor force is engaged in either farm production, production, sale, and servicing of farming inputs, and processing and marketing of food and fiber. However, this larger labor force does not necessarily feel a close and common economic interest with on-farm producers. They are part of the urban-industrial labor force, and their basic interests are shaped by the vicissitudes and the pressures related thereto.

Thus while the land policies of the nineteenth century favored the establishment of a small-farm, owner-operated agriculture, small in the context of available area—the coming of the tractor and the machinery that accompanied it changed the economic circumstances and favored larger and larger farms. Economies of scale in on-farm production did not become important until widespread mechanization occurred. Economies of scale in on-farm production are related directly to this machinery, and can be realized only by farm enlargement and labor displacement. Only relatively minor economies of scale are associated with the technology primarily responsible for increased productivity per acre.

Past Achievements—Continuing Problems

Agriculture has had a highly successful production record in the U.S. economy. That performance has been significantly influenced by developments in the industrial sector. From the early mechanical inventions to the technological revolution of recent decades, industry, with strategic support from public investment in research and education, played a significant role. Agriculture became increasingly dependent on off-the-farm factors —modern capital inputs, research, extension, communication and transportation facilities, markets, credit, and legal and social services.

Notable in U.S. agricultural development has been the absence of comprehensive public planning. There have been no five-year plans or production targets. Yet agriculture has contributed impressively to capital formation and to the economic development of the non-agricultural sector. In recent decades, the U.S. Department of Agriculture has performed a production planning function for agriculture through administration of the price support and production adjustment programs. But, primary reliance is placed on income inducements to elicit voluntary participation.

Despite the good production performance, many problems have emerged from the transformation of U.S. agriculture and the concomitant development of a predominantly urban-industrial society. These problems include those facing the commercial farming sector such as high capital requirements, and those associated with the continuing agricultural transformation such as underemployment and poverty. They are clearly interrelated.

Commercial Farm Problems

The rapid transformation of U.S. agriculture has generated increasingly large capital requirements for an efficient farming unit. For an efficient family-sized unit, although varying by type of farming, capital requirements now range from $400,000 to $600,000 and more. This creates an especially acute problem for young people trying to get a start in farming. Many farms are transferred within the family and special financial arrangements may be worked out between the

parents and the children—full market value may not be applied to the land, interest rates asked may be lower than going market rates, allowance may be made for the years of underpaid labor provided by the children, etc. Some young people begin by renting some or all of the land for a number of years and purchasing later. In most cases very substantial borrowing is involved and a heavy debt is assumed by beginning farmers. Federal legislation has been proposed to provide special financing for beginning farmers, but thus far has not been enacted. The Farmers Home Administration has not had sufficient funds or personnel to meet these needs. Several states have passed legislation setting up special state funds to assist young, beginning farmers (Dobson *et al.* 1979).

There is growing concern over the movement into farming by large corporations. Such large corporations are heavily involved in the production of such commodities as fruits and nuts, broilers, some vegetables, sugarcane, and a few others. In the mid-1970s's receipts of corporations whose major income was from farming totalled about 20 percent of U.S. farm product sales. However, this overstates the case since most farm sales by corporations were made by relatively small corporations with less than ten stockholders. In the late 1950's changes in income tax laws permitted farm corporations with ten or fewer (fifteen under the 1976 Tax Reform Act) stockholders to be treated as partnerships for federal tax purposes. If the income is passed directly to the owners who pay the income taxes, no corporate tax is paid. For a number of reasons, including farm transfers within families which may be facilitated by incorporation, many farm families have incorporated their farming operations. According to the most recent estimates, agricultural corporations with more than ten stockholders produced only 5.3 percent of total U.S. farm sales (Edmondson and Krause 1978).

Nevertheless, the issue of increasing corporate control over land and farming operations (either directly or indirectly through vertical integration) is a serious one. There is no special federal legislation but, as of 1977, ten states had legislation providing restrictions on corporate farming and several others required annual reporting by corporations engaged in farming. Seven additional states had legislation pending (Edmondson and Krause 1978).

Finally, an issue that is of increasing concern and significance is the rising cost of energy and the energy-intensive nature of the U.S. food system. The food system uses about sixteen percent of the total energy used in the U.S. Only about 3 percent of total U.S. energy consumption is used directly in farm production and the manufacture of farm inputs produced in the industrial sector. The largest energy users in the U.S. food system are processing and home preparation of food (USDA Handbook of Agricultural Charts, 1977). Efforts to conserve energy and to shift to other sources (wind, biomass, solar—especially for crop drying) are underway, but achieving significant change will take many years. Various experimental and educational programs are being undertaken by the individual states. In this area much will depend on the effectiveness of national energy conservation and development policies (USDA Yearbook of agriculture 1980).

Poverty and Related Problems

Many people were left behind and did not benefit from the rapid increase in labor productivity in U.S. agriculture. The incidence of poverty in both the farm and the nonfarm population is higher among the nonwhite population. However, poverty is by no means confined to that part of the population. Of the 14 million rural poor reported by the National Advisory Commission on Rural Poverty (1967), 11 million were white.

The rapid adoption of labor-saving technologies and the massive displacement of people from farm employment may not be

the root causes of urban poverty, but they have certainly intensified the problem. People most adversely affected were those who remaind on farms but were unable to adjust, and those who left the farm but were ill prepared for well-paying city jobs.

Compared to the 1920's and 1930's, most jobs today now require greater skill. Many of the people who have been pushed and/or pulled out of farming face a labor market demanding skills they do not possess. Subsistence employment opportunities have virtually vanished. There are far fewer rungs on the ladder of economic opportunity, both in farming and in nonfarming occupations, within reach of those lacking education and specialized training than in earlier decades. The poverty problem, both rural and urban, would be less acute today if rural migrants had been better trained and if the agricultural sector had not released so many unskilled workers. Furthermore, severe racial and ethnic discrimination intensified the problems for blacks and other minorities.

These problems are extremely complex. They do not lend themselves to quick solutions. Policymakers are recognizing these problems as major issues in economic development. In recent years we have accepted as one measure of economic progress the number of people lifted from the misfortune of being poor.

Historically, there was a strong faith in the ultimate justice and maximum welfare to be derived from a free-enterprise exchange economy. "A man earns what he gets and gets what he deserves." This faith has been badly shaken, especially by the severe depression of the 1930's. In recent decades we have placed great emphasis on the efficacy of fiscal and monetary policies to maintain high levels of effective demand and employment. But, after four decades without a major depression, far too many people still live in poverty—disconnected from the growing points of the system. They remain on the outside looking in.

The history of agricultural development in the United States is illustrative of some major successes intermingled with areas of failure and continuing problems. The productivity of the U.S. system is undisputed. However, the very rapid transformation of the past forty to fifty years created adjustment problems for millions of people. In addition, the environmental long-term effects of these changes are just becoming evident. In countries with factor endowments quite different from those existing in the U.S. (e.g., where capital is scarce and labor is in overabundant supply), any transformation must take different forms and proceed at a slower rate; under such conditions a transformation similar to that which has occurred in the U.S. could be disastrous.

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DEVIL'S LAKE STATE PARK: THE HISTORY OF ITS ESTABLISHMENT

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Although Wisconsin's state park system had an uncertain beginning,[1] Wisconsin now has a total of 54 state parks.[2] Among the earliest was Devil's Lake State Park, located three miles south of Baraboo in south-central Wisconsin.

The establishment of Devil's Lake State Park is an intriguing story centering on public support and the conservation movement of the early 1900's. The story also involved such dissimilar elements as a railway company and geologists, a quarry, and a typhoid outbreak.

Devils Lake is the most popular park in the Midwest and has probably been so since its beginning. Since 1952 it has attracted more than a million people a year. "Large crowds" gathered at the lake "every Sunday" in the early park years, and more than 100,000 people visited the park in the summer of 1919, "the greatest day being July 17, when homecoming exercises were held for the soldiers of Sauk County, and over 10,000 people visited the park." By the 1920's the park was being "visited each season by about 200,000 persons," and by 1940 the annual attendance was approximately half a million.[3]

Tourism at Devil's Lake is an old story. Soon after this area was settled by whites, the lake became a popular place to visit, and heavy use of Devil's Lake began some 50 years before the state park was established in 1911 (Fig. 1).

Among the first to visit, in 1849, was Wisconsin's pioneering scientist, Increase A. Lapham: "A large body of broken fragments have accumulated along the edge of the water rendering it very difficult to walk along shore: yet two of our party made a circuit of the Lake, jumping from rock to rock as best they could."[4] A few years later, in the 1850's, the first building, a bathhouse, was erected on the north shore.[5]

In 1853, 20 years before trains started whistling past the lake, the *Milwaukee Sentinel* commented: "The lake is well worth a visit, and no one should pass by without stopping to examine it." Four years later, a Baraboo newspaper remarked: "This charming piece of water is visited by pleasure parties nearly every day . . ." Lewis Wood, in an 1861 paper on the industry of Sauk County, called Devil's Lake "a noted . . . resort for parties of pleasure," and added prophetically, "and will become eminently so, as population increases."[6]

The first hotel opened in 1866: it was located near the northeastern corner of Devil's Lake, and called the Minniwauken House, after a supposed Indian name for the lake. In that year, a local newspaper predicted that Devil's Lake would become a fashionable summer resort, "not only for the Northwest, but also for the East," and the next year the same paper decided that its prophecy had come true—"It is already a fashionable resort for excursion parties from Chicago, and other places. . . ."[7]

In 1872, a year before the inauguration

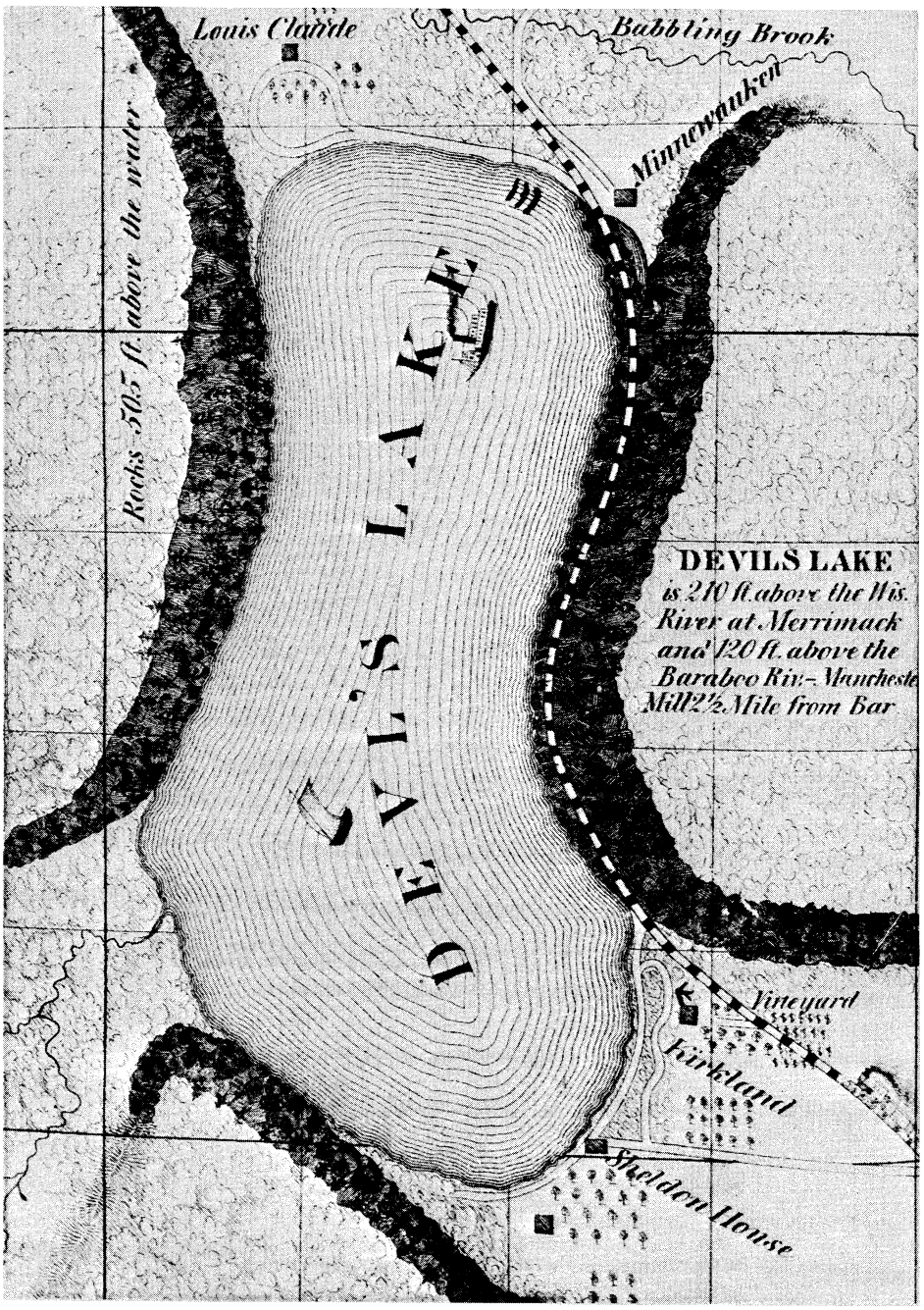

Fig. 1. Devil's Lake as depicted by William H. Canfield about 100 years ago in *Outline Sketches of Sauk County*. The south bluff is at the bottom, with the west bluff on the left and the east bluff on the right. The Sheldon House later was enlarged and renovated by E. T. Hopkins into the Lake View Hotel. Notice Kirkland with its vineyard along the south shore, north of the Sheldon House. This map was drawn before the Messengers developed their resort at the southwestern corner of the lake, between the south and west bluffs. At the north end of the lake, note the Claude property, a creek, and the Minnewauken House, which later was enlarged into the Cliff House. The railroad track runs along the east side of the lake; a steam train is at the lower right.

Fig. 2. Devil's Lake, looking north from the south bluff. The railroad track can be glimpsed at the south end of the east bluff; the track runs along the east side of the lake, past the campground on the right, and east out of the park along the bottom of the south bluff.

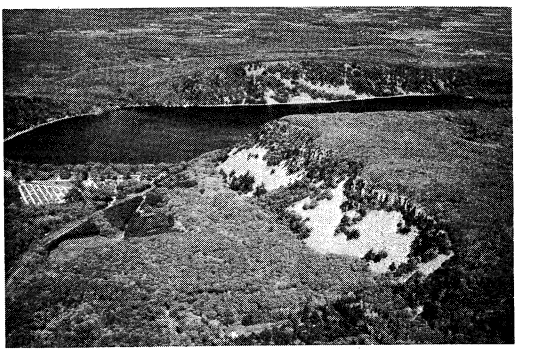

Fig. 3. Devil's Lake from the air, looking west, with the west bluff in the upper part of the picture, the east bluff to the right, and the south bluff to the left. The railroad curves through the left half of the picture.

of regular train service, a LaCrosse, Wisconsin, newspaper was quoting property owners at the lake as estimating that 15,000 people "have already visited the Lake this season, and yet they come. And why should they not, for there is not a place in the State more attractive. . . ." William Canfield, Sauk County's pioneer historian, put the figure for 1872 at "probably 20,000 visitors . . . from regions outside of its immediate neighborhood."[8]

These early tourists took the train to Portage, next a private carriage for the 16 miles to Baraboo, then another private carriage for the remaining 3 miles to the lake. But a new age was dawning for Devil's Lake, created by that wonder of 19th-century technology, the railroad train. At one time as many as nine passenger trains snorted and smoked past Devil's Lake and through Baraboo each way and each day. E. D. Jackson of nearby Greenfield Township in Sauk County recalled the first locomotive he saw: "It was profusely ornamented with brass trimmings as bright as burnished gold, and in the glistening sunshine was something of a marvelous beauty to behold." Railways permeated the American way of life; in some respects, they became the American way of life.[9]

The railway running past Devil's Lake is a main line of the Chicago and Northwestern between Chicago and Minneapolis-St. Paul. Its coming ushered in a hotel-resort era at Devil's Lake that lasted for 30 colorful years and made Devil's Lake a household name.

Publicity for the lake, generated by the Chicago and Northwestern in the form of notes and articles, appeared in such publications as *Railway Age,* but the railway's most effective advertising came from correspondents who wrote alluring and sometimes romantic accounts of this strange and wonderful place (Figs. 2 and 3). Here are the impressions of a visitor from Chicago in 1874: "The loneliness enhanced the beauty. The next minute the train was stopping by a platform at the upper end of the lake . . . and a Swiss cottage, with bright dresses on its ample galleries, came to view through the trees." Rand McNally's *Tourist Guide to the North-West* promised that at Devil's Lake the tourist would see "one of the loveliest sheets of water in the whole world . . . in a tremendous gorge . . . hemmed in on all sides by frowning rocks, of prodigious size, piled up in every conceivable form. . . . Other lakes have much in common. This is absolutely unique. . . ." *The Standard Atlas*

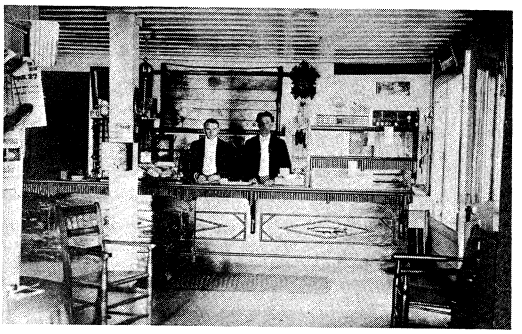

Fig. 4. The lobby of the Cliff House on a summer afternoon about a century ago. William B. Pearl, the manager is on the right and the post office is to the left of Pearl's assistant.

Fig. 5. Hiking at Devil's Lake. People in Sunday attire are climbing the east bluff with the help of wooden steps and a railing. The Cliff House is beyond the trees in the center of the picture. When this picture was taken about the turn of the century the lake was very low.

and Gazetteer of the World, which was published in Chicago in 1890, prefaced the Rand McNally description with a reference to "the wierd beauty of Devil's Lake, which in the mystery of its origin rivals Lake Tahoe. . . ."[10]

In 1873, when train service began for Baraboo and Devil's Lake, the owners of the Minniwauken House enlarged it into a new structure—the Cliff House (Fig. 4). Verandahs and galleries extended around the main part of the building. While the original structure accommodated a maximum of 20 guests, the new hotel, which had some 50 rooms, could house about 200 people.[11]

The Cliff House featured a 40 by 80 foot dining room with a spacious view of the lake; 200 people could eat together in this dining room, but only in the proper attire: suits for the men and dinner dresses for the women. "Elegant" would be an apt description of this resort.[12]

The Cliff House also had a telegraph, ticket and baggage office, a post office, a grocery, a barber shop, a billiard room, and the first bowling alley in the area—"It would make your sides ache with laughter to see the boys at the lower end of the alley dodging the wild projectiles."[13]

This resort became so popular that another building, called the Annex, was added in 1884; it had 30 rooms. With the 63 rooms in the enlarged Cliff House, the two buildings could lodge up to 400 people.[14]

If visitors did not like these accommodations, there were others—family cottages, a log cabin, or in the adjacent sugar maple woods, camping.[15]

What could guests do? Rent fishing tackle and a rowboat. Go swimming. Climb the bluffs (Fig. 5). Play croquet or quoits. Test their archery skill. Take an excursion in a rig ("reasonable rates") to Wisconsin Dells ("this is a full day's trip") or some closer place of interest.[16]

A visitor could also take a ride on the resort's steamboat. The Capitola, launched on Devil's Lake in 1869, was the first sidewheel steamer on the lake; it carried 100 passengers "comfortably." In 1874 it was replaced by another sidewheel steamer, the Minniwauken, which carried 100 people "with safety" (an interesting distinction). This woodburner was still being used on the lake in 1895, but by the turn of the century gasoline launches were becoming popular. Band picnics were held at the lake in the resort years and one moonlit night, the Spirit Lake Band of Baraboo and the Baraboo Choral Society went to the middle of the lake on the Minniwauken, "and there discoursed sweet music with charming ef-

fect. . . ." On another moonlight band excursion, all the rowboats were rented because so many people wanted to be near the music.[17]

There were activities at this resort for everyone. Geologists from the University of Chicago spent a month in field work at Devil's Lake in 1894. One of them, Rollin D. Salisbury, gave a public lecture at the resort about the origin of the lake, stressing non-volcanic forces.[18] Once there was "an interesting exhibition of mind reading." Then there was Zenia, "the noted palmister of Chicago," who lectured on her speciality and then examined "the hands of those wishing . . . in a private parlor." One evening the balcony scene from Romeo and Juliet was presented "to a large and enthusiastic audience." Often these activities were concluded with a dance, and nightly dances were a regular feature once the orchestra arrived for the season. The orchestra, at least in 1889, consisted of 2 violinists, a cornet player and a pianist.[19]

Almost every evening some of the guests would walk to a place called Shadow Town to listen to cylinder records played on an Edison phonograph and drink pop and eat cracker jack. This phonograph was one of the first in the area, so Shadow Town was also popular with local people, who came in horse-drawn wagons. Concerts were given from 1899 through 1903 or 1904, when the resort closed, as did Shadow Town.[20]

Many local people visited the lake in those years, arriving by team or train. At that time, a road just to the east of the railroad tracks was the main wagon and carriage route between Baraboo and the lake, and one Sunday in the summer of 1903 a family on this route counted 32 teams in one hour going past their home to the lake.[21]

In the summer there were special trains to Devil's Lake from Baraboo and Chicago, but most exciting were the excursion trains. Although the manager of the Cliff House once wrote, "There is no money in feeding excursionists,"[22] he encouraged train excursions in the hope that they would be profitable for the resort. Coming mainly from Illinois, they became especially popular in the 1890's. One excursion in 1894 consisted of 2 separate trains pulling a total of 22 coaches; both trains stopped at the Cliff House, where some 2000 people emerged, stretched, "and then began gazing in wonder at the sights." Another 1894 excursion is the largest on record: three trains with a total of 34 coaches. The passengers lined the entire north shore of the lake, a distance of one half mile. One can imagine these steel monsters breathing fire and smoke and uttering strange noises as they screech to a halt by the Cliff House and there disgorge up to several thousand cramped tourists.[23]

Excursion fares were within the means of lower income families. In 1906, for example, an excursion from Chicago cost $2, from Milwaukee $1.50, and from Madison, $1.[24]

Before the days of the railroad diner, trains stopped for breakfast and supper at the Cliff House. This resort was also a flag stop, but the train station was located at the southeastern corner of the lake. Later, in 1908, a new depot was built 1200 feet to the south. The popularity of Devil's Lake in these early years was indicated by the fact that an agent was on duty at that station 24 hours a day in the tourist season.[25]

The railroad company was making money but the resort was not. The season was short, June often was rainy and cold, and the buildings, especially the Cliff House, were in constant need of repair. Also involved in the closing of the resort was the railway's decision to reduce the number of passes and their refusal to give a lower rate on a round trip from Chicago. Misunderstandings with local people may also have been a factor. And so, in 1905, the Cliff House was demolished by order of the owner; the Annex stood until 1914.[26]

Today one may search in vain for any

sign of the Cliff House, but in the lawn near the north shore boat landing are a few flat stones. They are part of the foundation of the Annex. This is all that remains of that "elegant" resort.

The southeastern shore was called Kirkland, after Mr. and Mrs. Noble C. Kirk, the owners. The Cliff House was deluxe but Kirkland was rustic, reflecting the personality of the "genial little man" who always kept his property open to the free use of the public. Kirk, in 1854, bought property at the south end of the lake and added to it over the years. Kirkland consisted of a pavilion—a combination kitchen-living quarters-post office which was the focus of life at this resort, about a dozen cottages, a winehouse and cellar, croquet grounds, picnic grounds, and arbors and seats. Kirk's widow had a 14 room hotel built in 1906-1907 and a bathhouse erected in 1910.[27]

Entertainment at Kirkland included dances or masquerades on Friday and Saturday nights for the guests and the help. All day hay rides for guests were another feature. Kirkland was a place lower income families were apt to visit and return again.[28]

The material evidence for Kirkland today is the hotel foundation, but the Kirks, who wanted a park at Devil's Lake, had their wish fulfilled.

The Kirks owned about half of the southeastern valley. Adjacent to Kirkland, on the other half of this valley, stood another of the lake's early hotel-resorts, the Lake View. The most imposing structure there was the hotel, a three-level building with a telegraph office and entertainment halls on the ground level, and eating and sleeping quarters above. This resort also had five cottages and a bathhouse.[29]

There were dances on weekends at the hotel, but not as often as at Kirkland and they were for guests only. The Lake View had a pleasant atmosphere, but it was more formal than Kirks' resort.[30]

Sometimes the people from these two resorts got together for a concert, and on one occasion they united for an evening of singing and story telling, with a "Dutch lunch" at 9:30.[31]

In those years, climbing the bluffs was always popular, and in the evening there might be a dance or a corn roast or a marshmallow roast. Sometimes one of the resorts held a benefit concert for a local church.

The southwestern shore, across from Kirkland and Lake View, was called Messenger shore, after a family that lived there in the hotel-resort years. Oscar Messenger managed the Lake View for a few years in the early 1890's, then he erected his own buildings, including a hotel and a pavilion, at the southwestern corner of the lake.[32]

The Messengers and also Edward Martin, a local farmer, were cutting marsh hay on Messenger shore before the park was established, and this activity continued after 1911. Some of the hay was stored in the Messenger barn. The people from the west and south who journeyed to the lake intending to picnic at Kirkland, left their wagons at Messenger shore and rented a boat for 25 cents. If they wanted their horses to feed while they were at Kirkland, they put the animals in the barn for 10 cents and the horses could munch on hay cut along the lakeshore. The barn might be full on Farmer's Picnic Days, when up to several thousand rural people converged on Messenger Shore or Kirkland.[33]

An annual railroad picnic at Kirkland also attracted as many as several thousand people. The German Club of Sauk City and the Baraboo Maennerchor (Men's Chorus) each had picnics and festivals at the lake, and so did the Grand Army of the Republic and the Baraboo Valley Veterans' Association. A big event was the Grand Regatta of 1877, when several thousand people lined the lakeshore to watch the races and to hear two bands from Baraboo. The 4th of July was often an exciting day at the lake. In 1878, for example, some 2000 people were

there: they listened to speeches and watched a horse race and a race between a hiker and an oarsman; in the evening there were fireworks, and, in the Cliff House, a dance.[34]

But publicity for the lake arose not only from the railway and the tourists. Geologists also started coming to Devil's Lake in the early years; for example, Lapham in 1849, and a group of eight men, one of whom was T. C. Chamberlin, the well-known glacial geologist, in 1872.[35]

The *Madison Democrat* in 1906 reported: "Hundreds, perhaps thousands, of students visit this storehouse of knowledge each year to study and admire." The earliest reference to a class of geology students is to one from the University of Wisconsin in 1892; doubtless there were groups here even earlier. Charles R. Van Hise of the University of Wisconsin included field trips to Devil's Lake in his geology courses before 1900. He once said of Devil's Lake: "I know of no other region in Wisconsin which illustrates so many principles of the science of geology." The University of Chicago had a geology camp at the lake, beginning in the 1890's (the earliest reference is 1894), and A. C. Trowbridge of the University of Chicago and later of the University of Iowa began bringing geology classes to the lake in 1905. Trowbridge, in 1908, gave an informal address at Kirkland to the annual state assembly of the Wisconsin Archeological Society, which had included Devil's Lake in its itinerary that year.[36]

Possibly Northwestern University also scheduled geology field trips at Devil's Lake by the turn of the century; however, the earliest recorded date for such trips is 1910.[37]

Because of the publicity the lake was receiving, it was almost inevitable that someone would conceive the idea of developing a summer resort city on the bluffs overlooking the lake. That someone was Arthur R. Ziemer (1871-1895).[38] If his resort had been successful, Devil's Lake State Park might have been very different, if indeed it had been established at all.

The development on top of the west bluff imitated similar enterprises in New York's Catskill Mountains; the west bluff was said by Ziemer to be a "counterpart of the Palisades on the Hudson River." He called his resort "Palisade Park."[39]

For about a year, beginning in 1894, there was much activity: 90 acres were platted into lots, parks, and a hotel site; several cottages were built,[40] a road of crushed stone was constructed, a reservoir of several acres was installed, and a tower 85 feet high was erected.[41]

"The time is now at hand," according to a promotional pamphlet for Palisade Park, "when the great middle class, the heart and soul of our country, can enjoy summer houses. . . . For $500 we will build you an artistic story and a half house with stone fire place, and deed you a lot. . . . No saloons, stores, or boisterous crowds will be tolerated. . . ." Palisade Park was publicized as superior to other midwestern retreats because of its mountainous setting and elevation—"The highest resort within 600 miles of Chicago." Here one could withdraw from the busy and noisy city life to a "quiet mountain retreat." The advertising was especially aimed at Milwaukee and Chicago. Platted lots were sold at a real estate office in Baraboo.[42]

Then, in October of 1895, tragedy struck —Ziemer died of typhoid in his cottage, presumably from drinking contaminated water from the Palisade Park spring.[43] The word spread and with a few exceptions people stayed away from the resort, although there was talk in the early 1900's of reviving the project. A plat of Palisade Park was still being shown in the county atlases of 1906 and 1922.[44]

All that survives today of what the promoters hoped would become the "most prominent summer resort in the northwest" are stone steps and the debris of a fallen

sandstone chimney, the foundation of one of the cottages, and 8 flat stones arranged in a square 24 feet on a side—the foundation of the tower.[45]

By 1900 virtually all the shoreline around Devil's Lake was privately owned and developed for catering to summer tourists. While these resorts accommodated people mainly from outside the area, local people were also coming to the lake. Although the resort people allowed the public free use of their grounds and supplied services such as ice water at no charge, they found it necessary to remind non-guests that "special privileges are due only to guests of the hotels and cottages and that they should be treated with due consideration." The resort people also cautioned the public "not to strew victuals promiscuously upon the grounds, nor annoy the innkeepers and their guests by indulging in boisterousness and indiscretion," this being most noticeable "when boys are in bathing." The landlord of the Cliff House probably was speaking for the resort people in general when he said that the visitors "who did not receive a warm welcome were those who desired to use the grounds for picnicking." The resort people were being reasonable and fair in these admonitions, yet one can understand how friction and charges of elitism arose. It is likely that local people had come to regard Devil's Lake as "their lake," and any attempts to control its use or visitation would have met with their resistance. Also, the resort prices, for the most part, excluded people of lower incomes, and at least two of the resorts were for gentiles only.[46]

But what if this area were made a public park? This was a new and strange concept in the early 1900's but most local people liked the idea of making such a choice tract public property.

A proposal made in 1903 envisaged a sort of gigantic zoo. A local newspaper expressed the idea this way: "If the undertaking develops to its fullest possibilities a high fence will be constructed to enclose cliffs and water—a two mile area, more or less, with suitable cattleguards at the points where the Northwestern railway enters and leaves the tract to curtail the range of deer, antelope, buffalo and other animals of harmless nature that may be secured. Bear pits and cages for the more savage beasts and for winged creatures, and the open lake whereon shooting will never occur, for the web-footed, and for fish of all varieties are a part of the pleasing project." Three years later the Baraboo Lodge of Elks "voted its intention of installing a pair of Elks," whereapon one local person decided that he didn't like the idea of a state park at Devil's Lake because, as he put it, a man once had been killed by an elk which had jumped out of an enclosure. The idea of a mammoth zoo was still alive in 1910, but it never gained much support. Many people wondered whether the state would lay out cement walks and flower beds.[47]

By 1903 enough interest had been shown by Baraboo residents to cause Franklin Johnson, the local assemblyman, to introduce a bill in the State Assembly authorizing the governor to appoint a three-member commission "to investigate the advisability of establishing and maintaining a state park about Devil's Lake."[48] Termed a bill "which opens the alluring subject in a modest and rational way," it called for the commission to report its findings and recommendations to the governor on or before March 1, 1904. This bill received additional support from the Senate Committee on State Affairs, which held a hearing on it in March 1903 and presented it for passage. So favorably was this bill regarded that the hearing "was not extended and of course no one appeared to oppose the bill." An option-taking clause was added at the suggestion of Evan A. Evans, an attorney at Baraboo. This bill, approved in May of 1903, later was amended

to give the commission until March 1, 1906, to submit its report. In the amended version the commission was given the added responsibility of studying the Wisconsin Dells area for park status. In 1907 this study commission evolved into the State Park Board, which the governor said would guide him and the legislature.[49]

The early 1900's were marked by increasing public sentiment in favor of a state park system. Not only were Wisconsin citizens beginning to realize the benefits of parklands and forest preserves, but a similar movement was taking hold in other parts of the country as well. This national sentiment for protection of America's natural resources was influenced by John Muir and the newly formed Sierra Club, the Theodore Roosevelt administration, and the Progressive era. In 1905 at a meeting of the American Forestry Congress, Roosevelt had said: "You are mighty poor Americans if your care for the well-being of this country is limited to hoping that that well-being will last out your own generation." This was the president who in 1908 called a White House conference of governors to discuss conservation problems.[50] The *Madison Democrat* expressed it this way: "A movement nation wide for the extension of park areas, for a more systematic and intelligent park supervision and for the cultivation of the beautiful and the esthetic is in progress."[51]

In line with these feelings, Assemblyman Estabrook of Milwaukee in 1907 introduced a bill into the state legislature calling for the appointment of a state park board. Citizens supported such a board and a state park system for various reasons. The public, it was believed, needed retreats for its full enjoyment and well-being. "Not only are playgrounds essential for the welfare and happiness of children, but there is a demand, a necessity, for larger playgrounds or parks for older people—and it may be well to remember that men and women are but children a little older grown." Much of the public attitude toward preservation looked to the future. Citizens felt a need to save places of natural beauty, such as Devil's Lake, so that succeeding generations could enjoy nature in much the same form as they knew it. A few people spoke prophetically of the time when the state would be more populous and in greater need of land for public recreation. Charles R. Van Hise, when President of the University of Wisconsin, urged the state to start preserving areas of natural beauty for the future before an increase in population would deplete the land available for public use. A newspaper reporter, in speaking of the proposed State Park Board, stated that we must look ahead, "when Wisconsin shall have become fully settled, with a population of perhaps 10,000,000 people, and when the necessity for parks and playgrounds are more largely felt." A few people were even beginning to favor preserving places of natural beauty for their intrinsic value, and there was a growing realization that areas such as Devil's Lake should be set aside for their scientific and educational importance. As a Madison, Wisconsin, newspaper expressed it: "Such scientific worth, right near the doors of our University, must be preserved to posterity." Lands must also be put into public ownership, people had come to believe, before private interests destroyed them. Wisconsin had witnessed first-hand the destruction of its forest lands, and an increasing number of voices now were being heard in favor of preventing similar occurrences by setting aside acreage in public ownership. The rhetoric for preserving open space was very much like that of today: "With the advance of civilization, one by one all the places of scenic beauty, and historical interest, are passing away. Before it is too late, it is well to pause and consider whether it is not befitting that some of them be preserved for all time as state parks. . . . Once destroyed,

they are never restored." In addition to these more or less altruistic considerations, there were utilitarian ones, notably that parks were economic investments, since tourists represented money.[52]

With the passage of the Estabrook bill and the establishment of the State Park Board in 1907, the drive to create state parks in Wisconsin gained momentum.

By 1906 local residents had become formally involved in the effort to establish Devil's Lake State Park. "A goodly number of citizens met at the city hall . . . for the purpose of discussing the matter of establishing a state park at Devil's Lake. Among those present were owners of the property. The meeting was called to order by W. H. McFetridge, who has taken considerable interest in the matter . . . a committee was appointed by Mr. McFetridge, with himself as chairman." Under the direction and inspiration of McFetridge, this committee of eight members worked for a state park. As the chairman related: "Since 1903 certain citizens of Baraboo have been endeavoring to have the state preserve this region. The time is now ripe . . . there is a strong general public sentiment . . . of preserving accessible nature spots like this one."[53]

Evan Evans, the attorney who suggested the option-taking clause to the state park commission and now secretary and treasurer of McFetridge's committee, summarized the committee's thinking: "The Devil's Lake project leads all others in the state because it is easy of access, and because it is located in the southern portion of the state where it is most densely populated. The spot is one of the most beautiful and unique in the state. Another point is that the land is cheap because it cannot be utilized for agriculture. The state must have forest preserves. . . ."[54]

The committee hoped to influence the state legislature to pass a bill providing for an annual appropriation of $35,000 for 3 years for the establishment of a state park at Devil's Lake. One way in which it promoted this goal was through the distribution of a 38 page illustrated booklet entitled *An Appeal for the Preservation of the Devil's Lake Region.* Two thousand copies were printed and sold for 50¢ apiece. The first part of the booklet stressed the need to protect the region from despoilment by commercial and material interests, and the remainder described the area's geology, its potential as a forest preserve, its plant life, its suitability as a bird sanctuary, and its archeology; the last page was devoted to endorsements. Interspersed throughout the prose are full page photographs of the region, attesting to its natural beauty.[55]

The committee also wrote about the proposed park in various publications, advertised in newspapers, exercised "much personal advocacy," and appeared before clubs and other organizations.[56]

One example of the committee's work with organizations is a 1906 meeting of Baraboo's Ten Thousand Club, a business group. McFetridge spoke of the work his committee had been doing on the Devil's Lake project, and Evans also endorsed the park, stating that it would be of "great financial benefit as it would draw more people" to the area. Not surprisingly, the Club then adopted a resolution to appoint a committee of its own to cooperate in efforts to promote the venture.[57]

Local individuals of some influence, for example, Louis A. Goddard, the pastor of the First Congregational Church in Baraboo, also began to speak for the project.[58]

While all these activities were taking place, a local fund was being established to help pay the expenses of advertising the project. Local newspapers published the names of the contributors and at least several hundred dollars were collected.[59]

There was also outside support. In 1906 the *Milwaukee Journal* editorialized for a state park at Devil's Lake—"It is a worthy

project which ought to be carried out." Later that year a lengthy article appeared in the *Milwaukee Sentinel,* which referred to McFetridge's committee, quoted extensively from their booklet, and treated the Devil's Lake proposal in considerable detail.[60]

State legislators and guests came to Devil's Lake on a special train for a May Day picnic in 1907. There were speeches; the Baraboo Marine Band "discoursed some choice airs"; a luncheon was served in the Kirkland pavilion, and many of the people climbed the bluffs, where residents and guides pointed out choice views and rare plants, and the work being done by a quarry which had located at the north end of the east bluff in 1906. As it turned out, blasting continued at this site until 1921.[61]

Quarrying at the lake actually was an incentive for establishing a park because with this activity it was possible for McFetridge to write: "Unless the state buys their property several of the largest owners have signified their intention of selling to whomsoever will pay the most, without regard for what use the property is intended. . . . To preserve the region the state must own it—there appears to be no alternative."[62]

In February of 1907 Senator Browne of Waupaca introduced a bill providing an appropriation of $35,000 annually for 3 years to establish a state park at Devil's Lake. The Senate passed this bill, 20 to 2, then in June of that year it came before the Assembly where it was defeated 32 to 31 despite public support and strong pleas by some legislators for preservation of the bluffs. One assemblyman who had spoken for the park stated that he was sure the measure would pass until Thomas Reynolds of Door County voted against it. "He wants a park in his county." Some of the Devil's Lake property owners lobbied against the bill, causing some legislators to conclude that the state would not be able to obtain all the land bordering the lake without "undue expense." The chances of the bill passing were also lessened by the vote coming in the closing days of the session. A local newspaper gave this advice: "Friends . . . should open the campaign now to insure favorable action by the next legislature. . . ."[63]

They did. More people began to speak and write in favor of a state park at Devil's Lake. Women became involved. Mrs. Eliza Mulcahy wrote a poem pleading for the preservation of Devil's Lake which appeared in a local newspaper in August of 1907. Mrs. H. A. J. Upham in 1908 read a paper to the Women's Club of Milwaukee in favor of a "public reserve" at the lake, and later that year talked to the Wisconsin Natural History Society in Milwaukee on the importance of preserving Devil's Lake and the Dells of the Wisconsin River. The Wisconsin State Federation of Women's Clubs saw the need for parks and worked for them; in fact, their principal interest in the first decade of this century became the establishment of Devil's Lake State Park. Club members had drafted and signed resolutions and presented them to legislators in the unsuccessful 1907 project—"this agitation . . . is not given up as a lost cause . . . hopes are entertained that strength may be gathered for a more vigorous attack when the next legislature convenes." Near the end of 1908 the State Federation of Women's Clubs had W. H. McFetridge as a guest speaker and Devil's Lake was the main topic. A member in attendance called upon the women of Wisconsin to "move to the fray," then urged her cohorts to work with legislative candidates before the next election, specifically to extract pledges from them and determine how they would vote on the park question. The meeting ended with the adoption of a resolution for the appointment of a committee to work for passage of the park bill in the next legislature.[64]

Meanwhile a nationally known and re-

spected landscape architect from Boston, John Nolen, was surveying Wisconsin for park sites. His report to the State Park Board, published in 1909, continues to influence Wisconsin's state park system. Nolen devised five criteria for judging a site for state park status: large size, since great numbers of people would destroy the natural qualities of a small area (he recommended a minimum size of 2000-3000 acres with 5000 acres being "even better"); natural beauty; healthy climate; accessibility; and reasonable property cost and maintenance expenditures. Based upon these criteria, Nolen recommended four places as particularly suitable: Wisconsin Dells, Devil's Lake, the Fish Creek area in Door County, and the Wyalusing area in Grant County. Only the Dells did not become a state park. Although Nolen assigned highest priority to the Dells, a dam on the river caused water to rise and submerge much of the area, while land values increased to a level which precluded acquisition by the state for public park use.[65]

The State Park Board was plagued from the beginning by a lack of funds for buying recommended properties. When the Board was originally established, the only money provided was a maximum of $500 for actual expenses incurred by Board members. The breakthrough came in 1909 when Senator C. L. Pearson of the Sauk-Columbia district introduced a bill which called for an appropriation to the State Park Board of $75,000 annually for three years for buying park lands. The legislature acted upon this bill and although it reduced the appropriation to $50,000 annually for two years, this was sufficient to enable the board to start buying land at Devil's Lake.[66]

In 1909 the Board estimated that a park could be established at Devil's Lake for $125,000 and, as it turned out, this was accurate (the initial park holdings cost $128,497.44), except for unforseen troubles with the company that was quarrying the east bluff. At the June 1910 meeting of the Board the members voted unanimously to proceed in securing certain lands around Devil's Lake and by the end of the year the board had acquired 740 of the 1150 acres it deemed essential for the park, namely, the Kirk, Hopkins (Lake View) and Messenger properties and several estates at the south end, and the Vilas estate (the Cliff House property) at the north end.[67]

The board started condemnation proceedings on the remaining acreage, which proved especially difficult to acquire. A number of people had purchased cottage lots along the south shore at the turn of the century, and while most of them sold to the state for a dollar in exchange for a rental-free lease to expire in 60 years, and the understanding that the state would negotiate for the removal of the quarry from the park and build a road into the cottage area, various complications and misunderstandings arose with other property owners. Quite understandably, some of them wanted to remain on the land.[68]

A bill passed by the state legislature allowed for such cases when the owners had occupied the homestead for 25 years or more. It was introduced by Assemblyman C. A. Harper on behalf of Mrs. Louis J. Claude and her daughter, whose family had been among the earliest settlers at Devil's Lake.[69] While the Board had been allowing elderly owners to retain their residences, it did not want to extend the same privilege to younger family members—in this case, Mrs. Claude's daughter. The bill was approved over the objections of the Board and the Claudes were allowed to keep their home and an acre of land. This was a most commendable service, for the Claudes (and the Kirks) could have sold to the quarry companies and retired with much more money than they received from the state for their properties. For a time a quarry com-

pany had an option on the west bluff from the Claudes and wanted to build a spur line from the railroad tracks to the property, but the Claudes refused; they preferred the natural setting. These decisions by the Claudes and the Kirks helped make Devil's Lake State Park a reality.[70]

When the park was being established, the State Park Board consisted of Thomas C. Brittingham of Madison, the chairman, L. C. Colman of LaCrosse, and Gustaf R. Egeland of Ephraim. Like McFetridge, Brittingham had a dream of a public park at Devil's Lake and worked long and hard for it. His world travels had convinced him that the lake was a very special place, and he also came to believe that local people did not appreciate the area because of familiarity. He and Colman made themselves personally responsible for certain Devil's Lake properties by agreeing to buy and hold them for the state for 5 years; if the state did not take the land then the owner could repurchase it.[71]

After some misunderstandings had been settled and certain appeals satisfied, the State Park Board controlled about 1100 acres, and in June 1911 newspapers were announcing that there really was a Devil's Lake State Park. The *Baraboo Republic* noted the overall approval of the project: ". . . it is good to know that the beauties of the Devil's Lake region are to be preserved by the great State of Wisconsin. . . . There is no doubt about the action . . . being sanctioned by the people of the state for all time to come."[72]

But the quarry was still there and blasting was still going on. A year after the creation of the park, the State Park Board commented: "It was found impossible to purchase the . . . quarry . . . at a price the board considered reasonable as compared with lands nearby equally suitable for the same purpose." The lands in question amounted to 110 acres and were owned by the American Refractories Company; they were using the rock for fire brick and paving stones. While economic interests were saying that paving stones from the Devil's Lake quarry were being used on "some of the most important avenues inside of the loop district of Chicago," environmentalists countered with charges that quarry blasting caused fish kills in winter—"The theory . . . is that they went into the shallow water to feed during the winter, and because of the ice the concussion of the dynamite blasts caused death to those in the shallow water."[73]

Negotiations to resolve the conflict with the American Refractories Company remained at a standstill until the state legislature in 1919 authorized the Conservation Commission to remove the quarry from the park; if it proved necessary, the Commission could purchase land for exchange. This bill at first was defeated in the State Assembly by one vote, "but on reconsideration a big majority was secured when the facts were fully explained by Sauk County members." In the following year American Refractories sold its property in the park to the state for $75,000 plus a small tract of land at the south end of the east bluff, then purchased a farm adjoining this tract and moved there in 1922. At the time, this area was outside the park boundary. The company worked this site through 1967; the cut that can be seen there is the result of 45 years of quarrying.[74]

In 1970 President Nixon signed the bill creating Wisconsin's Ice Age National Scientific Reserve, which consists of 9 units. One of these is Devil's Lake State Park with an enlarged boundary including the quarry property. Recently the state purchased this property and thus completed a land transaction which had been started in 1910.

A private resort thus evolved into a public park with the impetus of the widespread conservation movement of the early 1900's, evidence of the influence of citizen activity

in determining this country's natural resources policies.

Notes

AUTHORS' NOTE: This paper is based upon *A Lake Where Spirits Live: A human history of the midwest's most popular park,* by Kenneth I. Lange and Ralph T. Tuttle, Baraboo Printing—Baraboo, Wisconsin, 80 pages (1975), and *Preserving Wisconsin's Natural Beauty: The drive to establish Devil's Lake State Park,* by D. Debra Berndt, a seminar paper for Urban and Regional Planning —Resource Policy Issues: Regional and National, University of Wisconsin-Madison, 64 pages (1977). See also Chapter 16 (Tourism), pages 97-99, in *A County Called Sauk: A human history of Sauk County, Wisconsin,* by Kenneth I. Lange, Sauk County Historical Society, 168 pages (1976).

We are indebted to George J. Knudsen and especially Walter E. Scott for directing us to sources we would otherwise have overlooked.

[1] *Laws of Wisconsin,* Chapter 324 (1878) and Chapter 367 (1897); *Annual Reports of the Wisconsin Conservation Department, Biennial Reports of the Wisconsin State Conservation Commission,* and James J. Damm, *Development of Wisconsin's Park and Forest Recreation System, 1867-1967,* M.S. thesis, University of Wisconsin-Madison (1968), 81 pp.

[2] *Visitor's Guide to Wisconsin's State Parks, Forests and other Recreation Lands,* Wisconsin Department of Natural Resources, Pub. 4—8400(80). 50 state parks are listed, but Kohler-Andrae is actually 2 parks, not 1, and Lake Mendota, Lake Pepin, and Thunder Mountain are not listed.

[3] *Annual Reports of the Wisconsin Conservation Commission,* and the *Wisconsin Blue Books; Baraboo Republic,* 20 July 1916; *Wisconsin Conservationist,* 1:2 (1920); *Baraboo Weekly News,* 24 April 1924.

[4] Increase A. Lapham, "Geological notes of a tour to the Dells October 22 to Nov. 1st 1849," entry for 28 October, unpublished manuscript, Lapham papers, State Historical Society of Wisconsin. The most comprehensive biographical sketches of Lapham are by S. S. Sherman, "Increase Allan Lapham, LL.D.," Milwaukee News Co., Printers, 80 pp. (1876) and N. H. Winchell, "Increase Allen Lapham," *American Geologist,* 13:1-38 (1894). See also P. R. Hoy, "Increase A. Lapham, LL.D.," *Transactions of the Wisconsin Academy of Sciences, Arts, and Letters,* 3:264-267 (1876); Milo M. Quaife, "Increase Allen Lapham, First Scholar of Wisconsin," *Wisconsin Magazine of History,* 1:3-15 (1917); Walter E. Scott, "An Appreciation of Increase Allen Lapham," *Wisconsin Academy Review,* 22:20-28 (1975).

[5] Mrs. Bella French (Editor), "History of Baraboo and Devil's Lake, Wis.," *The American Sketch Book,* 2:189 (1876).

[6] "The Baraboo Country," *Milwaukee Sentinel,* 11 May 1853; *Baraboo Republic,* 18 June 1857; Lewis N. Wood, "Industry of Sauk County," *Transactions of the Wisconsin State Agricultural Society,* 6:328 (1861).

[7] *Baraboo Republic,* 14, 21 and 28 February 1866, and 19 September 1866 and 26 June 1867.

[8] *Republican and Leader* (LaCrosse, Wisconsin), 27 July 1872; William H. Canfield, "Guide book to the wild and romantic scenery in Sauk County, Wisconsin," in *Outline Sketches of Sauk County* (1873).

[9] *Baraboo Republic,* 19 September 1866; *Baraboo News-Republic,* 10 February 1973; E. D. Jackson, "Old Greenfield Days," *Baraboo Weekly News,* 12 July 1905, also, as "Town of Greenfield," in *A Standard History of Sauk County, Wisconsin,* 1:556 (1918).

[10] *Baraboo Republic,* 12 August 1874; *Tourist Guide to the Northwest,* Rand McNally Company —Chicago, pages 30-31 (1877); Loomis T. Palmer, *The Standard Atlas and Gazetter of the World,* Standard Publishing Company—Chicago, page 375 (1890).

[11] *Baraboo Weekly News,* 7 July 1921; C. W. Butterfield (Editor), *The History of Sauk County, Wisconsin,* Western Historical Company—Chicago, page 700 (1880).

[12] *Sauk County Democrat* (Baraboo, Wisconsin), 19 July 1884; *Baraboo Republic,* 11 August 1875.

[13] Butterfield, *loc. cit.;* James B. Hale, "The postal history of Devil's Lake State Park," *Badger Postal History,* 14:1-2 (1974); *Sauk County Democrat,* 2 August 1894; *Baraboo Republic,* 9 May 1877 and 30 April 1879.

[14] *Sauk County Democrat,* 19 July 1884.

[15] *Baraboo Republic,* 3 May 1882; *Sauk County Democrat,* 21 April and 9 June 1882; N. H. Wood, in *Outline Sketches of Sauk County,* Third Sketch, Devil's Lake, page 22 (1870).

[16] Butterfield, *loc. cit.;* William H. Canfield, *Outline Sketches of Sauk County, Wisconsin. Volume Second—Baraboo. Ninth Sketch,* page 47 (1891).

[17] *Baraboo Republic,* 11 August 1869, 1 July 1874, 29 August 1900, 2 July 1879; *Sauk County Democrat,* 23 August 1894.

[18] *Baraboo Republic,* 15 and 29 August 1894, and *Sauk County Democrat,* 30 August 1894. Salisbury was a geology professor at Beloit College in the 1880's, at the University of Wisconsin

in 1891-1892, and at the University of Chicago from 1892 until his death in 1922.

[19] *Baraboo Republic,* 14 and 21 August 1895; *Sauk County Democrat,* 3 August 1889 and 22 July 1897.

[20] *Baraboo Republic,* 4 July 1900, 19 June 1901, 17 June 1903, and 5 October 1904; Kenneth D. Martin to Lange, letter dated 15 November 1969 (Martin, who died in 1971, was a grandson of William B. Pearl, the manager of the Cliff House from 1878 until its closing in 1904).

[21] Lange interview with Perry Loomis, February 1979.

[22] William B. Pearl, in a letter to William F. Vilas, 20 August 1899, the Vilas papers, St. Hist. Soc. Wis. The Cliff House was owned by the Vilas estate and Pearl always communicated with William F. Vilas; Vilas was a lawyer, lieutenant colonel in the Civil War, member of President Cleveland's cabinet, and U.S. Senator for Wisconsin from 1891-1897.

[23] *Baraboo Republic,* 8 August 1894; *Sauk County Democrat,* 23 August 1894.

[24] *Sauk County Democrat,* 21 June, 26 July, and 9 August 1906.

[25] *Baraboo Weekly News,* 8 October 1908, and *Sauk County Democrat,* 8 October 1908; Ralph T. Tuttle, an unpublished history of Devil's Lake State Park.

[26] Martin to Lange, letter dated 18 September 1969; *Sauk County Democrat,* 16 June 1910; *Baraboo Republic,* 10 June and 1 July 1903, 22 March 1905; *Baraboo Weekly News,* 8 March 1917; "Minutes of Meetings. Wisconsin State Park Board," 4 March 1914.

[27] Canfield, *op. cit., loc. cit.,* and Guy O. Glazier, *Baraboo Weekly News,* 6 October 1938; Katherine Martindale to Lange, letter dated 5 November 1968 (Miss Martindale stayed with her family at Kirkland for 14 summers in the early 1900's); *Baraboo Republic,* 12 June 1895, and *Sauk County Democrat,* 14 July 1892; *Baraboo Republic,* 20 May 1868; Butterfield, page 695 (1880), and Canfield, "Guide book to the wild and romantic scenery in Sauk County, Wisconsin," in Outline Sketches of Sauk County (1873); *Baraboo Weekly News,* 1 May 1907; *Sauk County Democrat,* 4 August 1910.

[28] Lange interview with Ella Marquardt, April 1970 (Miss Marquardt worked at the south shore resorts in the early 1900's); notes written by Katharine Martindale on the back of a 1901 picture of people on a horse-drawn wagon.

[29] Lange interview with Ella Marquardt in 1970 and Louis T. Martin in 1969 (Martin worked at the Lake View in the summer of 1910); an undated Lake View folder; *Sauk County Democrat,* 13 July 1893.

[30] Lange interview with Ella Marquardt, February 1973.

[31] *Baraboo Republic,* 17 and 24 July 1895; *Sauk County Democrat,* 22 August 1901.

[32] *Sauk County Democrat,* 4 June 1891 and 21 April 1892; *Baraboo Republic,* 12 June 1895, and *Sauk County Democrat,* 15 September 1892, 26 July 1894, 10 June and 9 September 1897, and 29 August 1901.

[33] Lange interview with Rollo Martin, a son of Edward Martin, in 1968; *Baraboo Republic,* 16 July 1891; *Baraboo Weekly News,* 5 August 1915 and 13 July 1922; "Northwestern News," *Milwaukee Sentinel,* 21 August 1874.

[34] *Baraboo Republic,* 20 July 1877, 24 July 1889 and 30 July 1890; *Baraboo Republic,* 7 August 1867 and 9 September 1896; *Baraboo Republic,* 18 April and 27 June 1877, "Wisconsin Matters," *Milwaukee Sentinel,* 29 May 1877, and *Portage Democrat,* 29 June 1877; *Baraboo Republic,* 10 July 1878.

[35] *Baraboo Republic,* 14 August 1872. Thomas Chrowder Chamberlin at this time was a professor of natural sciences at the State Normal School in Whitewater, Wisconsin.

[36] *Madison Democrat,* cited in *Baraboo Republic,* 25 April 1906; *Sauk County Democrat,* 12 May 1892 and 11 May 1893; *Baraboo Republic,* 15 and 29 August 1894; *Proceedings of the State Historical Society of Wisconsin,* page 63, 1915 (1916); *Baraboo Republic,* 13 August 1908, and "The Pilgrimage to Devil's Lake," *Wisconsin Archeologist,* 7:152-153 (1908).

[37] Arthur L. Howland, professor of geology at Northwestern University to Lange, letters dated 14 April 1973 and 7 May 1974.

[38] Ziemer was a member of a geology field party from the University of Wisconsin that in 1893 visited Devil's Lake, Rock Springs and Wisconsin Dells (*Sauk County Democrat,* 11 May 1893); perhaps his resort plans originated with this trip. As a student at the university, Ziemer was active in politics, and as the president of the class he gave an oration at graduation (*Baraboo Evening News,* 23 October 1895).

[39] *Baraboo Republic,* 1 August 1894 and (souvenir supplement, page 38) 12 April 1899.

[40] The first cottage, a double one, was dedicated with a banquet and toasts in September 1894, when Ziemer and two companions "furnished amusement by rolling a large boulder over the cliff, just to hear it drop" (*Baraboo Republic,* 26 September 1894). Ziemer's personal cottage, a ten room structure, was completed in the summer of

1895; he called it "Beacon Pines" (*Baraboo Republic,* 12 June and 23 October 1895). One other cottage (the Coleman cottage) was built (*Baraboo Republic,* 17 July 1895).

[41] The view on a clear day would have been magnificent, and the *Baraboo Republic* (12 June 1895) reported that the dome of the capitol in Madison could be seen from the top of the tower. For this tower, see also the *Baraboo Republic,* 22 May 1895, and the *Sauk County Democrat,* 6 June 1895. For the road, see the *Baraboo Republic,* 8 and 29 August 1894, and 12 June 1895, and for the reservoir, see the *Baraboo Republic,* 29 August 1894.

[42] "The New Mountain Summer Resort. Palisade Park. Devil's Lake, Wis.," a 4 page pamphlet (1895); *Baraboo Republic,* 3 July 1895.

[43] *Baraboo Evening News,* 23 October 1895, and *Baraboo Republic,* 23 October 1895. A sister, Myrtle, who lived with Ziemer in "Beacon Pines" also contacted typhoid but she recovered; along with an aunt and uncle, and a nurse, she traveled in a special train car to Milwaukee, where the Ziemers lived (*Baraboo Republic,* 30 October 1895).

[44] *Baraboo Republic,* 9 September 1903; *Standard Atlas of Sauk County Wisconsin,* Alden Publishing Company—Chicago, page 53 (1906); *Standard Atlas of Sauk County Wisconsin,* George A. Ogle and Company—Chicago, page 10 (1922).

[45] *Baraboo Republic,* 5 September 1894.

[46] *Sauk County Democrat,* 9 August 1894 and 3 August 1893; *Baraboo Republic,* 1 July 1903.

[47] *Sauk County Democrat,* 19 February 1903; W. H. McFetridge, *Baraboo Republic,* 25 July 1906; *Baraboo Weekly News,* 1 August 1906 and 14 July 1910.

[48] The three members of the "state park commission" were Alfred C. Clas, E. M. Griffith (the first state forester), and Frank Hutchins of Madison, formerly of Baraboo.

[49] *Sauk County Democrat,* 19 February and 12 March 1903; *Laws of Wisconsin,* Chapter 232 (1903) and Chapter 169 (1905); *Baraboo Weekly News,* 31 October 1906.

[50] This conservation movement of the early 1900's was characterized by two schools of thought. One school, represented by Roosevelt, centered around the conservation of material raw resources for their orderly and rational development. The other arm of the movement, led by such figures as Muir, emphasized the preservation of landscape and wildlife from all development and for the health and enjoyment of the public. For details, see Robert McHenry and Charles Van Doren, editors, *A Documentary History of Conservation in America,* New York, 306 pages (1972); Stewart L. Udall, *The Quiet Crisis,* New York, 120 pages (1963); and Linne Marsh Wolfe, *Son of the Wilderness: The life of John Muir,* Madison, Wis., 315 pages (1978).

[51] Cited in *An Appeal for the Preservation of the Devil's Lake Region,* Lakeside Press—Chicago, page 38 (1906); "That State Park Bill," *Madison Democrat,* 19 March 1907.

[52] *Madison Democrat, loc. cit.,* and 21 March 1907 ("Parks as Investments") and 21 April 1906 ("Devil's Lake Park"); "Letter from President Charles R. Van Hise, University of Wisconsin," in *State Parks for Wisconsin,* Report of John Nolen, page 53 (1909); Message of Governor James O. Davidson on state parks (1909); *Laws of Wisconsin,* Chapter 495 (1907).

[53] *Sauk County Democrat,* 19 April 1906; W. H. McFetridge, *Baraboo Republic,* 25 July 1906. The McFetridge family owned the Island Woolen Mill in Baraboo (*A Standard History of Sauk County Wisconsin,* 1:87, 1918). W. H. McFetridge hoped that all the land in the Baraboo Hills from Durward's Glen on the east to around Leland on the west eventually would become public property (*Baraboo Weekly News,* 31 October 1906), and also wanted to see the "entire Baraboo Valley as one great park system" (*Baraboo Weekly News,* 11 March 1908). He was concerned about people dumping trash in the Baraboo River and pleaded that it be treated with respect (*Baraboo Weekly News,* 26 June 1907); in 1914 he set aside an area on the woolen mill property as a dumping ground in an effort to induce people to stop littering the river and its banks—"Everything which will not float or pollute will be allowed" (*Baraboo Republic,* 23 April 1914).

[54] E. A. Evans, *Baraboo Republic,* 31 October 1906. Evans later became federal judge on the Seventh Circuit (*A Standard History of Sauk County Wisconsin,* 2:1009, 1918).

[55] *An Appeal for the Preservation of the Devil's Lake Region,* 38 pages (1906); *Baraboo Republic,* 26 September and 24 October 1906.

[56] e.g., W. H. McFetridge, "The proposed Devil's Lake State Park," *Wisconsin Arbor Day Annual,* pages 40-43 (1907); also W. H. McFetridge, *Baraboo Republic,* 25 July 1906.

[57] *Baraboo Republic,* 31 October 1906; *Baraboo Weekly News,* 31 October 1906.

[58] *Baraboo Weekly News,* 16 January 1907.

[59] *Baraboo Weekly News,* 21 November 1906.

[60] The *Milwaukee Journal* support is cited in *Reedsburg Free Press,* 25 October 1906; "Preservation of the Devil's Lake Region," *Milwaukee Sentinel,* 2 December 1906.

[61] *Baraboo Republic,* 1 and 8 May 1907; *Baraboo Weekly News,* 7 July 1910. One of the guides was President Charles R. Van Hise of the University of Wisconsin, who led a large party to the top of the east bluff; there he "delivered a short lecture on the surroundings. . . . It was a treat that one rarely hears, for Mr. Van Hise is probably the most noted geologist of the age." (*Baraboo Republic,* 8 May 1907). In just three years Van Hise would be autographing copies of his new book, *The Conservation of Natural Resources in the United States,* a publication that has been called conservation's most valuable book.

[62] *Baraboo Republic,* 25 July and 31 October 1906.

[63] Harriet M. Holcombe, in *Wisconsin State Federation of Women's Clubs, Proceedings of the Eleventh Annual Convention,* pages 50-51 (1907); *Baraboo Republic,* 3 July 1907; *Baraboo Weekly News,* 3 July 1907; *Sauk County Democrat,* 4 July 1907; "Devil's Lake Park Delayed," *Madison Democrat,* 30 June 1907.

[64] *Sauk County Democrat,* 8 August 1907; *Sauk County Democrat,* 12 March 1908 and *Baraboo Weekly News,* 3 June 1908; Mrs. Thos. B. Davies, in *Wis. St. Fed. of Women's Clubs, Proc. Eleventh Ann Conv.,* pages 23 and 24 (1907); Mrs. Charles E. Buell, "Wisconsin," *General Federation of Women's Clubs, Ninth Biennial Convention, Official Report,* page 234 (1908); *Baraboo Weekly News,* 29 October 1908. The contributions of women's clubs to the conservation movement of the early 1900's have been little noted nor fully appreciated. In Wisconsin, in addition to their support of parks, the State Federation sponsored forestry lectures at open meetings and lobbied for protective legislation for birds. Their zeal is evident in these remarks of Mrs. Charles E. Buell: "In my prophetic vision I see the Wisconsin Federation of Women's Clubs, not only aiming to raise themselves to higher planes of living, not only protecting birds, trees, parks, and all the national resources of this God-favored state, helping to make ideal conditions for all our own people, but striving to extend all these services to some sister state." ("President's Address," in *Wis. St. Fed. of Women's Clubs, Proc. Twelfth Ann. Conv.,* page 9, 1908).

[65] John Nolen, *State Parks for Wisconsin,* 56 pages (1909); E. J. Vanderwall, "Historical Background of the Wisconsin State Park System," Wisconsin Conservation Department, page 1 (1953).

[66] "Minutes of Meetings. Wisconsin State Park Board," 1909-1915; *Sauk County Democrat,* 21 May 1908, and 11 February 1909 and 9 February 1911.

[67] *Baraboo Weekly News,* 4 March 1909; *Biennial Report of the Wisconsin State Conservation Commission for the years 1915 and 1916,* page 87 (1916); *Baraboo Weekly News,* 15 December 1910, and *Sauk County Democrat,* 15 December 1910.

[68] *Baraboo Republic,* 14 September 1898 and 9 September 1903; *Sauk County Democrat,* 14 July 1910 and 2 February 1911; *Standard Atlas of Sauk County Wisconsin,* page 53 (1906).

[69] The Claudes were intimately linked with the early history of Devil's Lake. Louis J. Claude (1825-1893) was born and raised near Lake Windemere in the lake country of England, where he was a boyhood friend of Matthew Arnold and possibly knew or met Robert Southey and William Wordsworth, who lived in the lake country when Claude was growing up. Claude was educated as a civil engineer and in his younger years worked in India. When he first came to this country, he settled in Kentucky where he "practiced his profession," but his anti-slavery convictions caused him to leave the South in 1851 and settle in Wisconsin in 1857 along the north shore of Devil's Lake, which reminded him of Lake Windemere. Claude wanted to be near water and a place he could farm. The Claude residence was of Tudor style and in designing it Claude apparently incorporated some of the ideas of Andrew Jackson Downing, America's first important landscape architect. This building was a landmark at Devil's Lake until 1953 when it was removed by the state. Claude also designed the Cliff House, the "elegant" resort at the northeastern corner of Devil's Lake. He married an American woman, Elvira Ward (1834-1929); the two children were Louise (1865-1951) and Louis Ward 1868-1951). Miss Claude, who was educated by her father, loved nature and wrote poetry, and the son became an architect in the tradition of Frank Lloyd Wright. All four Claudes, and the son's wife, are buried in Baraboo's Walnut Hill Cemetery (Canfield, page 47, 1891; *Baraboo Republic,* 11 August 1859 and 29 June 1893; Ralph T. Tuttle, a family friend, personal communications to Lange).

[70] *Laws of Wisconsin,* Chapter 511 (1911); *Baraboo Republic,* 29 June 1911; *Sauk County Democrat,* 8 and 29 June 1911, and *Baraboo Weekly News,* 15 June 1911; L. W. Claude, *Baraboo Republic,* 19 October 1922.

[71] *Sauk County Democrat,* 9 February 1911; *Baraboo Weekly News,* 18 August 1910, and *Sauk County Democrat,* 15 December 1910. Brittingham came to Madison in 1855 and founded a lumber yard. He quickly became prominent in local affairs, e.g., member of the University of

Wisconsin Board of Regents. He was notable for contributions to park and hospital funds and in his will left large sums to the city of Madison and the University of Wisconsin.

[72] *Baraboo Republic,* 22 June 1911, and *Baraboo Weekly News,* 22 June 1911.

[73] "Minutes of Meetings. Wisconsin State Park Board," 13 July 1912; *Baraboo Republic,* 7 May 1914 and 30 May 1912.

[74] *Baraboo Weekly News,* 6 November 1919, and *Baraboo Republic,* 3 July 1919; *Baraboo Weekly News,* 11 November 1920 and 2 March 1922.

THE FOLK SONGS OF CHARLES BANNEN: THE INTERACTION OF MUSIC AND HISTORY IN SOUTHWESTERN WISCONSIN

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The musical tradition of Charles Bannen, an eighty year old dairy farmer living in rural Crawford County, Wisconsin, is a composite of many of the threads that constitute the larger fabric of the folk and traditional music of Southwestern Wisconsin. Bannen is by no means typical of the farmers who work the unglaciated hills of Southwestern Wisconsin, for, in addition to farming, he is a singer of folk songs and a spinner of tales of his family and the area in which he lives. Bannen learned the songs he heard as a child from his family and friends, and he continues to maintain this tradition of folk music. He has been not merely a curator of the family songs, but, throughout his life, he has been a performer at dances, in churches, at social gatherings in nearby towns, and, in short, anywhere a group of neighbors might gather. Bannen does not have to be persuaded to sing; he knows that he has something vital to communicate through his songs.

Because he is aware of the importance of his song tradition, Charles Bannen has put much thought and care into the maintenance of the tradition. He understands how various songs have functioned in his past and in the past of his family, and is quick to explain the importance of music not only in his life, but also in the lives of all people; furthermore, he understands the value of tradition and is willing to undertake the labor and practice necessary to maintain tradition.

The family of Charles Bannen was also musical. He learned songs not only from his parents but also from aunts, uncles, and cousins. Through these family members, the Bannen song corpus reached out into other areas of Southwestern Wisconsin. Many of the Bannens were schoolteachers who collected songs in the small places where they taught. For such reasons, songs of the eclectic Bannen tradition represent more than Irish immigrant songs. The contents range widely: Irish-American; British ballad; translated German; temperance; railroad; dance; school; Christmas and other holidays; Civil War; sea shanties; Child ballads; children's songs; miners' songs; gospel hymns; and country-western. The Bannen song tradition represents music from the many different cultural and social groups found in Southwestern Wisconsin and is a musical representation of the complex cultural contacts that occurred in this hilly, rural region. Much as the social structure of the area has changed, so has the Bannen music tradition changed to reflect that cultural flux.

Southwestern Wisconsin has many unique features which contribute to its unusual history and folklore. The "driftless area" of Southwestern Wisconsin is the only area of the Midwest not to suffer the erosive forces of the huge glaciers. The hilly topography is cut into irregular sections by ancient valleys creating both isolation and unity among the residents. Travel is not as rapid as in other areas of the state, for Southwestern Wisconsin has yet to be served by four-lane highways. Farms and towns are usually formed within the irregular boundaries of winding streams or steep bluffs. The sense of community is intensified by towns strung along a narrow ridge or tucked in a valley served by few roads. It is such Crawford County geog-

raphy that Ben Logan describes in the following passage:

> Look in any direction and there were other ridges, with dots of houses and barns, and the blue shadows of other ridges still beyond them, each a full world away from the next narrow ridge. Down below, in the valley, was yet another world. The valleys had different trees and animals. Even the seasons were different—watercress stayed green all winter in the valley spring.[1]

But the hills of Southwestern Wisconsin are not only forces of isolation. They are also forces of community, for they act to link people together, to cause people to share, to bind people in a world occupied by friends and neighbors. Again, Ben Logan described this sense of community in a tale of a thresherman of Crawford County:

> Abe took a chew of tobacco and got it going. 'Why, he said a man used to hill country could lose his mind out there [on the Great Plains]. Said that country swallowed you up without even a belch. Said there was no surprises. Country shows itself to you all at once. No privacy either. A neighbor living twenty miles away can look out in the morning, see if you're up and got the fire going yet.'
>
> Abe raised his head. A long stream of tobacco juice went sizzling into the brown grass. 'So he came back here, my grandfather did. Said hill country had a feel of home about it, didn't keep leading a man off toward a horizon that was never there.'[2]

The early settlers of Southwestern Wisconsin represented an ethnic polyglot. French-Canadians were dominant among the earliest to enter the area. They settled in and around Prairie du Chien, which was the fur-trading center of the area because of its location at the confluence of the Wisconsin and Mississippi Rivers. Most of the miners who poured into Southwestern Wisconsin were from the British Isles; albeit, representatives of the different parts of the British Isles brought with them a variety of ethnic traditions. Today, it is still possible to discern which towns were settled by English, Cornish, Welsh, Scottish, and Irish. German settlers also entered Southwestern Wisconsin, although not in the numbers as in southeastern and north-central Wisconsin. Norwegians, too, settled in the area in the later nineteenth century, especially near Vernon and LaCrosse Counties.

In short, Southwestern Wisconsin is not dominated by any single ethnic group. This ethnic variety produces cultural pluralism, a process in which the larger socio-cultural life of a group of people or geographic region becomes a composite of the diverse characteristics of the subcultural groups which constitute the larger society.[3] The history and cultural change of Southwestern Wisconsin provide a prime example of the shaping of social structures by cultural pluralism. On one level, the relative isolation of towns and the variety of ethnic groups encourages the subsocietal maintenance of socio-cultural patterns. On a different level, the unity provided by living in an area which differs from other areas of the state, gives the residents of Southwestern Wisconsin the sense of combining the subsocietal patterns of life into a larger social pattern representative of Southwestern Wisconsin. The recognition of such pluralism by members of a particular society is not always overt and, in many cases, is completely subconscious; yet, within recent years, a growing consciousness of a Southwestern Wisconsin way of life can be seen emerging in the socio-cultural patterns of the residents of this area.

Recent developments in the folklife of Southwestern Wisconsin indicate that the area is evolving a sense of cultural individuation[4] similar to other semi-isolated societies in the United States.[5] In some of these subsocieties, the individuation derives from a racial admixture characteristic of only a small group of people and thus acts as a

means of separating that group from the larger society which surrounds it. In other cases, the differences are primarily ethnic.[6] In still other cases, the unique patterns of life are ascribed for reasons which are unconsciously manufactured, often with no basis in reality. Such is the case of the Melungeons of Hancock County, Tennessee. For years, this group of people was believed to be a racially distinct group with ancestors who were Portuguese, Native American, Black, Scotch-Irish, and various other admixtures. The racial uniqueness was manifested in the lifestyle maintained by the Melungeons. Not until the recent work of Saundra Keyes Ivey[7] did it become apparent that the Melungeons were no different than other groups which lived in semi-isolated areas of the Appalachian region of the United States. The concept of being and living like a Melungeon was probably imposed by outside observers and later adopted by the Melungeons themselves.

Certain similarities, although at an incipient stage of development, can be observed in Southwestern Wisconsin. During the early 1970's, the term, "Ocooch Mountains," began to be used to describe Southwestern Wisconsin. Exactly what "Ocooch" means is debatable; most residents believe it a term "the Indians" used to describe the area.[8] In 1975, a quarterly periodical entitled the *Ocooch Mountain News* began publication and established a currency for the term, "Ocooch Mountains." The *Ocooch Mountain News,* which is now published monthly, soon became a purveyor of folklore and helped to establish pride in the special features of Southwestern Wisconsin. It is not unusual to find articles which begin like this: "Does it give you a feeling of special importance to know that you live in a place unlike any other in the world? If you are a resident of Southwest Wisconsin this is true."[9] Moreover, some residents of Southwestern Wisconsin have begun referring to themselves and their neighbors as "Ocooch people." The process of cultural individuation has been progressing rapidly.

It is not my intention to assert that the cultural individuation of Southwestern Wisconsin will develop like that of such groups as the Melungeons in Tennessee; such extremes are probably no longer possible with mass communication as it is today. Furthermore, the cultivation of the term "Ocooch Mountains" with its concomitant folkloric implications lies largely in the hands of newcomers who have settled in Southwestern Wisconsin for a variety of reasons, but virtually all in pursuit of a more fulfilling life which they imagine exists in a rural area like Southwestern Wisconsin. These newcomers to the area, therefore, come to their new way of life with the expectation of finding something very special. Greeting them is the aforementioned pluralism which is, indeed, a special product of the particular diversity of Southwestern Wisconsin. The term, "Ocooch Mountains," evolved as a term of pride on several levels. Outsiders and newcomers used the term in an exoteric fashion; that is to say, the term was used to describe a geographic location which possessed a special pattern of social functions. The long-term residents of the area began to accept the term in an esoteric fashion; for them, the singularity was a matter of unconscious acceptance of the quality of life in Southwestern Wisconsin.

Charles Bannen was born and lives in rural Southwestern Wisconsin. In a sense, he is an "Ocooch person" *extraordinaire.* Bannen was born in 1900 on a farm in section fifteen of Scott Township, Crawford County, just east of Mt. Zion. At the age of sixteen, he moved to a farm on section seventeen of Scott Township, just west of Mt. Zion, where he farms today (Fig. 1).

First settlement of the area around Mt. Zion began in the decade following that of the Black Hawk War. The oldest permanent

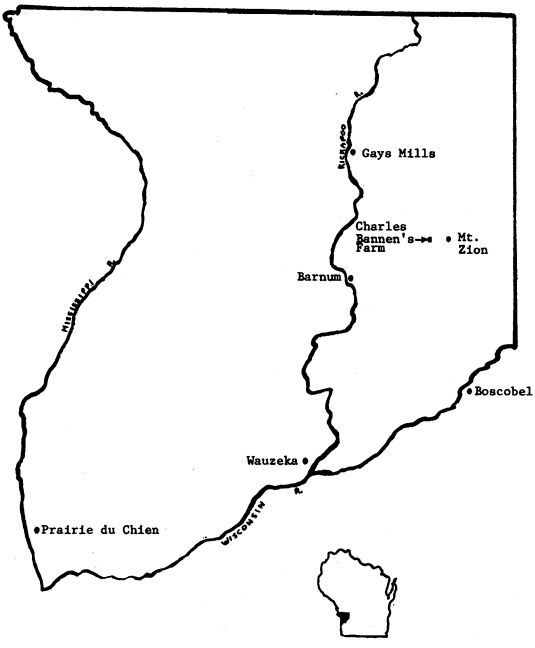


Fig. 1. Crawford County, Wisconsin.

settler of the area was John R. Hurlbut, whose relatives remained in the Mt. Zion area for many years. Another early settler of Mt. Zion, Charles F. Coalburn, describes the early settlement of this area:

> Late in the summer of 1846, J. R. Hurlbut, William and Elmer Russell, Anthony Laughlin and myself, all residents of Grant County visited within the present limits of the town of Scott. . . . We followed the road by the left wing of the troops in their pursuit of Black Hawk and his people; this road led from the ferry [across the Wisconsin River] . . . , up Knapp's creek, to a spring branch coming in from the northwest, following the branch up and out onto the ridge, to about the center of section 14, and thence west through sections 15, 16, 17 and 18, and to the Kickapoo.[10] This road was used by the earlier settlers of Scott and adjoining towns in moving in, and is now the main thoroughfare, crossing the town east and west. . . . When we reached the high lands, two or three days after, our dogs struck a bear trail and followed until a little 'too fresh,' for they overtook the animal, and one of them being part bull, had more courage than discretion, and consequently, was badly used up. We found a small cabin near the top of the ridge, which had been occupied, we afterwards learned, by William and Randolph Elliott while hunting, and perhaps by others; here we spent the night. The next day we looked over the land, noting the quality of soil and timber, etc. and then left, favorably impressed with what we saw. Three years later Hurlbut became the first permanent settler of the town. I came back with my family in 1855.[11]

Charles Bannen knows well the history of his area and speaks knowledgeably of the early settlers, some of whom he knew personally. Mt. Zion itself was established in 1881. Even today, the town is small, consisting of a few modest buildings near a crossroads. Mt. Zion is served by the Boscobel School District and the Gays Mills Post Office. Mt. Zion guards the descent from the ridge country of Crawford County into Marietta Valley and the Wisconsin River Valley; today, there is little significance to such a location.

Like the larger population of Southwestern Wisconsin, the immediate environs of Mt. Zion are inhabited by various ethnic groups. Along Mt. Zion Ridge, on which Charles Bannen lives, most of the farms are worked by Irish-Americans and Anglo-Americans; in Crow Hollow, the farms are worked by German-Americans. However, Irish-Americans are found in relatively greater numbers in Scott Township than in most areas of Southwestern Wisconsin. As early as 1860, twenty-one percent of the families in the township were Irish-born, a figure exceeded only by the twenty-four percent in Seneca Township.[12] The history of Scott Township seems to be marked by a balance maintained at times by the Anglo-American Methodists and the Irish-American Catholics, of which group Charles Bannen is a member.

Irish-American Catholicism is central to

the musical tradition of Charles Bannen. He represents the third generation of his family to live in the United States. He is well aware of his roots in Ireland and speaks with great pride of his Irish heritage; in October 1977, Bannen and his wife visited Ireland with the hope of gaining a better sense of that heritage. Parts of his family history have passed to Bannen both by means of oral tradition and through the efforts he has made to reconstruct that family history.

Many Irish immigrant families in the nineteenth century remained for a time in the large cities of the East upon their arrival to the United States.[13] Both the Bannens and the O'Kanes, Charles Bannen's paternal and maternal ancestors, demonstrated unusual immigration patterns because they moved westward immediately and settled in the area of Southwestern Wisconsin which is still farmed by their descendants.[14] It is, perhaps, because his ancestors did not remain in the East and therefore were not subjected to major anti-Irish prejudice that the Irish-American songs in Bannen's repertoire are almost devoid of references to anti-Irish sentiments in the New World.[15]

Despite its strength, the Irish-American aspect of Charles Bannen's musical tradition is but one aspect of that tradition. Bannen has always been an inveterate song-monger; his repertoire has continually absorbed new styles and genres. An examination of the songs that make up the active core of Bannen's repertoire (Table 1) evidences the diversity of musical sources from which

TABLE 1. The Active Core of Charles Bannen's Song Repertoire.

A-Bummin' the Railway Train
After the Ball
The Baggage Coach Ahead
Barbara Allen
Barney McCoy
Because We Were Poor
Beyond the Sunset
Blue Tail Fly
Bonny Doon
Boston Burglar
Boston Theater
Danny Boy
Dear, Little Shamrock
Down in Front of the Saloon
Galway Bay
The Green Hills of Atram
Jingle Bells
Just as the Sun Went Down
Kickin' Mule
Kitty Rells
Leaving Dear Old Ireland
The Letter Edged in Black
Listen to the Mockingbird
Little German House Across the Sea
Little Homes of Ireland
Little Old Sod Shanty in the West
Little Peter
McCarthy's Mare
Miss Fogarty's Christmas Cake
Naming the Boy
Odd Fellows' Hall (Cleaning Out Odd Fellows' Hall)
An Old-Fashioned Photograph
Old Hamburger (fiddle tune in scatted version)
O'Shaugassy on the Railroad
Out in the Gloomy Night, Sadly I Roam
Over the Waves (scatted version)
Pat Malone
Put Me in My Little Bed
Rose of Tralee
Redwing
Sailor's Grave
School Days
Schottische (fiddle tune in scatted version)
Seamus O'Brien
Sherman's March to the Sea
Ship That Never Returned
Soft Were the Mountains
Some Twenty Years Ago
Sparkin' Peggy Jane
Streets of Laredo
Sweet Bunch of Daisies
Sweet, Sunny South
Tell 'Em That You're Irish
The Three Leaves of Shamrock
Two Step (fiddle tune in scatted version)
Way Down in Maine
When It's Springtime in the Rockies
When You Have Fifty Cents
Who Threw the Overalls in Mrs. Murphy's Yard?
The Wreck of the Old 97
Young Charlotte

Bannen has drawn his songs. In part, this diversity is due to the dispersion of his family throughout culturally diverse Southwestern Wisconsin. Furthermore, the diversity has resulted from contact with the plethora of music styles that the mass media offers to the American public. However, most important as a catalyst for the diversity of Bannen's musical tradition has been his development of a performance style which facilitates incorporation of different musical styles as well as different musical vocabularies into his music.

Charles Bannen's musical training was mostly rote-learning from his father and other relatives. His inability to read notes at times frustrates him. Nevertheless, Bannen has an insatiable desire to understand and learn music. This desire has resulted in a carefully designed music theory stamped with the musical personality of Charles Bannen. The reed organ that Bannen plays is an indispensable part of his performance style. Despite the few lessons he had with a local teacher, Bannen learned most of his organ technique from his father. The technique was acquired as he repeated the chord patterns used by his father until he learned which chords "sounded good" with certain songs. The harmonic patterns learned by Bannen could be used to accompany most hymns; nevertheless, the patterns are used by Bannen so that the songs assume new versions.

Some of the songs entered the Bannen family repertoire from printed sources whose origins were not in Southwestern Wisconsin. The most important of these sources was the *Renfro Valley Bugle,* a small newspaper containing song texts, printed monthly in Renfro Valley, Kentucky. Renfro Valley is a well-known center of the country music business which, in addition to supporting the *Renfro Valley Bugle,* has, for a number of years, sponsored road shows and radio broadcasts.[16] The *Renfro Valley Bugle* publishes material ranging from gospel to country and western; however, some issues, for example those published near St. Patrick's Day, are occasionally devoted to Irish-American texts, perhaps in deference to the sizable Irish-American population in the southern mountains. A second major written source has been the New York publishing firm of H. J. Wehman. The Wehman firm, which no longer exists, was known as a publisher of Irish-American broadsides, or single sheets of printed song texts. Several of the songs in Bannen's repertoire initially appeared in print in broadsides published by Wehman; for example, one of Bannen's favorite Irish-American songs, "Because We Were Poor," appeared as a broadside with the titles, "The Irish Immigrant" or "I Left Ould Ireland Because They Were Poor," and in a different version in *Wehman's Irish Song Book.*[17]

Songs and tunes entered the repertoire of Charles Bannen from the many dances he attended and at which he often played. Not only did these dances provide an exposure to American fiddle tunes, but they also brought Bannen into contact with ethnic groups other than his own. Very often the fiddlers at the dances were German-Americans, for they were generally known as the best fiddlers in the area. Several of the tunes in Bannen's repertoire are versions of German fiddle tunes which he sings with scat syllables. At such ethnically mixed dances Bannen danced with and courted his wife, Emma, a Bohemian-American from a contiguous area of Southwestern Wisconsin.

Popular music and country music were also absorbed into Bannen's repertoire. Some country and western songs were taken from the *Renfro Valley Bugle.* The currency of both popular and country songs was unquestionably increased through the influence of radio and television as well as by Bannen's frequent performances in diverse settings.

Charles Bannen is more than a simple bearer of tradition; he is a performer who can step out of a single tradition and reshape musical materials so that they will speak more specifically for him and the changing contexts of his performance. When learning new songs, he not only memorizes the words but writes them down, copies them, edits them when he feels it is necessary, and chooses which ones to perform under given conditions. He asserts his personality not only by recreating former versions (one criterion for the role of tradition in a folk setting), but by creating new versions and combinations of music. Bannen's role as a performer is essential to his ability to embrace the various traditions present in Southwestern Wisconsin and to represent this pluralistic culture in his musical repertoire.[18]

Whatever their sources, Charles Bannen invariably accompanies his songs with an organ style which is derived from a rural hymn tradition. Although he is Catholic, Bannen is called upon to sing at the churches of other denominations in Southwestern Wisconsin, usually for funerals or social gatherings. Chord patterns seldom waver from a simple tonic—subdominant—dominant—tonic pattern; chords in such a pattern are built on the notes of the common, seven note scale as follows: first, fourth, fifth, and back to first. Occasionally a supertonic or dominant of the dominant will precede the dominant in a cadential pattern; the supertonic and dominant of the dominant are respectively minor and major chords built on the second degree of the seven note scale. These harmonic patterns are among the most basic found in the music of Europe and the United States. However, the patterns often do not account for the simplicity and/or complexity of some of the songs performed by Bannen.

Often, Bannen sings songs from which only pentatonic (five note) or hexatonic (six note) scales may be abstracted; yet his accompanying patterns imply a heptatonic (seven note), diatonic (using whole steps and half steps) scale structure. The conflict between modal, non-heptatonic scales and the heptatonic scale which is often necessary when instruments accompany a folk tune is common in the history of folk and country music in the United States.[19] In some instances, the conflict has been resolved by simply expanding the five note scale to include seven notes. This technique of scale modification was especially common during the 1920's and 1930's when rural singers, like the Carter Family, recorded old ballads for the commercial record industry.[20] In other instances, the conflict of five note scale versus seven note harmonic system was not resolved or only incompletely resolved. Such an incomplete mixture of musical styles was probably common in rural areas of the United States during the nineteenth century. To understand oral music traditions in the nineteenth century, we are forced to rely on scattered accounts, which tend to support a hypothesis that the syncretism of musical styles often existed in the type of incomplete state of resolution described above.[21] Writing in 1934, Charles Ives speaks of the experiences his father, an observant band leader, had while his band was camped in the South:

> When Father was in the Civil War, a negro boy, whose mother did the washing for the band, would stay around the tent while the band was practising, and Father said that the boy would stand by him whistling and humming the airs and tunes the band would play. And [Father] found quite often that he would change the melody by leaving out the 7th of the scale and sometimes the 4th—for instance, if the tune ended lah-te-doh upward, he would sing either lah-lah-doh or lah-doh-doh. . . . The negroes took many of the phrases, cadences (especially plagal —they liked the fah chord), and general make-up, and the verse and refrain form, and the uneven way many of these hymns

> were sung rhythmically, especially the choruses. . . . The Gospels used the 4th and 7th sometimes, but the negroes were still too near Africa and the oriental five-note scale to get these.[22]

The conflict of scale structure was characteristic not only of the oral traditions of black and white singers and musicians in the nineteenth century. It also lay at the root of the rural hymnody traditions which were found among the fundamentalist sects of the southern mountains. In describing the traditions of the southern "fasola" folk, or shaped-note hymn-singers, Jackson describes processes similar to those observed by Charles Ives' father during the Civil War:

> Another important modal-melodic peculiarity of the old songs, one whose existence seems nevertheless to have been completely ignored by the fasola folk themselves, was the use of gapped scales, that is, melodic progressions which avoided or skipped regularly certain notes in the diatonic scale with which we are familiar, the one which is conveniently represented by the white keys on the piano. The simplest note avoidance in the major modes was that of the fourth, or E flat in the scale of B flat major. In skipping this note the fasola singers produced what are called six-tone or hexatonic melodies. Another skip was that of the seventh, or A natural in the scale of B flat major. When both four and seven are avoided we have a five-note or pentatonic scale.[23]

The points of melodic conflict which the excerpts from Ives and Jackson described are most often the fourth and seventh degrees of the scale. These are the same points of conflict which can be found in the songs of Charles Bannen. For example, when Bannen sings a song which lacks a fourth scale degree, he still uses harmonic patterns which utilize chords built on a fourth degree. The process which is involved is exactly the same as that used in the camp meetings of the South in the nineteenth century and later taken into hymn traditions which would reach the Midwest in the last part of the nineteenth century. The well-known composer of hymns, Ira D. Sankey, also had problems dealing with the fourth in his four-part harmonizations of hymns.[24] Like the folk singer, Sankey often treated his melody as though it were autonomous from the vertical harmony of a hymn; Charles Bannen certainly conceives of music in this fashion. Such a distinction between melody and harmony provides a sharp contrast with the nineteenth-century art and popular music of urban centers in which melodic and harmonic functions are intertwined. Thus, it is my assertion that Charles Bannen's unfamiliar use of the fourth degree as well as other degrees of the scale, like similar use by Ira Sankey and some other hymn composers, is not the result of an incorrect interpretation of nineteenth-century music theory; on the contrary, it demonstrates a melodic and harmonic independence which was not present in the art music of the nineteenth century.

Charles Bannen and his family have copied the texts of many of their songs into a volume they called the *Old Bannen Song Book*. The *Old Bannen Song Book* exists in two parts. The first part contains primarily "old songs" and Irish-American songs; the second part contains the "new songs." There is no doubt that Charles Bannen prefers the "old songs," for he sings almost entirely from the first part. The *Old Bannen Song Book* contains one "hundred sixty-some odd" songs of which I have now recorded sixty-two over the past three years.[25]

Elements of both stability and flexibility interact in the songs of Charles Bannen. By a close look at different performances of one of his favorite songs, "Pat Malone," it is possible to understand which elements are stable and which elements are flexible in Bannen's tradition. "Pat Malone" is a song Bannen sings wherever he performs. He is known for his performances of "Pat Malone" and the song has become a local favorite because of these performances.[26] Whenever he

sings "Pat Malone," he recounts the tale of that Irishman before singing the song:

> See this Irishman, Pat Malone, had a life insurance and they was hard up, pinched for dollars. And his wife tried to tell her husband that if he lay down and pretended to be dead awhile 'cause she could get the insurance check. Now, this is far-fetched, see. Insurance check, why that'd relieve their depressed condition. So, finally, old Pat got right down and laid aside his work. He lay down pretendin' dead and in come the Irish for a wake. Naturally, neighborhood friends and all. And some of those devils brought in some liquor, whiskey and stuff. They was all passin' the bottle around and finally old Pat was layin' there and he could smell that whiskey and he wanted some. When he got some liquor in him, he wouldn't keep still and he'd just talk, talk, talk all the time. He was supposed to be dead but he wasn't minding'; he wouldn't keep quiet!

The tale of Pat Malone is inextricably bound to the song itself. Commentary is added between the verses as well as before and after the song.

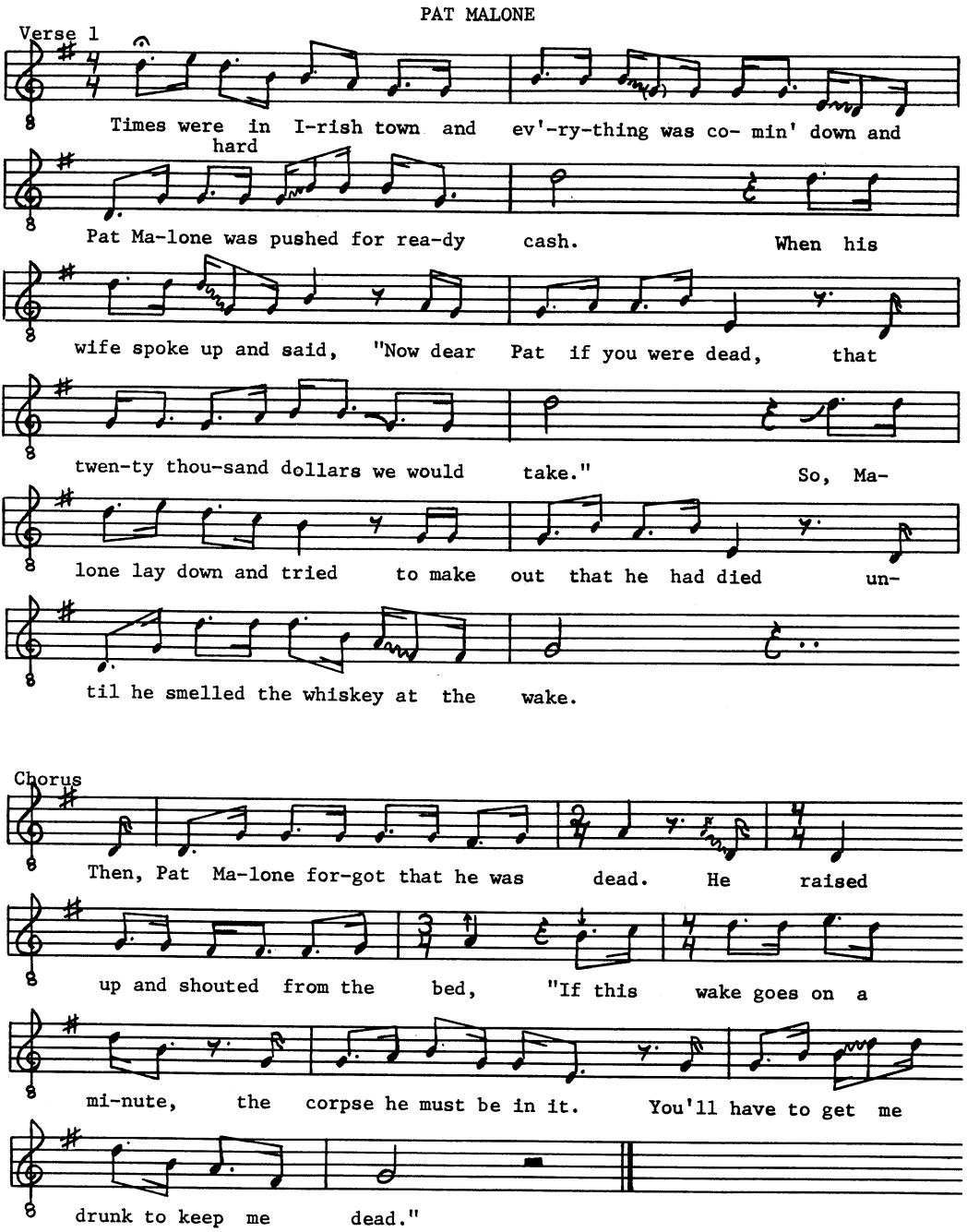
The two performances of "Pat Malone" which will be examined here were recorded in September and October of 1977; the September performance was not accompanied by the organ, whereas the October performance employed accompaniment (see Figs. 2 and 3). Variants between the two performances of "Pat Malone" are of two sorts. The first is the result of the differences caused by the accompaniment or lack thereof. The second is a result of the melodic restructuring and flexibility which is widespread in Bannen's melodic vocabulary.

Of the two performances, the unaccompanied version more clearly demonstrates a seven note scale. The melody of the accompanied version has essentially six tones, lacking the seventh note, or leading tone, of the scale throughout much of the song. When the leading tone does occur, Bannen demonstrates instability by singing it out-of-tune. Unlike many of his accompanied songs, the accompaniment of "Pat Malone" does not serve to tie Bannen to a hymn-oriented melodic structure, but instead frees him from the necessity of using a seven note scale throughout the song.

Metric differences between the choruses of the two versions are easily seen; whereas the meter of the unaccompanied version shifts from four beats per measure to two or three beats per measure at the ends of internal phrases, the meter of the accompanied version remains in four throughout. The reason for this is obvious: the organ accompaniment serves to maintain constant meter.

Rhythmically and melodically, differences tween the versions seem restricted to a single beat and seldom demonstrate consistency with regard to the setting of individual words or larger phrases to music. The overall shape of phrases and the initial and final notes of each phrase are in most cases the same. Whereas melodic motion may differ slightly within a phrase, phrases are generally arched or falling in overall shape. The comparison of two performances of "Pat Malone" clearly demonstrates the freedom and flexibility in the performance style of Charles Bannen. Yet, despite the freedom found in the use of smaller units, the larger framework of "Pat Malone" makes it clear that both performances represent the same song.

It is not unusual for Bannen to combine tunes from several songs or several versions of the same song in one performance. Bannen's version of the well-known cowboy song, "Streets of Laredo," demonstrates this curious problem of tune identification: the first verse appears to be taken from a different song than the three subsequent verses. The first verse differs from the other verses both in melodic shape and rhythmic complexity. The lines of the first verse encompass a melodic shape which falls from the initial note of the line, whereas the lines of the other verses rise from the initial note. Furthermore, the harmonic implications of



Notational conventions: Bruno Nettl, Theory and Method in Ethnomusicology, (New York: Free Press, 1964), p. 107.

Fig. 2. "Pat Malone": Music and text version of Charles Bannen, September 1977, transcribed by Philip V. Bohlman.

the first verse of Bannen's "Streets of Laredo" are different from those of the last three verses. "Streets of Laredo," also called "The Cowboy's Lament" or "Tom Sherman's Barroom," is one of the most widely circulated songs in North America; thus, it is probable that Bannen has another version of the song, or perhaps a completely different song, in mind when he begins "Streets of Laredo." The ease with which the two versions are combined within a single performance demonstrates Bannen's ability to combine music from different sources into a newly created version.

Verse 1

Times were hard in Irish town and ev'rything was comin' down,
and Pat Malone was pushed for ready cash.
When his wife spoke up and said, "Now, dear Pat, if you were dead,
that twenty thousand dollars we would take."
So, Malone lay down and tried to make out that he had died,
until he smelled the whiskey at the wake.

Chorus

Then, Pat Malone forgot that he was dead.
He raised up and shouted from the bed,
"If this wake goes on a minute, the corpse he must be in it.
You'll have to get me drunk to keep me dead."

Verse 2

So, they gave the corpse a sop, afterwards they filled him up
and laid him out again upon the bed.
And before the mornin' grey, ev'rybody felt so gay,
they forgot the corpse had played off dead.
So, they took him from the bunk, still alive but awful drunk,
and placed him in the coffin with a prayer.
Says the driver of the cart, "But it I'll never start,
until they see that someone pays the fare."

Chorus

Then, Pat Malone forgot that he was dead.
He raised in the coffin and he said,
"If you dare to doubt me credit, you'll be sorry that you said it.
Drive on boys or the corpse will punch your head."

Verse 3

So, the fun'ral started out on a cemetery route,
and the neighbors tried the widow to console,
till they stood beside the base of the lone, last resting place
and quickly lowered Patrick in the hole.
Now, Malone began to see, just as plain as one, two, three,
that he forgot to reckon on the end.
And as the clods began to drop, he kicked off the coffin top,
and to this earth he quickly did ascend.

Chorus

Now, Pat Malone forgot that he was dead,
and from the cemetery quickly fled.
He came nearly going under. It's a lucky thing by thunder,
that Pat Malone forgot that he was dead.

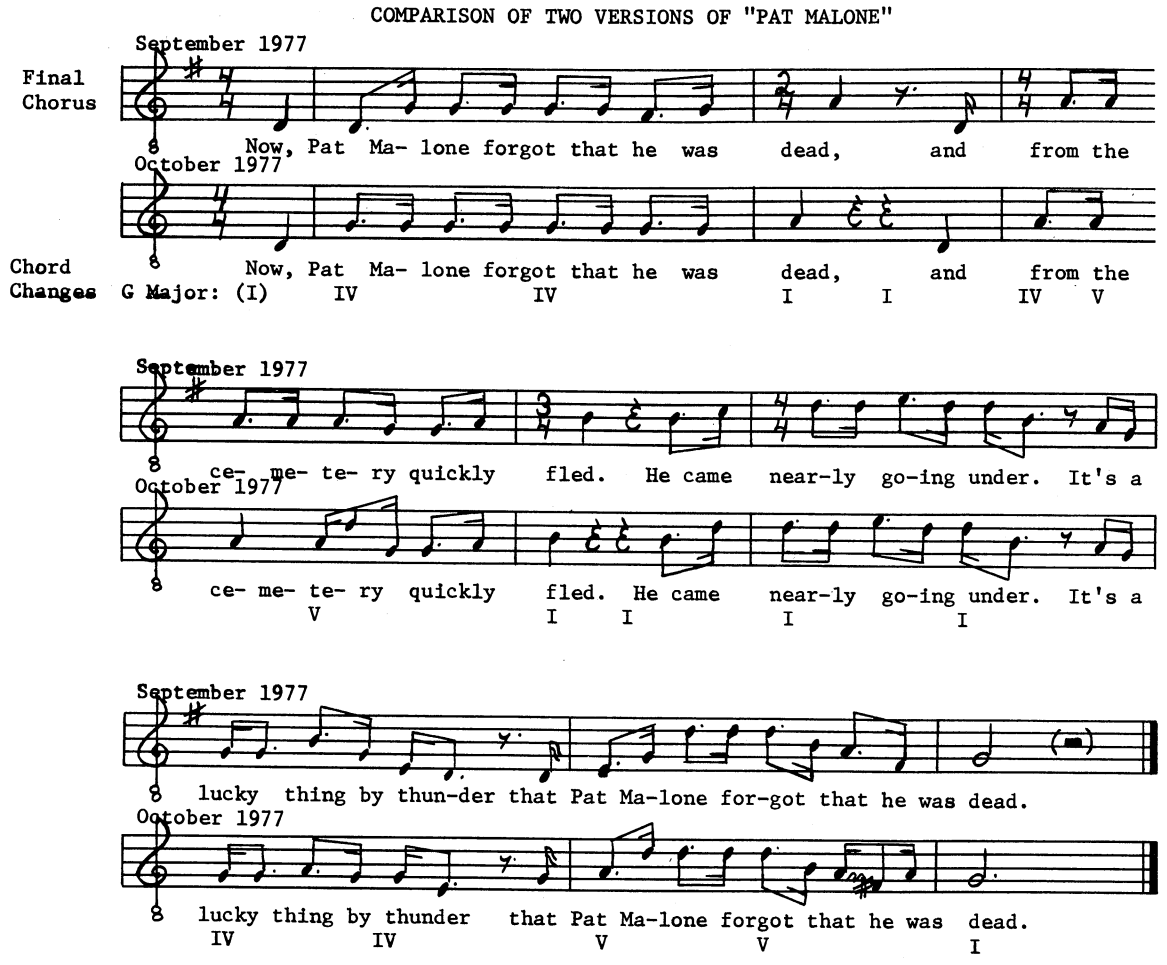


Fig. 3. Comparison of two versions of "Pat Malone."

A particularly striking case of melodic and harmonic conflict can be found in Bannen's version of "Barbara Allen," Child #84. "Barbara Allen" is the only song included by Francis James Child in *The English and Scottish Popular Ballads*[28] which is actively sung by Bannen. Such a situation is not unusual, for the Child ballads are not widespread among most Irish groups. However, because Bannen has chosen to include "Barbara Allen" in his repertoire, it provides one of the clearest examples of the mixture of traditions represented by his music.

The story of "Barbara Allen" is simple and representative of a type of love story which is found in many Child ballads. Sweet William comes to court Barbara Allen, but is shunned. With his love unrequited, William wastes away and is about to die when Barbara Allen decides to return his love. She is too late and when William dies, Barbara Allen soon dies of a broken heart. The ballad ends with the rose from William's grave entwining with the briar from Barbara Allen's.

The version of "Barbara Allen" sung by Charles Bannen is the most common found

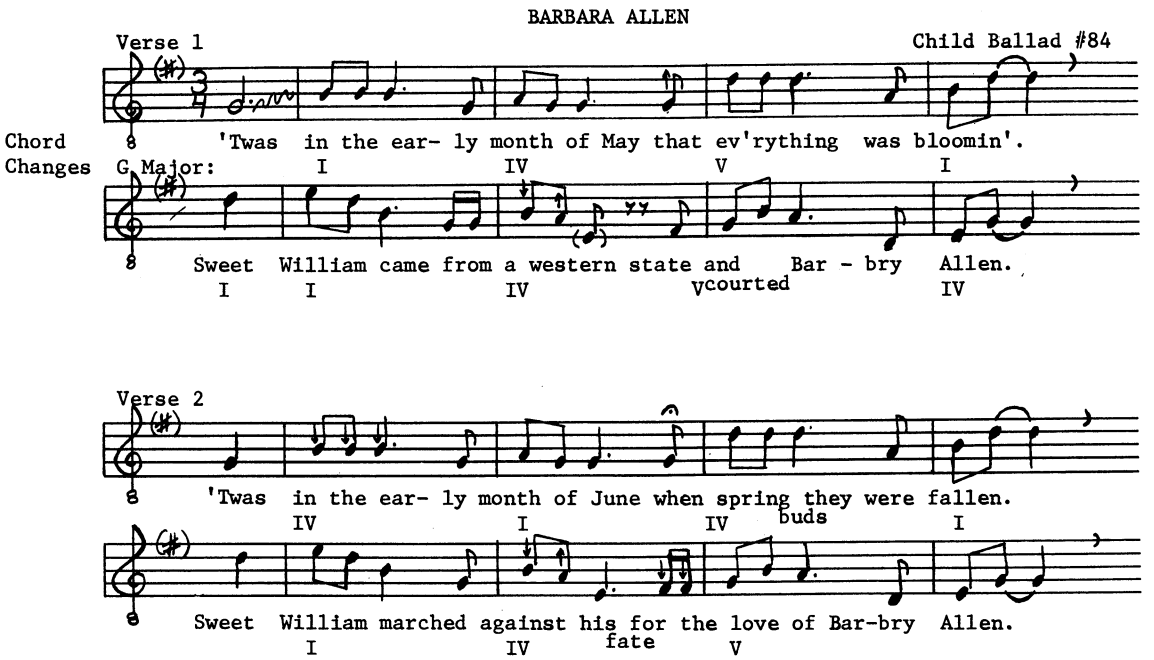


Fig. 4. "Barbara Allen": Music and text, Child Ballad #84, version of Charles Bannen, October 8, 1977, transcribed by Philip V. Bohlman.

Verse 1
'Twas in the early month of May
that ev'rything was bloomin'.
Sweet William came from a western state
and courted Barbry Allen.

Verse 2
'Twas in the early month of June,
when spring buds they were fallen.
Sweet William marched against his fate
for the love of Barbry Allen.

Verse 3
He sent his men unto the town
where Barbry was a-dwellin'.
"See my master dear he has sent for you,
yer name be Barbry Allen."

Verse 4
Then slowly, slowly she got up
and slowly she came nigh him,
and all she said when she got there,
"Young man, I think you're dyin'

Verse 5
Don't you remember in yonder town,
when we were at the tavern?
You gave a hand to the ladies all around
and slighted Barbry Allen."

Verse 6
"Yes, I remember in yonders town,
in yonders town a-drinkin'.
I gave a hand to the ladies all around
but my heart to Barbry Allen."

Verse 7
When she was on the highway home,
she spied his corpse a-comin'.
"Oh, lay down, lay down that corpse of clay
that I may look upon him."

Verse 8
The more she looked, the more she mourned,
till she fell to the ground a-cryin'.
"Oh, pick me up and carry me home,
I am now a-dyin'."

Verse 9
They buried her in the old churchyard
and William close a-nigh her.
'Pon William's grave there grew a red rose
and on Barbry's grew a briar.

Verse 10
They grew to the top of the old church wall,
till they couldn't grow any higher.
They leapt and they twined in a true lovers' knot,
and the rose around the briar.

in the United States.[29] In this version the text is primarily iambic (although the prosody does not make this clear) and is divided into quatrains which usually have an ABCD musical representation. The pentatonic scale used by Bannen is modally major, can be produced by playing the black notes of a piano, and, lacking the fourth and seventh degrees of the scale, is one of the most common five note scales found in British-American folk song.[30]

Of the ten verses sung by Bannen in October 1977 (Fig. 4), he accompanies himself on the reed organ for only four verses. Seemingly, Bannen's performance was encumbered by the organ accompaniment. The encumbrance results from the difficulty of fitting chords derived from a diatonic harmonic system against a pentatonic scale. Bannen's most obvious difficulty is his attempt to harmonize the melody with chords built on the fourth scale degree even though that degree is not found in the melody. At some places, for example in the initial measures of verses two and four, he attempts to harmonize the third degree of the scale (B) with a chord built on the fourth degree (C). The result is a harmony which sounds glaringly "wrong" and the singing of the third degree out-of-tune or off-pitch. Furthermore, Bannen unconsciously adjusts the scale of "Barbara Allen" to make more diatonic sense with the accompaniment by the occasional introduction of a seventh degree into the melody; this note, also, is sung out-of-tune.

In very simple terms, Charles Bannen has created a melody which contains "blues notes." Blues notes are scale degrees, especially the third and seventh degrees of the scale, which sound out-of-tune. They were common in the music of rural, southern blacks and are part of a style of singing which evolved into jazz during the first part of the twentieth century. Yet, it becomes clear upon examining the musical style of Charles Bannen that he, too, uses blues notes in singing. In his case, the returning of certain vocal pitches is a direct result of a melody which conflicts with accompaniment; when the accompaniment is dropped for the last six verses of "Barbara Allen," the blues notes disappear as does the presence of a seventh degree.

The performance of "Barbara Allen" points toward the incompatibility of certain elements in Charles Bannen's musical style. It demonstrates the instability with which a five note melody is realized by hymn-type harmonic functions. More importantly, it also demonstrates the means by which different styles converge in the music of Charles Bannen. Just as the Ocooch Mountains of Southwestern Wisconsin have acquired a particular cultural pluralism derived from a diverse populace, so too has the music of Charles Bannen come to represent diverse music traditions. "Barbara Allen" becomes a way of further examining the manner in which Irish immigrant, rural hymnody, and Anglo-American balladry traditions are brought together by a single performer. Some elements are shared and others are eschewed; nevertheless, the musical tradition of Charles Bannen acquires new directions and new strength.

CHARLES BANNEN SPEAKS: A PERSONAL INTERPRETATION OF MUSIC AND TRADITION IN SOUTHWESTERN WISCONSIN

Introduction

When Charles Bannen talks about his music and life in Southwestern Wisconsin, he does so with a unique eloquence. During his life, Bannen has been a careful observer of the changes in the world about him, and he recounts those changes with the wisdom of a folk historian. In short, the inner qualities which contribute to Charles Bannen's

Fig. 5. Charles and Emma Bannen, 40th Wedding Anniversary photograph (Photo courtesy of Charles Bannen).

aplomb as a performer of folk music also make him a first-rate storyteller (Fig. 5).

It is only fitting that Charles Bannen should be allowed to add a few comments of his own concerning his past and his music. The following narrative is drawn entirely from taped conversations that Charlie and I have had over the past two years. The words are Charlie's alone; I have edited and arranged them so that the story of Charlie's family, music, and experiences in rural Wisconsin unfolds in an orderly fashion. On occasion, I have substituted a few words in parentheses to make sentences flow more smoothly as they make the difficult transition from oral to written presentation.

A few names of families and places will be unfamiliar to those who read the narrative; places like Tom Price's farm are not to be found on most maps of Wisconsin or, for that matter, of Crawford County. Still, the use of such nomenclature best describes the sense of community which lies at the heart of a rural area. The world may be filled with families similar to those described by Charles Bannen; but only through his understanding of the ways in which these people contribute to the web of life in Southwestern Wisconsin can we glimpse the sense of community which is so important for the maintenance of the traditions in Bannen's life. And, perhaps, this glimpse of the people and places in the world of Charles Bannen will serve to remind us all that history and tradition ultimately grow from the interaction of human beings with other human beings on stages as remote and intimate as the parlor in old Bill Hudson's farmhouse.

P.V.B.

Ancestral Emigration from Ireland and Homesteading in Southwestern Wisconsin

Well now, Grandma Bannen, she was a Kelly girl and she came from Offaly County in Ireland from the little village they call Birr, and it was right along in the bend of the Shannon River. The O'Kane side of me, my mother's people, they came from Cork, pretty well south.

The old grandparents on the O'Kane side got onto a sailboat—wasn't a very big one—and the ocean was more or less rough and the wind was the wrong direction part of the time. They had to take down their sails and just drifted. It took 'em six weeks to get across the sea from Ireland to the United States. And they landed on the east coast, of course, of the United States.

After a while they decided to get into a covered wagon and come west to take up land. The government was giving away the land, posted it. So they was ridin' along and my grandma pretty soon said sometime she had to have her first baby girl. And they got out of the covered wagon and she lay down by a big log by the sawmill site and had her first baby girl. In due time they got back in their wagon and took off again. They landed in Marietta Valley back of Tom Price's farm, right close by here.

I can remember my grandmother on my father's side very much. I used to sit on her

knee when I was a little kid. We'd go over there; she'd come over to our house. I'd seen her and I's three or four when she died. But I never seen my grandparents on my mother's side. They died before I was even born.

Absorbing Musical Traditions as a Youth

One time Ol' McDaniel and her husband, John, and her son, Johnny that married Blanche Gray, came over to Hudson's one day in the winter with teams and sled. I was a little kid—oh, 'leven years old and my sister was about nine or so—and anyway, after dinner Ol' McDaniel got into the organ in the front room. And, of course, old Bill Hudson liked to hymn-sing, sing the hymns. That was my uncle by marriage. It was Maggy Hudson's house; Will's, see.

And finally Ol' played for quite a little while. Then, Aunt Maggy, my own aunt, she set at the organ and they all sang. But she could read notes pretty good. Then, finally my pa got down into the organ and he could play the chords, and they all sang for a while. Oh, I bet they sang around for about two hours. But, I was a little kid sittin' on a chair and I listened—oh, a lot of them was hymns too.

Pretty soon after a while, why Hudsons —when I was a kid around thirteen or so— they got one of these round records: Edison, you pushed on a little cylinder. And I went up there one wintertime in the afternoon. Of course, they was proud as the dickens of their Edison phonograph. They sit on there different hymns that I have heard the old stock sing; had a big horn on it. And anyway, Aunt Maggy watched me to see if I recognized a lot of those songs. Of course, I did! She could read my expressives on my face; see that I was interested. I enjoyed the records very much. Course, that was way back there, a long time ago.

Grandmother Bannen lived about three miles from here. Hudsons would go there for Christmas dinner, and we'd go there for Christmas dinner. Aunt Mary McCormick and her children would go there, and sometimes a neighbor or two around. Then after dinner, when they'd get done with the meal, they'd go in the front room. There's so many of 'em that the chairs was all taken and the front room was a fair-sized room, too.

I guess pa was at the organ. There was something like a half-a-dozen of 'em singing, and there was no place for me to sit, no chair. So, I'd sit on Lee McCormick's knee while they's performin' for awhile. You see, there was quite a bunch of them when they all got together.

Mother's sisters were good singers: Mrs. Grant Burton, Marian Moran way out west, and Maggy Mulhaire way out west, and Kate that married old Tom McKnight, Civil War guy. Old Tom played the fiddle, and he was a brother to that lady that married old John McDaniel, Olive, that was such a dandy, nice singer and organ player. Old Will Hudson used to sing with her at the funerals at Mt. Zion so many times. Ol' McDaniel was an awful nice singer. She was musical!

Well now, Mrs. Ol' McDaniel played the chords similar to what I'm doing. (Her niece, Maud) could read notes nice, too. She's the one I took music lessons under, what little I got. Maud had a little organ about like (mine), she taught me on. Margaret, my sister, though, she went down there for three different seasons under Maud McDaniel. And she could read notes and do a pretty nice job at one time. But then she kind of lay down on the job and then she got rusty.

Well now, (as schoolchildren we sang from) those old yellow-covered songbooks —I've got one if I dig a while. The teacher would lead usually. And sometimes the teacher (was) Mina Brown, Mina Childs she was; she taught over there at the Coalburn school when I was a chunk of a kid. Sometimes in the Christmas program she'd ask me to take the lead in the program, singing on the stage there. Sometimes she'd ask

my sister, Margaret, to take the lead and sing.

I's a little boy and other children would take flowers—would pick 'em out of the woods little 'head of time and keep 'em down cellar. When Decoration Day would come, we'd place 'em on the old soldiers' graves, here and there. My sister and I was the main program, entertainers in singin' different war songs and things. And usually they had Maud McDaniel on the organ and played for us. Generally we'd have to practice ahead.

Musician and Performer

Well, I'd sing the songs when pa got home. We'd milk cows that evening and he'd come home with some of them same hymns. Oh my, I've heard my father sing! We'd be milkin' cows and so on. One of the sisters got large enough, she would help milk too; course, I was milkin' then and we was milkin' by hand. And we children would sing right along with pa. But I can start dance tunes that I never heard a word of what would go with them: all kinds of 'em, off the violin. I can just hum 'em by the dozen: different ones played over at the house dances all over the country. We'd help pa sing as we was all milkin' cows in the barn. And ma sang on some occasions. But he sang three-fourths of the time and ma, now and then. But mother's sisters, most of them were right good singers. She sang too, but she couldn't play the organ; dad could play the organ.

It's about fifty-five years old, the old organ is. We bought it from Emmett Haggerty here at Mt. Zion. Mrs. Bill Campbell really was the owner of it. But she borrowed her some money from her cousin, Emmett, and so he sold the organ to get nearly even as he could. We had it repaired; the bellows was leakin' and we fixed it up so it sounds pretty fair now. We had another old organ. It gave out, so we just tossed it out. Then we got this one; it's a better machine (Fig. 6).

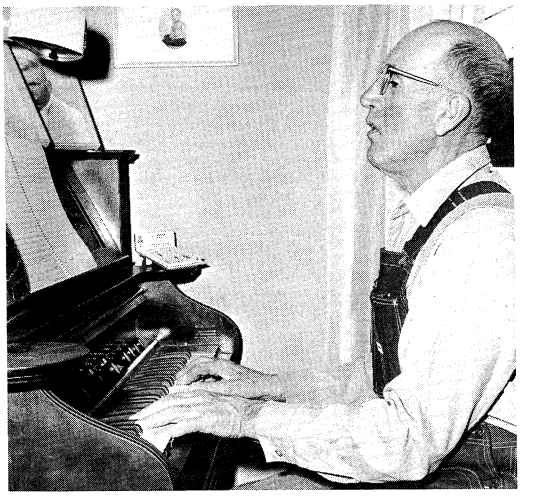


Fig. 6. Charles Bannen at his organ (Photo courtesy of Charles Bannen).

When you're picking out the keys you play on, if they've got sharps and flats on, you know what chords use the sharps and flats. If it's C, you don't use any sharps and flats. Now this is the way my pa and I kinda studied things out from our own experience. If they use a certain amount of these sharps and flats then you know they're either F or A or some of those. These black fellows are halfway between the white ones as a rule on some of the things. Some of them chords I don't use very much. Now some pieces, you know you got to try them out. You can feel them out here (on the organ) first. And then you can try it with a F♯, you can try G or C, or whatever sounds nicest to you.

Oh, fiddle's just lovely! That's tops in waltz music or any other dance music; providing they keep time. But a lot of our old fellows that picked it up by ear, they get into such bad habits and they don't quite finish out the last measure so many times. And they'll throw you out of step when you're waltzing so bad. Or if they hold it over extry long, it'll raise the divil too, you know, the last measure.

One time I was down to a house close to Barnum, down there this side of Barnum in

a house dance in a farmhouse. And they had lamps, of course; they didn't have electricity yet. They had a great big old piano, and it was a pretty good piano. Anyhow, this Ward had some young fellow playin' the guitar; he wanted a rest. So, they wanted to get me on the piano there to second for this chunky, short Ward. Oh, he was just as ruthless as he could be on the violin; but that's all right. Anyway, he played a waltz and I was a-followin' him the best I could.

After one of the rest beats I says, "Say, gentleman, you aren't a-finishin' out your last measure on those waltzes. You're puttin' your dancers all out of step."

"Oh, am I?" says he.

And so he got up and he placed his foot on that piano seat-bench right behind me. Now I was a-workin' away like a good fellow and the rosin off that fiddle was goin' right down the back of my neck. I kept still. I didn't howl. He did do a lot better when he watched the chords. He held his measure out where he should. Course, I was just a kid and he was a middle-aged man. Maybe that wasn't quite proper. Oh yah, I helped him out! You know, he was so loud and he's right back of my head there, sawin'. Oh, almost unbearable!

One fellow asked me—he played the fiddle, Will Miller over here, he was on the Tim Freight land in the Hard Times. The land, they took that away from most people and he rented it from the manager of the land bank in this area, down around Steuben. He played fiddle for house dances too. But, he done a sweet job, though, that Will Miller did. Old Will Miller was a pretty sharp old boy now on the violin. He knew that I'd been down someplace to a dance where this Ward had played. And he asked me, "What kind of a job did Mr. Ward do playin' the violin?"

Well, I told him, "He was like the Irishman on the railroad. He was on again, off again, gone again, Finnegan." I told him about helpin' him straighten him up when I was helpin' play the piano. And he just laughed like a good fellow. But he has heard him play somewhere, sometime. He knew that he was kind of punky at it.

The House Dance as a Social Institution in Rural Wisconsin

Oh, my! I loved house dances. I learned square-dancing when I was between sixteen and seventeen years old. I was just as green as they made 'em, and I didn't know how to square dance. But, I danced with the old, middle-aged ladies that knew how so well. It wasn't very long till, oh my Lord, I could just dance as nice as any of 'em.

Walter Shield who lived on the Hudson farm called a lot. Mike Coyne called, down over the hill. Mike Monahan called some, and Hank O'Kane called some now and then. Well, they'd have lots of square dances. 'Bout every third dance would be a square dance, and sometimes the crowd'd be so thick that they'd have to call numbers for the next ones to dance. You know the house'd be stuffed! There wasn't room enough on the floor if they all got on the floor, and they'd call numbers so part of 'em would dance one whirl and part of 'em would dance the other whirl. They had to do it so the crowd would have a fair shake at it. That's the way that was.

Dances were held usually ev'ry other Friday night through this area. Sometimes in the moonshine days they'd bring liquor, and it just messed up the dancin' bad, though, when they done that. Oh they'd fight sometimes. Oh, my! Some of these Irish made moonshine up here a ways. But Steuben had 'em by the bushel down there.

Joe Coyne, the whole Coyne family before Joe got married, was over here where the old Mike Ferrick place just over to the barrel of the hill where Dowling lives now. Well they had a nice square house there, nice big square house. The Coynes were great fellows to dance. The mother was keepin' house for 'em; none of 'em got mar-

ried yet. Oh, they'd have a dance about ev'ry once-a-month, generally, and ev'rything went off pretty nice though. They generally had old Dean Powers play the violin, and they had one of these self-player pianos there.

Emma, my wife, she lived over here on the Hudson place where Emil Mindham did, and we lived here. Used to dance with her once-in-a-while at the dances around. And one time she started after me and she caught me.

The Bannen Song Tradition and the Old Bannen Song Book

Well you see, I once sent to a music place, where they put out poems and songs, at Renfro Valley, Kentucky. They come once-a-month, and they'd have different poems certain times: different old songs. Those that I didn't have the chords of that I'd heard in my young days; and when those words would appear in that cute little paper, why, I'd think a while and here would come that tune in my head and I could just play it right over those words; just like nothing! I'd heard a lot of that stuff way back.

Songs in the *Old Bannen Song Book* were picked up all over. My Aunt Maggy Hudson was my dad's sister. She taught at North Clayton at one time. I remember Mary McCormick's little sister taught other places. Uncle Will Bannen was the younger one. He taught school at Senicky (Seneca), Bell Center, all over, too. And they brought home songs.

The Daughertys was Irish. The Daughertys, one of them girls, I don't know whether 'twas Nan or which one of 'em, could play the organ. And they knew a lot of songs. Some of these songs the Bannens got out of those old Daugherty books, too. They was back-and-forth. They lived just a hundred rods apart. Sometimes they'd play the organ and sing; sometimes they'd dance.

Oh, I've heard songs. One time in the Hard Times in the thirties, there was a couple of fellows in town, they's younger men, from out of a train. They rode the freight cars west trying to get a job. These were coal miners and one of 'em was a nephew to old Jack Lester. My Uncle Richard Bannen was always after help, more or less, so he brought out these two fellows to his place. They worked for fifty cents a day and their board. They were acquainted and more or less coal miner pals. One of 'em was German, a relation of old Jack Lester's nephew. The other one was an Irishman, McDonnell. That McDonnell, oh he could sing miners' songs that wasn't fit for an ole pig to listen to!

Generally speaking, in my opinion, of course I don't know too much about it, the old music suits me better because I've heard it. And some of the later pieces, oh, there's nothin' to 'em. They jumble up; you're speaking one word or one line over and over and over again. Gets too tiresome to me. It doesn't sound like music.

Well, up here at Mt. Zion about two months ago or thereabout, Emily Yonash sang with me, and Orla May Brown played the piano for us. You know that schoolhouse with a big room there—was big too, but oh was it crowded, my, my! It was so crowded that people just got back to their cars and away they went. It was too bad! We'd a-made a lot more money if they had suitable rooms. We was gonna raise money for North Crawford and ambulance-bus for Boscobel area. First I sang "Dumb Wife." Then I went for "Pat Malone." And, oh my, they did have an awful spell then!

Acknowledgments

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NOTES

[1] Ben Logan, *The Land Remembers* (New York: Avon Books, 1976), p. 7. In *The Land Remembers,* Ben Logan recounts the experiences of his childhood which was spent in northern Crawford County.

[2] *Ibid.,* pp. 141-142. The brackets are mine.

[3] Two theoretical, and rather different, discussions of cultural pluralism are Milton M. Gordon, *Assimilation in American Life* (New York: Oxford University Press, 1964), and Horace M. Kallen, *Cultural Pluralism and the American Idea: An Essay in Social Philosophy* (Philadelphia: University of Pennsylvania Press, 1956). For anthropological interpretations of the process of pluralism see especially Julian H. Steward, *Theory of Culture Changes The Methodology of Multilinear Evolution* (Urbana: University of Illinois Press, 1976); and Frederik Barth, ed., *Ethnic Groups and Boundaries: The Social Organization of Culture Differences* (Boston: Little, Brown and Company, 1969). Two recent studies of German settlement in Wisconsin that assume pluralistic stances are Kathleen Neils Conzen, *Immigrant Milwaukee, 1836-1860: Accommodation and Community in a Frontier City* (Cambridge: Harvard University Press, 1976); and Philip Vilas Bohlman, "Music in the Culture of German-Americans in North-Central Wisconsin," M.M. thesis, University of Illinois, 1980.

[4] I borrow this term from Larry W. Danielson, "The Ethnic Festival and Cultural Revivalism in a Small Midwestern Town," Ph.D. dissertation, Indiana University, 1972.

[5] See B. Eugene Griessman, sub-editor, "The American Isolates," *American Anthropologist,* LXXIV, 3, (June, 1973), pp. 693-734; also Saundra Keyes Ivey, "Ascribed Ethnicity and the Ethnic Display Event: The Melungeons of Hancock County, Tennessee," *Western Folklore,* XXXVI, 1 (Jan., 1977), pp. 85-107.

[6] Danielson, Op. cit.

[7] Ivey, Op. cit.

[8] In the masthead of the *Ocooch Mountain News,* "Ocooch" is defined as "one form of a Winnebago word meaning 'place you go to shoot fish.' The name was used in the 19th Century to refer to the hills of SW Wisconsin."

[9] Halsey Rinehart, "Geology," *Ocooch Mountain News,* III, 5 (May, 1977), pp. 28-29.

[10] This road, the present County W, runs through the middle of Charles Bannen's farm.

[11] Excerpted from Anonymous, compiler, *History of Crawford and Richland Counties, Wisconsin* (Springfield, Ill.: Union Publishing Co., 1884), p. 699. The brackets are mine.

[12] Sister M. Justille McDonald, *History of the Irish in Wisconsin in the Nineteenth Century* (Washington, D.C.: Catholic University of America Press, 1954), p. 280.

[13] *Ibid.,* pp. 9-10.

[14] Joseph Schafer, *Four Wisconsin Counties, Prairie and Forest* (Madison: State Historical Society of Wisconsin, 1927), p. 88, discusses the usual pattern of Irish immigration to Wisconsin.

[15] See Robert L. Wright, ed., *Irish Emigrant Ballads and Songs* (Bowling Green: Bowling Green University Popular Press, 1975), for an excellent compendium of Irish-American songs. For a nineteenth-century description of anti-Irish sentiment and its effects on Irish immigrants, see the June 10, 1887 letter from Dr. P. O'Connell of Chicago to Archbishop Croke of Cashel in Arthur Mitchell, "A View of the Irish in America: 1887," *Eire-Ireland,* IV, 1 (Spring, 1969), pp. 7-12.

[16] Bill C. Malone, *Country Music, U.S.A.: A Fifty Year History* (Austin: University of Texas Press, 1968), p. 194.

[17] Wright, Op. cit., p. 606. The broadside is without imprint; a copy can be found in the Newberry Library in Chicago.

[18] A folk musician as a performer and creator of folk materials has been the subject of several recent studies: Henry Glassie, " 'Take That Night Train to Selma': An Excursion to the Outskirts of Scholarship"; Edward D. Ives, "A Man and His Song: Joe Scott and 'The Plain Golden Band' "; and John F. Szwed, "Paul E. Hall: A Newfoundland Song-Maker and Community of Song" in *Folksongs and Their Makers* (Bowling Green: Bowling Green University Popular Press, 1970); and Almeda Riddle, *A Singer and Her Songs: Almeda Riddle's Book of Ballads,* Roger D. Abrahams, ed., and George Foss, music ed. (Baton Rouge: Louisiana State University Press, 1970). Edward D. Ives, *Joe Scott: The Woodsman-Songmaker* (Urbana: University of Illinois Press, 1978) is one of the most painstaking and poetic examinations of such a folk creator.

The interpretation of folklore as a "process of performance" increasingly characterized the studies of a number of American folklorists in the late

1960's and early 1970's. Two diverse anthologies concerning the performance aspects of folklore are Americo Paredes and Richard Bauman, eds., *Toward New Perspectives in Folklore* (Austin: University of Texas Press, 1972); and Dan Ben-Amos and Kenneth S. Goldstein, eds., *Folklore: Performance and Communication* (The Hague: Mouton and Co., 1975).

[19] Malone, Op. cit., pp. 9-10. For a theory which asserts a relationship among the modes of pentatonicism of African, Anglo-Irish, and Native American music, see Bence Szabolcsi, *A History of Melody,* trans. by Bynthia Jolly and Sára Karig (London: Barrie and Rockliff, 1965 [Budapest, 1950]), especially pp. 226-228; it is my opinion that this theory must be regarded with a degree of circumspection, for it is based on limited historical and ethnographic considerations concerning the settlement of North America.

[20] Malone, Op. cit., p. 66.

[21] See Richard A. Waterman, "African Influence on the Music of the Americas," *Acculturation in the Americas,* Sol Tax, ed. (Chicago: Proceedings of the 29th International Congress of Americanists, 1952), 2: pp. 207-218, for the types and patterns of musical syncretism, or hybridization, which have characterized some styles of American music.

[22] Charles Ives, *Memos,* John Kirkpatrick, ed. (New York: W. W. Norton, 1972), pp. 53-54; the parentheses are added by Charles Ives; the brackets enclose the editorial additions of John Kirkpatrick.

[23] George Pullen Jackson, *White Spirituals in the Southern Uplands: The Story of the Fasola Folk, Their Songs, Singings, and "Buckwheat Notes,"* (New York: Dover Publications, Inc., 1965 [1933]), p. 161.

[24] See, for example, P. P. Bliss and Ira D. Sankey, *Gospel Hymns and Sacred Songs* (Chicago: Biglow and Main; and, Chicago: John Church and Co., 1875); the hymn, "Yet There Is Room" (No. 81), is a prime example.

[25] Recordings of Bannen's songs are deposited in the Archive of Ethnomusicology, University of Illinois, Collection No. 195.

[26] For another Version of "Pat Malone" see Harry B. Peters, ed., *Folk Songs out of Wisconsin* (Madison: State Historical Society of Wisconsin, 1977), p. 300.

[27] Francis James Child, *The English and Scottish Popular Ballads,* Vol. II (New York: Dover Publications, Inc., 1965 [1885]), pp. 276-279.

[28] Charles Seeger, "Versions and Variants of the Tunes of 'Barbara Allen,'" *Selected Reports in Ethnomusicology,* I, 1 (Los Angeles: Program in Ethnomusicology, Department of Music, University of California, Los Angeles, 1966), pp. 120-167. Seeger suggests that Version II of "Barbara Allen" may stem most directly from Ireland and Scotland, and not from England; this is largely speculation on Seeger's part.

[29] Bertrand Bronson, *The Singing Tradition of Child's Popular Ballads* (Princeton: Princeton University Press, 1976), pp. 221-228; and Mieczyslaw Kolinski, "'Barbara Allen': Tonal Versus Melodic Structure," *Ethnomusicology,* XII, 2 (May, 1968) pp. 208-218, and XIII, 1 (Jan., 1969) pp. 1-73.

THE LATE WISCONSINAN GLACIAL LAKES OF THE FOX RIVER WATERSHED, WISCONSIN

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Abstract

The pre-Woodfordian Fox River flowed through the Marquette bedrock valley to the Wisconsin River. This river was dammed by glacial deposits during the maximum glacial advance of Woodfordian time.

During the Woodfordian and Greatlakean recessions and lesser advances, glacial lakes formed in the Fox River watershed as glacial ice blocked drainage to the north through Green Bay. As the ice retreated, successively lower outlets were exposed, first at Portage and later through the Neshota and West Twin, Kewaunee, and Ahnapee Rivers. The Manitowoc River may have also served as a spillway for waters from the glacial lake.

During glacial advances, lake levels were stable or changed only slowly. During glacial recessions, lake levels changed quickly and perhaps catastrophically. Erosion and alluviation within the outlets of the glacial lakes were more pronounced during times of glacial recession than during times of glacial advance.

The extent of each glacial lake associated with each outlet is illustrated. A change in terminology is proposed to define more specifically the extents and outlets of the glacial lakes.

INTRODUCTION

Deposits of lacustrine sediment have been recognized in the Fox River watershed for 125 years. These deposits have traditionally been interpreted as having formed in glacial lakes. Studies of the glacial lakes of the area have proceeded concurrently with studies of regional glaciations. The years of investigation have produced terminology which is in part confusing, poorly-defined, and out-of-date.

This paper presents an historical perspective of studies of the glacial lakes of this area, describes current hypotheses and observations which apply to the topic, and suggests simplifications in terminology.

STUDY AREA

The area of study includes the Fox River watershed and those channels that served as drainageways for water that was present in the watershed at times of glaciation (Fig. 1).

The Fox River watershed of northeastern Wisconsin is irregular in shape, reaching to nearly 46° latitude at its northward extent, 43° 30′ latitude to the south, 89° 45′ longitude to the west, and 87° 45′ longitude to the east. The rivers that may have discharged waters from the watershed during glaciations are the Wisconsin River near Portage, the Rock River, the Manitowoc River, the Neshota and West Twin Rivers, the Kewaunee River, the Ahnapee River, and the strait at Sturgeon Bay (Fig. 1).

LOBATION OF GLACIERS

Two glacial lobes, the Green Bay Lobe and the Lake Michigan Lobe (Fig. 2), are related to the history of the glacial lakes. At several times during the Pleistocene, the Green Bay Lobe, an extension of the larger Lake Michigan Glacier, moved up the north-

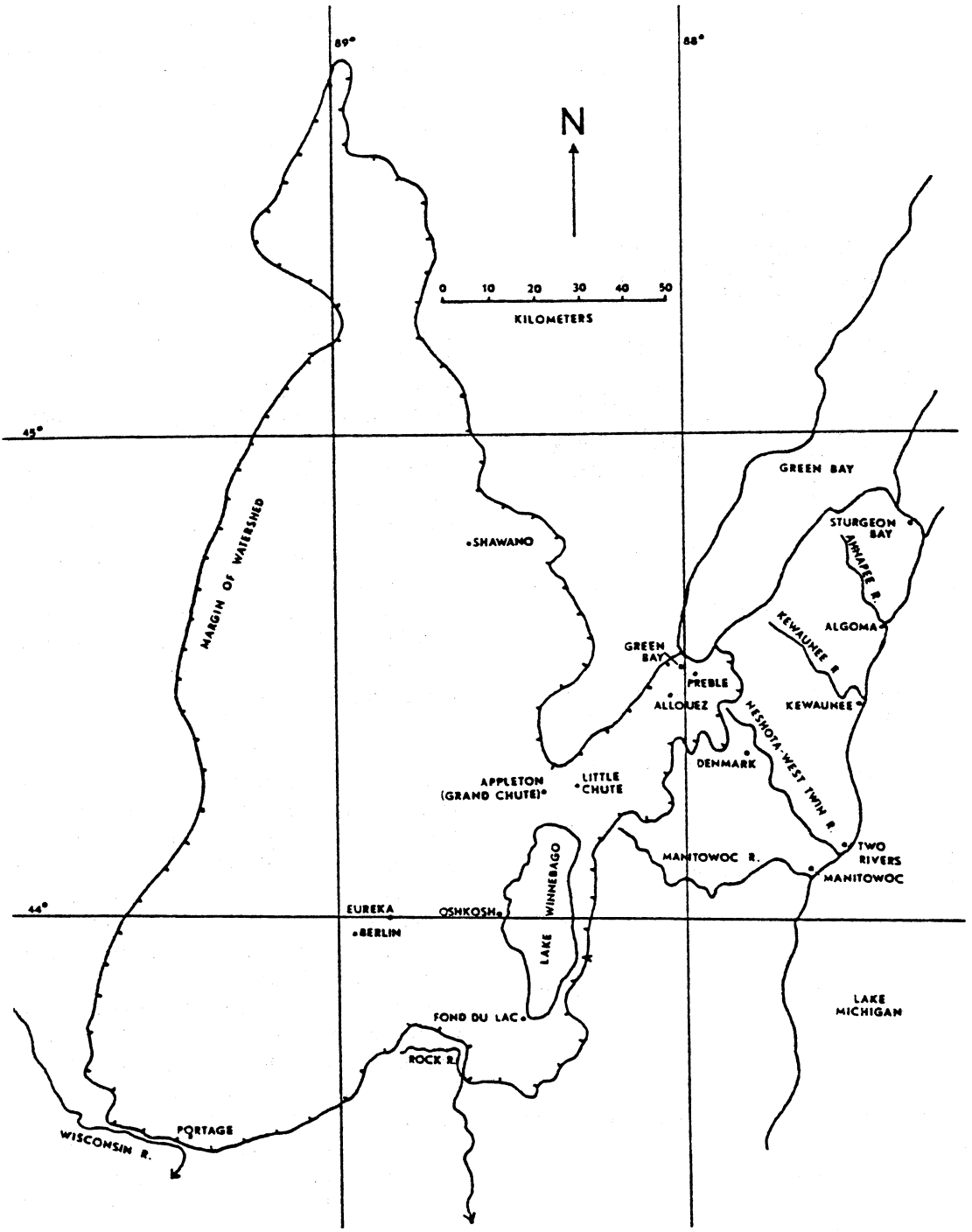

Fig. 1. Area of study in northeastern Wisconsin.

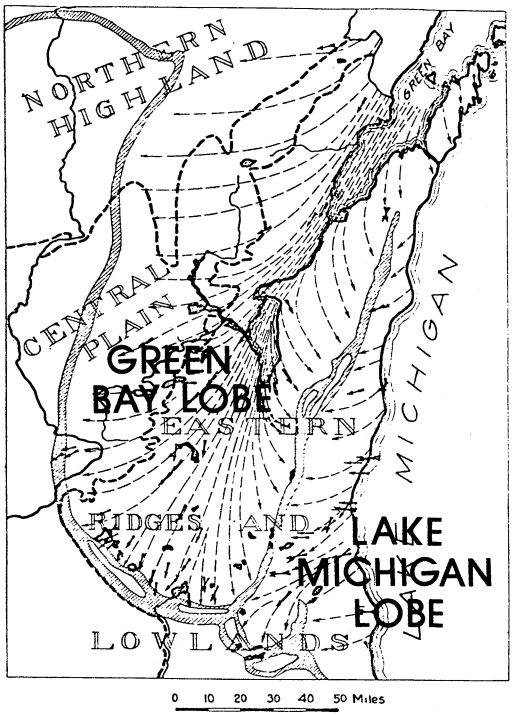

Fig. 2. Location of glacial lobes in northeastern Wisconsin (from Martin, 1932).

TABLE 1. Time terms used in this paper (previously-used terms in parentheses).

Years Before Present				
	4,000		Holocene	
	8,000	Wisconsinan Stage	Greatlakean	(Valderan)
	12,000		Twocreekan	
	16,000			(Cary)
	20,000		Woodfordian	
	24,000			(Tazewell)

ward sloping Fox River watershed from Green Bay. Initially, the ice was contained on the east margin of the watershed by the Niagara Escarpment, a cuesta of dolomite extending from the tip of the Door Peninsula southward through eastern Wisconsin. Ice of the Lake Michigan Lobe eventually merged with the ice of the Green Bay Lobe along the Kettle Moraine area. Ice of the Green Bay Lobe spread south and west, at times covering the entire Fox River watershed.

Time Terms

The time terms used in this paper are presented in Table 1. During the Holocene and Twocreekan intervals, ice was not continually present in Wisconsin. During the later portion of the Greatlakean subage, Wisconsin was ice-free. The Woodfordian subage was a period of glaciation when fluctuations in the glacial margins may have rendered Wisconsin free of ice for short periods.

Cary and Tazewell were for many years used as subdivisions of the Wisconsinan age, but are no longer recognized. The term Valderan has been a source of confusion in the literature and the term Greatlakean, suggested by Evenson and others (1976), is being used in this paper. The previous common use of these terms warrants their recognition in this paper.

Previous Studies

The initial report bearing on the glacial lakes of the Fox River valley was that of Charles Whittlesey (1849). This report, part of David Dale Owen's *Report of a Geological Survey of Wisconsin, Iowa, and Minnesota* (1852), noted widespread existence of "loose diluvial material" throughout much of the Great Lakes area. He noted extensive "red clay" deposits throughout the valleys of Lake Winnebago, the Fox River, and Wolf River. He attributed the red clay to inland lakes. The distribution of the red clay deposits in the Fox River valley was not specified, but stratigraphic sections taken from well records included red clay at Fond du Lac, Oshkosh, Green Bay, and Grand Chute. In addition red clay deposits were

described from Appleton, Shawano Lake, and the falls of the Wolf River.

General G. K. Warren (1876) mapped the approximate extent of the red clay in the Fox River valley. He regarded it as sediment of a previously larger Lake Winnebago; he believed that the lake had drained past Portage to the Wisconsin River.

T. C. Chamberlin (1878) described the red clay deposits as occurring within the Green Bay valley and extending a few miles south of Fond du Lac, up the Fox River beyond Berlin, and up the Wolf River beyond Shawano. He concluded that the red clay represented a subaqueous deposit that was the result of former higher lake levels of Lake Michigan and Green Bay. To account for differences in the elevations of red clay, he postulated crustal movements associated with or following deposition of the clay. Chamberlin described a second stratigraphically-higher red clay deposit that is restricted to areas adjacent to Lake Michigan north of Manitowoc. He suggested the lower red-clay deposit formed at a higher lake level of Lake Michigan and Green Bay following a glacial retreat. When lake levels then dropped and rose again, the upper red clay unit was deposited only in the Lake Michigan basin. Finally lake levels again dropped. The source of the red clay was thought to be the underlying coarse "bowlder clay." Through shoreline erosion the fine material within the "bowlder clay" was washed out, providing the sediment for the subaqueous red-clay deposits.

T. C. Chamberlin (1883) reiterated these observations and hypotheses and added that the lakes may have gradually formed as the ice retreated, producing great fringing lakes along the border of the glacier. He also noted that at some point the meltwater from the Green Bay Lobe was probably discharged through the Wisconsin River valley. He observed that there had been many important channels of discharge crossing drainage divides that now appear as extinct channels.

Aware of glacial discharge channels from other known glacial lakes, Warren Upham (1903a) visited Portage. He suggested that the northern part of the Fox River valley had at times been blocked with glacial ice and that at these times the lowest point in the Fox River divide had been in the vicinity of Portage. He speculated that water from the glacial lake in front of the Green Bay Lobe had discharged into the Wisconsin River through this divide. Upham found the Fox River above Portage to be decidedly underfit. The river was found to be 10 to 15 m wide and 30 cm deep, while the valley was over 300 m wide and 10 m deep. He concluded that the existing Fox River occupied the ancient eroded channel of a larger river that flowed in the opposite direction.

Upham wrote (1903a p. 111):

> when Warren and Chamberlin thus described the region of the Fox river, lake Winnebago, and Green bay, the effect of the barrier of the waning continental ice-sheet to form lakes in basins sloping northerly toward the receding ice border had not been fully and generally recognized. Neither of these writers appealed to the glacial barrier on the north as the cause of the formerly greater lakes which they mapped and described; nor did Chamberlin refer to the southward outlet at Portage, near the head of the Fox valley, but rather ascribed this entire lacustrine tract to an expansion of lake Michigan when the lake Winnebago region was much depressed below its present altitude.

It was now apparent that meltwaters from the Green Bay Lobe were periodically restricted to the Fox River valley and did not merge with those of the Lake Michigan Lobe. For at least a time there had been two distinct glacial lakes. The lake in front of the Lake Michigan Lobe previously had been named "Glacial Lake Chicago." Up-

ham proposed "Glacial Lake Nicolet" for the glacial lake that had existed in front of the Green Bay Lobe.

The separation of the two glacial lakes made unnecessary Chamberlin's hypothesis of localized crustal movement to account for the differing elevations of red clay in the two lake basins. Upham noted that as the ice receded, the two ice-marginal lakes would eventually merge and assume the same level. The elevation of the floor of the channel that served as the outlet at Portage was estimated to be 780 feet above sea level. Upham also suggested that the red clay was partially reworked red till rather than a sorted fraction of Chamberlin's "bowlder clay."

Upham (1903b) later altered his proposed name to "Glacial Lake Jean Nicolet" to distinguish it from "Glacial Lake Nicollet," named for Joseph Nicollet, the name previously assigned to a glacial lake that had existed in Minnesota.

Weidman (1911) recognized seven ancient shorelines in the Green Bay area and ascribed these to previous shorelines of "Glacial Lake Jean Nicolet." Weidman ascribed the highest two shorelines, at elevations of 800 and 830 feet above sea level, to the Portage outlet. The lower five elevations, at 600, 620, 650, 675, and 730 feet above sea level, were thought to be related to changes in the elevations of outlets of Lake Chicago and later stages of Lake Michigan.

Alden (1918) noted numerous deposits of sand and gravel in the Fox River basin at elevations approximately 800 feet above sea level. These he believed to represent shoreline deposits of water ponded in the basin after the retreating ice front had opened the outlet at Portage. Alden wrote (1918 p. 324-325):

> on the east this glacial lake was limited by the steep slope of the Niagara escarpment, and south and west of Fond du Lac by the red till ridge. The site of Fond du Lac was thus submerged beneath 40 to 60 feet of water. The upper part of the ridge just south of Eureka, as well as other ridges between Fox River and Lake Poygan, in Rushford and Poygan townships, must have stood as islands in the lake. Farther west and southwest, in Waushara and Marquette counties, the water submerged much of the lowlands now occupied by the extensive marshes. North and west of Oshkosh the lake waters extended far up the valleys and spread widely over the intervening lowlands, submerging considerable parts of Marinette, Shawano, Brown, Outagamie, Waupaca, Winnebago, Green Lake, Marquette, and Columbia counties.

Alden recognized that the red clay was derived from a red till that he believed to have been related to the final glacial advance in northeastern Wisconsin. Alden also noted that glacial lakes of similar extent were developed during the retreat of the earlier (Woodfordian-Cary) glacier and with both the advance and retreat of the glacier that deposited the red till. Alden was not satisfied with the name "Glacial Lake Jean Nicolet," and suggested that this name be applied only to the stage at which the Portage outlet was active. Alden suggested that a lower outlet was probably present providing drainage across the Door Peninsula after additional retreat of the glacier. This proposed outlet channeled the water across the Door Peninsula and into Glacial Lake Chicago.

F. T. Thwaites suggested in a 1927 unpublished work that the name "Glacial Lake Jean Nicolet" be discarded, and that the name "Early Lake Oshkosh" be applied to the lake at times when the Portage outlet was active, and the name "Later Lake Oshkosh" be applied to lower levels of glacial waters in the same basin, presumably when some lower outlet was discharging waters from the lake (Ellsworth and Wilgus, 1930).

Martin (1932) recognized the Portage outlet of Early Lake Oshkosh, but proposed

an apparently higher outlet that channeled water down the Rock River beginning near Fond du Lac. Martin described possible shorelines of Lake Oshkosh at elevations of 755, 800, and 830 feet above sea level.

Thwaites (1943) concluded that the highest water level of Lake Oshkosh could not have reached the elevation of 822 feet above sea level and suggested a maximum lake level of between 800 and 820 feet above sea level for Lake Oshkosh at times of discharge through the Portage outlet. Thwaites concurred with Alden's view that Lake Oshkosh existed during the recession of the Woodfordian (Cary) Glacier as well as at the times of the advance and recession of the Greatlakean Glacier. Five figures in Thwaites' publication show portions of Lake Oshkosh at various times.

Thwaites continued to distinguish Early Lake Oshkosh from Later Lake Oshkosh, but applied the name "Later Lake Oshkosh" to a stage when lake waters were discharging at Portage. He described a beach deposit of Later Lake Oshkosh at Little Chute at an elevation of 815 feet above sea level, implying a Portage outlet. He seems to have applied the name "Early Lake Oshkosh" to lakes associated with the Woodfordian (Cary) glacial recession and the Greatlakean glacial advance. The term "Later Lake Oshkosh" seems to be applied in this context to lakes associated with the maximum extent and subsequent regression of Greatlakean ice. This represents an apparent change in definition from Thwaites' previous (1927) work.

Thwaites (1957) postulated a glacial lake in the Fox River lowlands in advance of the Woodfordian Glacier based on well records from Preble and Allouez. He applied the name "Early Lake Oshkosh" to the glacial lakes that existed in the same lowlands during the recession of the Woodfordian Glacier and during the subsequent advance of the Greatlakean Glacier. The name "Later Lake Oshkosh" was again reserved for the lake as it existed during the Greatlakean glacial maximum and throughout the following recession.

In addition, he indicated that the history of drainage of Early Lake Oshkosh across the Niagara Escarpment was unknown but implied that the Portage outlet was used during the high water level of Early Lake Oshkosh.

The first outlet of Later Lake Oshkosh was in the vicinity of Portage at an estimated elevation of 800 feet above sea level. The second outlet proposed by Thwaites was through a sag in the Niagara Escarpment near the north end of Lake Winnebago and from there down the Manitowoc River to Lake Michigan. The elevation of this divide was estimated to be 800 feet above sea level, nearly the same elevation as the Portage outlet. The next outlet was through the Neshota and West Twin River at an estimated maximum spillway elevation of 765 feet above sea level. The Kewaunee River with an estimated divide elevation of 682 feet above sea level served as the next outlet. The Ahnapee River with a spillway elevation 640 feet above sea level was the next outlet. This outlet was active until retreating ice opened the strait at Sturgeon Bay, at which point the water levels of Lake Oshkosh and Lake Michigan merged.

Thwaites postulated rapid lowering of lake levels as each succeedingly lower outlet was opened. Erosion within the spillways had, in places, eroded the channels down to bedrock. Thwaites attempted to compute discharge rates for three of the outlets. This computation requires data on channel depth, channel slope, bottom roughness, and channel width. Only channel width was directly measurable. Stream velocities for the Neshota and West Twin, Kewaunee, and Ahnapee spillways were estimated to range from 1.2 to 1.6 m/s once grade was established. Initial velocities were thought to be higher.

Computed discharge values ranged from 4000 m^3/s to 5000 m^3/s. Again initial discharges would be expected to be greater.

Paull and Paull (1977) recognize spillways of Glacial Lake Oshkosh at Portage, the Manitowoc River, the Kewaunee River, and the Ahnapee River. They fail to note the Neshota and West Twin spillway.

Outlets of the Glacial Lakes

The preglacial drainage of the study area has been postulated by Stewart (1976) to have been through the Marquette-Wisconsin system. He suggested that this system was dammed by glacial deposits during the maximum advance of Woodfordian ice. As such, Glacial Lake Oshkosh probably was not present until this damming was accomplished. While it appears likely that the first Lake Oshkosh formed during the recession of the Woodfordian Glacier from its maximum extent, the possibility remains that an earlier glaciation may have blocked the Marquette-Wisconsin system, producing a pre-Woodfordian series of lakes.

Both Goldthwaite (1907) and Thwaites (1957) recognized that postglacial isostatic uplift had raised beaches along Lake Michigan north of Two Rivers. For example, the beach of Lake Algonquin, a high-water stage of Lake Michigan, is present at an elevation of 610 feet above sea level at Two Rivers and occurs at an elevation of 670 feet above sea level at Detroit Harbor. This represents an uplift of 60 feet in approximately 90 miles. Little evidence exists to suggest that isostatic uplift was significant south of Two Rivers.

A significant part of the Fox River watershed lies north of the latitude of Two Rivers, and some evidence of the effects of isostatic rebound might be expected to be present in the watershed. Thwaites (1943) explored this possibility and concluded that there was little definite evidence of tilting of shorelines in the region. He believed that postglacial earth movements were probably confined to a region farther to the north. The factor of isostatic readjustment must be considered to have potential importance in the history of

Table 2. Elevations of locations of outlets proposed as spillways for Glacial Lake Oshkosh.

Outlet	*Divide Elevation (feet above sea level)*	*Location (topographic maps of area in parentheses)*
Rock River	885	NE¼ Sec.18, T.14N., R.16E. N½ Sec.28, T.14N., R.16E. SE¼ Sec.12, T.14N., R.15E. (Waupun 1:62,500)
Manitowoc River	815	W½ Sec.15, T.20N., R.19E. (Chilton 1:62,500)
Portage	780	Sec.16, T.13N., R.9E. (Portage 1:62,500)
Neshota and West Twin River	775	Sec.25, T.23N., R.21E. (Denmark 1:62,500)
Kewaunee River	685	Sec. 30, T.25N., R.23E. (New Franken and Casco 1:62,500)
Ahnapee River	635	NE¼ Sec.35, T.27N., R.24E. (Little Sturgeon 1:62,500)

the glacial lakes even though no evidence of this process has yet been demonstrated in the area.

Six outlets for Glacial Lake Oshkosh have been suggested by previous authors. They are, from highest divide elevation to lowest, the Rock River outlet south of Fond du Lac, the Manitowoc River outlet, the Portage outlet, the Neshota and West Twin River outlet, the Kewaunee River outlet, and the Ahnapee River outlet (Table 2).

Rock River Outlet

The only previous study to propose the Rock River as a spillway for Lake Oshkosh was that of Martin (1932). The proposed outlet was in the vicinity of the Niagara Escarpment north of the Horicon Marsh. The topographic map indicates three potential locations for such an outlet, each with a divide elevation approximately 885 feet above sea level.

The region of the Fox River watershed south of Fond du Lac is surrounded on the east, south, and west by divides (Fig. 1). At various times during glaciation, ice-marginal lakes probably formed in this area as glaciers to the north closed the area, each time producing a lake within this small embayment of the watershed. At these times water probably discharged to the Rock River system through one or more of the divide locations described.

This area was probably isolated before advancing ice reached the Portage outlet and after receding ice cleared the Portage outlet. At each time this small lake was present, it appears likely that a larger Lake Oshkosh still existed to the west and continued to discharge through the Portage outlet. For this reason the Rock River outlet is not considered by this author to represent a primary outlet of Lake Oshkosh.

Manitowoc River Outlet

The lowest point in the divide between the Fox River watershed and the Manitowoc River is at approximately 815 feet above sea level. Although a slight topographic sag is present in the divide area, no distinct channel is present. The Portage outlet, far to the southwest, has a divide elevation of 780 feet above sea level, and considerable evidence exists to suggest that at an earlier time the divide elevation may have been 800 feet above sea level. Since an advancing glacier would cover the Manitowoc River outlet before approaching the Portage outlet, and since the Portage outlet would be open before the retreating glacier opened the Manitowoc River outlet, it appears that this outlet could not have served as a spillway for Lake Oshkosh.

A number of possibilities exist through which this outlet may have been active. During the late Woodfordian glaciation, retreating ice made several minor readvances, depositing considerable thicknesses of glacial debris in the general area of the divide. Prior to that time, the elevation of the divide area may have been considerably lower. If Lake Oshkosh existed prior to the maximum extent of the Woodfordian Glacier, the divide elevation of the Manitowoc River outlet may have been lower than the divide elevation of the Portage outlet. During the advance of the Woodfordian Glacier the water from Lake Oshkosh may have drained through the Manitowoc River valley until the advancing ice closed the outlet. Greatlakean glacial deposits are also present in the area, but typically occur in thicknesses of only a few feet, so their absence probably would not have been sufficient to activate this outlet during the Greatlakean glacial advance.

The Lake Michigan Lobe was much larger than the Green Bay Lobe, and it is likely that any isostatic depression of areas close to the Lake Michigan Lobe was greater than any similar depression associated with the Green Bay Lobe. It is possible that the area of the Manitowoc River outlet was more severely depressed than the area of the

Portage outlet. If the isostatic rebound was slow enough, the retreating ice may have exposed the Manitowoc River outlet at a time when it had not rebounded sufficiently to have a higher divide elevation than the less-depressed Portage outlet. If this were to occur, water from Lake Oshkosh would flow down the Manitowoc River valley until isostatic rebound raised the elevation of the Manitowoc River outlet above the elevation of the Portage outlet, or until further northward retreat of the ice opened the lower Neshota and West Twin River outlet.

The role of the Manitowoc River as an outlet for Glacial Lake Oshkosh must remain problematical.

Portage Outlet

Water from Lake Oshkosh drained out near Portage through a narrow spillway with a current bottom elevation of slightly less than 780 feet above sea level. Water discharging from Lake Oshkosh through this valley merged with water of the Wisconsin River to the south. The Wisconsin River flows on through another narrow spillway near Dekorra at Sec. 12, T. 11 N., R. 8 E. (Poynette 1:62,500). This spillway also has a current bottom elevation of slightly less than 780 feet above sea level. Since water from both the Wisconsin River and Lake Oshkosh flowed through the Dekorra spillway, the elevation of the floor of the spillway at Dekorra appears to have acted as a control of the levels of water in the Wisconsin River and Lake Oshkosh above it.

Many writers have noted beach deposits of Lake Oshkosh at elevations of 800 feet above sea level. Along the Wisconsin River above Portage similar topographic breaks are known to be present. It appears that for significant periods water was stabilized near the 800 foot level both in Lake Oshkosh and in the Wisconsin River valley north of the Dekorra spillway because there are pronounced beaches in the Fox River watershed at 800 feet elevation, and there are large alluvial deposits along the Wisconsin River at a similar elevation. Because the Wisconsin River did not follow its present course past Portage prior to the Woodfordian recession, the 800 foot beaches and alluvial deposits are features that were most likely formed following the maximum Woodfordian glacial advance.

Clearly there was an apparent change in lake level from 800 to 780 feet above sea level. This change may have been caused by downcutting of the Dekorra and Portage spillways during or following the recession of the Woodfordian Glacier or by a combination of isostatic uplift and downcutting of the Dekorra and Portage spillways during or following the recession of the Woodfordian Glacier. In either case it appears that in more recent times the maximum level of Lake Oshkosh when waters discharged through the Portage outlet was approximately 780 feet above sea level.

A definite channel from the spillway north of Portage to the Wisconsin River at 780 feet elevation is not evident, probably because of more recent alluviation by the Wisconsin River during flooding.

Neshota and West Twin River Outlet

The lowest point in the divide between the Fox River watershed and the Neshota and West Twin River is 775 feet above sea level. From this location the Neshota and West Twin River flows southwest to Two Rivers through a valley that is decidedly underfit. The valley walls are steep and high. North of Denmark the valley has been cut more than 30 m below the surrounding terrain. In many places the valley floor is flat, suggesting that alluvium partially fills it.

The well-defined channel, steep valley walls and flat valley floor suggest that this outlet was recently active. Thwaites (1957) noted that in places this valley was eroded down to bedrock. It appears likely that this valley repeatedly served as an outlet for

Lake Oshkosh, most recently during the recession of Greatlakean ice.

Kewaunee River Outlet

The divide for the Kewaunee River outlet occurs south of Dyckesville at an approximate elevation of 685 feet above sea level. The Kewaunee River is decidedly underfit in a larger abandoned channel. The channel is as much as 1 km wide and 35 m deep. The channel floor is flat, suggesting the presence of alluvial fill. Large rounded boulders of dolomite, some exceeding 1 m in diameter, are present in the streambed at the south edge, Sec. 28, T. 24 N., R. 24 E.

The well-defined channel, abandoned cutbanks, and flat valley floor of this spillway suggest that this outlet was recently active. Thwaites (1957, p. 870) suggests that red till of probable Greatlakean age is cut by this valley at Kewaunee, suggesting that this outlet was active following the recession of Greatlakean ice. This valley was probably repeatedly utilized as an outlet for Lake Oshkosh.

Ahnapee River Outlet

The spillway divide between the Ahnapee River and the Fox River watershed occurs at approximately 635 feet above sea level. Although topographic evidence suggests that this valley must have served as an outlet for Lake Oshkosh during times when the channel to the north at Sturgeon Bay was blocked with ice, there is an absence of the deep, flat-floored channel of other outlets.

Alden (1918) mapped the highest level of glacial Lake Chicago, a high-water stage of Lake Michigan, at approximately 640 feet above sea level. Ancient beaches occur along the Wisconsin shoreline of Lake Michigan from Waukegan north to Manitowoc. Mickelson and Evenson (1975) have shown that bluffs of Greatlakean till north of Manitowoc do not have evidence of similar ancient shorelines. This led them to conclude that following the Twocreekan interglacial times, Lake Michigan was at a level lower than 640 feet above sea level. Had Lake Michigan been at the 640 foot level during the Greatlakean recession, similar beaches would be expected to be found cut into the Greatlakean deposits along Lake Michigan.

At times when Lake Michigan water was at the 640-foot level, this outlet would have been entirely submerged, and the level of Lake Oshkosh would have been the same as the level of Lake Michigan. It is only during the Greatlakean glacial recession that Lake Michigan water level was substantially lower than the divide elevation of the Ahnapee outlet. This would have been the only time when major channel erosion was possible. During this recession it is likely that this outlet was active only during the short period of time when it was free of ice and the nearby channel at Sturgeon Bay was still blocked.

The absence of major erosional features in the Ahnapee River outlet can probably be attributed to the fact that erosion must have been active for only a short period during the Greatlakean glacial recession.

Extent of the Glacial Lakes

Any attempt to describe precisely the extent of the various glacial lakes in the Fox River valley is complicated by several factors. Although it is known from stratigraphic studies that there have been several glacial advances and retreats through the Fox River watershed, the specific number, sequence and extents of the glacial advances within this area are not yet established. Although several probable outlets for glacial meltwater have been noted, each outlet may or may not have been used during a specific glacial advance or retreat.

Lake levels may have fluctuated as overriding glaciers partially filled the spillways with sediment, increasing the elevations of the divides within the spillways. In addition, when each outlet was active, erosion could be expected to lower the level of the divide,

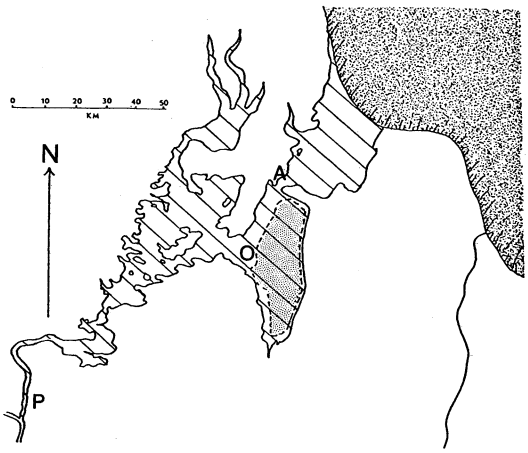

Fig. 3a. Glacial Lake Oshkosh at the Portage level—lake level 780 feet above sea level.

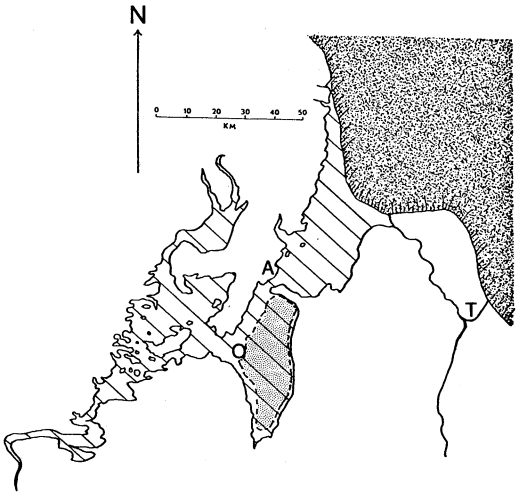

Fig. 3b. Glacial Lake Oshkosh at the Neshota and West Twin level—lake level 775 feet above sea level.

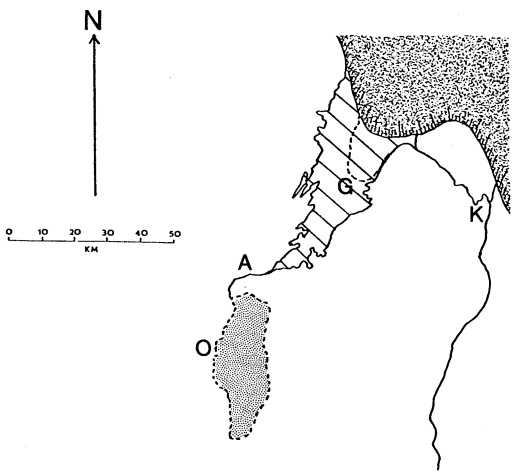

Fig. 3c. Glacial Lake Oshkosh at the Kewaunee level—lake level 685 feet above sea level.

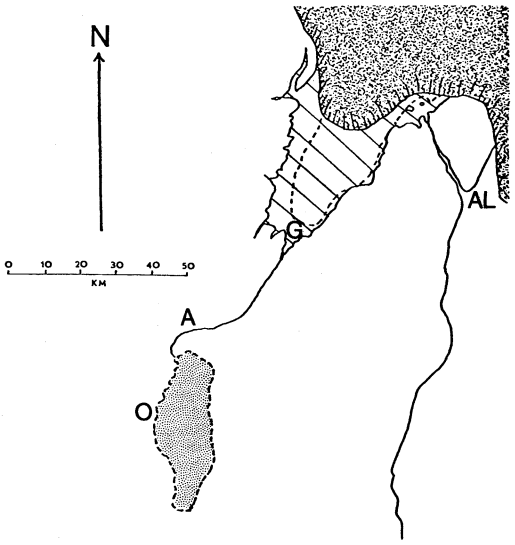

Fig. 3d. Glacial Lake Oshkosh at the Ahnapee level—lake level 635 feet above sea level.

Fig. 3. Approximate extent of Glacial Lake Oshkosh at the Portage, Neshota and West Twin, Kewaunee and Ahnapee levels. The extent of the Lake at each level is shown as a diagonally-ruled area. The outlines of Lake Winnebago and Green Bay are indicated by dashed lines and Lake Winnebago is also stippled. Irregular shading denotes the hypothetical location of glacial ice. Letters indicate the location of cities: P—Portage, O—Oshkosh, A—Appleton, T—Two Rivers, G—Green Bay, K—Kewaunee and AL—Algoma.

producing lower lake levels in the glacial lake behind it. Determination of lake levels on the basis of preserved shoreline deposits is difficult because the advancing glaciers overrode and destroyed many of the previous beaches.

Finally, there have been no detailed stratigraphic studies of the sediment of the glacial lakes. Indeed, until a fuller understanding of the history of glacial movements is reached, study of the stratigraphy may yield findings that are potentially misleading. For example, the past practice seems to have been to identify any buried wood found in Fox River valley sediment as being of Two-creekan age. These deposits were assumed to be correlative with the buried forest deposits near Two Creeks. While the deposits at Two Creeks are, by definition, Two-creekan age, no direct correlations have been made to the similar deposits of the Fox River valley. The radiocarbon ages of the samples generally agree, although the range of experimental uncertainty is such that some of the samples from the Fox River valley may be of latest Woodfordian age.

It should be clear that a detailed chronology of all the glacial lakes that have existed within the Fox River watershed is not within the capabilities of science at this time. It is possible, however, to grossly estimate the extent of the most recent glacial lakes.

The procedure used to determine the areas of the most recent glacial lakes involved determination of the modern divide elevations of the outlets (Table 2). Using 1:62,500 topographic maps when possible, these elevations were mapped throughout the Fox River watershed. In areas where 1:62,500 scale maps were not available, 1:250,000 scale maps were used. Four maps were prepared using this procedure (Fig. 3a, b, c and d).

The extent of each glacial lake is shown as a diagonally-ruled area. The outlines of Lake Winnebago and Green Bay are indicated by dashed lines, and Lake Winnebago is shaded. Irregular shading denotes the hypothetical location of glacial ice. The locations of the glacial termini are largely hypothetical and it is acknowledged that glacial movements would result in modified locations of the termini.

The procedure employed fails to compensate for erosion of divide elevations in recent time, for possible changes in divide elevations due to isostatic readjustment, and for any differences between current divide elevations and the somewhat higher level of water which probably existed in the channel and lake. While the figures presented here may be imprecise, they represent a first attempt to illustrate the extent of the most recent glacial lakes which were present in the Fox River watershed.

Draining of the Glacial Lakes

Conditions and events within the spillways and lake basins of the Green Bay Lobe differed significantly with the direction of movement of glacial ice. It is suggested that during glacial advances, lake levels were stable, or changed only slowly. During glacial recessions, however, lake levels changed quickly and perhaps catastrophically. Erosion of the presently identifiable spillways occurred primarily during intervals of glacial recession.

During glacial advances, lake water ponded in front of the advancing ice and water level within the lake rose until it reached the divide elevation of the next-higher outlet. At this point the elevation of the lake surface stabilized, then slowly decreased as a result of slow channel erosion within the spillway. Eventually the advancing ice covered the spillway and lake level rose again until the next-higher outlet was reached. During glacial advance it is likely that the length of time necessary for the lake level to rise to the next outlet was small in

comparison to the length of time during which the lake level was relatively stable and the outlet was active.

During glacial recession it appears logical that when a glacier receded past a lower outlet, this outlet then opened rapidly and large quantities of water surged through the spillway as the level of the glacial lake quickly dropped. When a dam of glacial ice was breached, the effects could be expected to be as violent as those related to the breaching of a modern dam.

A major factor governing the magnitude of such an event is the amount of water which must pass through the spillway before the lake level stabilizes at the elevation of the lower outlet. The difference in lake levels bears consideration. The drop from the Portage level to the Neshota and West Twin level represents a drop of only a few meters, the drop from the Neshota and West Twin level to the Kewaunee level is about 30 m, and the drop from the Kewaunee level to the Ahnapee level is about 15 m.

A second factor is the area of the lake that is drained. Although the change in elevation from the Portage to Neshota and West Twin level is small, the area of the lake at that time was large. The 30 m drop from the Neshota and West Twin to Kewaunee level was significant because the initial extent of the lake was large. The 15 m drop from the Kewaunee to Ahnapee level was less significant because even at the higher Kewaunee level the area of the lake was relatively small.

It is also probable that major erosion of the spillways occurred during these rapid drops in lake levels. Because the major changes in lake volume are associated with the openings of the Neshota and West Twin and Kewaunee spillways, it is likely that erosion would be most severe in these spillways.

Physical effects that suggest rapid draining of the glacial lakes appear to be present. The valley sediment of the Kewaunee River contains large boulders of dolomite. Some exceed 1 m in diameter and most are rounded. These boulders are stratigraphically near the top of the valley alluvium deposits. The rounded character of the boulders and their presence in a deposit of fluvial sediments suggest that they were most likely rounded through fluvial processes. The existing river is narrow, shallow and much too small to move these boulders even in time of flood. The inability of the modern stream to move these boulders suggests that they are relics of a time when the Kewaunee River had much greater current velocity and discharge. It seems probable that these boulders were carried to this location and rounded during times when the Kewaunee River served as an outlet for the glacial lakes. If this interpretation is correct, the stratigraphic location of the boulders near the top of the valley deposits suggests that little erosion or deposition has occurred within this spillway since it was last the site of discharge from a glacial lake, and that the sediment was primarily deposited during the time that water from Lake Oshkosh flowed out through this valley. Excellent examples of the boulders can be seen where a bridge crosses the Kewaunee River at the southeast corner of Sec. 28, T. 24 N., R. 24 E., approximately 1 mile south of Slovan.

In summary, both erosion and alluviation within the outlets of Lake Oshkosh appear to have been more pronounced during times of glacial recession than during times of glacial advance.

A Proposal for Revised Terminology

It is proposed by this author that a revised terminology be used in future descriptions of the glacial lakes of the Fox River valley. It is appropriate to retain the name Glacial Lake Oshkosh, to refer generally to all levels of the glacial lake. In addition, it is proposed that the terms Portage Level, Neshota and West Twin Level, Kewaunee Level, and Ahnapee Level be employed to more fully communicate the respective levels

and extents of Glacial Lake Oshkosh during times of discharge through the spillways named. It is also necessary to propose the provisional term Manitowoc Level, should this valley be shown to have been a spillway of Glacial Lake Oshkosh.

While these new terms are not time-dependent, and do not therefore represent or imply sequence, they do impose more specific definitions on the extents and outlets of the various levels of Glacial Lake Oshkosh.

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A RELICT GEOMORPHOLOGICAL FEATURE ADJACENT TO THE SILURIAN ESCARPMENT IN NORTHEASTERN WISCONSIN

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Abstract

A terrace-like bench and accumulations of coarse talus occur at the foot of the Silurian escarpment in northeastern Wisconsin. Talus slopes, now nearly stabilized, apparently were formed by ice-wedging and shattering of dolomite. Solifluction of loose rock materials apparently formed the bench. Absence of talus and bench forming processes today suggests development during an anomalously severe climatic episode, probably during the final Wisconsinan glacial recession.

INTRODUCTION

In Northeastern Wisconsin, the Silurian dolomite outcrops along the east shore of Green Bay forming the bedrock of the Door Peninsula. In some places northwest-southeast trending drainageways have cut through the dolomite and the rock is covered by various glacial deposits. However, for the most part, the erosional edge forms a prominent northwest facing escarpment (Fig. 1).

Much of the base of the escarpment is fringed by a low-level bench which is readily observable in the field but generally is not pronounced on available topographic maps. On the campus of the University of Wisconsin-Green Bay the bench is well displayed varying in width between 8 and 15 meters and rising an average of 3 to 4 meters above a somewhat more gently sloping surface of lake sediments and thin till. The flat upper surface of the bench is at an elevation of approximately 220 meters, and the lip of the escarpment rises to 230 meters producing a 10-meter step. At that point the edge of the escarpment is approximately 1850 meters from the shore of Green Bay.

Elsewhere along the Bay shore where the bench has been observed it is locally narrower with steeper surface slopes. Talus blocks, some very large, are usually found upslope from the bench. The bench may even be absent where the dolomite is close to the water or actually forms the shoreline. And, in many places the bench has been

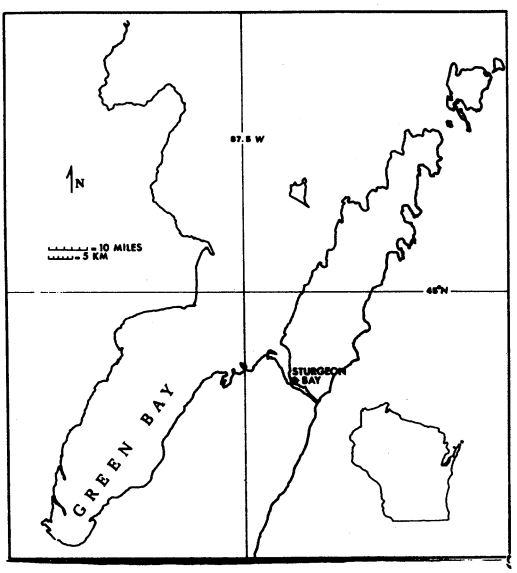

Fig. 1. Location of study area.

modified by human activity including farming, construction, and quarrying.

Research Objective

In the summer of 1977 we began an investigation of the escarpment front. Our purpose was to gather information on the morphology and materials of the bench in order to develop a reasonable hypothesis for its origin. Our ultimate goal was to place the feature in the context of the late glacial or post-glacial history of northeastern Wisconsin.

Several modes of origin for the bench have been suggested informally by various investigators: 1) Some combination of periglacial processes, 2) ice shove or direct deposition from the ice as it spread out of the Bay, 3) meltwater deposits caught between the ice and the escarpment face, 4) washover of material from the top of the escarpment. None of these hypotheses, however, were documented by field evidence.

Investigation

Our approach was two-fold. First, we took cores along the face of the escarpment northward from the UW-Green Bay campus. We then constructed profiles at a number of points along the Bay shore. These profiles taken from 7.5 minute topographic maps—although generalized—are useful for they show a progressive steepening of the escarpment face from profile No. 1 in the south to profile No. 7 in the north (Fig. 2). The steepening reflects a regional trend in which the escarpment becomes more prominent northward and at least partially buried by glacial deposits southward.

Coring was only partially successful. Because of dry conditions and the limitations of our equipment, we could not penetrate the feature to a meaningful depth. Our trailer mounted soil probe enabled us to reach a maximum depth of only two meters. The cores were split, described and samples analyzed for particle size. Layering was not apparent and textural analyses of samples from the upper surface of the bench and adjoining slopes showed the sediment below the soil to be rather homogeneous and composed of red sandy clay.

Inspection of the bench along the escarpment revealed several places where internal characteristics are exposed. A particularly useful exposure occurs at Bay Shore Park about 10 kilometers north of the campus where a road has been cut through the dolomite ledge to provide a boat launching facility. There the edge of the escarpment was, prior to modification, within 10 meters of

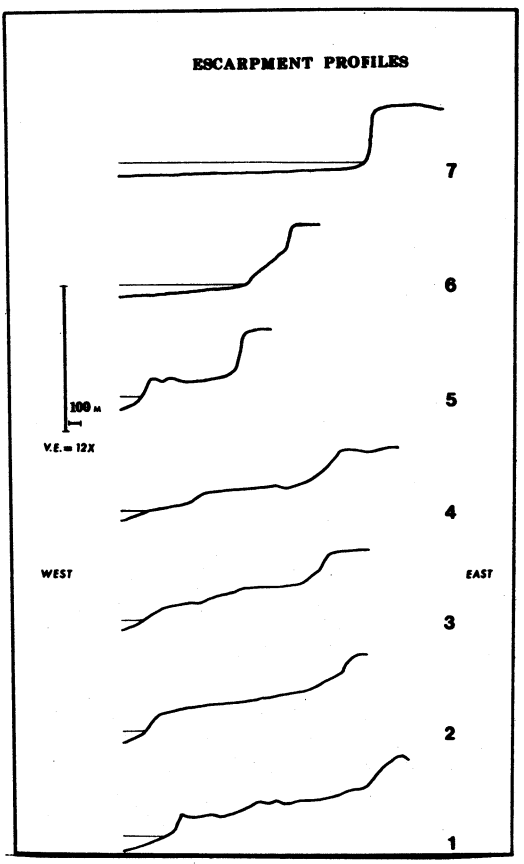

Fig. 2. East-West profiles along escarpment front oriented from south to north (1 to 7).

Fig. 3. View of escarpment front at Bay Shore Park showing park access road and truncated talus slope.

the water's edge and is mantled by a steeply dipping talus slope (Fig. 3). The free face of the dolomite rises approximately 8 to 10 meters above the talus and is well jointed. Large blocks, some the size of houses have been separated along nearly vertical joint planes and occur, in various orientations, downslope. Generally they tilt outward away from the escarpment at the top (Fig. 4). Downslope the size of the blocks decreases over a short distance as they undergo further separation along joint and bedding planes. Rectangular blocks are, for the most part, oriented with their longer axes downslope. Near the base of the slope, although some large blocks several meters across remain, most of the material is much smaller and is mixed with soil (Fig. 5). A low scarp formed

Fig. 4. Large wedge block separated from escarpment front in Bay Shore Park.

Fig. 5. Typical talus blocks in solifluction apron at base of escarpment in Bay Shore Park.

by wave erosion is found locally at the base of the slope and narrow pebble and cobble beach deposits occur along the water's edge.

The Bay Shore Park road has also exposed the underlying Maquoketa Formation, a soft incompetent clay-rich unit. The exposure appears to show drag and deformation of beds in the upper part of the Maquoketa. The toe of the slope now has been truncated and replaced by fill on which the boat harbor is constructed. North and south of that point the talus slope extends nearly to the water line.

Interpretation

Based upon observations of the escarpment on the UW-Green Bay campus, at several places along its extent, and on the exposure at Bay Shore Park, we believe that there are a number of significant factors that influence the present expression of the bench, and shed light on its origin. These factors are:

1) The presence of talus, expanded joints, and wedge blocks along the escarpment face. The talus slope is tree covered and is now nearly stable. There are some indications of movement (such as tilted trees) but these appear to be minor adjustments possibly related to wave erosion of the toe of the slope. Little new talus is being added.

2) The presence of the incompetent and relatively impermeable Maquoketa Formation below the dolomite. At Bay Shore Park, the exposed upper beds of the Maquoketa are deformed and have shifted downslope. On campus, the Maquoketa is covered but the upper contact is marked by a series of springs and seeps along the escarpment bench.

3) The relationship of the escarpment face to the Bay shore. Where the dolomite is near the shore the slope of the talus is steeper as only the upper part of the feature remains. Where the escarpment is situated a considerable distance from the shore the feature is broader.

4) The feature appears to be controlled to some extent by post-glacial relief, and the thickness of the dolomite beds at the escarpment edge. Locations of high relief and thick dolomite exhibit greater volumes of talus and in some instances larger block failures.

5) Modification of the bench by human activity. In places buildings have been constructed on the bench and the surface has been altered by grading. On the UW-Green Bay campus the escarpment face has been quarried for lime and building material at least as long ago as early in this century. The upper part of the talus slope has been removed and the feature substantially modified.

Based upon our interpretation of these factors, we propose that the feature origi-

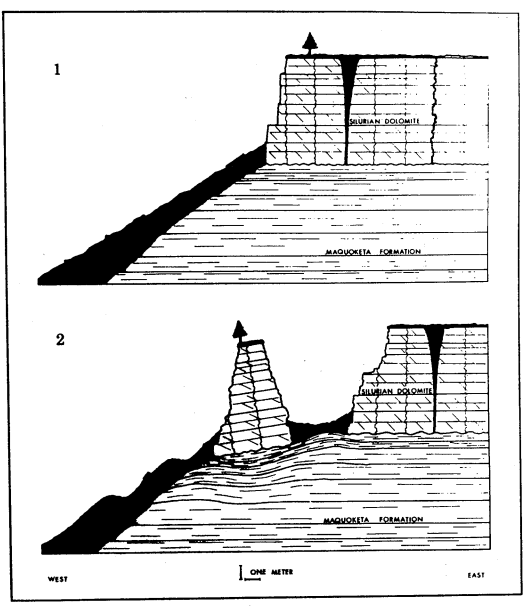

Fig. 6-1. (above) Schematic representation of original escarpment profile and talus slope.

Fig. 6-2. (below) Schematic representation of escarpment front modified by severe periglacial conditions. Note the adjustment of the wedge blocks and talus overlying the Maquoketa Formation.

nated as a talus slope during severe periglacial conditions (Fig. 6-1. Ice-wedging and shattering separated talus blocks from the escarpment face along intersecting vertical joint planes. In some cases very large blocks appear to have been aided in their separation from the dolomite by the failure, along the upper surface, of the underlying shale. Similar talus accumulations and blocks have been reported from Silurian dolomite in eastern Iowa by Hedges (1972), and in Ontario by Straw (1966), and from a much more resistant quartzite in the Baraboo area of southern Wisconsin by Black (1964) and Smith (1949). In each case the features are thought to be consequences of periglacial processes operating during severe glacial climatic episodes.

The next stage in the development of the fringing bench involved solifluction and movement of talus and other loose debris downslope (Fig. 6-2). Originally the base of the talus slope was developed on the Maquoketa Formation and adjustments appear to have occurred on that unit. Solifluction is suggested by the local origin of the angular blocks of dolomite, the mixing of soil and rock, and the distortion of shale layers. The feature is now nearly stabilized as evidenced by vegetation and the presence of structures on the debris-covered talus slope. Movement of the talus is also suggested by the finer material downslope forming a well-defined bench. Where the talus slope closely approaches the Bay shore the lower part of the feature is not preserved, perhaps having been eliminated by wave action.

Significance

Features found along the base of the escarpment are significant for several reasons. If our interpretation of the origin of the talus and the bench at the base of the escarpment is correct, periglacial conditions prevailed in the area during late Wisconsinan time. Black (1964) has mapped the location of periglacial features, including block fields, in Wisconsin and with one exception they are all preserved south of the Woodfordian boundary and were apparently formed under conditions associated with advance of the ice to that position. To our knowledge, no periglacial features have been documented from northeastern Wisconsin and in fact none have been reported from Port Huron or younger materials.

The severe periglacial conditions postulated for northeastern Wisconsin are consistent with reconstructions of climate along the entire ice sheet margin (Péwé, 1973). Paleobotanical evidence (pollen, primarily) indicates that Laurentide ice sheet was bordered by a relatively narrow zone of tundra or taiga-tundra. And, fossilized remains of ice-wedges (and an occasional pingo) suggest that the tundra was sporadically underlain by permafrost. Typically, relic frozen ground features are interpreted as having developed either in nonglaciated regions near the ice front or in drift during deglaciation. It is reasonable to expect that climatic conditions responsible for ice-wedge development would also trigger severe talus activity. This activity would be most pronounced in outcrops exhibiting a favorable geologic structure such as the Silurian escarpment.

It appears that if the talus and bench had formed prior to the last ice advance down the axis of Green Bay, they would have been removed or extensively modified by the ice. However, thick deposits of sand with some coarser and finer beds or lenses are found filling major reentrants in the escarpment that served as drainageways for meltwater. These clastics are covered by a red till and either formed during the retreat of Port Huron ice or in advance of Greatlakean ice. This may suggest that the talus escaped destruction by later, thin ice. We have not found evidence that the sands are younger than the talus. In fact we have not observed the two in contact nor any apparent deformation of the talus by ice.

Following retreat of the ice from the Two

Rivers till limit (Evenson and others, 1976), the waters ponded in Green Bay apparently drained through a series of progressively more northerly outlets until the northern Bay was free of ice. Sometime prior to 11,000 BP temporary stabilization of the ice front along the Sands-Sturgeon moraine in Upper Michigan at the northwestern end of Green Bay (Saarnisto, 1974) may have coincided with periglacial type conditions in parts of northeastern Wisconsin. The Sands-Sturgeon moraine is approximately 120-140 km north of our study area.

Escarpment front features are significant not only in regional glacial history but also to contemporary engineering problems. Much of northeastern Wisconsin, including the escarpment, is experiencing pressures from development. A wide variety of structures are being built along the base or on top of the escarpment. Failure to recognize the presence of buried coarse talus may result in differential support for foundations triggering uneven settling and structural damage. Furthermore, it is possible that structures built on top of the escarpment might be sited on blocks that have separated from the massive rock along expanded joints. Because of the conditions described in this report, such blocks may become unstable under the proper combinations of load and water content.

Finally, the features described here supply evidence of the mechanisms modifying the escarpment front and causing retreat since the last glaciation. [These are subjects of ongoing investigations.]

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TYPE C BOTULISM LOSSES AT HORICON NATIONAL WILDLIFE REFUGE, 1978[1]

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Abstract

Avian botulism was responsible for the death of over 6,000 waterfowl at Horicon National Wildlife Refuge in Wisconsin in 1978. The outbreak occurred in early fall on a flooded 250 hectare fallow agricultural area, on the northeast end of the refuge. The species most severely affected was the green-winged teal (*Anas carolinensis*), which made up almost 45% of the total birds found. Carcass pick-up, mouse toxicity tests, and antitoxin injections of waterfowl are discussed.

INTRODUCTION

Avian botulism (also known as "western duck sickness" and "limberneck disease") has been recognized as a major cause of mortality in wild waterfowl since the early 1900's (Kalmbach and Gunderson, 1934). The lethal toxin produced by the bacterium *Clostridium botulinum,* type C, affects the nervous system and affected birds often lose control of their neck musculature; hence the synonym "limberneck" disease. The combination of high temperature, a shallow aquatic environment, decaying vegetable matter, and the presence of *C. botulinum* may precipitate an outbreak at almost any time, but outbreaks generally occur in late summer or early fall (Rosen, 1971). Lands flooded by heavy rains or pumping that form large expanses of shallow waters appear to be particularly vulnerable. These bodies of water create an anaerobic environment with increased proteinaceous matter that provides conditions conducive to the growth of the *C. botulinum* bacteria and to toxin production. Shorebirds and puddle ducks are the principal victims of the disease since their feeding characteristics bring them into the shallow areas where invertebrates containing toxin are most abundant. Millions of waterfowl have succumbed to botulism over the years in North America (Jensen and Williams, 1964). This paper describes losses from type C botulism at Horicon National Wildlife Refuge (NWR) in Dodge County, Wisconsin, in September and October 1978 when over 6,000 waterfowl died.

AREA AND METHODS

Mortality of waterfowl was first detected on 29 September 1978 by Horicon NWR personnel patrolling the area by air boat. The affected site was about 250 hectares of a flooded fallow agricultural area along Wisconsin Highway 49 east of Waupun. The National Wildlife Health Laboratory (NWHL) at Madison was notified and staff members began an investigation on 30 September. Carcass pickup was immediately initiated to (1) avoid attraction ("decoy

[1] A contribution from USDI Fish and Wildlife Service project 1210-903.02 and 1210-901.04.

[2] Current location Trempealeau National Wildlife Refuge.

effect") of susceptible waterfowl into the area, and (2) eliminate dead birds as contributory factors to *C. botulinum* growth and as toxin-concentrating sources for the fly maggots that susceptible birds might ingest (Duncan and Jensen, 1976). The pickup of carcasses continued for about 3 weeks until losses began decreasing by mid-October. The recovery of moribund and dead birds was accomplished using 4 airboats, a canoe, an all-terrain vehicle, a helicopter and by personnel on foot (Goose Watch III, 1979). These efforts were most intensive the first ten days of the outbreak and were reduced when it was evident that mortality was subsiding (Fig. 1). Necropsies were performed at the Horicon NWR and at the NWHL. Standard mouse toxicity tests to type the botulinum toxin were conducted by the bacteriology section of the NWHL according to the procedure of Quortrup and Sudheimer (1943). The tests involved inoculating 0.5 ml of sera from each bird into two mice, one of which was protected by antitoxin. Death of the unprotected and survival of the protected mice is considered diagnostic for type C botulism. Periodic necropsies performed during the die-off indicated that mortality from other diseases was not occurring. Carcasses retrieved during the pickup operations were burned daily. Sick birds (243 ducks, 24 Canada geese, 22 coots and 2 shorebirds) were housed in cages converted to "hospital" facilities. Most of these sick birds received botulism antitoxin to assist in their recovery. Ducks were injected intraperitoneally with 0.5 ml and the Canada geese (*Branta canadensis*) with 1.0 ml of the Type C antitoxin. All birds were

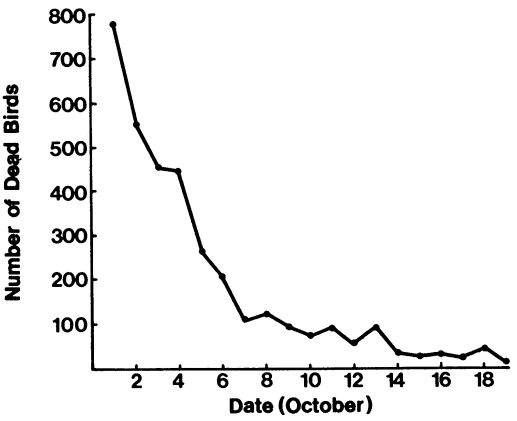

Fig. 1. Daily pick up of waterfowl carcasses at the Horicon NWR during an avian botulism outbreak in October 1978.

TABLE 1. Number of birds collected during the type C botulism die-off at Horicon NWR (30 September-23 October 1978)

Species	*Sex*			*Total*	*%*
	Male	*Female*	*Unknown*		
Green-winged Teal	1249	955	719	2923	44.9
Wigeon	424	237	334	995	15.3
Blue-winged Teal	134	172	287	593	9.4
Mallard	75	119	203	397	6.1
Shoveler	31	30	22	83	1.3
Pintail	39	40	16	95	1.5
Wood Ducks	59	12	4	75	1.2
Canada Geese	50	31	30	111	1.7
Coots	—	—	557	557	8.5
Shore Birds	—	—	424	424	6.5
Unknown Ducks	—	—	231	231	3.5
Other Ducks	—	—	33	33	0.5
				6517	

allowed to leave the cages when recovered, except that the Canada geese were physically released.

Results and Discussion

From 30 September to 23 October 1978, 6,517 waterfowl and shorebirds were incinerated at Horicon NWR (Table 1). Losses were heaviest early in the botulism die-off with 61% of the total carcasses retrieved during the first 5 days (Fig. 1). Carcasses picked up early in the epizootic were showing signs of decay, indicating that losses may have been occurring for as long as 3 to 4 days before the discovery.

Birds that probably were exposed to food materials most likely to contain toxins of *C. botulinum* suffered the heaviest losses. Green-winged teal (*Anas carolinensis*), the species most affected, accounted for almost 45% of all losses (Table 1). Losses among other dabblers appeared to be proportional to their numbers present in the area. Wigeon (*Mareca americana*), blue-winged teal (*Anas discors*), and mallards (*Anas platyrhynchos*) constituted 30% of the total retrieved. Shovelers (*Spatula clypeata*), Pintail (*Anas acuta*), and Wood ducks (*Aix sponsa*) made up less than 5% of the total. Coots (*Fulva americana*) constituted 8.8% of total losses, while shorebirds accounted for 6.6% of the total. About 30,000 Canada geese were using the area when the botulism outbreak began but the noise and activity from the pickup operations tended to force the geese to other areas of the refuge, where the epizootic was not occurring. The total number of geese incinerated was 111, or 1.7% of the total waterfowl picked up.

Reported waterfowl losses from this die-off exceeded those noted in NWHL and Wisconsin DNR files from earlier die-offs in Wisconsin at Grand River Marsh in 1975, at Green Bay in 1976 and 1977, and at Horicon NWR in 1976. However, comparable botulism losses occurred in 1973 when 5,009 birds were picked up at Horicon NWR and an additional 5,464 were retrieved at nearby Lake Sinnissippi that same year (Bell and Hunt, 1973).

The 1978 die-off subsided by mid-October with the onset of cooler weather (highs in mid-50's and low 60's) and following concentrated removal of the carcasses. Daily pickup of less than 100 birds after 8 October and of less than 50 after 13 October indicated that the die-off was indeed subsiding. Searches of surrounding areas showed that the die-off was confined to the particular portion of the marsh described previously. Total mortality is unknown, but because of the limited area involved, the majority of the carcasses probably were retrieved. Also, all deaths cannot be attributed definitely to botulism since not all birds were necropsied. The daily pickup ended on 19 October and subsequent periodic checks showed that the outbreak was over by the end of October.

Acknowledgments

We thank all personnel at the Horicon NWR and at the NWHL for their conscientious efforts expended during the die-off. The efforts of Wisconsin DNR in providing surveillance of nearby wetlands was also appreciated. Special appreciation is expressed to J. Toijala for his technical assistance in the NWHL bacteriology laboratory and to L. N. Locke for conducting many of the necropsies.

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