Herbert E Wright, Jr – a biography

by John Birks

Introduction

Herb Wright (1917–2015) was one of the world’s most distinguished Quaternary scientists. He was a great scientific polymath and an intellectual giant within the broad field of Quaternary research. He had an immense impact on many aspects of Quaternary science during the second half of the 20th century. He contributed greatly to our understanding of landscape history and environmental changes over the past 100,000 years in many parts of the world. He started with arid-region geomorphology and landscape evolution, which naturally shifted when he moved to Minnesota to glacial geology and climate history. The study of these topics led him to the study of vegetation development and environmental history and allowed him to define the timing and mechanisms of climate-driven vegetational shifts in North America during the last 18,000 years and to recognise the role of natural fire in the dynamics of northern forests. He was able to apply effectively these insights on fire history to wilderness conservation and landscape management. His endless curiosity expanded to cover many other aspects of palaeoecology including lake development and palaeolimnology, and the history and development of the vast patterned peatlands of the Northern Hemisphere. His work was concentrated in Minnesota, with its complex glacial, landscape, vegetational, and climatic history, but his broader vision led him to be involved in a major synthesis of global palaeoclimatology. Beyond Minnesota and the Great Lakes region, Herb studied a wide range of research questions elsewhere in North America, and in the Near East, Europe, Asia, Latin America, and Antarctica. His multidisciplinary approach and great powers of synthesis uncovered how the Earth’s landscapes and biota have been transformed at a wide range of spatial and temporal scales in the past through the interactions between climate, flora, fauna, landform, and human activity.

Herb, who died peacefully at his home in St Paul, Minnesota after a long illness on 12 November 2015, was born in Malden, Massachusetts on 13 September 1917. He studied at Harvard University, including his PhD on arid-region geomorphology and landscape evolution in New Mexico under the supervision of Kirk Bryan Sr. He completed his PhD thesis in 1943 whilst also training to be a B-17 Flying Fortress pilot during 1942–43. He flew many missions over Europe in 1944 and early 1945. In late 1945 he was appointed a teaching assistant at Brown University in Providence, Rhode Island and moved in 1947 to be an assistant professor in the Department of Geology, University of Minnesota. He remained there for over 60 years and continually broadened his research interests and experiences and areas of study. He was appointed full professor in geology in 1959 and Regents’ Professor of Geology, Ecology, and Botany in 1974. The Limnological Research Center (LRC) was founded in 1959 and Herb was its director from 1963–90. The LRC quickly became the leading North American centre and power-house for palaeoecological, palaeolimnological, and neolimnological research. He always realised the importance of international communication and collaboration so a key policy of the LRC was to attract a large number of overseas visitors who provided inspiration, allowed a cross-fertilisation of ideas, and introduced multidisciplinary approaches to the LRC and its students. Between 1963 and 1990, visitors had come from at least 18 countries. During his long academic career, Herb supervised over 75 graduate and doctoral students, mentored countless other students, post-doctoral researchers, and research visitors from around the world, and influenced the careers of a very large number of students, friends, and colleagues. Very many are now leading scholars and making outstanding contributions to many different aspects of Quaternary research.
Between 1943 and 2014, Herb published over 200 papers or monographs, and edited 15 influential books and six Special Issues of journals on a very wide range of topics within Quaternary science.

The major underlying theme of Herb’s scientific activities was the reconstruction of late-Quaternary landscape history at various spatial and temporal scales to explain the functioning of our present landscapes and ecosystems and how they might respond to climate change and human impact in the future. Thus he synthesised the vegetational and climatic history of Minnesota and adjacent states using a range of geological and palaeoecological approaches. With Miron ‘Bud’ Heinselman and others, Herb unravelled the key role of natural fire in the dynamics of coniferous forests. This led to Bud, Herb, and others to mount a successful campaign to save an extensive area of unlogged old-growth forest in northernmost Minnesota. Herb made major contributions to the understanding of the complex glacial history of the Great Lakes region and the control of the landscape on the development of peatlands and the origin of their spectacular surface patterns in the extensive peatlands of northern Minnesota and also in Labrador, Ireland, central Sweden, and northern Norway. He co-directed the multi-institutional Co-operative Holocene Mapping Project (COHMAP) with John Kutzbach, Tom Webb, Pat Bartlein, and others in the late 1970s and early 1980s. In COHMAP, past climates were simulated by a global circulation model at 3000 year intervals for the last 18,000 years. Most importantly, attempts were made to validate the model simulation results against actual palaeoclimatic data. COHMAP resulted in a major paradigm shift in Holocene climate research.

Another of Herb’s major contributions was the development of geo-archaeology starting in Lebanon and proceeding to Iraq, Iran, Kurdistan, and Turkey, and subsequently to Greece, Labrador, Peru, and Bolivia to study how the landscape and environment influenced the development of human societies and land-use practices.

Herb was one of the first American scientists to realise that understanding environmental history required continuous sedimentary archives extending back in time: the most informative being lake sediments. A major but often unrealised contribution was Herb’s perfection of techniques for coring lake-sediments. This contribution has enabled the vast majority of palaeolimnological and palaeoecological research today. He had a passion for fieldwork and sediment coring, seeming to enjoy it most under difficult or near impossible winter conditions in Minnesota and the Dakotas, in wilderness areas such as Labrador, Alaska, and the Yukon, and in physically demanding regions such as the Peruvian and Bolivian Andes and the Siberian Altai. He loved fieldwork and he was coring lake sediments in the Pirin Mountains of Bulgaria just before his 90th birthday.

Herb’s distinguished career was recognised by many honours and awards including honorary doctorates from Trinity College Dublin, Lund University, and University of Minnesota, membership of the National Academy of Sciences, a Distinguished Career Award from the American Quaternary Association, and a Lifetime Achievement Award from the International Paleolimnological Association.

Major contributions and achievements – a summary

This biography attempts to describe and document the major contributions of Herb to Quaternary science and to outline his early life and education, career, family life, and retirement, as well as his influence on many students, colleagues, and friends. Before discussing Herb’s early life and his wide-ranging academic activities over 70 years, I summarise what to me are Herb’s ten most important contributions to Quaternary science. I discuss them in greater detail as separate topics within the large section on his ‘Scientific research activities and their impact’, before I conclude with a discussion of Herb’s lasting legacies and some personal comments.

Herb had many research interests and made major contributions to a wide range of topics. His scientific contributions include the following.
1. Developing geo-archaeological studies in the Near East (Lebanon, Iraq, Iran, Turkey, Kurdistan) and presenting important and challenging hypotheses linking early domestication and cultural events with climate change. In contrast to the long-standing hypothesis of environmental determinism in cultural history presented by Gordon Childe in the 1920s, Wright’s hypotheses were based on the results of detailed palaeoecological studies which he had initiated and which showed that climate in south-western Asia changed from dry to moist in the earliest Holocene. Childe had assumed the opposite, namely a moist-temperate period in the glacial period had changed to the semi-arid climate of today, thereby forcing animals, plants, and humans to congregate at oases where domestication had begun.

Herb maintained a keen and active interest in multidisciplinary archaeological projects and worked on such projects later in, for example, southern Greece, Labrador, Peru, and Bolivia. These geo-archaeological studies ranging over 50 years of Herb’s scientific career showed how the landscape and environment influenced, in different ways and in different settings, human development and societies.

2. Deciphering the complex glacial history and resulting geomorphology of Minnesota and adjacent states with their multiple ice-lakes, glacial surges, tunnel valleys, pro-glacial lakes and their shorelines, and ice-advances and ice-retreats. Herb also worked on many aspects of glacial geomorphology and landscape evolution elsewhere in areas as diverse as Alaska, the Yukon Territory, the Rockies, New Mexico, the high Andes of Peru and Bolivia, northern Greenland, Siberian Altai, the Near East, and Antarctica.

3. Synthesising the late-Quaternary vegetation and climate history of Minnesota and adjacent states primarily based on the results of detailed pollen-analytical and plant-macrofossil studies. He also facilitated innovative studies on the vegetational and environmental history of Labrador, the Yukon Territory, Alaska, the south-eastern United States, New Mexico, Mexico, Ecuador, Peru, Bolivia, Switzerland, Czech Republic, Bulgaria, Iran, and Siberian Altai. He had a great passion for fieldwork and sediment coring (see 8 below).

4. Creating a centre (the LRC) for North American palaeolimnology and neolimnology where critical questions on recent and prehistoric impact on lake ecosystems, past lake-levels, hydrological changes, patterns of lake ontogeny in recently deglaciated areas, and long-term lake development were studied intensively.

5. Co-directing the multi-institutional COHMAP research consortium with John Kutzbach, Tom Webb, Pat Bartlein, and others. The basic idea was to simulate past climates at 18, 15, 12, 9, 6, 3, and 0 ka and to compare the climate-model simulations with available palaeoclimatic data. COHMAP led to a major paradigm shift in Holocene climate research and Herb was a key contributor to this.

6. Understanding the origin and maintenance of the spectacular surface patterns of northern Minnesotan peatlands, and subsequently, of patterned peatlands in Labrador, Ireland, central Sweden, and northern Norway.

7. Recognising with Bud Heinselman the essential role of natural fires in determining the composition, structure, and dynamics of northern Minnesotan coniferous forests. Herb and colleagues pioneered the detailed reconstruction of Holocene fire histories from charcoal fragments preserved in annually laminated lake sediments. This early work showed the importance of fire in coniferous forest dynamics and had major implications for forest management and fire-suppression policies. Herb’s synthesis of landscape development, forest fires, and management was one of the earliest studies where palaeoecological results were used to propose management and conservation policies. Bud, Herb, and others campaigned tirelessly in the 1970s to save an extensive area of virgin, unlogged old-growth forest in northernmost Minnesota as a wilderness area where snow-mobilers,
outboard motors, and logging would be prohibited. They succeeded in 1978 when President Jimmy Carter signed the relevant legislative bill.

8. Perfecting field-craft and lake-sediment coring. Herb was as much at home in the field, even under difficult or sometimes atrocious conditions as he was in his departmental office or in his St. Paul home. He had a passion for coring sediments in lakes and he perfected coring from open-water using a variety of boats, canoes, home-made rafts, fallen logs, and even truck-tyre inner-tubes as platforms to core from. He continually improved lightweight piston corers and drive rods. Fieldwork with Herb could often turn into an adventure, or a serious adventure, or even a struggle to survive! He claimed never to remember any of these adventures, misadventures, or struggles! He loved all types of fieldwork, particularly in wild and remote areas.

9. Writing clearly and concisely and editing manuscripts were two of Herb’s many skills and contributions to science. His publications are models of simple, concise, and elegant scientific writing. Herb commented after his 80th birthday that he must enjoy editing and thought that perhaps it went back to his days editing his high-school newsletter in the early 1930s.

10. Networking and international collaboration were an important part of Herb’s scientific modus operandi. Soon after World War II, Herb travelled widely in Europe and by the time he established the Pollen Laboratory in Minnesota in 1958, he had visited all the main European pollen laboratories and met the leading palynologists of the time. The LRC was a hotspot of international activity and collaboration in the 1960s–1980s thanks to Herb’s networking and collaborative skills. After his retirement, he continued to be a regular visitor to Europe to visit laboratories and friends, explore new landscapes, attend field excursions, and, of course, to help core sediments in lakes and mires in, for example, Norway, Ireland, Switzerland, the Czech Republic, Bulgaria, Georgia, Siberian Altai, and on the Azores and Madeira, as well as in Kenya, Bolivia, Peru, and Alaska.

Biography

Early life and education

Herbert (‘Herb’) Edgar Wright Jr was born on 13 September 1917 in Malden, Massachusetts. His father, Herbert Edgar Wright Sr was an osteopath who died during the ‘Spanish flu’ pandemic of 1919–20. His mother, Annie Mabel Richardson (1878–1964), was a nurse. Herb had an elder sister, Helena (1915–2010). As a child Herb spent much time in the western suburbs of Boston with his favourite uncles and their families. He attended high school in Malden, where he enjoyed playing basketball and football. A high-school essay written on 14 November 1932 by the 15-year-old Herb on “Thoughts and Achievements” in College English 3 survives and provides details about Herb’s early life, and his thoughts, achievements, and ambitions. Herb’s father had been taught the clarinet by his brother-in-law and Herb Sr travelled around the eastern USA with a jazz band. He subsequently took up the new subject of osteopathy and he practiced his clarinet in the day and went to night-school in the evenings. Herb Jr records that he was a most active boy when young and had to be strapped into bed until he went to sleep. He started school when he was six and Herb wrote “I did not dislike school. I always took an interest in and tried to get all I could out of it”. He supplemented his meagre pocket money by cutting grass, selling papers, delivering and selling doughnuts made by his mother to some of his paper-round customers on Saturday mornings, and singing in local choirs. By 1932 Herb had saved enough to pay for a year at college. He was clearly a meticulous notekeeper, as he kept records of his finances, books read, movies, plays, lectures, etc. attended, marks received at school, and so on. In the concluding outlook in his essay, Herb wrote “If finances and other difficulties permit, I will continue to college, one of the best, I hope, and study as exclusively as I can in some subject that interests me. … Whenever I hear anyone speak about history from the fall of Rome to 1700, I am immediately interested. Why, I don’t know. Whenever anyone
speaks of the creation of the world, or of ancient man before the first signs of cultivation, or of psychology, I am enthusiastic. Maybe I shall be a doctor or a college professor, for these two professions interest me a little, but whatever my occupation may be, it will take plenty of study and hard work. I am determined to go through college, though I haven’t planned on any certain one yet, although Harvard, Dartmouth, and West Point interest me. The selection, however, is not for me to decide now. I must wait until I finish my present course before I look too far ahead."

The 15-year-old Herb’s ambition of studying at Harvard came to fruition as he graduated with a BA magna cum laude from Harvard College in 1939 and received his MA and PhD in geology from Harvard University in 1941 and 1943, respectively. His other ambition of becoming a college professor materialised in 1947. Herb started out as a Harvard biology student, with some thoughts of reading history or biology, following the footsteps of his sister who majored in biology at Radcliffe College, but after a trip to all the national parks west of the Mississippi River with their spectacular landscape, Herb’s interests shifted to geology, in particular arid-region geomorphology, landscapes, and their patterns and evolution (Herb Wright, pers. comm. 1971). He was greatly encouraged by Kirk Bryan Sr, a person who also greatly influenced the interests and careers of many students and colleagues. During his years at Harvard, Herb was Austin Teaching Fellow, laboratory assistant to Kirtley Mather, and field instructor for Kirk Bryan Sr (Schwartz 1972). He also helped to pay for his Harvard education by cutting grass, by driving tourists around downtown Boston, by working as a parking-lot attendant, by waiting at the student lunch club, and by other jobs at 50c an hour.

When America entered World War II, Herb enlisted in 1942 as an air-cadet and became a B-17 Flying Fortress bomber pilot in the Army Air Corps. He finished writing his PhD thesis in boot camp in Nashville and whilst he was being trained to fly B-17 bombers at Geiger Field and Ephrata Air Bases, Washington, Rapid City Army Air Base, South Dakota, and Pyote, west Texas. He made two tours of combat duty based in Britain and flew 48 missions in 1944–1945 including runs over Germany during D-Day, over Berlin after D-Day, and at the Battle of the Bulge (Wright, unpublished note ‘1944 England’). He served as a pilot, command pilot, and group operations officer, reaching the rank of major (Schwartz 1972) (Figure 1). He belonged to the 95th Bombardment Group stationed at RAF Horham near Bury St Edmonds in East Anglia. The 95th Group was the only Eighth Air Force group awarded three Distinguished Unit Citations and had the highest total claims of enemy aircraft (425) destroyed (Morris & Hawkins 2012). He was awarded the Air Medal six times, the Distinguished Flying Cross twice, and the Croix de Guerre from Charles de Gaulle. During his spare time at Horham, Herb visited by bicycle several classical Quaternary sites in the area including the famous interglacial site at Hoxne where he found Palaeolithic implements and Diss Mere, a lake that he was to revisit to core in 1979.

When he was on leave and away from Horham for a few days, Herb often visited London with fellow airmen. There he attended concerts (e.g. Bach Mass in B Minor, Elgar The Dream of Gerontius), ballet, and plays; bought vinyl LPs of Beethoven’s piano concertos; ate and drank whisky and brandy at the Savoy Hotel; was fascinated by the soap-box orators at Hyde Park Corner; and
spent exciting days in the library of the Geology Museum in Kensington where he lunched with its
director. He also visited Oxford and Cambridge, learnt to play golf and bridge, and enjoyed English
and French cuisine. His Quaternary field excursions, concerts in London, and visits to the Geology
Museum are not listed in the official ‘Instructions for American Servicemen in Britain’ (War and Navy
Departments 1942) which provides advice on the peculiarities of the “British, their country, and their
ways” in an attempt to “lesson the culture shock for those embarking on their first trip to Great
Britain and, for the most part, abroad”. Herb did not seem to suffer from any cultural shock whilst
stationed in England!

Herb considered his most exciting war-time moment came after his flight training when he was
given a four-engine B-17 Flying Fortress nicknamed Lizzie to fly from Goose Bay in Labrador to
England with a crew of 10 in the winter of early 1944. One engine had low oil pressure before taking
off but Herb was allowed to set off across the Atlantic. Another engine failed halfway across the
Atlantic. The plane began to lose power and altitude towards the Irish coast and Herb was forced to
make an emergency landing at St Angelo airfield on the shores of Lough Erne near Enniskillen, Co.
Fermanagh. He landed too fast owing to ice that had accumulated on the wings and ran off the
runway, coming to an abrupt halt with Lizzie’s right landing-gear intact but buried in mud and peat
up to the top of the wheel and the left landing-gear buried up to the hub. The ball target, nose glass,
and fixtures were damaged and three of Lizzie’s propellers were bent. Fortunately no-one was hurt
but Herb confessed that he “felt a bit stupid after landing” (transcript of Wright’s crash report). He
remarked later that to his amazement he simply signed a chit and was given a new plane (Paul
Glazer, pers. comm. 2015). He also said that his landing at St Angelo may have been his first walk on
a bog, many of which he visited professionally in years to come (George Jacobson, pers. comm.
2016).

In May 1945, Herb flew important aid-drops to The Netherlands. Sacks containing potatoes,
flour, chocolate, etc. were dropped into marked fields bordered by cheering local residents. One
young Dutch boy from near Arnhem collected some of the sacks – his name was C Roel Janssen
(1930–2015) (Janssen, pers. comm. 2014). Janssen became a palynologist with a major research
group in Utrecht, and worked with Herb in Minnesota 1962-1964 and later on short visits up to 1990.

After his European tours flying B-17s, Herb returned to the USA and volunteered to fly in the
Pacific theatre of war. He was sent to Sioux Falls Army Airfield, South Dakota for training with the
new B-29s. In his spare time he borrowed a bicycle and explored the interesting Dakotan landscape.
The 95th Bombardment Group was inactivated on 28 August 1945. Herb commented many years later
that his favourite times flying were when he just had to put in hours in the air (for his pilot
certification) because on those flights he could enjoy the clouds and the geomorphology of the
landscapes beneath (George Jacobson, pers. comm. 2016).

Herb’s first scientific paper (Wright 1943) was on the petrology, formation, and age of Cerro
Colorado, an isolated non-basaltic volcano in central New Mexico. This was his first introduction to
the geology and geomorphology of semi-arid landscapes. He continued in such landscapes for his
PhD, which was on the Tertiary and Quaternary geology and geomorphology of the arid Lower Rio
Puerco valley in western New Mexico (Wright 1946). It was during this work that he developed his
strong and ever-lasting fascination with landscape history rather than only bedrock geology and
geomorphological processes. He quickly realised, however, that landscape history could not be
quantified without a chronology, and he puzzled about how to obtain such a chronology. He rapidly
recognised the potential of lakes as they contained organic material that might be suitable not only
for palaeoecological and palaeoenvironmental investigations such as pollen analysis but also,
perhaps in the future, for some form of relative or absolute dating. Herb continued this fascination
and interest in the study of lakes and their sediments for over 60 years.
His PhD advisor and influential mentor, Kirk Bryan Sr (1888–1950), made a major impact on Herb’s career and research interests (Wright, unpublished note ‘Wangen’). Herb acknowledges Kirk Bryan Sr (Wright 1946) for planning and guiding his Lower Rio Puerco study and gracefully suggests that “many of the ideas herewith presented were inspired by discussions with him”. Bryan was interested in many aspects of environmental history, especially climate change (Whittlesey 1951). His graduate students translated current papers by German scientists who were reconstructing ice-age conditions in Europe. In his early career as a faculty member at the University of Minnesota, Herb continued this tradition and distributed to colleagues translations of papers by, for example, Hans Poser (1907-1998), Julius Büdel (1903-1983) (Wright 1959; Wright & Alt 1959), and Carl Troll (1899-1975) (Wright 1958), mainly about the periglacial record in central Europe and periglacial processes globally. After visiting Europe in the late 1940s and meeting leading Quaternary scientists and geomorphologists in Germany, Switzerland, and Austria, Herb published a large review paper on the Late Pleistocene climate of Europe (Wright 1961a). Kirk Bryan was also interested in European vegetational and climatic history and late-glacial chronology and in the linkage between archaeology and geology. Both interests were keenly followed by Herb during his own research career. Another Kirk Bryan tradition that Herb followed was to hold weekly seminars in his home. For over 50 years, Herb held Wednesday-evening seminars on Quaternary glacial geology, palaeoclimatology, palaeoecology, palaeolimnology, and neolimnology in the Wright home in St Anthony Park, St Paul (McAndrews 2016). The seminars continue to this day in the same house, now hosted by Vania Stefanova.

When Herb was appointed Assistant Professor of Geology at the University of Minnesota in September 1947, he had already developed interests in lakes and their sediments, in geological applications to archaeology through his 1947 study near Beirut (see below), in landscape history, and in European vegetational and climatic history; interests that he would develop extensively during his long and distinguished academic career.

**Professional career**

After his war service in the Army Air Corps, Herb Wright was appointed in 1945 to be a teaching instructor at Brown College (now Brown University) (Providence, Rhode Island), then a liberal-arts college. He moved to the University of Minnesota in September 1947 as an Assistant Professor in the then Department of Geology (in 1962 it became the Department of Geology and Geophysics and is now the Department of Earth Sciences). The search procedure for this faculty position in 1947 consisted of a short informal interview with George A Thiel (1892-1979), the Chair of the Department. Thiel was attending a Geological Society of America meeting in New York. He telephoned Herb and asked him to take the train from Providence to New York so that they could meet. The ‘interview’ was in the lobby of Thiel’s hotel. At the end of their meeting, Thiel told Herb that he was hired – quite a contrast to today’s procedures of search committees, evaluation boards, trial lectures, counting publication citations, h-indices, etc. Once installed in Pillsbury Hall where the University of Minnesota’s Department of Geology is housed, Herb remained there for over 60 years. He was promoted to Associate Professor of Geology in 1951 and to Professor of Geology in 1959 (Figure 2). He was also appointed...
Professor of Botany in 1965 and in Ecology in 1970 within the newly-formed Department of Ecology and Evolution and Behavioral Biology (now Department of Ecology, Evolution, and Behavior) at the University of Minnesota. He was named Regents’ Professor of Geology, Ecology, and Botany in 1974 and became Regents’ Professor Emeritus in 1988.

Herb had a large teaching load (Schwartz 1972) with courses or seminar series on structural geology, stratigraphy, and glaciology, as well as on his research interests such as physical geology and geomorphology, glacial geology, Quaternary environmental change, and landscape and climate history. He lectured to thousands and advised more than 75 graduate and PhD students during his 60+ years at the University of Minnesota. The lessons that Herb taught extended far beyond the lecture-hall or the field – they were lessons in modesty, conciseness, kindness, loyalty, devotion to sharing and understanding, and survival (Baker 2016).

After his PhD work in New Mexico and his visits to Europe and the Near East in the early 1950s, Herb became interested in the potential of pollen analysis as a tool for reconstructing environmental change and landscape history. Thanks to a grant from the Hill Family Foundation in 1956, he was able to establish in 1958 a pollen laboratory in Minnesota. Herb invited experienced European pollen analysts and palaeoecologists to help in the development of the laboratory and to help in advising students. Magnus Fries (Sweden: 1959–60), William A Watts (Ireland: 1961 and later), Willem van Zeist (The Netherlands: 1960–61), Roel Janssen (The Netherlands: 1962–64 and later), Maj-Britt Florin (Sweden: 1964–65), Krystyna Wasylikova (Poland: 1964–65), Kazimierz Wasylik (Poland: 1965), Elizabeth Haworth (UK: 1967), Johanna Grüger (Germany: 1968–69), Eberhard Grüger (Germany: 1968–69), Hilary Birks (UK: 1970), H John B Birks (UK: 1970–71 and later), and, in later years, Jan Janssens (Belgium and Canada: 1980–89), Richard W Battarbee (UK: 1981–82), Svante Björck (Sweden: 1981–82 and later), and Ingemar Renberg (Sweden: 1991). With a separate grant from the Hill Family Foundation, the Limnological Research Center (LRC) was established in 1959. The pollen laboratory was incorporated within the LRC in 1963 when Herb became the LRC Director. The LRC rapidly developed expertise not only in palaeoecology but also in palaeolimnology and neolimnology with faculty members such as Joe Shapiro, Robert (‘Bob’) O Megard, Alan Brook, and Eville Gorham. The LRC attracted many foreign visitors for short (1–3 month) visits from Canada, UK, Norway, Sweden, Germany, Czech Republic, Slovenia, France, Spain, and Japan. Its multi-national flavour was supplemented by graduate students and post-doctoral fellows from Canada, UK, Ireland, Norway, Sweden, Finland, Germany, The Netherlands, Belgium, France, Spain, China, and Japan. The LRC under Herb’s leadership became a major international centre for palaeoecological, palaeolimnological, and neolimnological research. Herb retired from being LRC director in 1990.

Throughout his professional career, Herb conducted major and demanding research projects not only in Minnesota but also across North America from Florida via New Mexico to Alaska, as well as in the Yukon, Labrador, and Mexico. Abroad he worked in Norway, Sweden, Russia, Siberia, UK, Ireland, Switzerland, Azores, Madeira, Greece, Bulgaria, Turkey, Georgia, Lebanon, Iran, Iraq, Kenya, Peru, Bolivia, and Antarctica. He made extended academic visits to Russia, China, Australia, and several European countries. He published more than 200 international scientific papers, edited 21 books or Special Issues of journals, and supervised at least 36 PhD dissertations and 38 MSc or MA theses in the University of Minnesota’s Departments of Geology, Ecology, and Botany, and its Center for Ancient Studies. He was involved as an invaluable advisor for countless more graduate students and post-doctoral visitors. Many of his students and post-doctoral visitors are now leading scholars and are making outstanding contributions to many different aspects of Quaternary research as well as to teaching, supervision, and mentoring.
Retirement

Herb Wright formally ‘retired’ from his Regents’ Professorship in 1988 at the mandatory (at that time) age of 70 and from being director of the Limnological Research Center in 1990. He continued to teach and advise graduate students for many years thereafter. In his retirement he participated in numerous sediment-coring expeditions to remote parts of the globe, including the high Peruvian Andes, Glacier Bay in Alaska, the Azores, the Bulgarian Pirin mountains, the Caucasus of Georgia, and the Siberian Altai. He was visiting Hilary and John Birks in Bergen in December 1988 when he decided to stay an extra day or two in Norway before returning to the USA. Fortunately, he was able to change his reservation that was for PanAm flight 103 on 21 December 1988, the flight that was blown up over Lockerbie in Scotland, to a later flight with a different carrier. Until about 2010, Herb was actively engaged in science with writing and editing. He travelled to Guadalajara in Mexico to receive on 16 December 2009 his Lifetime Achievement Award from the International Paleolimnology Association (Wright 2010). His last publication (Ammann et al. 2014) formed part of a festschrift volume in honour of Hilary Birks who worked with Herb on various projects since her post-doctoral year in the LRC in 1970.

Family life

Herb Wright met his wife-to-be Rhea Jane Hahn (1921–1988) in church choirs at Harvard University and Radcliffe College in the early 1940s. They married on 27 June 1943 at the Moody Field Post Chapel, Valdosta, Georgia. Herb was then an air-cadet in the Army Air Corps and Rhea was a nursing student at Yale College of Nursing. They spent their honeymoon at Sea Island, Georgia followed by a short residence at Sebring, Florida. They had six sons (Richard (1944–), Peter (1948–1955), John (1950–), Rex (1953–1988), Andy (1955–), and Jeffrey (1959–)).

Herb and his family enjoyed many cross-country skiing trips, sometimes with their neighbours in St Anthony Park, St Paul. His sons often accompanied Herb on field expeditions to core in, for example, Iran, Iraq, Kurdistan, Labrador, the Yukon, Minnesota, New Mexico, Peru, and Bolivia. For many summers, Herb and Rhea rented a rustic cabin with no electricity on an island in Lake Minnetonka just west of the Twin Cities. Several families, some of whom were faculty at the University of Minnesota, would often have supper together in the summer evenings and enjoy the idyllic tranquillity of Lake Minnetonka.

Herb greatly loved classical music (see below) and he regularly attended concerts of the Minnesota Orchestra (formerly known as the Minneapolis Symphony Orchestra), the St Paul Chamber Orchestra, and Music in the Park. Besides the music of Schubert and Brahms, he was very attracted to Faure’s Requiem. Herb once told Brigitta Ammann (pers. comm. 2015) that he would like Faure’s Requiem at his funeral but said “just too bad that I will not be able to hear it”. At his Memorial Service on 5 December 2015, the music was by Bach, Handel, Marcello, and Beethoven. He avidly read liberal newspapers and regularly listened to Minnesota public radio. Rhea (Figure 3) also loved music and she played piano, flute, and recorder and taught piano in the 1950s–1960s. Rhea and Herb hosted local recorder groups in their home.

Herb and Rhea were an important part of the ‘Hythe Street Regulars’ for over 50 years and the many visitors to Herb’s LRC quickly experienced the wonderful camaraderie of the ‘Regulars’ from

Figure 3. Rhea Wright and Henry Lamb being punted under the Bridge of Sighs by Jane Allard Grimm on the River Cam in Cambridge, 1981 (photo by Hilary Birks)
Kemper Kirkpatrick, Kim and Ann Munholland, John and Judy Howe, Dick and Finette Magnuson, Bobbi and Bob Megard, and all their respective children. They made visitors from far afield feel very much at home, even in the midst of a fierce Twin Cities January night. Herb and Rhea became ‘second parents’ to many young children of their friends and colleagues (Figure 4).

Herb died peacefully at his St Anthony Park home in St Paul on 12 November 2015 after a long illness. Rhea predeceased him on 21 January 1988 as did sons Peter and Rex. His sons Richard (‘Dick’), John, Andy, and Jeffrey survive him along with his grandchildren Patrick, Christopher, Thierry, and Theora, and great-grandson Adrian, as do daughter-in-law Sylvie (widow of Rex), Vibeke, Christa, and Maria, partners of Dick, John, and Jeffrey, respectively, and Marianne Wright. For the last 14 years of his life, Herb was lovingly cared for by his dear friend and colleague Ivanka (‘Vania’) Stefanova.

Figure 4a. The Birks family (Hilary, young Christopher, John) with Mary Edwards and Rhea Wright, Cambridge, 1979 (left) and the Birks family and Herb Wright outside the Botany School, University of Cambridge, June 1979 (right) (photos by a passer-by)

Figure 4b. Åsa Björck listening captivated to her big favourite Herb, reading an exciting story, with Rhea Wright as an attentive spectator, Twin Cities, 1982 (photo by Svante Björck)
Classical music

Classical music was a very important part of Herb’s life (Wright, unpublished letter 27 May 2001). He described himself as an “addict of classical music”. He met his wife-to-be Rhea in choirs at Harvard and Radcliffe Colleges. Herb had sung in two local church choirs as a schoolboy – one because the choir-master organised a basketball team and the other because a small salary was paid for participating. By his own admission, Herb was not a good singer but he learnt to read music and carry a tune. In his first year at Harvard College, he took a course on music appreciation and learnt all the proper forms and styles. He spent long hours in the listening rooms trying to memorise themes and dissect the musical structure. The professor was so deeply involved in the beginnings of music in Medieval times that the course never reached the 19th century! Herb’s fascination with music tempted him to volunteer as an usher at the monthly concerts of the Boston Symphony Orchestra in the College auditorium. Herb also enlisted in the Harvard Glee Club along with the legendary Leonard Bernstein. Herb also joined the university chorus and he sang in the chorus for a recording of Beethoven’s Symphony no.9 (‘Choral Symphony’) by the Boston Symphony Orchestra. After moving to Minnesota, Herb again joined the university chorus and again sang the Choral Symphony but this time with the Minneapolis Symphony Orchestra (now the Minnesota Orchestra). He regularly attended its concerts over 60 years with season tickets for seats near the front on the right-hand side, exactly where he was an usher back in the early 1930s in Boston. He usually bought four or six season tickets and sold or gave them to friends or colleagues. He also keenly supported the St Paul Chamber Orchestra and was a friend of the Music in the Park series, now renamed The Schubert Club who dedicated their concert on 25 September 2016 to Herb, twelve days after his birthday. Herb enjoyed listening to radio programmes that included interviews with soloists or directors commenting about the music they would be performing in the Twin Cities. He greatly enjoyed the articulate, informal, and talented English musician and scholar Christopher Hogwood talking as Artistic Director of the St Paul Chamber Orchestra to explain the connections between pieces that he would direct at the next concert. One such example of ingenious Hogwood programming that Herb greatly enjoyed was Tippett’s Fantasia Concertante on a Theme of Corelli, Holst’s St Paul’s Suite Op.29, number 2, and A Fugal Concerto Op.40, number 2, Corelli’s Concerto Grosso in F Op.6, number 2 and Trio Sonata Opus 3, number 4, and Bach’s Fugue in B minor on a Theme of Corelli (BWV579).

Herb’s musical tastes focused on the late 18th and the 19th centuries with the music of Mozart, Beethoven, Schubert, Schumann, Brahms, Berlioz, Tchaikovsky, and to a lesser extent Haydn. He was fascinated by Schubert’s Eight (‘Unfinished’) Symphony. His wife’s tastes, as a recorder player, were more in the late 17th and early 18th centuries of the Baroque period. I once bought her and Herb an LP of the Academy of Ancient Music’s superb and stylistically unique rendering (1981) of Pachelbel’s Canon and Gigue directed by Christopher Hogwood. Rhea loved it so much that she almost wore the LP out. It was played at the wedding of their son Rex to Sylvie.

Scientific research activities and their impact

During his long and distinguished scientific career, Herb Wright had many research interests and made major contributions to at least ten topics. The overarching aim of Herb’s activities was to reconstruct the late-Quaternary history of individual areas and ultimately of the world and to use these reconstructions to improve our understanding of the present and the future (Shane & Cushing 1991a; Wright 1973a). To Herb the term history had a broad meaning to include geological, geomorphological, climatic, biotic, and anthropological change over a wide range of temporal and spatial scales (Shane & Cushing 1991a). Herb (Wright 1973a) discussed Quaternary science and public service in modern society with all its environmental problems. Herb concluded “many aspects of the projects in which one might become involved are interesting scientific problems themselves, apart from their application to an environmental crisis. A combination of intellectual stimulation and
emotional satisfaction is hard to beat. I recommend it as a modest ingredient in an academic diet.” Clearly for Herb it was a very important diet that sustained him as a Quaternary scientist and active environmentalist for 70 years.

Chapters in *Quaternary Landscapes* (Shane & Cushing 1991b) review six of the ten topics discussed below – origins of food production and archaeology (Watson 1991), Quaternary glacial history and stratigraphy (Mangerud 1991), peat growth (Clymo 1991), palaeoecology (Ritchie 1991), palaeolimnology (Battarbee 1991), and climate and vegetational change (Kutzbach & Webb 1991). These papers were presented at a symposium in Minneapolis in May 1988 to honour Herb on the occasion of his formal retirement as Regents’ Professor. The additional four topics discussed below concern Herb’s contributions and legacies to fire history, conservation, and landscape management; field-craft and sediment coring; writing and editing; and scientific networking and collaboration.

1. **Geological Archaeology**

Before being hired by the University of Minnesota, Herb Wright was a teaching instructor at Brown University (Providence, Rhode Island) (1945–1947) where he worked on glacial geology. During the summer of 1947, he went to coastal Lebanon to make a sedimentary and geomorphological study of the Ksar Akil Upper Palaeolithic rock shelter near Beirut (Wright 1951), as part of a Boston College–Fordham University excavation at the suggestion of Kirk Bryan Sr and Hallam Movius (1907-1987). The rock shelter is now recognised as an important site that encompasses Mousterian and Upper Palaeolithic industries in a 23-metre thick deposit. Herb wrote “I shudder to think that my field area was in West Beirut itself, where cemented coastal sand dunes and intercalated soils and marine shell beds suggested a story of environmental change” (Wright, unpublished note ‘Wengen’). Initially Herb travelled each day by tram (street-car) from his lodgings at the American University of Beirut. He later lived with Jesuit archaeologists at the archaeological site. They were looked after by an Armenian cook who maintained an excellent field camp. Herb borrowed an old car and explored the marine terraces and other geomorphological features of the Lebanese coast and became fascinated by the environmental history and landscapes of the Near East (Wright 1996; Wright, unpublished note ‘Wengen’).

The archaeological contacts that resulted from Herb’s 1947 Lebanon expedition led to him being engaged by the Oriental Institute, University of Chicago as a field geologist to work with Robert J Braidwood (1907–2003) and others on the ‘hilly flanks’ of Iraq, in particular Iraqi Kurdistan. Herb worked there in 1951 when he had a leave of absence from the University of Minnesota for three months during which he held a Wenner-Gren Fellowship (Schwartz 1972). He determined the extent of erosion of the prehistoric site of Jarmo (the earliest city in the world) on top of a river bluff that had been eroded away. He also worked at Karim Shahir and the middle Palaeolithic site at Barda Balka (Wright 1952). There were inevitable adventures and misadventures on this 1951 expedition – vehicle malfunctions and other problems, running out of fuel, getting stuck in mud (Figure 5), illness, unusual food, etc. (Wright, unpublished notes ‘Wadis’, ‘Another adventure with mudholes and empty gas tanks’, ‘Iraq March 14 1951’, ‘Iraq Jan 30 1951’, ‘51-22 Jarmo’).

These geo-archaeological studies and those of his in Lebanon in 1947 were some of the first geological interpretations of Near Eastern prehistoric sites and they served as a major stimulus for Herb’s interests in the role of climate in the development of civilisation, especially the question of the origins of agriculture; interests that he had acquired from his Harvard mentor Kirk Bryan Sr. When Herb saw the Kurdistan landscape (Wright, unpublished notes ‘Wengen’ and ‘Silis remarks’), he began to consider its history and palaeoenvironmental reconstructions of a larger area than the Jarmo site. Braidwood’s main aim was to find evidence relevant to the causes of the transition from food gathering to food production and the origin of village life. Bob Braidwood therefore encouraged Herb to explore and travel throughout Kurdistan and the mountains of Iraq, Iran, and Turkey in
search of former glaciers and relic landforms that might provide hints about past climate. These studies and travels coincided with the establishment of the US National Science Foundation and Braidwood developed the idea that any understanding of the origins of agriculture required a multidisciplinary approach involving archaeology, prehistory, and the natural sciences (geology, botany, zoology). Radiocarbon dating was also developing rapidly at this time under the direction of WF Libby (1908-1980), a colleague of Braidwood at the University of Chicago, thereby providing a means to develop an absolute chronology of past events (Wright 1957a, 1996). This opened up many new research possibilities in prehistoric archaeology, palaeoenvironmental studies, and landscape history (Wright, unpublished note ‘Wengen’). In 1954–55 Herb – sponsored by a Guggenheim Fellowship, a Wenner-Gren Fellowship, the University of Chicago’s Oriental Institute (Schwartz 1972), and its Iraq–Jarmo Project – began trying to decipher the environmental history of Iraqi Kurdistan on the basis of landforms and correlations and teleconnections with glacial events in Europe. He drove a Land Rover and trailer with his wife Rhea and family of three small boys from London to Baghdad by way of Interlaken, Graz, Belgrade, Istanbul, Damascus, and the pipeline road across the desert of Jordan (Wright 1996) and spent an adventurous year exploring Kurdistan and living in primitive Kurdish villages (Wright 1996; Wright, unpublished note ‘Wengen’). He published a detailed glacial history of the area (Wright 1961b) but the chronology was uncertain and its relevance to the origin of agriculture remained uncertain (Wright 1960, 1996).
The Iraqi revolution in 1957 precluded further work in Iraq, so activities shifted across the mountains into Iranian Kurdistan in 1960 (Wright, unpublished note ‘Wengen’). Herb’s frustration with undated landforms, along with his developing interest in lakes and their sediments, resulted in him coring many small lakes in western Iran including Lake Zeribar (Figure 6) north-west of Kermenshah (which he also cored in 1960, 1963, and 1970) in the Zagros Mountains and other sites later in eastern Turkey and Israel. He had several more field seasons in the Near East as part of Braidwood’s investigations of early villages and the origin of agriculture. With Krystyna Wasylkow (Krakow), Willem van Zeist (Groningen), Bob Megard (Minnesota), and others Wright masterminded in the early 1960s a detailed multidisciplinary study of the Zeribar sediments, involving pollen, plant macrofossils, diatoms, cladocera, mollusca, geochemistry, stable isotopes, and radiocarbon dating (Wasylkow & Witkowski 2008). Herb and his colleagues found a reasonable correlation between the time when the regional vegetation changed from steppe to forest and the time when plants were first domesticated, and Herb subsequently developed several new hypotheses to link climatic change and cultural events (Wright 1968a, 1976a, 1977a; Wright & Thorpe 2003). These replaced the earlier ideas of Childe (1929) on the early domestication of plants and animals in the Near East.

Following this early work in the Near East (Figure 7), Herb maintained a keen interest in multidisciplinary archaeological projects (Anfinson 2016). He worked with the archaeologist WA McDonald in the University of Minnesota Messenia Expedition on late Bronze Age environments at Osmanaga Lagoon in the Peloponnes of southern Greece (Wright 1984a; Wright, unpublished note ‘Wengen’). He assisted Tom Shay in his detailed palaeoecological analysis of the Itasca bison kill site (Shay 1971). Herb also initiated detailed palaeoenvironmental studies (pollen, charcoal, geochemistry) in the remote wilderness of Labrador in response to a suggestion of Bill Fitzhugh (Smithsonian Institute) that the interactions of prehistoric Native American and Inuit populations in that area were related to the movement of reindeer herds which depended on ground lichens as a major food resource (Farrand et al. 1990; Wright, unpublished note ‘Wengen’). It was hypothesised that the extent of lichen cover was a function of the occurrence and distribution of forest fires and that fire history could be reconstructed from charcoal fragments preserved in lake sediments. Herb and colleagues survived seven field seasons in Labrador: some of these involved having to live off ‘cream of Cladonia soup’ (made by Nancy Eyster-Smith) for a time and being forgotten by a bush-pilot and having Dan Engstrom and Henry Lamb hike and raft to Port Hope Simpson on the Labrador coast to get help (Wright 1996). Although the original archaeological premise was shown to be intractable (Farrand et al. 1990), this archaeological question inspired extensive and detailed palaeoecological studies on several aspects of the landscape history of Labrador (Wright 1985) (see also sections 6 and 7 below).
Herb’s most recent involvement with prehistoric archaeology was in the central Andes of Peru and Bolivia in response to questions raised by Kent Flannery (University of Michigan) about the environmental setting for the first hunting cultures in the highlands and by John Rick’s (Stanford University) excavations of cave sites that were apparently occupied contemporaneously with the nearby wasting glaciers (Farrand et al. 1990; Wright, unpublished note ‘Wengen’). Expansion and then retreat of the still-existing glaciers during the last 1000-2000 years suggested major climatic changes. Archaeological surveys in areas close to the upper limit of cultivation indicated population shifts and other cultural changes prior to the Incan period (Seltzer & Hastorf 1990; Wright 1980a, 1986; Wright et al. 1989). Herb spent six summers in the Andes working with John Rick, Geoff Seltzer, Christine Hastdorff, Julie Stein, and Carrie Jennings, starting in Peru but shifting to Bolivia because of dangerous Peruvian guerrilla activities in the study areas. Other archaeological contributions by Herb include Wright (1974a, 2000, 2006) and Anfinson and Wright (1990) (see Anfinson 2016).

In 1989 Herb received an Award from the Archaeological Geology Division of the Geological Society of America (Farrand et al. 1990), and wrote when discussing his role as a geologist and palaeoecologist in multidisciplinary projects with archaeologists that “the director of an interdisciplinary project must be willing to spend the time and resources in facilitating peripheral adventures, such as providing a vehicle and perhaps a guide, arranging permission with appropriate authorities, and tolerating an absence from the site for extended periods. Beyond that, however, the director must also be willing to spend the time and intellectual effort to understand the purpose of such explorations and the research methods, and to learn about the results in detail, for it is the director’s ultimate responsibility to integrate these results into a synthesis that should be the ultimate goal for the project. It has been my good fortune to be associated with archaeologists who have made these commitments in time and energy, and I believe that their success in the profession is in some part a result of such an approach. What small scientific contributions I have made to archaeology can be attributed in part to their willingness to allow their resident geologist and paleoecologist to roam so widely, and in part to their interest in incorporating the results of such peregrinations into their archaeological thinking.” (Farrand et al. 1990).

2. Glacial Geology and Geomorphology

Soon after joining the Department of Geology, University of Minnesota in 1947, Herb Wright was urged by the Director of the Minnesota Geological survey to begin a revision of the complex glacial geology and Quaternary history of Minnesota with several ice-lobes criss-crossing the state of ‘ten thousand lakes’ (Schwartz 1972). This topic had largely been ignored since the pioneering studies by NH Winchell (1839–1914), Warren Upham (1850–1934), Frank Leveretta (1859–1943), Frederick B Sardeson (1866–1958), and WH Emmons (1876–1948) in the early part of the 20th century. Herb started work in Minnesota and the Great Lakes region in the summer of 1948. Herb’s studies and those of his graduate students such as Charles L Matsch (1930–2014), Edward J Cushing, Jim Zumberge, Stan Chernicoff, Barry Goldstein, Howard Mooers, Al Schneider, and Carrie Patterson (Jennings) helped decipher and understand the complex glacial history and resulting geomorphology of Minnesota and adjacent areas with multiple ice-lobes, glacial surges, tunnel valleys, drumlins, eskers, pro-glacial lakes and their shore-lines, complex ice-advances and ice-Box 1. Major papers on the glacial geology and geomorphology of Minnesota and adjacent areas by Herb Wright and his students and colleagues.

Björck and Keister 1983
Björck 1985, 1990
Chernicoff 1983
Goldstein 1989
Grigal et al. 1976
Hu et al. 1997
Keen and Shane 1990
Matsch & Schneider 1986
Matsch & Wright 1967
Mooers 1989a, 1989b, 1990a, 1990b
Schneider 1961
Wright & Ruhe 1965
Wright & Watts 1969
Zumberge 1952
retreats, inland sand-dunes, and periods of erosion and deposition in the Minnesota and Mississippi River valley as a result of glacial recession. These studies by Herb (Figure 8) and his students and colleagues resulted in a large number of important primary publications (Box 1). Herb provided two masterly reviews (Wright 1972a, 1972b) on the Quaternary history and physiography of Minnesota.

Herb also worked on glacial geology and geomorphology in many other areas including Alaska, the Yukon Territory (Rampton 1970, 1978), the North American Rockies, particularly Wyoming (Figure 8) (e.g. Potter 1969, 1972), the central states of Nebraska (e.g. Watts & Wright 1966; Wright et al. 1985) and Iowa, New Mexico (e.g. Appeldorn & Wright 1957; Wright 1964), the Siberian Altai (Blyakharchuk et al. 2008; Wright 2005), the Near East (e.g. Watson & Wright 1969; Wright 1961b), the Mediterranean basin (Arkhipov et al. 1995), the high Andes of Peru and Bolivia (e.g. Seltzer 1990, 1992; Wright 1983a, 1984b; Wright et al. 1989), northern Greenland, and Antarctica. He was a regular participant on the Friends of the Pleistocene field trips. His first such trip was in May 1947 to the Finger Lakes areas of central New York. Many well-known American Quaternary scientists were on this trip including Hugh M Raup (1901-1995), Kirk Bryan Sr, Richard F Flint (1901-1976), and Richard P Goldthwait (1911-1992) (Friends of Pleistocene Geology 1947).

Herb’s keen sense of adventure and his constant drive for interdisciplinary studies led to a month-long expedition in 1971 to the Klutlan Glacier in the wilderness of the St Elias Mountains of the Yukon (Wright 1980b, 1996). The impressively surging Klutlan Glacier with large areas of spruce forest growing on dead-ice was a possible modern analogue for the late-glacial landscape of Minnesota (Florin & Wright 1969; Wright 1976b, 1981a; Wright & Stefanova 2004). Studies were...
made on the flora and vegetation (Birks 1980a), soils (Jacobson & Birks 1980), modern pollen and recent vegetational history (Birks 1980b), limnology (Whiteside et al. 1980), lake development (Bradbury & Whiteside 1980), glacial geology (Drisco 1976, 1980a, 1980b), geomorphology (Watson 1980), and hydrology (Drisco 1980b) of the Klutlan Glacier and its ice-cored moraines. The 1971 Klutlan party consisted of Herb and a glacial geologist (Fletcher Driscoll), a plant ecologist (John Birks), two limnologists (John Platt Bradbury, Melbourne (‘Mel’) C Whiteside), and a philosopher of science (Richard (‘Red’) A Watson) whose task was to observe how these people applied different approaches to a common problem during a month in the wilderness (Wright 1996). Fletcher Driscoll and George Jacobson returned in 1972 to complete hydrological and ice-wastage measurements and soil-development studies. George and Fletcher were not at all thrilled that the provisions Herb had arranged for their month-long stay on the Klutlan Glacier in 1972 consisted entirely of a large bag of rice and a large bag of raisins (George Jacobson pers. comm. 2016)! Besides various adventures and exciting and challenging camp-fire discussions, the 1971 and 1972 Klutlan studies stimulated more detailed limnological, palaeolimnological, and hydrological studies on neoglacial moraines in the oceanic Glacier Bay, Alaska by Dan Engstrom, Sheri Fritz, and Jim Almendinger (Engstrom & Fritz 2006; Engstrom et al. 2000; Fritz et al. 2004) often with Herb, Geoff Seltzer (1969-2005), and others as devoted field helpers.

3. Pollen Analysis and Vegetational History

The establishment of the pollen laboratory at the University of Minnesota in 1958 with a grant from the Hill Family Foundation in St Paul was an important stage in Herb Wright’s scientific activities (Schwartz 1972; Almendinger and Jennings 2016). During his doctoral studies in New Mexico in the early 1940s, he had already developed an interest in lakes and their sediments as a potential source of data for inferring relative chronologies and vegetational as well as environmental and climatic history. His research in the Near East and Minnesota in the early 1950s continued to inspire and stimulate this interest.

Herb’s initial awareness of the potential of pollen analysis as a tool in reconstructing landscape history, past climates, and relative chronologies probably came from his Harvard mentor Kirk Bryan Sr who closely followed the European literature on pollen analysis and climate history in the 1940s and 1950s. Herb’s interest was stimulated further by the publication of Edward S Deevey’s (1914-1988) masterly review of Pleistocene biogeography (Deevey 1949) and by his own travels around Europe in the early 1950s. Besides meeting many European Quaternary geologists, Herb also visited the main pollen-analytical centres in Europe and met Max Welten (1904-1984) in Bern, Franz Firbas (1902-1964) in Göttingen, Johannes (Johs) Iversen (1904-1972) and Svend Th Andersen (1926-2009) in Copenhagen, Tage Nilsson (1905-1986) in Lund, Gunnar Erdtman (1897-1973) in Stockholm, Knut Fægri (1909-2001) in Bergen, and Harry Godwin (1901-1985) in Cambridge.

Herb recalled (Wright, unpublished note ‘Sils Remarks’) that whilst a graduate student and after he discovered lakes and their sediments were suitable for pollen analysis he gained “a background in plant identification and ecology. I took to a course offered by the great plant taxonomist ML Fernald (1873-1950), editor of the authoritative Gray’s New Manual of Botany. But I was soon discouraged by the requirement to draw in Indian ink the leaves of mostly tropical plants mounted on herbarium sheets and to memorize the attributes of tropical plant families. This seemed not to be a productive way to approach vegetation history”. So as Herb admitted (Wright, unpublished note ‘Wengen), “Not being an avid microscopist, I called upon experienced European specialists to establish a pollen laboratory at Minnesota and to help in advising students.” On the advice of Johs Iversen, Herb invited Magnus Fries (1917-1987) from Uppsala to come and develop the laboratory and to train a group of talented graduate students (Wright 1994). Fries worked in Minnesota during 1958, established the pollen laboratory, started building up its modern pollen reference collections, trained graduate students such as Edward (‘Ed’) J Cushing (Figure 9), Louis
('Lou') J Maher Jr, Robert ('Bob') C Bright (1928-1995), John ('Jock') McAndrews, Thomas C Winter (1936-2010), and Harvey L Patten, and did a detailed palynological study of Weber Lake in north-east Minnesota (Fries 1962).

Figure 9. Three of the mainstays of Herb Wright’s pollen laboratory in the LRC, all of whom have made major contributions to vegetation history, pollen analytical methodology and quantification, and teaching future generations of palynologists and macrofossil analysts: Ed Cushing, 1970 (left) (photo by John Birks); Bill Watts, 1979 (centre) (photo by John Birks); Barbara Hansen, 2004 (right) (photo by Brigitta Ammann)

Fries was followed by Saskia ('Kiek') Jelgersma (1929-2012), Willem van Zeist, and C Roel Janssen (1930-2015) (all from The Netherlands), William ('Bill') Watts from Ireland (1930-2010) (Figure 9), Krystyna Wasylkova and Kazimierz ('Kazik') Wasylik (1925-2000) from Poland, Johanna and Eberhard Grüger from Germany, Hilary and H John B Birks from the UK, and Svante Björck from Sweden. All these visitors contributed significantly to reconstructing floristic, vegetational, and climatic history of Minnesota and neighbouring states and, in the case of Bill Watts, of many other states in the eastern, central, and south-eastern USA.

The publications by Winter (1962), Fries (1962), Cushing (1963), McAndrews (1966), and Wright and co-authors (Wright et al. 1963) presented the first detailed modern pollen diagrams from different ecological regions of Minnesota. Many of these studies revealed the dynamic behaviour of the prairie-forest ecotone in the Holocene.


Bill Watts visited the LRC and worked with Herb for over 40 years. Besides providing an unrivalled amount of new information about the late-Quaternary floristic, vegetational, and environmental history of the Great Lakes region, south-east USA, and Appalachia, Bill pursued many other careers (Watts 2008). He was a lecturer and subsequently a professor at Trinity College Dublin, as well as Trinity’s Provost from 1981 to 1991. He was an outstanding Provost and he initiated significant modernisation and expansion of research and teaching within the College. He was also
active in Irish nature conservation, Dublin hospital management, President of the Royal Irish Academy 1980–82, and chaired various Irish charitable trusts. Despite all these duties, Bill remained active in research, particularly the vegetation history of Florida and Italy (Watts 2008).

Bill also developed an interest in the Pacific North West and co-supervised Cathy Whitlock (Figure 10) in her work in Washington and Oregon (Barnosky 1984, 1985a, 1985b; Barnosky et al. 1987a; Whitlock 1992; Whitlock & Bartlein 1997; Leopold et al. 2016). Cathy also spent time at the LRC when she worked on the pollen stratigraphy of Elk Lake (Bartlein & Whitlock 1993; Whitlock et al. 1993) and of the Red Lake peatlands (Janssens et al. 1992).

One of Herb’s MSc students Richard (‘Dick’) G Baker learnt macrofossils from Bill Watts (Baker 1965) and went on to do detailed and important macrofossil work in Yellowstone (Baker 1976) and in the Midwest (Baker et al. 1989, 1996, 2002, 2009).

Several of Herb’s early doctoral students spent a year working in some of the major European palynological laboratories (e.g. Ed Cushing in Copenhagen, Lou Maher in Cambridge, Jock McAndrews in Groningen, Bob Bright in Uppsala) allowing them to benefit directly from leading European researchers.

The activities of the pollen laboratory were not confined to Minnesota and adjacent states. Willem van Zeist, Krystyna Wasylikowa, Kazik Wasylik, and Bob Megard studied pollen, plant macrofossils, diatoms, and cladocerans, respectively, in cores from Lake Zeribar in Iran (e.g. Megard 1967; Snyder et al. 2001; van Zeist 1967; van Zeist & Bottema 1977; van Zeist & Wright 1963; Wasylikowa 1967, 2008; Wasylikowa & Witkowski 2008; Wasylikowa et al. 2006). The geochemistry and stable oxygen isotopes were also studied later (Stevens et al. 2001, 2008; Wright 1966). These investigations plus those on Charales oospores, molluscs, and charred plant macrofossils made Lake Zeribar one of the most palaeoecologically intensively studied lakes in the world with multiproxy records extending to about 48,000 years ago (Wasylikowa et al. 2008). To provide a factual basis for the interpretation of the Zeribar pollen stratigraphy, Wright, McAndrews, and van Zeist (1967) did an extensive survey of modern vegetation and its pollen rain in western Iran. This study showed the importance of studying modern pollen assemblages as an aid to the interpretation of fossil assemblages. The Lake Zeribar studies initiated by Herb in 1960 (Megard B 2016; Megard RO 2016) have provided unique insights into environmental and climate history relevant to our understanding of the origins of agriculture in the Near East (Wright & Thorpe 2003).

Despite all this activity on Minnesotan and Iranian vegetational and environmental history, Herb maintained an interest in the arid landscapes of the American South-West where he had done his doctoral research. The Chuska Mountains in north-western New Mexico are dotted with many small lakes so Herb started to explore these (Wright 1964; Wright & Bent 1968). Whilst the sediments of Minnesotan lakes are most effectively cored through ice in the winter or early spring, the Chuska Mountains are inaccessible in winter so Herb used primitive wooden coring platforms and

Figure 10. Cathy Whitlock and Herb Wright with a core of surface-mud from a small lake in Yellowstone National Park, 1987 (photo by Dan Engstrom)
rafts made of truck-type inner-tubes for summer coring. Cores from Dead Man Lake in the Chuska Mountains yielded a long Wisconsin-stage record (Bent & Wright 1963; Wright et al. 1973b). Detailed quantitative pollen-morphological studies (Hansen & Cushing 1973) showed that Pinus flexilis (limber pine) was present in the past, although today it grows farther north in the Rockies.

As well as this work on late-Quaternary vegetational history, pioneering studies in Herb’s pollen laboratory on modern local-scale pollen deposition in relation to vegetation (Janssen 1966, 1967a, 1967b, 1967c, 1973, 1984), differential pollen preservation and redeposited pollen (Cushing 1964, 1967a), delimitation of pollen assemblage zones and their mapping in space and time (Cushing 1967b), using pollen ratios to identify elevational limits of different conifer genera using modern pollen assemblages (Maher 1963), experimenting with different pollen sums (Wright & Patten 1963), exploiting transects of pollen sites across natural climate gradients to explore past vegetation and climate dynamics (McAndrews 1966; see also Nelson & Hu 2008), and developing integrated pollen, plant macrofossil, and vegetation studies in the Rockies (Bright 1966) were all important conceptual and methodological contributions to Quaternary palynology and palaeoecology as a whole.

Within about 10 years Herb’s pollen laboratory had become the leading centre for Quaternary pollen analysis in North America and one of the leading centres in the world with a strongly international flavour. Pollen analysis and vegetational history continued to be a major part of Herb’s scientific activities until his retirement (and beyond), through new visitors from Germany, England, and Sweden and returning visitors from the Netherlands, Ireland, and England, and via the many outstanding collaborators and graduate students who worked on a wide range of projects involving pollen analysis, often linked to specific ecological or Quaternary geological problems (Box 2).

Box 2. Selected publications by LRC students and visitors on pollen analysis and vegetational history 1968–2000

- Eolian activity in Minnesota: Keen & Shane 1990
- Elk Lake, Minnesota: Bartlein and Whitlock 1993; Whitlock et al. 1993
- Myrtle Lake, Minnesota: Janssen 1968
- Pinus banksiana in Minnesota: JC Almendinger 1990, 1992
- Pinus strobus in Minnesota: Jacobson 1979
- Red Lake Peatlands, Minnesota: Griffin 1975, 1977
- Wild rice in Minnesota: McAndrews 1969
- Lake St Croix, a river lake, Minnesota-Wisconsin: Oyster-Smith et al. 1991
- Central Plains: Wright 1970
- Northern Great Plains: McAndrews & Wright 1969; Hansen & Wright 1987
- Illinois, Kansas, Nebraska: E Grüber 1972a, b; J Grüber 1973; Wright et al. 1985; Teed 2000
- Virginia: Craig 1969
- Yukon Territory: Rampton 1971
- Rates-of-change analysis: Jacobson and Grimm 1986
- Syntheses: Wright 1971a, 1981a; Webb et al. 1983

In addition there are many other publications by Herb, Bill Watts, Ed Cushing, Barbara Hansen, Willem van Zeist, Anne McKnight Bent, Lou Maher, and others mentioned in the text.

A major mainstay in the pollen laboratory was Barbara Hansen (Figure 9) who worked with Herb and various colleagues on pollen analyses from a wide range of geographical areas for many years. Within North America, Barbara has worked in North Dakota (Hansen & Wright 1987), Kentucky (Wright et al. 1966), Minnesota (Janssens et al. 1992), New England (Foster et al. 2006; Parshall et al. 2003; Oswald et al. 2007), Labrador (Engstrom & Hansen 1985), Hudson Bay Lowlands (Glaser et al.
Further afield, Barbara has done major pollen-analytical studies in Guatemala (Johnson et al. 2001), and Peru and Ecuador (Bush & Hansen 2005; Hansen 1995a, 2003; Hansen & Rodbell 1995; Hansen et al. 1984, 1994; Wright et al. 1989), and even in Mongolia (Fowell et al. 2003). She has perfected conifer stomata analysis in North America (Hansen 1995b; Hansen et al. 1996) and resolved several critical pollen morphological problems (Hansen & Cushing 1973; Hansen & Engstrom 1985). Barbara’s friends and colleagues, especially Herb, were delighted when in 2001 she was awarded an Outstanding Achievement Award by the University of Minnesota.

4. Palaeolimnology

With the ever-increasing interdisciplinary nature of many of Herb Wright’s research activities involving lake sediments and the importance of lakes in the Minnesotan landscape, it was natural that in 1959 a Limnological Research Center (LRC) was established within the University of Minnesota with the support of a separate grant from St Paul’s Hill Family Foundation. Herb became the director of the LRC in 1963 and the pollen laboratory was incorporated into the LRC within the Department of Geology and Geophysics. As he had done in the early days of the pollen laboratory, Herb enticed several leading European palaeolimnologists to come and work in the LRC, including Maj-Britt Florin (1905-1993) and Ingemar Renberg from Sweden and Elizabeth Haworth and Richard (‘Rick’) W Battarbee from England. Herb also attracted many talented post-doctoral palaeolimnologists including Bob Megard, John Platt Bradbury (1936-2005), John C Kingston (1949-2004), Richard (‘Dick’) B Brugam, Mel Whiteside, and Thomas Crisman and recruited several outstanding graduate students (e.g. Sherilyn C Fritz, Daniel R Engstrom) to work on different palaeolimnological projects (Wright 1994). A wide range of such projects quickly developed (e.g. Bright 1968; Winter & Wright 1977; Wright 1966, 1981b, 1992a, 2010). The original emphasis was on diatoms (e.g. Bradbury 1975), cladocerans (e.g. Megard 1964, 1967; Quade 1969), and ostracods, but broadened as new techniques were developed and refined such as pigment analysis, stable-isotope analyses, sediment geochemistry, mineralogy, and magnetics. Studies on lake-level changes and palaeohydrological modelling of prairie lakes (e.g. JE Almendinger 1990, 1993; Digerfeldt et al. 1992; Winter & Wright 1977) and on lake-sedimentation processes (Almquist-Jacobson et al. 1992) were also pursued.

Important studies on lake eutrophication were made in the 1970s (Birks et al. 1976; Bradbury 1975; Bradbury & Megard 1972; Bradbury & Waddington 1973; Brugam 1979; Gorham & Sanger 1976), often involving a multiproxy approach with pollen and diatom analyses and sediment geochemistry. Palaeolimnological techniques such as diatom analysis, pigment analysis, or geochemistry were applied to several ‘classic’ Herb Wright sites such as Kirchner Marsh (Brugam 1980; Florin 1970; Florin & Wright 1969; Sanger & Gorham 1972) and Pickerel Lake (Dean & Schwalb 2000; Haworth 1972).

Elk Lake (Figure 11) in north-west Minnesota became a site for much LRC palaeolimnological research (Anderson et al. 1993; Bartlein & Whitlock 1993; Birks et al. 1976; Bradbury & Dean 1993; Bradbury and Dieterich-Rurup 1993; Bradbury et al. 1993; Brugam 1993; Dean et al. 1984; Megard et al. 1993; Sanger & Hay 1993; Stark 1976; Whitlock et al. 1993; Wright 1993; Zeeb & Smol 1993). The first study (Stark 1976) involved collecting seven sediment cores and 25 surface samples from a transect across the lake. The surface samples were used to establish the ostracod, mollusc, and chironomid assemblages at different water depths. Stark (1976) determined the fossil composition for 14-25 levels in each of the seven cores to reconstruct the trophic sequence with respect to the sediment type (Wright 2010). The environmental settings for the trophic histories were inferred from skeletal pollen diagrams prepared for each core. This demanding multi-proxy study was all done by Donna Stark for her doctoral study. A second study at Elk Lake (Birks et al. 1976) concerned recent lake responses to catchment changes. The study involved three lakes, two badly polluted (Sallie Lake 2004a), Washington (Hansen & Easterbrook 1974), Alaska (Engstrom et al. 1990; Hansen & Engstrom 1996), Florida (Grimm et al. 1993; Hansen 2006; Hansen et al. 2001; Watts et al. 1992), and Bermuda (Watts & Hansen 1986). Further afield, Barbara has done major pollen-analytical studies in Guatemala (Johnson et al. 2001), and Peru and Ecuador (Bush & Hansen 2005; Hansen 1995a, 2003; Hansen & Rodbell 1995; Hansen et al. 1984, 1994; Wright et al. 1989), and even in Mongolia (Fowell et al. 2003). She has perfected conifer stomata analysis in North America (Hansen 1995b; Hansen et al. 1996) and resolved several critical pollen morphological problems (Hansen & Cushing 1973; Hansen & Engstrom 1985). Barbara’s friends and colleagues, especially Herb, were delighted when in 2001 she was awarded an Outstanding Achievement Award by the University of Minnesota.
and St Clair Lake) and one control (Elk Lake) and pollen, plant macrofossil, cladoceran, and diatom analyses (Birks 2016). The third and major palaeolimnological study at Elk Lake involved (after several unsuccessful coring attempts) a 22-m-long series of cores from a continuously laminated sequence of post-glacial (10,400 years) sediment recovered from 29.6 m water depth in the deepest part of Elk Lake in 1978 and 1982. These cores were intensively studied by several investigators for their pollen (Bartlein & Whitlock 1993; Whitlock et al. 1993), diatoms (Bradbury & Dietrich-Rurup 1993; Brugam 1993), chrysophyte cysts (Zeeb & Smol 1993), charcoal (Clark 1993; Whitlock et al. 1993), geochemistry (Dean 1993; Dean & Megard 1993; Dean et al. 1993), mineralogy (Anderson 1993; Dean 1993), stable carbon and oxygen isotopes (Dean & Stuiver 1993), pigments (Sanger & Hay 1993), and sedimentation (Dean & Megard 1993; Nuhfer et al. 1993; Sprowl 1993). The results of this remarkable study were published as 20 papers in a Geological Society of America Special Paper edited by J Platt Bradbury and Walter E Dean (Bradbury & Dean 1993). Herb had been involved in many attempts at obtaining continuous cores from the deep hole of Elk Lake from 1967 to 1982 and he had many more failures than successes! 1970 produced a successful continuous core but on our return to Minneapolis the trailer containing the cores became detached and the cores were badly damaged and unusable. Herb was mortified and silent, but in a day or two he was talking quietly about a possible return to Elk Lake! He had to wait until 1971 for that.

Figure 11. Elk Lake, Itasca State Park, north-west Minnesota, in July 1970 (left) and coring its sediments from the ice in March 1970 (centre and right) (photos by John Birks)

During her 1970 stay at the LRC, Hilary Birks examined the relationship between modern assemblages of seeds and fruits in surface sediments and aquatic vegetation in over 50 Minnesotan lakes across the state (Birks 1973). This innovative study provided basic information on macrofossil representation today as a guide for interpreting fossil assemblages. Bob Bright examined modern diatom assemblages in relation to water chemistry in Minnesotan lakes (Bright 1968). This study was extended by Dick Brugam (Brugam 1993).

Another innovative study was initiated by Rick Battarbee whilst he was a visiting researcher at the LRC in 1981-82. This involved lakes in the Northern Great Plains along gradients of lake-water salinity and conductivity (Fritz 1990; Fritz & Battarbee 1988; Fritz et al. 1991, 1993; Radle et al. 1989). Work on the history of the Northern Great Plains has now been extended by Dan Engstrom, Sheri Fritz, Eric Grimm, Jim Clark, Emi Ito, Kate Laird, Brian Cumming, Will Hobbs, and others using diatoms, pollen, charcoal, ostracods, isotope ratios of ostracod carapaces, and models of groundwater flow (e.g. Barnosky et al. 1987b; Brown et al. 2005; Clark et al. 2001, 2002; Dean &
Schwalb 2000; Grimm 2011; Grimm et al. 2011; Hobbs et al. 2011; Laird et al. 1996; Valero-Garcés et al. 1997). Related multi-disciplinary work has been done in the Nebraska Sand Hills (e.g. Schmieder et al. 2011, 2012), an area that fascinated Herb since his early work there with Bill Watts (Watts & Wright 1966), in the Yellowstone National Park (Engstrom et al. 1991), and in the Eastern Prairie Peninsula in Illinois (Nelson et al. 2006).

Whilst visiting Hilary and John Birks in Cambridge, UK, in 1979 Herb asked if there were any nearby lakes that needed coring. Herb, John Birks, and several Cambridge researchers including Henry Lamb, Pete Coxon, Brian Huntley, and Mary Edwards visited Diss Mere in Norfolk and raised a 13 m core from the lake centre. When we got to the lake, Herb realised that he had been there before, in 1944 when he was based near Bury St Edmonds, and he had wondered then how this perfectly circular basin had formed. The sediment core collected in May 1979 and a second deeper core collected in 1980, provided the material for detailed pollen analysis by Sylvia M Peglar and for detailed diatom analysis by Sherilyn C Fritz that formed major parts of their two doctoral theses, one in Bergen and one in Minnesota. This work led to important publications about lake ontogeny, the relationship between lake-catchment and land-use, the likely cause of the elm decline in the mid Holocene, changing land-use, and the formation of annually laminated sediments in Diss Mere (Fritz 1989; Peglar 1993a, 1993b; Peglar & Birks 1993; Peglar et al. 1984, 1989). None of this work would ever have been done if Herb had not asked if there was a nearby lake to core!

The LRC quickly developed expertise in modern limnology, phytoplankton ecology, lake restoration management, and biomanipulations of lakes through its Associate Director Joseph Shapiro and affiliated faculty members including Bob Megard, Eville Gorham, Alan Brook, and Hans-Olaf Pfannkuch. The Wednesday-evening seminar series at Herb’s home was extended to include one quarter devoted to limnology and one to palaeoecology in order to promote the interdisciplinary heart of the LRC and for many years these were active interactions among the LRC palaeoecological and neolimnological graduate students and post-graduate fellows, including limnologists such as Val Smith, Edward Swain, Michael Lynch, Bruce Forsberg, and David Wright. When Herb retired as Director of the LRC, Kerry Kelts (1947-2001) was appointed Director until 2000 (Johnson & Talbot 2002). Emi Ito is now the LRC Director and she has established excellent facilities for stable-isotope analyses in palaeolimnology, which were close to Wright’s interests (Hu et al. 1977, 1999; Stevens et al. 2006). The LRC hosts the LacCore – the national lacustrine core facility – a major research facility for state-of-the-art handling and logging of lake-sediment cores.

5. Global Climates since the Last Glacial Maximum

Much of Herb Wright’s research was at a local (e.g. Lake Zeribar) or regional (e.g. Minnesota) scale (Wright 1996) but in 1977 he and Ed Cushing with John E Kutzbach and Thompson (‘Tom’) Webb III from the University of Wisconsin and Brown University, respectively, initiated a group called COHMAP (Climates of the Holocene – Mapping Based on Pollen Data). The aim was to attempt for the terrestrial realm what the CLIMAP project (Climate: Mapping, Analysis, and Prediction; a multi-institutional consortium led by John Imbrie (1925-2016), James D Hays, Nicholas J Shackleton (1937–2006) and Andrew McIntyre) had done so successfully in the marine realm (CLIMAP Project Members 1976, 1981; Gates 1976). CLIMAP had, for the first time, combined results of general circulation models of past climate with palaeoceanographic data (primarily foraminifera). COHMAP quickly became global in its research extent and in the climate proxies it considered (terrestrial pollen, lake-levels, marine plankton, pack-rat middens). It changed its name to the Co-operative Holocene Mapping Project after incorporating researchers from the UK, Canada, and New Zealand and from other universities in the USA. Masterminded by John Kutzbach, Herb, Tom Webb, Pat Bartlein and many others (Wright et al. 1993), COHMAP focused on simulating past climates at 18,000, 15,000, 12,000, 9000, 6000, 3000, and 0 years ago and comparing the model simulations with the available palaeoclimate data (COHMAP Members 1988; Wright & Bartlein 1993).
COHMAP’s modelling experiment results show how orbitally induced changes in insolation and changes in surface boundary conditions affect regional climates and hence the observed broad-scale changes in vegetation, marine plankton, and hydrology (COHMAP Members 1988). COHMAP was a major turning point in Holocene climate research for several reasons. First, it used what were then state-of-the-art general circulation models to simulate palaeoclimate under specified boundary conditions. Second, it resulted in detailed compilations and syntheses of palaeoclimate proxy data that were then used in data-model comparisons. Third, it considered the global climate as a whole and revealed the strong regional interconnections between different components of the Earth’s climate system. Fourth, it revealed the remarkable spatial and temporal variation in circulation patterns and climate at 3000-year intervals during the Holocene (Wright 1996; Wright et al. 1993).

Herb played a major part in COHMAP because of his deep curiosity about the Earth’s climate system, his extensive knowledge of late-Quaternary history, his willingness to share data, his synthesis with Neil Roberts of the vegetation, lake-level, and climate histories of the Near East (Roberts & Wright 1993), his lead editorship of the large COHMAP volume (Wright et al. 1993; Wright, unpublished note ‘Wengen 2’), and in making one of its first detailed data-model comparisons for 18,000 years ago for North America using the COHMAP climate model simulations and extensive palaeoclimatic and geological data (Kutzbach & Wright 1985).

COHMAP was a major paradigm shift in Holocene climate research (Birks 2008) and Herb was an important contributor to this paradigm shift, or in his words part of the “breakthroughs in Ice-Age history” (Wright 1996). COHMAP was a model of multi-institutional and interdisciplinary collaboration with its yearly meetings that brought together all the principal investigators, graduate students, and post-doctoral fellows from the many laboratories involved to discuss and advance ideas about late-Quaternary palaeoclimates. Herb greatly enjoyed and valued this approach to collaborative research involving early-, mid-, and late-career scientists, all with a common scientific interest.

Because of the highly dynamic nature of Holocene climatic and biotic changes (Hu et al. 1999), Herb wrote several important critiques and reviews of chronostratigraphic classification in which he argued that formal chronostratigraphic procedures may not be appropriate or useful when one has, as in the Holocene, an absolute chronology (Watson & Wright 1980; Wright 1976c, 1981c). He also wrote valuable reviews about the Quaternary in general (Wright 1989a), interglacial pollen records (Wright 1972c), palaeoclimates (Wright 1992b, 1995), vegetation history and climate change (Wright 1981a), and Holocene chronologies (Wright et al. 2004).

6. Patterned Peatland Development

Minnesota has more peat than any other US state except Alaska. The northern Minnesotan peatlands exhibit spectacular surface patterns with forested islands, ovoid islands, water tracks, sedge lawns, raised bogs, flarks, and other surface features. These patterns are most clearly seen when viewed from the air (see, for example, plates 1-16 in Wright et al. 1992 and Figure 12). They reflect the complex interactions between vegetation and local environment. In the early 1950s, Donald B Lawrence (1911-1996), a plant ecologist at the University of Minnesota, showed Herb Wright some aerial photographs of the Red Lake peatland taken by a Naval Reserve pilot on training flights. Herb, who was fascinated by aerial photographs and landforms at a range of spatial scales, was immediately struck by the vegetation patterns but was puzzled by their nature and possible origin. Don Lawrence and Herb set out a set of stakes in one patterned area to test the hypothesis that the peat ridges resulted from soil or peat creep, possibly triggered by frost activity. After a year the stakes were removed but no significant movement was detected (Heinselman 1992).
Miron (‘Bud’) L Heinselman (1920-1993) began his doctoral research on the ecology and growth of black spruce (*Picea mariana*) on the Glacial Lake Agassiz peatlands east of the prairies of the Red River Valley in northern Minnesota. He attended several of Herb’s courses on glacial geology and geomorphology and Herb joined Bud’s doctoral committee. They became life-long friends with many common interests, most particularly conservation and management (see the next section of Fire History). Herb encouraged widening Bud’s doctoral research topic to include peatland hydrology and the striking vegetational patterns that are so characteristic of these peatlands. Heinselman (1963) concluded that the peatland patterns were examples of a whole suite of peatland surface-patterns that occur in different forms around the entire circum-boreal region (e.g. Sjörs 1959, 1961).

Some of Herb’s students (e.g. Griffin 1975, 1977) and colleagues (e.g. Janssen 1967b, 1968, 1984) began studies on the modern vegetation and pollen assemblages and on the peat and pollen stratigraphy of these northern Minnesotan peatlands. Heinselman (1970) completed investigations on the history of Myrtle Lake and the development of the vast peatlands north-west of the lake. As a result of these and other studies, Bud and Herb became actively aware that pulp-wood logging, Christmas-tree harvesting, and the use of Muskeg tractors (bombardiers) were having an impact on these fragile ecosystems. The great impacts of possible drainage, road construction, and peat mining were also in their minds (Heinselman 1992). In 1962 the Myrtle Lake peatland was designated a research natural area—the Lake Agassiz Peatlands National Area—and in 1964 a Registered National Natural Landmark. However, its official registration was never accomplished because of local opposition. Then in 1975 the Minnesota gas company (Minnegasco) wanted to lease 300,000 acres of the Red Lake peatland for peat mining. That proposal prompted the first major efforts to protect some of Minnesota’s most distinctive patterned peatlands. Fortunately, the Minnegasco threat never materialised but it resulted in the extensive and detailed studies in the Minnesota Peat Program. These studies included flora, fauna, vegetation, hydrology, ecology, palaeoecology, history, peatland development, and human influences and they were published together in the book *The Patterned Peatlands of Minnesota* edited by Herb Wright, Barbara A Coffin, and Norman E Aaseng (Wright et al. 1992). The threats to these peatlands and all the research focused on these peatlands stimulated concern and interest in designating certain peatlands for protection against future disturbance. On 4 June 1991 Governor Arne Carlson signed into law the Wetlands Conservation Act of 1991 that dedicated all 146,239 acres of state-owned lands in the core areas of the 18 peatlands as scientific and natural areas (Aaseng & Djupstrom 1992).

Herb’s fascination with these Minnesotan patterned peatlands and the origin and development of the patterns led to major projects on peatland ecology and palaeoecology not only in Minnesota but also elsewhere in eastern North America and in the Hudson Bay Lowlands with Jan Janssens (e.g. Janssens et al. 1992), Paul H Glaser (e.g. Glaser 1987a, 1987b, 1992; Glaser & Janssens 1986; Glaser et al. 1981, 1990, 2004b; Wright & Glaser 1983), George A King, and David R Foster. Besides research on patterned bog ecology and development in Labrador (Foster & Glaser 1986; Foster & King 1984; Foster et al. 1983, 1988a; Glaser & Foster 1984), David Foster, Herb, and associates also studied patterned mire development in Sweden (Almquist-Jacobson & Foster 1995;...
Besides peatland ecology, Bud Heinselman intensively researched the role of natural fire in northern conifer-dominated (*Pinus* spp., *Picea* spp.) forests, particularly in the Boundary Waters Canoe Area (BWCA) of north-eastern Minnesota’s Superior National Forest (Figure 13). He had canoed this wilderness area since he was a boy. Between 1960 and 1974, Bud and Albert (‘Al’) M Swain, a doctoral student of Ed Cushing, canoed through parts of BWCA in the summers and took incremental cores for tree-ring counting from pine trees, mainly *Pinus resinosa* (red pine) to reconstruct the stand age-structure and fire history in different parts of the BWCA. Bud located and mapped the remaining virgin, unlogged old-growth forests dating back to 1595 within the million acres of the BWCA. An obvious question was could the natural fire history be extended further back in time by analysing charcoal particles in lake sediments, ideally with annual laminae (varves) to provide an absolute chronology for the charcoal peaks? Herb, Bud, and Ed Cushing set out not only to find a suitable lake with annual laminae but also to work out how to recover undisturbed laminae from the near-surface sediment without having the laminated structure disrupted by escaping gas bubbles (ebullition). The 31-metre deep Lake of the Clouds in Lake County, north-east Minnesota on the border with Canada was selected and cored because of its laminated sediments. It was one of the first sites whose uppermost sediments were sampled by an effective freeze-corer improvised on site by Herb, Bud, Ed Cushing, Al Swain, Noel Potter, and Mel Whiteside (see Wright 1980c for details of freeze-corers and ‘frozen fingers’).

Alan J Craig constructed a complete Holocene pollen diagram (Craig 1972) for Lake of the Clouds and Al Swain (Swain 1973; see also Swain 1980) reconstructed a detailed record of charcoal and hence fire history for the last 1000 years, showing an average fire frequency of approximately 60-70 years with a range of 20-100 years.

It was clear from Bud and Al Swain’s extensive field observations and Al’s (1973) palaeoecological studies that “fire largely determined the composition and structure of the pre-settlement vegetation of the Boundary Waters Canoe Area as well as the vegetation mosaic on the landscape and the habitat patterns for wildlife. It also influenced nutrient cycles, and energy pathways, and helped maintain the diversity, productivity, and long-term stability of the ecosystem. Thus the whole ecosystem was fire-dependent. [...] To restore the natural ecosystem of the Canoe Area fire should soon be reintroduced through a program of prescribed fires and monitored lightning fires. Failing this, major unnatural, perhaps unpredictable, changes in the ecosystem will occur.” (Heinselman 1973).

To highlight fire history and ecology, and the use of fire in management, Herb and Bud organised a symposium and field excursion devoted to the ecological role of fire in natural conifer
forests of western and northern America at the August 1972 meetings of the Ecological Society of America and the American Institute of Biological Sciences. The symposium papers were published in the journal *Quaternary Research* rather than in a more strictly ecological journal to emphasise the basically historical nature of the role of fire in natural forest ecosystems (Heinselman & Wright 1973; Wright & Heinselman 1973).

Wright (1974b) provided an important and wide-ranging critical review of landscape development, forest fires, and wilderness management in which he argued that fire may provide the long-term stability needed to preserve certain conifer-dominated forest ecosystems. It is one of the earliest papers where palaeoecological studies were used to suggest management and conservation policies. His approach of integrating long-term palaeoecological data into contemporary and future landscape management has been elegantly extended by Whitlock *et al.* (1991) to the Yellowstone National Park.

In the 1970s Herb and Bud campaigned tirelessly to save the BWCA as a wilderness area. Bud and others founded the Friends of the Boundary Waters Wilderness in 1976 to push for new federal legislation to protect the BWCA. Their efforts largely succeeded in October 1978 when Congress passed the BWCA Wilderness Bill and expanded the area by 50,000 acres and banned snow-mobiles, outboard motors, and logging. President Carter signed the bill into law on 21 October 1978. The book *Troubled Waters: The Fight for the Boundary Waters Canoe Area Wilderness* (Proescholdt *et al.* 1996) discusses the role of Bud in advocacy and of Herb in science and in presenting expert evidence to congressional committees (Engstrom 2015) in relation to this fight. Bud’s (1996) book *The Boundary Water Wilderness Ecosystem* describes in detail the vegetation, ecology, history, and management of the BWCA. Herb helped Bud’s widow (Frances (‘Fran’); 1923-2013) and their children to finish the book and to prepare it for publication by the University of Minnesota Press (Wright, unpublished note ‘Wengen 2’).

As an idea of the tensions that prevailed in northern Minnesota in the early 1970s about the BWCA and attempts to protect it, an effigy of the wilderness advocate Sigurd Olson (1899-1982) with the name of Bud Heinselman tacked to it was hung in Ely, northern Minnesota on 8 July 1971 (Figure 14). Olson and Heinselman had feared that their efforts to expand the BWCA and to have it designated as a wilderness area would anger fellow Ely residents – and it certainly did!

A national forest fire in May 1971, the Little Sioux fire, just outside the BWCA provided an opportunity to study the effects of a forest fire on the limnology of lakes within the burned area and on the forest ecosystem (Wright 1996). This was the first major area to be burnt since the US Forest Service initiated their fire-suppression programme in 1910. The results provided new insights into fire-lake interactions (e.g. Bradbury 1986; Bradbury *et al.* 1975; Grigal & McColl 1975; McColl & Grigal 1975; Tarapchak & Wright 1986; RF Wright 1976).

Herb returned to Minnesotan fire history when his doctoral student James (‘Jim’) C Clark improved techniques for analysing and quantifying charcoal in lake sediments by using petrographic thin sections (Clark 1988a, 1990a) and provided an underlying theory for charcoal records (Clark 1988b). Clark studied three deep lakes with annually laminated sediments in the Itasca State Park in north-western Minnesota. Greater charcoal abundances, except after 1910 (when fire-suppression policies began) were during times of low lake-levels (Clark 1988c, 1989, 1990a).
The charcoal records were not exactly the same for the three lakes, because different fires affected different catchments, as determined by fire scars on old pines dating back for several centuries (Wright 1992a). The charcoal record for the last 750 years at Deming Lake suggested maxima of fire frequency about every 90 years during the last few centuries of the ‘Little Ice Age’ (1700s, 1790s, 1880s) but a frequency about half that during the warm centuries preceding the ‘Little Ice Age’. Clark (1988c, 1990b) proposed a climatic periodicity based on the sunspot cycle of 22 years but that during an overall cool phase like the ‘Little Ice Age’ it took four cycles to build up enough dry fuel to sustain major fires compared to half that interval for a warm phase (Wright 1992a). These results suggest, for example, why fire suppression in the Yellowstone National Park in the Rocky Mountains since 1910 resulted in the great fuel accumulation that sustained the massive forest fires of 1988 and suggest how a combination of warm climate predicted for the 21st century and continuous fire suppression will result in even greater conflagrations in the future (Wright 1992a).

Herb’s never-ending sense of adventure, love of wilderness areas, and fascination of geoarchaeological research resulted in another fire-history project, this time where Herb describes as “seven trips I made to the wonderful insect-infested wilderness of Labrador” (Farrand et al. 1990). This work resulted from an idea from the Arctic archaeologist Bill Fitzhugh that interactions between Native American and Inuit populations in Labrador were linked to the movements of reindeer (caribou) herds which depend on ground lichens such as Cladonia, Cladina, Cetrararia, and Stereocaulon as a major food resource. The initial hypothesis was that the extensive lichen cover was controlled by the occurrence and distribution of forest fires. Fire history could be reconstructed from charcoal preserved in Labrador lake sediments (Farrand et al. 1990). Although the initial hypothesis was intractable (Wright 1996), extensive palaeoecological investigations were made by several of Wright’s students on vegetational history (e.g. Lamb 1980, 1984, 1985), fire history (e.g. Foster 1983, 1984a, 1984b, 1985), landscape and peatland development (e.g. Foster & Glaser 1986; Foster & King 1984; Foster et al. 1983, 1988a, 1988b; Glaser & Foster 1984), lake history (e.g. Engstrom 1984; Engstrom & Hansen 1985; Engstrom & Wright 1984), limnology (e.g. Engstrom 1987), and climate change, glacial history, and deglaciation (e.g. King 1985). Herb’s fieldwork in the Labrador wilderness, along with sediment coring attempts at Elk Lake have swelled the many legendary stories of adventures and misadventures of fieldwork with Herb (Engstrom 2015).

In a characteristically modest way, Herb wrote about the Labrador project “I served as field assistant and devil’s advocate around the campfire” (Farrand et al. 1990).

Herb also had a major influence on establishing detailed fire histories and long-term fire-ecological studies in Europe by asking Brigitta Ammann in Bern (Ammann 2016) “what is known about fire history in Switzerland?” This question initiated a Swiss National Science Foundation project (1993–95) which produced the first European charcoal–fire calibration study (Tinner et al. 1998) and provided new detailed insights into the fire ecology of central Europe (Tinner et al. 1999). In 1999, Herb convinced Willy Tinner, a PhD student of Brigitta Ammann to visit Feng Sheng Hu, a postdoctoral associate of Herb’s who had just been appointed Assistant Professor at the University of Illinois. During his year in the USA, Willy organised sediment coring expeditions in Alaska to reconstruct the Holocene fire history of the Copper River Basin. The 1999 field campaign only succeeded because of Herb’s great field experience, because after days of endless driving across the entire Copper River Basin, Herb immediately recognised Grizzly Lake as one of the most promising lakes in the area. Studies on the Grizzly Lake sediments (Tinner et al. 2006, 2015) have shown Herb’s choice was correct, as it so often was. When it came to site selection, Herb lived up to his initials – Hardly Ever Wrong!

Reconstructing fire history and fire frequency is now a major research activity in Holocene palaeoecology in the Americas, Europe, and elsewhere, due in part, to the pioneering work by Herb
and his students and associates such as Bud Heinselman, Al Swain, Ed Cushing, David Foster, Jim Clark, Cathy Whitlock, Willy Tinner, and others.

8. Field-Craft and Sediment Coring

Herb Wright was as much at home in the field, even under difficult or sometimes atrocious conditions, as he was in his office in Pillsbury Hall (he often had its windows open even in winter!) or sitting by the wood fire in the living-room of his Hythe Street home in St Paul reading, listening to music, and editing manuscripts. Besides having the many skills of a Quaternary geologist, geomorphologist, and palaeoecologist to decipher stratigraphical sections, understand landforms, and interpret biotic changes, Herb had a passion for coring sediments in lakes and mires for subsequent pollen or other palaeoecological analyses (Wright 2010). It is unclear when and where Herb collected his first sediment cores, possibly as early as the mid-1950s in Iran (Figures 15, 16) or the Chuska Mountains in New Mexico but maybe in the late 1950s in Minnesota. He initially cored from the peaty margins of lakes in Iran or New Mexico or from the winter lake-ice in Minnesota. He perfected coring from open-water (Wright et al. 1965) using a variety of set-ups to allow operations from boats of various sizes and qualities, including canoes, home-made rafts, fallen logs, wooden frames (Figure 17), and even truck-tyre inner-tubes (Figure 18). He developed a much-improved 5-cm diameter stationary piston corer with an inner square rod (Wright 1967) (Figure 19) and light-weight but strong magnesium-alloy drive rods (Wright 2010), as well as other types of corers (Wright 1980c).
He produced in conjunction with Jim Smith at a small machine-shop in St Paul hundreds of square-rod corers (including later a version suitable for coring into fibrous peat; Wright et al. 1984) and constructed over 4000 m of drive rods for colleagues around the world (Wright 2010) (Figure 20). There seems to be a physical limit to how much sediment can be collected with this type of equipment, even with the help of chain-hoists (Figures 15, 21) and a drill-frame (Cushing & Wright 1965; Wright 1980c, 1991; Wright et al. 1965). Herb’s record is 40 m of core from Lake Zeribar collected in 1970 from a fringing peat mat (Wright 2010) (Figure 15). This may be a world record.

Fieldwork with Herb could often turn into an adventure, even a serious adventure, or even a struggle for survival (Figure 21) (Birks 2016; Birks & Birks 2016a; Engstrom 2015; Shay 2016). Minnesotan or Dakotan winters can be cold, even very cold, the high Peruvian Andes of 3000+ m (Wright 1986) have less oxygen than at sea-level, and northern boreal areas far from civilisation like the Yukon, Alaska, and Labrador can be insect-infested in the summer. Herb usually brought sub-optimal coring equipment and boats, and minimal food and overnight bivouac equipment with him, for example one snow-shoe is of limited use with deep soft snow at just above freezing point. His field vehicles were usually inadequate (Figure 22) or had seen better days and they frequently ran out of petrol as mysteriously the fuel gauge usually did not function. Amongst his colleagues and students, there are masses of stories of adventures with Herb in the field (Almendinger and Jennings 2016; Baker 2016, Birks 2016; Birks & Birks 2016a; Engstrom 2015; McAndrews 2016; Shay 2016). Some of these have acquired legendary status. Herb particularly liked to sleep out ‘under the stars’ – he was quietly proud that he had slept out on all continents including Antarctica! Once in the Serra da Estrêla, eastern Portugal (Ammann 2016), Herb was sleeping out amongst granite blocks and tors. We had to leave early to get to Lisbon for a flight. We were about to leave in the dark when someone said “where is Herb?” I encouraged people to be quiet and listen carefully. His distinctive snore was soon heard, Herb was located, and the complete group left for Lisbon at 04:30!
Herb emphasised that “ingenuity and resourcefulness in the field are particularly essential in coring operations, but it is important to understand the physical principles involved in how the equipment works and why it sometimes doesn’t work” (Wright 1991). Very many of his field colleagues would reiterate the importance of ingenuity and resourcefulness (and personal survival skills) when being in the field with Herb! It remains a total mystery why Herb would set off on coring expeditions so poorly prepared with old, barely functional equipment and inadequate boats, food, or clothing and with seemingly little concern for safety of himself or his colleagues (Engstrom 2015).
9. Writing and Editing

Two of Herb Wright’s many attributes were his ability to write clear and concise prose and his great patience to edit (and often re-write) other people’s manuscripts to make them as clear and as concise as possible (Figure 23) (Amman 2016). In his 71 years of scientific publication from his first (Wright 1943) to his last (Ammann et al. 2014) publication, Herb’s papers are models of simple, concise, and elegant scientific writing. He encouraged all his students and colleagues to read, study, and follow Strunk and White’s (1979) *The Elements of Style*.

Herb published over 200 scientific articles or book chapters, edited 15 books, and six Special Issues of journals (see Appendix and publication list). He edited and often rewrote thousands of manuscripts by colleagues from all over the world, modestly writing in his comments and edits in pencil (Figure 23). For example, he played a major part (Wright, unpublished note ‘Wengen 2’) in the editing and illustrating of *Palaeoecological Events During the Last 15,000 Years* (Berglund et al. 1996), a compilation of Holocene events and important pollen-stratigraphical diagrams for almost all European countries. Herb (Wright, unpublished note ‘Wengen 2’) commented about editing the magnum opus *The Quaternary of the United States* (Wright & Frey 1965) “I must have enjoyed doing this – perhaps it goes back to my days editing the high-school newsletter – so I agreed to edit the proceedings, which involved finding publishers around the country who would take on a symposium with supplementary related papers.”

Many of the books he edited remain as major contributions to the literature of Quaternary research (e.g. Ruddiman & Wright 1987; Velichko et al. 1984; Wright 1983b; Wright & Frey 1965; Wright et al. 1993). Besides writing a large number of excellent primary research papers, Herb had a particular skill at synthesis and at writing many valuable and insightful review papers on a range of topics, starting with the Late Pleistocene climate of Europe: a review (Wright 1961a). Some of his most important reviews, as valuable today as they were when first published, include Wright (1966, 1968b, 1971b, 1974b, 1976c, 1976d, 1977b, 1981a, 1984c, 1987, 1989b), Watson and Wright (1980), and Yu and Wright (2001).

Herb had a brilliant eye for design and for detail. In conjunction with draughtsman Richard (‘Dick’) Darling at the LRC in the 1960s and artist Rebne Karchefsky in the 1970s, they produced many outstanding illustrations of complex pollen-analytical data for publications (e.g. Birks 1976; Janssen 1967a, 1967c, 1984; Wright & Watts 1969; see Fægri 1973 for comments). A life-size portrait of Herb in the field, painted by Rebne, hangs on the walls of Pillsbury Hall in the Department of Earth Sciences at the University of Minnesota (Figure 24). It was painted as part of Herb’s retirement functions from his Regents’ Professorship in 1988.

Herb’s generosity in editing (and often rewriting) manuscripts for his colleagues worldwide contributed greatly not only to the quality of the Quaternary literature but also invaluable scientific networking and international collaborations (Wright, unpublished notes ‘Wengen 2’ and ‘Sils remarks’).
10. Scientific Networking and International Collaboration

Herb Wright was one of the most international Quaternary scientists of his generation. Soon after World War II, he travelled widely by train, bicycle, and motorbike in Europe and met many of the leading Quaternary geologists and geomorphologists in Germany, Switzerland, and Austria (Wright 1957a, 1961b; Wright, unpublished notes 'Wengen' and 'Sils remarks'). Herb already had a nascent interest in lakes and pollen analysis acquired during his graduate days from Kirk Bryan Sr, so in the early 1950s he visited the major European Quaternary pollen laboratories in Switzerland, Germany, Denmark, Sweden, Norway, and England. He was also active in geological and archaeological studies in Lebanon and Iraq. By 1955 Herb had thus established a strong communication network of Quaternary geologists, palaeoecologists, and archaeologists (Wright, unpublished notes ‘Wengen’ and ‘Sils remarks’). When the Minnesota pollen laboratory and the Limnological Research Center were founded in 1958 and 1959, respectively, it was natural that it was quickly populated by European palynologists and later palaeolimnologists. These visitors not only helped develop the pollen and LRC laboratories and build up their facilities, but also helped to train a large number of graduate students, many of whom are now leading Quaternary scientists in their respective fields. At least 18 countries were represented in the LRC from 1963 to 1990 whilst Herb was its director. The strong camaraderie within Herb’s LRC of the 1970s and 1980s lives on thanks to the friendships that developed in the LRC, at seminars in Herb’s house, and in the field (Björck 2016).
In his retirement, Herb was a regular visitor to Europe to visit laboratories and friends, explore new landscapes, and, of course, help core lakes and mires. In addition he was a regular participant on the annual Moor Excursion (Moorexkursion) (later also lakes) of the University of Bern instigated and organised by Gerhard Lang (1924-2016) in 1976, and continued by Brigitta Ammann from 1990 to 2006, and by Willy Tinner from 2007 to today. Between 1980 and 2007, Herb joined 15 of these excursions (Figure 25) (Ammann 2016) and attended several international conferences and workshops in Europe. On the occasion of his 90th birthday (Figure 26), Herb wrote “I have felt like an academic uncle to her [Brigitta Ammann, Bern] students, whom I have helped with the englishification (John Birks would say americanization) of their manuscripts in preparation for publication” (Wright, unpublished note ‘Sils remarks’). He helped many colleagues core sediments in lakes and mires in Europe, as well as in Peru, Bolivia, Alaska, and Kenya. In his characteristically generous way, he played a large part in the fieldwork and/or in raising research money for several of these expeditions and in writing and editing the resulting manuscripts (e.g. Ahlberg et al. 2000; Ammann et al. 2013; Birks & Wright 2000a, 2000b; Blyakharchuk et al. 2004, 2007, 2008; Engstrom et al. 2000; Stefanova et al. 2006a, 2006b; Tinner et al. 2006, 2015; Verschuren et al. 2000; Westover et al. 2006; Wright et al. 2003).

Herb was a truly international scientist with very extensive and effective trans-Atlantic scientific networks and collaborations that he maintained and extended for over 60 years. He was a great polymath in his approach to science and his research interests and achievements.
Figure 26. Herb Wright and friends at the Morteratsch Glacier, Engadine, Switzerland on the occasion of his 90th birthday in 2007. Herb is in the back row wearing a blue hat, between Dan Engstrom and Carrie Jennings (photo supplied by Brigitta Ammann)

Awards and honours

1951, 1954–55  Wenner-Gren Fellow
1954–55  Guggenheim Fellow
1956–57  President of the Minnesota Chapter, Archaeological Institute of America
1957–61  Secretary, Geomorphological Division, Geological Society of America
1963–69  National Research Council Committee for International Quaternary Union
1966  DSc (Hon), Trinity College Dublin
1967–70  Chairman, Geomorphological Division, Geological Society of America
1971–73  President, American Quaternary Association
1974–88  Regents’ Professor of Geology, Ecology, and Botany, University of Minnesota
1977  Member, National Academy of Sciences
1984  Pomerance Award, Archaeological Institute of America
1987  Philosophiae Doctor Honoris Causa, Lund University (Figure 27)
1989  Archaeological Geology Division Award, Geological Society of America
1990  Science Achievement Award, Science Museum of Minnesota
1992  Distinguished Career Award, Quaternary Geology and Geomorphology Division, Geological Society of America
1993  Fryxell Award for Interdisciplinary Studies, Society of American Archaeology
1996  DSc (Hon), University of Minnesota
Legacies
Herb Wright’s legacies to Quaternary science and to our understanding of landscapes and environmental history are immense. He published prolifically, researched globally, studied and synthesised many diverse topics, collaborated broadly, advised and influenced multiple graduate students, post-doctoral researchers, colleagues, and friends, and taught in many venues, but his greatest legacy was as a role model for all who knew him and worked with him. He was a remarkable and unique combination of genuine modesty, scientific curiosity, great generosity and kindness, quiet but effective leadership, a passionate love of adventure and wild places, intense loyalty, deep friendship, and strong devotion and service to his university, department, science, colleagues, students, friends, and family. By his example, he taught people to think independently and clearly, to design their projects carefully, to consider multiple working hypotheses, to read the literature both current and older, to attend seminars on topics not directly linked to one’s particular project, and to interact effectively. He was a master of scientific synthesis (Engstrom et al. 2016; Whitlock et al. 2016) and he could see links between seemingly disparate topics. He encouraged people to think logically and laterally, as he did and to discover new connections between different palaeoecological, palaeoclimatological, and ecological patterns and processes.

Herb’s approach to science is elegantly summarised by Shane and Cushing (1991a) who wrote in the preface to the book Quaternary Landscapes that honoured Wright on the occasion of his formal retirement from the University of Minnesota.

“He [Wright] has accomplished so much by carefully cultivating within the Limnological Research Center an atmosphere of cooperation, scholarly exchange, interdisciplinary research, and continuing international contacts.

Wright has modeled much of his teaching and research style on that of Kirk Bryan. For his students and colleagues this has meant friendship combined with independence of thought and work, wide-ranging discussions, stimulating seminars in Herb and Rhea’s home, and fantastic field trips with varied hardships. We have learned from him again and again that new
technology such as isotopic dating techniques and computerized data manipulation provides only tools, not final answers; that scientific research is clearly and specifically founded in the most basic disciplines of orderly thought, constant questioning, and being sure of what one understands before moving toward speculation. In his leadership of the LRC, Herbert E. Wright, Jr., has shown us that careful research based on the desire for cooperation and discovery, and not tied to traditional scholarly boundaries, has both scientific and human value.”

Herb also taught many of his collaborators the importance of dogged determinism, ingenuity, and perseverance in the field, particularly in the harsh conditions of a Minnesota winter or the trying conditions in wilderness areas with hordes of insects in the Yukon or Labrador. Through these hardships, strong bonds and friendships developed, many of which continue to the present (Björck 2016). Such long-lasting friendships are something that Herb must have been very proud of, as they symbolise so well the unique character of the LRC that he created, developed, and nurtured between 1963 and 1990. Herb really was a great giant in so many ways.

Herb’s name will also live on through his invention of the Wright square-rod piston corer (Wright 1967). He also has a peak named after him, Wright Peak (1510 m) 0.9 km south of Sutley Peak in the Jones Mountains, Antarctica (73° 40' S, 94° 32’ W). It was mapped by the University of Minnesota Jones Mountains Party of 1960-61 who named it for Wright who was an advisor to the Party. Wright visited Antarctica including Wright Peak in the 1961-62 season.

The obituaries and memorials by Almendinger and Jennings (2016), Anfinson (2016), Birks and Birks (2016b), Birks et al. (2016), Björck (2016), Engstrom et al. (2016), and Whitlock et al. (2016) discuss additional aspects of Herb’s legacies, leadership, and mentoring.

Personal comments

Herb Wright (Figure 28) was by far the most important mentor in my scientific career and my life (Birks 2014). My post-doctoral year in 1970 at the LRC with Herb and Ed Cushing was a career-changing event (Birks 2014). Many of my subsequent research activities and interests have their first roots in Room 218 in Pillsbury Hall, at seminars in Herb’s home, in the winter wilds of Minnesota or Wisconsin, in the summer heat of Florida, somewhere driving across the vast Northern Great Plains with Herb, Ed, and others, or in the St Elias Mountains of the Yukon in 1971 – numerical methods, quantitative environmental reconstructions, adventure botany and expeditions, modern pollen–vegetation relationships, linking vegetation history with palaeolimnology, detailed pollen morphology, quantitative pollen-stratigraphical analysis, diatoms and water chemistry, broad-scale vegetation changes and pollen mapping, tree migration patterns, etc. Through Herb and his wide network of research colleagues and regular stream of visitors to the LRC (e.g. Roel Janssen, Lou Maher, Bill Watts, Willem van Zeist), or fieldwork helpers (e.g. Dick Baker, Jock McAndrews, Tom Webb) I was able to meet and interact at an early stage in my career with many wonderful and stimulating colleagues, all linked by their close association and friendship with Herb. Herb was a very major influence on my life and my research and I miss him greatly. I owe so much to him.

Figure 28. Herb Wright in Blekinge, 1979 (photo Björn E Berglund)
Acknowledgements

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Appendix

Books and Special Issues edited by Herb Wright

Books


Special Issues


A full list of Herb’s publications between 1943 and 2014 can be found on the Sedimental Journeys webpage.