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"Memoir"

by William G. McKay
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EIC HISTORY AND ARCHIVES

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Abstract

This *Memoir*, written by a former senior consulting engineer in the municipal engineering field, is important for at least three reasons. The longer part of the paper describes the activities and experience of a practicing professional over a period of thirty years in a field of engineering - water supply and waste disposal - that is vital for the health and well-being of everyone. It also describes the development of a consulting engineering company that began in the Prairie provinces. And the shorter part of it provides some idea of the satisfactions an engineer can obtain from service to the members of his profession through a variety of organizations. Even today, in his eighties, Bill McKay still serves others.

About the Working Paper Series

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The editors of this present Working paper were Peter R. Hart and Andrew H. Wilson

About the Author

William Gordon McKay was born in Regina, Saskatchewan, in 1917, attended high school in Portage la Prairie, Manitoba, began his post-secondary education at the University of Manitoba and completed it at Queen's University, graduating in civil engineering in 1940. During his final year, he also took courses leading to certification as a 1st Lieutenant in the Royal Canadian Engineers, but did not serve in the Canadian Army. When his master's degree course at Queen's was ended prematurely in 1941, Bill joined the engineering staff of the Public Health Engineering Division of the Department of Pensions and National Health, serving in its St. Catherines and Edmonton offices and working in the public health engineering field. In 1945, he joined the consulting engineering partnership of Underwood & McLellan, first in Edmonton and later in Saskatoon, continuing his

involvement with this engineering discipline. When the U&M partnership was dissolved in 1952, Bill became one of five principal shareholders of Underwood McLellan & Associates (UMA), headquartered in Saskatoon and later in Winnipeg. In 1955 he was appointed manager of the company. In 1962, he became president and general manager and, four years later, president and chairman of the board. Following a serious illness, he stepped down from these positions in 1970 and assumed the role of secretary of the various operating companies associated with UMA, although he did not retire fully until 1982.

Bill McKay joined Engineering Institute of Canada in 1944, was active in the divisions and branches in Saskatchewan and Manitoba, and was elected vice-president of the Manitoba-Saskatchewan Region in 1966. He served as president of the Institute in 1969-1970. He has also been president of the Association of Professional Engineers of Saskatchewan, the Western Canada Water and Sewage Conference, the Association of Consulting Engineers of Manitoba, and the Association of the Scientific, Engineering and Technological Community (SCITEC). In the late 1980s he became a member of the executive of the EIC Life Members' Organization, subsequently occupying the chair. He currently serves as secretary and as LMO representative on the EIC History & Archives Committee. Bill was awarded the EIC's John B. Stirling Medal in recognition of his long and distinguished service to the Institute in 1994

William G. McKay
President, EIC - 1969-70

Introduction

At the Annual Meeting of the Engineering Institute of Canada held in Hamilton in February 1941, the main address at the banquet was given by W.E. Wickenden, president of the Case School of Applied Science in Cleveland, Ohio. His topic was *The Second Mile*. In it, he implied that, while the first mile carries with it the compulsion to perform the routine duties and diligences of a profession, it is only during the second mile that a calling may truly attain the dignity and distinction of a profession. In my career, I have been aware of this from time to time.

University Years

After graduation from high school in Portage La Prairie in 1936, I entered the first year of engineering at the University of Manitoba, at its old Broadway site at the corner of Broadway and Osborne Street in Winnipeg. At the completion of the first year, it became necessary to choose a discipline. At that time, the mining industry in Manitoba was booming. The Hudson Bay Mining & Smelting Company in Flin Flon was the biggest development coming into production. However, there was no mining school at the University, so that a choice had to be made between Toronto, Queen's or McGill. I had heard that Queen's was well known in the Sudbury area. Moreover, it had the smallest enrolment and was located in the smallest city. I chose Queen's.

However, after arriving in Kingston, it was apparent that mining was the principal choice of the Science Class of '40. Many of the students had worked underground, while I had no experience whatever of mining. After discussing this situation with senior teaching staff, I changed my discipline to civil, probably because it seemed to me to include the elements of engineering design and construction in which I was interested. With the completion of all the necessary courses, I graduated in 1940.

During the summers of 1938 and 1939, I was fortunate to obtain work - along with several other students - at the hydroelectric plant at Island Falls in Northern Ontario. Island Falls was north of Cochrane, on the Temiskaming and Northern Ontario Railway, where the railway crossed the Abitibi River. This plant, owned and operated by the Abitibi Pulp & Paper Company, supplied power to the paper plant at Iroquois Falls and to the town of Cochrane. The rail line was the only year-round access from Cochrane to Island Falls although, in summer, a boat trip could be made downriver from Gardner. The plant and the townsite, which were about five miles off the main railway line, were connected to it by a short spur line. The townsite was mainly a small housing area for plant employees. Our work was day labour maintenance around the plant and spillway, the housing area of the townsite and the spur line. It was my first introduction to northern isolation and to the blackflies and mosquitoes that could make work miserable, especially on the spur line.

Returning to Queen's in the fall of 1939, the students were faced with the reality of living in a country at war and the prospect of military training. At the University of Manitoba, I had taken some preliminary training in the Canadian Officers Training Corps (COTC). At Queen's, the University offered an option of COTC training in-lieu of one of the non-engineering courses in final year. To

safeguard my graduation, I elected to take all the engineering courses and the COTC program! During the fall session, the latter included lectures that were "common to all arms," and used 1914 textbooks. There were lectures on trench warfare. Much to the surprise of the teaching staff, the failure rate in the military examinations was much higher than expected. After the re-write, the results were much improved. The spring session was "special to arms." For me, this included military engineering in subjects such as map reading, demolition and bridge building, After passing this course, I was certified in the rank of 1st Lieutenant in the Royal Canadian Engineers.

It was during my undergraduate years that I developed an interest in municipal engineering and, together with classmate C. Norman Simpson, was programmed to take a master's degree in municipal and sanitary engineering under professors J.B. Baty (municipal) and D.S. Ellis (hydraulics), beginning in the fall of 1940. The University had erected a building to house a soil mechanics as well as a sanitary engineering laboratory. This latter included water filtration and sewage treatment plants that provided primary sedimentation, activated sludge and trickling filtration as secondary treatment, and sludge digestion with de-watering. Lake Ontario water was treated in the water filtration plant and sewage from the O'Kill Street outfall was available to the sewage treatment plant. My particular interest lay in the sludge digestion and de-watering operations. Simpson was interested in the hydraulics course.

During the summer of 1940, before beginning the Master's course, I was engaged by R.C. Williamson, chief engineer of the Chlorine Division of Canadian Industries Limited (CIL) in Montréal, as a laboratory technician for a short-term research project on the chlorination of sewage from the city of Hamilton. At that time, at the Depew Street plant, the only treatment was a screening process - coarse bar screens and revolving drum screens, with effluent discharging into Hamilton Bay. The process removed only the coarse and fine solids, leaving a very high content of settleable and suspended material, which would then settle in the Bay, giving rise to a major polluted body of water. The object of the project was to determine what, if any, effect chlorine would have on the effluent. My role was to run the routine tests: settleable solids, chlorine demand, chlorine residuals, etc. The demand was so high that it was impossible to apply sufficient chlorine to achieve a residual - except for weekend low-flows - proving that, if chlorination was to be effective, it would be extremely costly. This project was my first insight into industry's contributions from the steel pickling process, canning plants, the garment dyeing process, etc., to a city's waste disposal system.

Public Health Engineering: Civilian Applications

The master's course during the fall of 1940 and the spring of 1941 was interesting. While Simpson favoured the hydraulics course, I found it difficult and favoured the operational and experimental programs in sewage treatment. Professor Baty held officer rank in the Sanitary Engineers Corps of the United States Army and received the call to duty. Consequently, with his departure and with the increasingly difficult wartime conditions in the University, the course came to an end. Simpson joined H.G. Acres at Niagara Falls and I was accepted by the federal government in the Public Health Engineering Division of the Department of Pensions and National Health and was assigned to the district office in St. Catherines, Ontario.

At that time, the Department's headquarters were in the Daly Building in downtown Ottawa. George H. Ferguson was chief engineer. There were regional offices in the Maritimes, Ontario, Manitoba and British Columbia, each of which was staffed by a district engineer. The reporting was done by mail, but some emergency requests would go by telegram and, on very rare occasions, the telephone would be used.

One of the roles of the division was the investigation and solution of problems - including the bacterial content - associated with the sources and treatment of water supplies on board common carriers operating on an interprovincial or international basis. For the most part, these were passenger trains but they also included passenger and freight vessels operating on the Great Lakes. A major concern was the quality of water on board commercial vessels operating on the Lakes. Many vessels, such as freighters, were taking water on board at locations where the bacterial quality was in doubt. In the smaller lakes, some areas were becoming polluted from the cities that bordered them.

One of the better locations for monitoring vessels was the Welland Canal, especially at the triple locks at Thorold, where one could board a vessel as it was starting up the locks, gather samples and make inspections, and then cross over and board a vessel starting down the locks. In addition to taking water samples from a drinking water tap on board, the division engineer would inspect the pumping equipment and the disinfection of the water intake, and note the use of hyperchlorite or another disinfectant in the holding tanks.

The quality of water on board trains had been improved by the use of closed pneumatic systems that raised the water to the taps in the coaches, and by disposable cups. The use of the common cup was forbidden; later on, in Alberta, I was to find one on a chain in a passenger coach! Solid wastes from the toilets were still being discharged directly onto the tracks, except in most major depots, where the toilets were usually locked.

In 1942, I was reassigned to the division's office in Edmonton.This office was being set up to reduce the size of the B.C. and Manitoba regions by allocating responsibility for all of Alberta, the western half of Saskatchewan, the Yukon and the Northwest Territories to it. The water and waste water investigations in the National Parks in the region were also the responsibility of this office at that time.

The Banff and Jasper National Parks were among these. Of the two, Banff was the major tourist park and, in the routine water sampling, the results had been consistently positive for *e-coli*. In consultation with the Alberta provincial sanitary engineer, it was learned that this bacterial count was normal, probably due to feces from animals on the watershed. The tests did not differentiate between the human and animal kinds. But hikers and others could enter this watershed. Chlorination was not in use and this process was strongly disliked by park officials. Much of the water distribution system was laid on coarse gravel formations and was subject to freezing, so that a bleeder was used on house connections. This often took the form of a bypass line from the house connection, usually in the basement area, which was controlled by a valve kept slightly open to provide a small flow that discharged into the house sewer at the floor drain. The risk of cross connection was reduced by

having an air gap just above the floor drain. Other bleeders were installed from the water mains into sewer manholes. In one case, with which I was involved, there were indications that the end of the bleeder had been completely submerged in sewage, suggesting a positive cross connection under negative water main pressure. However, local officials felt there would always be a positive discharge through the bleeder. But I was sufficiently concerned about the situation to include it in my report to Ottawa. Banff and Jasper Park water supplies had been a matter of debate - for and against chlorination - between mine and another federal department, so my findings were probably not the first to mention possible contamination.

Public Health Engineering: Military Applications

During the war years, one of the roles of the Public Health Engineering Division was the investigation of the water and waste systems and facilities servicing military establishments and military-related industries. I was involved in this work while based at St. Catherines and at Edmonton.

Generally, these industries were serviced by municipal systems and were not of major concern to us. However, I contributed to the reports on the cordite plant at Nobel and the shell filling plant at Pickering, Ontario, since they operated their own systems. I was also part of a major investigation of the sewage system at the Camp Borden Army Establishment, which was carried out with the assistance of the Camp Engineering Department of the Royal Canadian Engineers.

By far the largest number of military establishments we visited were RCAF bases, some in Ontario, but predominantly in Alberta and western Saskatchewan. Where possible, the water and sewage systems were connected to municipal systems. However, especially in the West, the bases had their own systems - often quite similar to small municipal systems, including fire protection and street drainage.

I should mention at this point that the conception and construction of many of the airbase facilities to put the Commonwealth Air Training Plan in place in Canada were carried through in an extremely short period of time and, considering that they extended from coast to coast, they may be one of the best kept secrets of Canadian engineering and construction. It was an entirely Canadian effort, without the aid of any other Commonwealth partners. The work was under the leadership of Air Vice Marshal R.R. Collard, a senior member of the construction firm of Carter-Halls & Aldinger of Winnipeg.

The design, construction and operation of the RCAF waste water systems in Alberta came under the administration of Flight Lieutenant R.A. McLellan of the Works and Buildings Division of #4 Training Command in Calgary. Mr. McLellan, who will appear again later in this *Memoir*, had left the consulting engineering firm of Underwood & McLellan to join the Air Force as a civilian, but was subsequently commissioned.

Different approaches to waste water treatment were adopted by different RCAF Commands. At one

Ontario base, for example, a septic tank discharged into a trickling filter constructed on a flat slab using large rocks and a wooden trough distributor, followed by a pea gravel filter. Some problems arose from the settling of the wooden troughs, resulting in unequal distribution of the influent over the filter area. The pea gravel bed, having no means of backwashing or cleaning, had burst to the surface. In the Alberta/Saskatchewan Command, the use of a combination clarifier/digester mechanical unit, followed by a trickling filter with a hydraulic rotary distributor and final settling tank, gave a much better influent with fewer operating problems. From reviews of the systems, it was apparent that the skill and the training of the operators was the essential element in the effectiveness of the systems. To this end, an operators' school was held at the Pearce, Alberta, base. I was one of the instructors.

In addition to filing reports on my investigations with Ottawa, I would often discuss, in detail, the design and operation of the systems with Flight Lieutenant McLellan with a view to improving their operation and the quality of the effluent.

During 1942, the American Armed Forces were much in evidence in Edmonton as the Alaska Highway was under construction and Edmonton was the co-ordinating centre for rail movement over the Northern Alberta Railway to Dawson Creek, B.C., the head of the highway. Headquartered in Edmonton was the U.S. Army Corps of Engineers, along with several major contractors.The Edmonton Municipal Airport, within the city limits, was initially a base for air operations, including the ferrying of aircraft to Russia. Slightly beyond the northern limits of the city, at Namao, a large American base was built (which, in later years, became part of the Strategic Air Command of NORAD). By relocating many aircraft to this larger base, the loading of the smaller municipal airport was decreased. Also headquartered in Edmonton at this time was the Canol Pipeline Project, as well as a major pipeline contractor, Bechtel Price & Callahan.

While I was not directly involved with the Americans, I did visit most of the air bases located along the Alaska Highway, beginning at Fort St. John and ending at Whitehorse. The operation of these bases was shared between Canadian and American personnel.

I was also involved in the investigations of air bases and army establishments located on the Prince George to Prince Rupert rail line, as well as several construction camps on its evacuation highway, which was under construction to provide access by road as well as by rail between these two cities. Inspections of construction camps were related to camp sanitation as well as to water supply and sewage disposal.

Prince Rupert was a major military base. The RCAF had a sea base at Port Edward as well as a radar scanning unit. The Army had anti-aircraft units within the city limits. The Royal Canadian Navy, and especially the Prince Rupert shipyard, was in full operation servicing naval craft. The American Armed Forces had constructed a large embarkation depot associated with their Pacific operations. All of these required water and sewer services. My investigations involved the water supply and sewage disposal systems of Prince Rupert. The water supply was a gravity system, from an upper reservoir, with no filtration or chlorination. The sewer system had been installed using wire-bound

wood stave pipe and, in some instances, where the pipe had collapsed in rock fills, the sewage flowed down the gullies towards the harbour area. In any case, sewage disposal - for the most part - was directly into the harbour area. Both systems were operating at capacity as a result of the increased population serving the military operations. Under wartime legislation, a water supply used by military personnel could be protected by disinfection - for example, chlorination could be installed if deemed necessary. However, the chlorination of many coastal B.C. municipal systems was not readily accepted. In the case of Prince Rupert, as I recall, the city council probably agreed to this procedure in the basis that, once the wartime measures no longer applied, the chlorinators could be turned off. The B.C. Health Department was in agreement with clorination and would strive to maintain it.

Yellowknife (NWT)

In the spring of 1945 I was a member of a small survey party sent to obtain information for the servicing of a new townsite at Yellowknife needed by the development of gold mining in the area, the Consolidated mine having been in operation for some time and the Giant mine almost ready to open. The federal government was aware that the existing townsite would be totally inadequate to meet the anticipated expansion of this activity. It was located on a rock outcrop juttting into Great Slave Lake, with access for float and ski aircraft. With very little overburden, there were no permanent municipal systems. Water service in winter was by pail, and in summer by a tap service from a small pipeline laid on the surface. Night soil was pail-collected and disposed of, year round, to an off-site location.

The legal survey of the new townsite having been completed, our investigation was to determine the requirements for water supply and sewage disposal and the layouts for the water distribution and sewage disposal systems. The chief of the party was a Mr. Johnson, a senior engineer with the Marine Division of the Department of Public Works, who had been involved in marine structures and navigation on the Mackenzie River system. He was the instrument man, I was the chainman and rodman, and there were several helpers.

The investigation of the water supply involved taking some soundings off the shore ice at the location of the proposed intake. After laying out a grid, Mr. Johnson indicated that I should use the manual ice auger. Inexperienced as I was, I managed to drill all the way through the ice, but failed to clear the ice shavings - with the result that I could not pull the auger out! He then pointed to the axe and advised me to chop out the auger, which proved to be a rather wet job. But I learned from this experience. Thereafter, I cleared the chips!

The blackflies and mosquitoes were very severe, as we did the field work on the new site, prompting Mr. Johnson to fabricate headnets for the two of us. But in the heat of the day, one tended to forget the headnet and, on occasion, to spit.

Although close to the original townsite, the new one had considerably more overburden and was on much more level terrain. Still, there was concern that there could be insufficient cover for frost

protection in some areas and a two-pipe recirculating system, similar to the one operating at Flin Flon, Manitoba, was suggested. (I knew nothing of such a system at that time but, four years later, I would become acquainted at first hand with the one at Flin Flon.) We submitted our reports and preliminary layouts for the new townsite, but it was after my departure from Yellowknife that the water system was built.

Underwood & McLellan: The Early Years

The original partnership between Franklin McArthur (a civil engineer) and A.A. Murphy (an electrical engineer) was formed in Saskatoon in 1911 to provide consulting services in the municipal field in the new province of Saskatchewan. J.E. (Ed) Underwood was hired as a field engineer in 1911 and, a year later, was offered a partnership. Shortly thereafter, McArthur resigned and the firm became known as Murphy & Underwood. In the fall of 1912 Roy A. McLellan (a civil engineer and land surveyor) joined the staff. During these early years the firm's work was mostly in the field of municipal engineering, including electrical power generation. The situation became difficult during World War I when there was little demand for consulting services. McLellan enlisted in the Royal Canadian Engineers and served for four years, returning to the firm in 1919. In 1920, Murphy retired and the name of the firm was changed to J.E. Underwood & Associates. Its business remained municipal services engineering, including water and sewage, drainage, and roads. Both Underwood and McLellan were registered land surveyors as well as engineers, with the result that the firm did legal surveys for cities and towns, provincial and federal governments and mining operations. In 1926, Mr. McLellan became a partner and the firm became Underwood & McLellan, remaining as such until the end of 1951.[1]

In 1945, as the wartime activities of the Department of Pensions and Public Health were winding down, I approached Mr. McLellan - who had left the RCAF to return to the partnership - with a view to employment and, as a result, I joined the firm as an assistant to Mr. McLellan in the Edmonton area. In this way, I was able to continue working in the same field of engineering and in a company that provided a complete consulting engineering service to its clients.

These years saw the beginning of the economic expansion across the provinces of Western Canada, With the drilling of Leduc #1, Imperial Oil established the oil industry and exploration spread across the Prairies. In the municipal engineering field, cities and towns were expanding their existing infrastructures and, with government support, the smaller towns were installing new systems. The day of the water pump in the kitchen, with the outhouse behind, was coming to a close. In the light of these developments, Mr. McLellan saw a future for the partnership in Alberta and opened an office in Edmonton. However, by the spring of 1946, activity in Saskatchewan - and particularly in the Saskatoon office - was such that both he and I returned there.

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[1]The Underwood McLellan story has been told in a book, "Looking Back: UMA Group - The First 75 Years," compiled and written by Alan A. Bell and published by the company in 1998. (UMA Group, 1479 Buffalo Place, Winnipeg, Manitoba R3T 1L7)

The expansion, upgrading and modernization of the existing system in Assiniboia was a prime example of this activity. Mr. McLellan and I visited there in mid-summer 1946, the town having called to advise that it was experiencing a very serious water shortage. Its water system had been installed by Murphy & Underwood in 1916. It operated from a well with ground storage and a pressure tank servicing the distribution system. A diesel-electric generation unit had also been added to this system. In the meantime, to augment the water supply, a surface source close to the town had been established. This water was being treated by three vertical pressure filters, and all water was chlorinated before distribution. At the time of our visit, the surface supply was virtually dry and water was being hauled from neighbouring sloughs. The maintenance of the filters had also been neglected to the point that they could not be backwashed. The chlorinator was not working. The distribution system was operating on a restricted basis. My concern was that, without filtration and disinfection, there could be a serious health risk; however, in discussion with the local medical officer of health, I learned that no associated illnesses had been reported and the problem did not seem to be of particular concern.

Meanwhile, in a large coulee to the east of the town, a substantial surface reservoir had been constructed under the Prairie Farm Rehabilitation Administration (PFRA) livestock watering program. This was the proposed new supply. It would require a 5-mile pipeline to bring the water into the town. Assiniboia had also entered into a major infrastructure program for a new water treatment plant, extensive water and sewer system expansion, and a preliminary treatment plant for the sewer system. I became responsible for the administration of this program at Underwood & McLellan's head office and soon became aware of what client relationships could be all about. During the latter part of the program, the current mayor - who, on occasions, when not of a particularly clear mind - would draw my immediate attention to some matter. I, in turn, learned to keep close contact with the town clerk, who would explain the situation to me more accurately and, by so doing, allow me to satisfy the mayor. So this was one of the early lessons I learned: mayors may come and go, but town clerks go on forever - and may be of great assistance to you!

My first major design project in 1946 was for a new sewage treatment plant for the city of Swift Current, which had a new-found industry - a horsemeat packing plant servicing European contracts. There was limited on-site treatment at the plant for the effluent, which had a high blood and grease content.The proposed new plant would provide preliminary sedimentation, trickling filtration, secondary clarification, separate sludge digestion and chlorination of the effluent discharging into the Swift Current creek. It would be a highly mechanized plant, requiring only day-time staff for operation and maintenance.

Usually the engineer designing a project of this kind becomes the resident engineer during the construction phase. This was my first such on-site construction experience and I was fortunate that the contracting firm had an experienced carpenter/superintendent. We had a good relationship. I became familiar with construction operations and he relied on me to interpret the plans and mechanical aspects of the equipment. Contractor-engineering relationships were then still on an open and trustworthy basis. The contractor - W.C. Wells - also noticed the attention and assistance I gave to the project. Wells was one ot the original contractors in the Prairie provinces, along with Bird, the

Dutton Brothers, Tomlinson and Ramsey, all of whom rose from small beginnings to become major operators. Wells approached me several times to join his company, but I declined, favouring the engineering side of the business - and the Underwood & McLellan partnership.

In 1948, the RCAF began a program of expansion and improvement at its larger bases in the Prairie provinces, and especially those that neighboured cities. Through Mr. McLellan's previous association with many of them, the partnership received contracts to supply engineering services for the design and supervision of the construction of water, sewer, roads and for expanded base sites, as well as for the new adjoining married quarters areas, at many of these bases. I was assigned the roads and storm drainage sections, involving curbs, gutters, pavements and storm sewers. In all, there were some seven major bases located across three provinces.

While each of these expansions involved a considerable amount of engineering work, the largest project was the establishment of an entirely new base at Cold Lake, Alberta. The initial site accommodated 3500 personnel and 555 housing units. My involvement was with the roads, providing design and head office inspection during the construction phase.

In 1949, Underwood & McLellan received a contract from the town of Flin Flon in northern Manitoba for a major expansion to its existing water and sewer system. I was a member of the on-site party, and assisted in the preparation of the report. The project was estimated to cost $1 million, with the Hudson Bay Mining & Smelting Company bearing the major infrastructure costs and the town those for distribution and collection.

Construction of the townsite at Flin Flon began in the early 1930s. The original water-sewer system served the first subdivision, which adjoined the mine site, and was completed in 1932. This subdivision was built on undulating terrain of either muskeg or rock outcrop, or a combination of both. The plan of survey was a grid system of streets and lots located irrespective of the terrain. To service it, a two-pipe cast iron water recirculating system was installed. The supply main was large enough to service the hydrants, and the return system was of sufficient size to return the water to the recirculating heating pumphouse with minimum loss of head. Each house connection had a supply/return two-pipe connection, the amount of the return being governed by the size and number of small orifices in a disc located between the two connections. The sewers - placed next to the property lines for ease of connection to each house - were of wood stave pipe, with no manholes.

Almost all of the piping system was housed above ground in a 4 ft. by 2ft rectangular utilidor box of timber frame construction, filled with sawdust insulation. However, it was deemed too costly to waterproof the boxes completely and the insulation would become wet and freeze in cold weather. So steam was applied by direct injection to the water on the suction side of the recirculating pump and helped provide a dry protective layer around the pipes. Steep grades, fast flows and the temperature of the domestic sewage protected the sewer pipes. In warmer weather the water system was fed from an elevated storage tank by gravity. In some areas, the boxes with a handrail served as sidewalks Professor N.M. Hall of the Department of Mechanical Engineering at the University of Manitoba had provided consulting services for the design and installation. This was the first use of

the utilidor concept for the installation of above-ground water-sewer systems in communities which might be sited on permafrost.

By 1950, the original Flin Flon townsite had grown to include an additional six subdivisions, spreading out from the original to locations with increased overburden. At the time of our project, there were approximately 8000 people and an estimated 2000 homes being serviced with pail delivery water systems and a similar pail night-soil collection. The need for a proper water and sewer system was therefore most pressing.

Design changes to the original system were considered, but the final design used the existing one since it was found that there were still larger areas of limited overburden than had been anticipated, even in the more distant subdivisions. The original box size was reduced since the insulating value of the shavings - used in place of sawdust - appeared to be limited. As the boxes were still not watertight to surface drainage, the shavings froze in winter. Heat exchangers were used in the new design, replacing direct steam injection and making for a more efficient operation of the boilers.

In addition to the design features, the overall project had several different features. For example, with an easement on all properties that provided entrance for public utilities, the distribution and collection system could be located on private property or on the street, or a combination of both. All design work was done on-site, with construction beginning in September 1949, about two months after the report had been approved, with the system to be completed and in operation by the fall of 1951. With this schedule, construction was put on a two-shift basis during the summer months. It involved a water supply pumphouse, a supply line, elevated tank storage, two heating and recirculating plants, seven sewage lifts and one primary treatment sewage plant, as well as the six subdivision distribution and collection systems. The contractor, W.C. Wells, supplied its services on a labour-cost basis and equipment rental at a fixed fee. The town was responsible, through the consulting engineers, for the purchasing of all materials and payment for the contractor's services. Professor Hall was again engaged as a consultant and his major contribution was associated with the two recirculating plants.

When the resident engineer for this project resigned early in the construction, I was appointed to replace him and stayed until it was completed. This project, completed at a cost of $1.6 million, was probably the first major one undertaken by the Underwood & McLellan partnership and was certainly the first for me as chief of the design and inspection team. On reflection, while one may have had the desire to improve on an original design, this was a case in which the earlier design principles were adopted. In any event, all of the systems have continued to operate satisfactorily ever since.

During the late 1950s the development of lagoons or stabilization ponds for the treatment of sewage became a major factor in the design and installation of municipal systems in Prairie towns with which I was involved. They were introduced in 1953, following the presentation of a paper at a conference in Edmonton that described the design and introduction of lagoons in the Dakotas.

Lagoons are dependent on the effects of sunlight and wind for aeration and organisms present in

sewage to produce a clarified and acceptable effluent. They are used most often for treating domestic sewage in towns with limited or no industrial waste. Their ponds or cells are earthen basins constructed with a compacted material or liner to reduce seepage. There are two or three of these, operating with 5ft depths of water, and the flow is from the first to the last, with the last being drawn down in the spring and fall and discharged into a receiving water course. The other cells are then lowered correspondingly for summer or winter operation.

Summer treatment depends on wind and sunlight to create aerobic action for the digestion of the solids with minimum odour. In winter operation, under ice cover, the settling action continues but the digestion becomes anaerobic. When the ice cover is removed in the spring, there is a period of offensive odour that could take one or more weeks to clear, depending on the availability of sun and wind to change the process back to aerobic. The first cell holds the largest amount of settled solids. There are contractors who will dredge out the solids, mainly from this first cell. These may then be used as farm fertilizer. Many lagoons continue to operate for several years before the solids are removed. Their construction and operating costs are usually lower than for the equivalent mechanical plants and their operating problems are, for the most part, minimal. However, lagoons are not problem-free. For example, there could be leakage from the cells and discharges that interfere with downstream farming operations, in addition to offensive odours. But as design standards have improved, they have continued to provide an economical and satisfactory form of sewage treatment.

Underwood McLellan & Associates: 1952 - 1982

By 1952, the Underwood & McLellan partnership had been in operation for 41 years. Ed Underwood, who was then 70, and Roy McLellan, who was 63, had probably sat across from each other at the same desk for at least half of that time. It was time for change. I believe it was primarily Mr. McLellan's direction that the new firm - Underwood McLellan & Associates Ltd.(UMA) - should be an incorporated company, something new in the consulting engineering field in the Prairie provinces at that time. There were five selected shareholders in addition to the original partners.[2] The initial issue was 6000 shares to each of the five, at $1 per share, and one each to Mr. Underwood and Mr. McLellan. By 1955, the transactions were complete and the partners began retirement. I held the position of general manager, becoming president in 1961, and past president in 1970.

Of the five shareholders, Fred Small should receive special mention. He had joined the firm as an undergraduate and, after graduation, had filled many positions, such as draftsman, instrument man, and even secretary, since there were so few on staff. Also, while in the RCAF at Calgary, Mr.

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[2] The selected shareholders were: Fred L. Small, civil engineering graduate of the University of Saskatchewan in 1928; W.G. (Bill) McKay, civil engineering, Queen's, 1940; David A. Ferguson, civil engineering, University of Alberta, 1945; B.M. (Bev) Ellis, chemical engineering, University of Saskatchewan, 1945, later MSc in sanitary engineering; and G.M. (Gerry) Beaumont, mechanical engineeering, University of Saskatchewan, 1949. Ferguson, although a civil engineer when he joined the firm in 1945, articled as a land surveyor and became registered in the three Prairie provinces. Beaumont left the firm in 1958 to become a lawyer, but returned in 1970 as corporate legal counsel and corporate secretary. At the time of writing, Beaumont and McKay are the only survivors of the five.

McLellan had taken Fred on his staff as a design engineer. But Fred's eyesight was not good and gradually worsened until he became totally blind, through retinal detachment, in the early 1960s.He had prepared himself for this situation, learning braille and becoming competent as a braille typewriter operator. He also qualified as a ham radio operator - and continued to be an excellent golfer, winning the Western Canada Blind Golf Championship. Fred also maintained his interest in the municipal engineering field, attending many water and sewage conferences in Western Canada, as well as meetings of the Consulting Engineering Association. But perhaps his most remarkable achievement was the writing and the publication in 1974 of his book, *The Influent and the Effluent.*[3] Fred and I were quite close associates and, especially after he became blind, we would travel together to various meetings. He was a truly remarkable engineer and an enjoyable travelling companion. Fred retired in 1961 from an active role, and died in 1992 at the age of 83.

As an industry, consulting engineering was growing in Western Canada in the 1950s, with local consultants making in-roads from within existing firms or in partnership with eastern consultants. The expansion of UMA began in 1952 with the opening of an office in Winnipeg, followed by the opening of others in other western cities At the same time, the firm was expanding its engineering services and increasing its staff. My own role in the firm changed considerably from that of design/inspection to management through the board of directors.

From time to time UMA would undertake ventures beyond its own engineering fields. One of the first of these was the provision of our own office facilities in Saskatoon, Winnipeg and Calgary. But there was always a problem of what to do with the renting of surplus space. Today, the company has no property holdings. The first technical venture was a company called Western Photogrammetry Ltd., which was involved in flying, aerial photography, mapping, and so on. Within a short period, UMA became aware that the flying-photography aspect could be highly dependent on weather, with very costly delays. Eventually, we disposed of the aircraft and the camera. A number of our offices - from Toronto to Edmonton - were equipped with mapping facilities but, today, this service is provided only from Edmonton.

In the 1950s, a new form of construction management company called Spantec was started and J.C. Taylor, an engineer formerly with the Dominion Bridge Company, was in charge of its operations. Its first major project was the new Royal Canadian Mint facility in Winnipeg. Another interesting early project was the field erection of a large earth-moving dragline for the Saskatchewan Power Corporation's thermal plant operation in the Estevan area. Spantec continued to grow and, today, is one of the major components of what became UMA Engineering Ltd. in 1984.

In the mid-1960s, increasing emphasis was placed on the improvement of municipal waste water treatment, and particularly of industrial wastes. A laboratory facility - Prosearch Ltd. - was established in Toronto to do bench studies of such wastes, with Dr. Jack Norman of McMaster University as an associate of the company. Through this work, UMA obtained a major project to

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[3] *The Influent and the Effluent: The History of Urban Water Supply and Sanitation*, by F.L. Small, P.Eng., was published in 1974 by Underwood McLellan & Associates, 1479 Buffalo Place, Winnipeg, Manitoba R3T 1L7

design and construct a new waste water treatment facility for the city of Sudbury, Ontario. However, as a result of inter-company management problems, UMA's role in this project was discontinued.

In the late 1960s, one of our engineers made contact with the London, England, head office of Sir Alexander Gibb & Partners (SAGP) and indicated our interest in a relationship through which UMA could draw on its expertise, particularly in the hydro-electric field. SAGP was no stranger to Canada. It had, much earlier, written the manual for the operation of the harbours administered in this country by the National Harbours Board. Also, during the sixties it - along with several other British engineering consulting firms and contractors - had opened offices in Ontario. During this time, its Toronto office was completing the design of a self-propelled crane for the St. Lawrence Seaway, as well as a warehousing terminal for the Lakehead. For its part, UMA was seeking SAGP's support for proposed hydro-electric developments in Western Canada, particularly on the Nelson River in Manitoba. A partnership - Gibb Underwood & McLellan (GUM) - was formed. It obtained, for example, the contract for the design of the Idylwyld Freeway in Saskatoon, including a low level river crossing downtown. In Newfoundland, the partnership received a contract from the provincial government for a simple marine haul-out facility at Marystown. However, before completion it had escalated into a complete shipbuilding facility - a major operation.

With regard to the GUM partnership, I should add a few comments. This was a partnership between a Canadian company operating under a board of directors and an historic British engineering organization operating on a world-wide basis under the direction of the partners. When discussions began, a senior associate and myself visited th SAGP offices in London and met with some of the partners, in particular with Angus Paton, who was to be knighted later for his presidency of the Institution of Civil Engineers. While there was cordiality between the parties at that time, there was ultimately a conflict in our respective methods of operation. Their approach to promotion was quite different from Canadian procedure. Moreover, the partners appeared prepared to finance the Canadian operation for much longer than the UMA board would sanction. So in due time the GUM partnership was dissolved. SAGP maintained its Toronto office and UMA opened one there. In retrospect, it was an interesting partnership of two very different engineering cultures, each going eventually in its own similar, but separate, direction.

A word about engineering in Manitoba's northern areas. In the late 1950s, I had several projects that served to introduce me to them. The company was awarded a contract for survey and engineering services for a new townsite at Thompson, associated with the International Nickel Company developments. There were possible complications from the existence of permafrost in this region. All of the buildings and service sites were investigated accordingly. However, it proved to be sporadic and, for the most part, did not affect the designs. In comparison with Flin Flon, Thompson was a much more suitable townsite and its services were installed under the usual design and tender call procedures. The design was done at Saskatoon, with a full-time resident staff at Thompson to inspect construction.

The company also provided engineering services to two Mid-Canada Line sites - at Bird and Cranberry Portage in Northern Manitoba. Bird is located on the Hudson Bay railway where it crosses

the Limestone River and proceeds directly north to Churchill. It is only accessible by rail, and is in a permafrost area with limited tree growth and heavy moss overburden. Fortunately, there was a gravel formation on the bank on the river that was sufficiently large to fill the needs for the radar buildings, hangar and the site accommodation. Once beyond the gravel formation, it was a terrain of moss with very silty permafrost underneath, upon which exposure and thawing had very minimal bearing capacity. The other site, Cranberry Portage, was more favourable, although the original site selected for the entire station was extremely rough with rocky outcrops, and unsuitable for the construction of the support buildings. A sandy gravel site on the borders of the community was suitable for these. The radar screen and its equipment were located on the original site, with the two locations linked by land line.

In 1968 the head office of UMA was relocated from Saskatoon to Winnipeg. In 1970, I stepped down as president and assumed the role of secretary of the various operating companies, did business development, looked after client relationship, and inspected municipal plants - all as a service to several branch managers. In 1982 I retired after 37 years with an organization that had grown far beyond any expectations when it began in 1952.

Professional Associations and Institutes

Throughout my working life, I have always belonged to professional associations and institutions. The importance of joining these and participating in their work had been stressed by Professor Baty during my long-ago days at Queen's. The main incentives to do so were meeting other members and benefiting from their publications. Over the years, this 'belonging' consumed a lot of my time and energy. I want now to share some random thoughts and reminiscences about them.

In 1945, I joined the Association of Professional Engineers of Alberta, transferring to the Saskatchewan Association (APES) when I moved to Saskatoon, and serving as president of it in 1956. This was an interesting time to do so, since APES and the Saskatchewan Division of the Engineering Institute of Canada operated under a shared organization and joint membership agreement, which was a form of professional confederation of the regulatory and 'learned' aspects of the profession..

One of the principal discussions at APES Council in these days was the relationship between engineers and architects. It was basically a matter of who had the right to be the 'prime' on a project. The Saskatchewan Professional Engineering Act at that time stated that engineers had the right to design 'public buildings.' However, there was no established definition of what such a building was. Consultations between APES and its sister architectural association were on-going and interestingly, to save travel expenses, both agreed to meet at Davidson, which is nearly half-way between Regina and Saskatoon. The problems were not resolved during my term. Indeed, the discussions between the associations may have continued up until the present time.

Tours of the regions and branches of the Institute were still, in the 1950s and 1960s, a major role for presidents of EIC. I recall well the visit by John B. Stirling, who served in 1952. While in Saskatoon,

he visited with Ed Underwood and Roy McLellan since, years ago, John had himself been the resident engineer (for E.G.M. Cape Ltd.) on the installation of the municipal services for North Battleford. The design engineers were Chipman & Power, an early 1900s consulting firm from Toronto, which had engineered a number of western town systems. At the time of John's 1952 visit, the Underwood & McLellan partnership was doing a major expansion of the North Battleford system. He recalled that, when he was the resident, the town had decided not to loop the dead ends of the water system as a cost-saving measure. After a winter of frozen services, the ends were quickly looped!

John Stirling was, to me, perhaps the most outstanding president of the Institute. In later years, at the beginning of my executive committee work for the EIC Life Members' Organization (LMO), we met again in Montréal and exchanged the written histories of our respective companies - *Fifty Years Plus*, in the case of Cape, and *A Consulting Engineering Partnership, UM&A*, in my case. John indicated that our meeting had revived many memories of his association with Chipman & Power - such as Estevan in 1911, North Battleford 1912-1914, as well as Edmonton, High River, Weyburn, Humboldt, Kamsack and Dauphin. It is interesting to note that, in the federal publication *Waterworks and Sewage Systems 1916,* John was listed as the city engineer of North Batttleford! I should add that it was with considerable surprise, and with a sense of fellowship, that I received the John B. Stirling Medal of the Institute in 1994 in recognition of my many years of service to it.

Another interesting EIC visitor-president was Jean-Paul Carrière, in 1968. At that time, I was senior vice-president of the Institute. I recall that on his tour of the Saskatchewan branches I drove Brigadier Carrière to Swift Current, and it was during this trip that he recalled some of his projects. One of these was the demolition of Ripple Rock, offshore from Campbell River in British Columbia. Another was the organization of the construction of parts of the Trans-Canada Highway. Interesting projects for a young engineer!

In 1969 I became president of EIC, just as the movement that led to the founding of the discipline-oriented constituent societies was beginning. Also, the Institute was beginning to experience financial difficulties, especially with regard to advertising revenues for the *Engineering Journal.* However, my activities as president were curtailed considerably by a serious illness, during which the general manager - Pierre Bournival - carried an increased load. But I did make a several branch visits. Probably the most successful was the one to St. John's, Newfoundland. Don Wilson, who had served on the Institute Council with me, was the host for my visit. He spared no effort to make it one of the most hospitable and memorable visits of my term.

With regard to the constituent societies, during my presidency the mechanicals were already drafting the constitution for what became the Canadian Society for Mechanical Engineering, and the chair of the committee responsible - Clifford Downing - produced successive drafts. The civils, who were beginning to consider *their* constituent organization, indicated clearly that it would be somewhat briefer than the one the mechanicals were producing!

There were also several overseas trips. On one of these, to Paris for a UNESCO-sponsored

engineering conference, Pierre Bournival and I were joined by John Dinsmore, the president of the Canadian Council of Professional Engineers (CCPE), Léopold Nadeau, the CCPE secretary/treasurer - and our wives. Everyone was at home with the French language except me, so I sat there with my headphones on listening to the translator! On this same trip, we travelled to New Delhi, India, for the Commonwealth Engineering Conference. One of our hosts was the chief engineer of the Indian Railways, who gave us an evening at his country home. He was very interested in Canadians, having consulted on several occasions with our national railway officers in Montréal. He was also well acquainted with Western ways of entertainment!

Two brief comments on changes in the activities of the EIC in Manitoba in recent years. First, while I was not on the Manitoba Executive Council, I still attended most of the functions, particularly those in Winnipeg. By the mid-1970s the Prairie and Western regions were holding a series of technical conferences. For example, one on "Building Heat" was held in Saskatoon in 1976, and one on "Nuclear Power in Manitoba" followed in Winnipeg in 1977. These were quite successful. However, support from headquarters in Montréal and from the local membership declined and they were discontinued. Second, a long standing activity of the Winnipeg Branch was the annual dinner at which final year students were hosted by practicing engineers. At these dinners, the EIC student prizes were presented, followed by the main feature - an address by a nationally known engineer. I recall one particular address. Dr. Robert F. Legget gave an interesting talk, in his impeccable style, on the re-enactment of the driving of the last spike of the Canadian Pacific Railway at Craigellachie. While sponsorship of this function is now strongly supported by the Association of Professional Engineers and Geoscientists of Manitoba and is still being maintained, support from senior engineers has been declining.

From 1968 to 1970 there was considerable public discussion about science and technology policy in Canada. With the encouragement of the Senate Special Committee on Science Policy chaired by Senator Maurice Lamontagne, a meeting of representatives of societies, associations and other interested organizations was held in Ottawa in 1969. President Carrière asked me to attend as the representative of EIC. CCPE was represented by John Dinsmore and Léo Nadeau. As a result, an organization called the Association of the Scientific, Engineering and Technological Community of Canada - SCITEC for short - was formed. Originally, there had been no specific mention of engineering in the context of science and technology. However, after pointing out that engineering - as represented by the membership of EIC and the CCPE associations - was probably the largest single professional unit within the community, it was added to SCITEC's formal title.

Several years later, I became president of SCITEC, and retained my membership in it for a number of years after that. Two events were of particular interest to me. The first was that SCITEC obtained a grant from the Science Council of Canada to do an inventory of the societies and associations whose activities fell under the rubric of "science and applied science." The results indicated that there were in Canada a large number of such organizations, that their interests varied from scientific research, medicine, applied science and engineering to the social sciences, including the law. Some were large, some were small, some had offices and paid staff, and some were operated entirely by

volunteers, sometimes out of the secretary's residence.[4]

The second was the interesting proposal that a "House of Science" be established in Ottawa. The need for such a "headquarters" for scientific and technical organizations in the nation's capital had become apparent, as the experience of CCPE - long headquartered in Ottawa - bore out. Under President Morrel P. Bachinsky of SCITEC, a report was prepared that set out the details and costs of operating such an establishment - patterned on a similar one that had been operating for some time in Australia. Office space would be provided for those organizations that wished to have a permanent presence in Ottawa, as well as temporary space for those that might wish to meet there from time to time. Board and meeting room space and office services would also be provided. The proposal was well meant, but failed to attract government support. It was abandoned, and some time later SCITEC itself ceased to be active.

Let me turn now to the Association of Consulting Engineers of Canada (ACEC), which began in 1925 as a national organization with headquarters in Ottawa and whose principal role was to foster and promote the engineering consulting industry in this country. Some years later, provincial and territorial associations were formed and became member-organizations of ACEC.

Mr. McLellan felt strongly about ACEC's role in building a strong Canadian consulting engineering industry. Years ago, at the time when EIC held annual meetings, it was customary for some of the ACEC officers to attend and to hold informal meetings with members of consulting firms in the regions. In the 1960s, at an EIC meeting in Banff, Mr. McLellan suggested to the ACEC officers that a Prairie chapter should be formed with membership from the various Prairie firms, and that it should have representation on the national board. These proposals were accepted. Fred Small was elected chairman, and I was elected secretary. Formal meetings were held. The problems of the industry in the region were discussed and concerns passed on to the board. Later, when the provincial organizations of consulting engineers were established, I was one of the early presidents of the Association of Consulting Engineers of Manitoba (ACEM). After my retirement from UMA in 1982, I took on the job of executive director of ACEM and asssisted with the programs to promote the services of member firms to the municipal, provincial and federal agencies in Manitoba.

By the 1950s, the direction of water and sewage associations had become strongly influenced by the Canadian section of the American Water Works Association (AWWA) and by the Canadian Institute of Sewage and Sanitation (CISS), which was affiliated with an American body - the Water Pollution Control Federation. At that time, Dr. A.E. Berry, head of the Public Health Engineering Division of the Province of Ontario, was the executive director of these Canadian sections. There was also a smaller organization in the Atlantic provinces, the Atlantic section of AWWA, and in British Columbia, membership was assciated with the Pacific Northwest section of AWWA. Québec formed

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[4]The report of this study, *National Engineering, Scientific and Technological Societies of Canada*, was published in December 1972 by the Science Council of Canada as its Special Study No. 25. The report was written by Professor Allen S. West and included "Perspectives and Recommendations" by the Management Committee of SCITEC, one of whose members was William G. McKay.

its own French language organization, l'Association québecoise des techniques de l'eau (AQTE).

The national conventions of the two major Canadian sections tended to be held in Ontario and their programs often reflected the operations of the major water and sewer utilities, with less emphasis on the training and education of the operators. However, as the modernization programs of the Prairies expanded, the need for a regional organization to serve the small town operators, in particular, became very apparent. Dr. Berry urged membership in the two major sections, but a three-Prairie-province concept prevailed and the Western Canada Water & Sewage Conference was formed.I became a member of this and, in 1953, was elected president. I have always been interested in the training and certification of operators which, today, is being strongly emphasised in the quest for safe water supplies.

It is interesting to note that, by the early 1970s, the Canadian section of AWWA and CISS had been disbanded in favour of Ontario sections. But several years later, a national organization - the Federation of the Associations on the Canadian Environment (FACE) - had representation from all the provincial associations.

In the late 1980s, I became a member of the Executive Committee of the Life Members' Organization of EIC and, in 1993, became chairman of it. I currently serve as secretary of this Committee and as its representative on the EIC History & Archives Committee.

My interest in the history of engineering has also been reflected in my membership in Heritage Winnipeg - a "built heritage" organization, of which I was president - and am now associated with the restoration of Car 356, the remaining streetcar of the old Winnipeg street railway system.

Mentors

Finally, a word about mentors - a few of the people who have guided the direction and development of my career. In high school, Miss Margaret Webster, a teacher of Latin, impressed on me and many of my fellow students the discipline of learning and respect for a learned teacher. At Queen's, Professor Jim Baty encouraged a strong interest in the field of water and sewage and guided me on several major investigations while I was with the federal Public Health Engineering Division and he was temporarily assigned to it. My time with Ed Underwood and Roy McLellan was a strong learning experience. From Mr. Underwood, I came to understand that one received one's political education in working with municipal councils and, from Mr. McLellan, I learned the engineering aspects of my job - both of which are essential for a successful consulting practice. Even after the partnership was dissolved and the five associates took over, there were numerous occasions when I would have welcomed the guiding hand of Mr. McLellan. But in their wisdom, these two men had confidence that we would survive - and we did!

Postscript

It has been an interesting "second mile"!