August 2018

Separating the Sands: Karl Clark and Early Oil Sands Research in Alberta

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Graduate Program in History

A thesis submitted in partial fulfillment of the requirements for the degree in Master of Arts

Abstract

Karl Clark's research on the oil sands had a huge impact on the province of Alberta. From the 1920s to the 1950s, Clark was one of few researchers who remained involved throughout the entire developmental period of the oil sands industry. Clark's persistence and systematic experimentation led to the development of an effective hot water separation process which resulted in viable commercial development of the oil sands. Without his extensive experience and sustained involvement and passion for the project, the oil sands would not have been developed when they were. The sparse earlier historiography of the developmental period has tended to underestimate his contribution. His personal papers and correspondence has provided evidence of his meticulous and systematic contributions. His work has also demonstrated the critical role that science plays in the development of an industry, a role that political will and entrepreneurial drive could not alone fill.

Keywords

Oil sands, Karl Clark, Alberta, hot water separation process, University of Alberta, Research Council of Alberta

Table of Contents

Introduction

In 1923, the basement of the University of Alberta power plant was the centre of oil sands research and development. Dr. Karl Adolf Clark, a Canadian oil sands scientist and research professor at the University of Alberta, began oil sand separation experiments there in a laboratory he had constructed. In order to conduct experiments, he shoveled clumps of oil sand through a small basement window. He was trying to figure out potential uses for the separated oil sand, which based on existing technologies was too thick to be refined into fuel oil or gasoline. He thought the sand's asphaltic qualities made it ideal as a material to surface roads in Alberta but there was not a big enough market for this to warrant commercial production. But even if there had been advancements in refining technology or a larger market for road surfacing, it still would not have made any sense to develop the oil sands in the era: conventional sources of oil and asphalt cost significantly less to produce. Nevertheless, Clark persevered, devoting countless hours, even years to research in the basement laboratory. Although it would be decades after Clark's death before the oil sands were commercially developed to the degree he had envisioned, it was his decades-long career in oil sands research, beginning in 1923, that ultimately made this development possible.

Oil plays an important part in the Canadian way of life. According to recent statistics, as a country Canada consumes approximately 119 billion litres of oil per year. This is the highest per capita rate of oil consumption in the world. Oil is also important to Canada's economy. In fact, domestic oil production in Canada has become such a mega industry that 700,000 kilometres of underground pipelines exist in Canada. These pipelines transport the country's crude oil and natural gas products all across North America, enough to circle the circumference

of the Earth about 14 times. One of Canada's most important oil reserves is Alberta's oil sands, which contain somewhere between 1.7 and 2.5 trillion barrels of oil, making it the largest deposit of oil in the world. The total area of the oil sands is comprised of three separate deposits known as Athabasca, Cold Lake, and Peace River. The total area of these three deposits is approximately the same size as the province of New Brunswick. In terms of monetary value, a 2007 Statistics Canada survey has valued the oil sands at $342.1 billion dollars, approximately 5% of Canada's total wealth. The existence of the oil sands in Northern Alberta has been common knowledge for a very long time. For hundreds of years, Indigenous peoples who lived in the region of the Athabasca and Clearwater rivers used the bitumen from these sands to repair their canoes. They also heated the bitumen in pots during the summer months to repel mosquitos. Additionally, the bituminous sands appear in the notes of European explorers such as Alexander Mackenzie who described them in his writings in 1787.[1] It was not until the 20th century though that interest arose in the oil sands as a potential commercial resource. Eventually, this led to the construction of the first commercial oil sands processing plant by the Great Canadian Oil Sands Company in 1967.

Historical literature on the oil sands has mostly focused on documenting the latter half of the 20th century. Most of the literature is not written by professional historians but rather by journalists and popular historians who have focused more on contemporary political debates surrounding the oil sands.[2] This has left a major gap in the historiography of the oil sands. Those

[1] Government of Alberta, "Facts about Alberta's oil sands and its industry," *Oil Sands Discovery Centre*, accessed March 2018, https://open.alberta.ca/publications/facts-about-alberta-s-oil-sands-and-its-industry; Andrew Sharpe, Jean-Francois Arsenault, Alexander Murray and Sharon Qiao, "The Valuation of the Alberta Oil Sands," *Centre for the Study of Living Standards*, 2008, Abstract.

[2] Some examples are Andrew Nikiforuk, *Tar Sands: Dirty Oil and the Future of a Continent* (Vancouver: Greystone Books, 2009); William Marsden, *Stupid to the Last Drop: How Alberta is Bringing Environmental Armageddon to*

who have written about it have often overlooked the first half of the 20th century, when several individuals and organizations were involved in experimental projects that attempted to find a method to allow for large-scale commercial development of the oil sands. Even what little historical scholarship on commercial development of the Alberta oil sands between 1920 and 1950 that there is, has not done enough to recognize the essential role played by Karl A. Clark. In my thesis I will argue that Clark's research on oil sands separation processes that spanned over 30 years played an important role in the eventual commercial development that began in the latter half of the 20th century. Paul Chastko's *Developing Alberta's Oil Sands* and Barry Glen Ferguson's *Athabasca Oil Sands* certainly acknowledge the role played by Clark but neither gives him the level of recognition that he deserves for his pivotal role in sparking the commercial development of the oil sands. Ferguson's 1985 monograph is the most significant in the historiography of early oil sands developments. His work was published earlier than Chastko's and focuses more specifically on the time period between 1920 and 1950. Ferguson also expressed a more clearly articulated opinion of Clark's value to the development of the oil sands, arguing that Clark's discovery of the hot water separation process was not that significant. According to Ferguson, Clark took too much credit for work done previously by others. Californian miners in the oil shales had already used hot water separation techniques as early as the 1890s.[3] Ferguson also suggested that Clark's publicly funded research might not have been as systematic and unbiased as he claimed. He suggested that, at times, Clark's work may have been hasty and too focused on solving commercial problems and also argued that it was not

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Canada (And Doesn't Seem to Care) (Toronto: Vintage Canada, 2008); Ezra Levant, *Ethical Oil: The Case for Canada's Oil Sands* (Toronto: McClelland & Stewart, 2010); and J. Joseph Fitzgerald, *Black Gold With Grit* (Sidney, British Columbia: Gray's Publishing Ltd., 1978).

[3] Barry Glen Ferguson, *Athabasca Oil Sands: Northern Resource Exploration, 1875-1951* (Edmonton: Alberta Culture, 1985), 38.

necessarily more objective and rigorous than the approach of private developers.[4] In Chastko's monograph, he similarly argued that Clark "provided few new findings" in his research.[5]

In 1989, Mary Clark Sheppard, Clark's daughter, published a collection of Clark's personal letters in her primary source based book *Oil Sands Scientist*. A closer look at this extensive collection of Clark's letters, diaries, and articles in the University of Alberta Archives and the Provincial Archives of Alberta reveal that Ferguson and Chastko underestimated Clark and the quality of his research and his overall importance to the development of the oil sands. It was not until the publication of *Oil Sands Scientist* which followed Ferguson's work that all of Clark's private papers and correspondence first became available. These writings document his extensive, essential involvement in an advisory or administrative capacity with many of Alberta's experimental projects regarding oil sands commercial development between 1920 and 1951. Many of these letters in *Oil Sands Scientist* were not available to Ferguson when he was writing his monograph *Athabasca Oil Sands*. Access to these sources make my research significant because it allows my thesis to gain a greater understanding of Clark's contribution to oil sands research than Ferguson and Chastko did. However, while it might be argued that Clark's own writings are biased and possibly self-aggrandizing, it is clear from the volume and detail of his communication, that he was meticulous in his pursuit of the knowledge required to develop an effective process. It is also clear that he was considered highly knowledgeable by his peers as his correspondence show that other experts regularly sought his advice. While he may

[4] Ferguson, 56.

[5] Paul Chastko, *Developing Alberta's Oil Sands, From Karl Clark to Kyoto* (Calgary: Calgary University Press, 2004), 13-14.

have been self-serving at times, his work was highly valued and he regularly sought consultation from others.

In a broader context, the story of Clark and the early experiments in oil sands development provides a window into the early oil industry and traces earlier roots of recurrent issues in Canadian political history. It illustrates conflict between the Albertan provincial government and the federal government. Through the context of Clark's early work, it is also clear that American involvement in the industry has been long-standing and has dominated the industry as it still does. The United States has a long held strong economic influence over Canadian business in part due to its greater size and wealth as a country.

Unfortunately, despite the best efforts of Clark and his team of co-workers, a proven method to develop the Alberta oil sands profitably was not realized during Clark's career. Although Clark was clearly more knowledgeable than many of the individuals heading up these major projects and had extensive experience in the field, he did not get to put that knowledge to full use as he was not included or only peripherally involved in several major projects where his consultation would have been very valuable. External factors outside of Clark's control such as the economic impact of the Great Depression on the province of Alberta also slowed progress towards the completion of an adequate separation process. This resulted in Clark having minimal time and financial resources to continue his research on oil sands separation processes throughout most of the 1930's.

Clark's extensive background in oil sands research was widely recognized by others in the field. He had a role in setting up and helping to operate four experimental projects and he also had a role as a consultant for multiple private companies that were looking to develop their own experimental projects. As evidenced through his letters and diaries, he also consulted with

dozens of experts involved in fields related to oil sands development in order to ensure that he had the most comprehensive information available to proceed with experiments on separation. He also wanted to determine which were the most economical and effective commercial products that could be developed from separated bituminous sand.

Unlike Clark, a number of private developers and government officials adopted a hurried approach to developing the oil sands for commercial opportunities from the 1920's and onwards. Clark developed a process that he found to be effective but many governmental and private experimenters had different ideas that were ineffective and more costly. At this time, it was not yet proven that there were any viable commercial opportunities for bituminous products. Despite this both the federal government and private developers tended to proceed with their projects in a non-systematic and disorganized manner and often did not heed Clark's recommendations and concerns. Clark tended to value setting up smaller less expensive experimental processes to prove viability before investing in larger facilities. Many developers, however, were concerned primarily with making profits as quickly as possible and consequently they failed due to lack of oil sands knowledge, poor planning, and sometimes arrogance. Like private developers, the federal government sought quick results due to the pressures of the Second World War and a need to appear effective to the voting public. Consequently, vast amounts of tax dollars were wasted without achieving the goal of determining the cost and viability of commercial development of the oil sands. Ultimately, I will argue throughout this thesis that Clark's significance is that he helped develop a mature, scientifically-backed industry. He was one of the most key contributors to the development of the oil sands and this importance is evident through the relevance of his work to modern day oil sands technology.

The 1920s: Early Experiments by Researchers and Private Developers

In the 1920s, Clark was very committed to research on oil sand separation processes. During this time, he played a central role in the operations of three significant pilot separation plants. These plants were miniature versions of future commercial plants with the goal of estimating the cost of a future large-scale commercial plant for oil sands development. They grew successively larger and provided a more accurate estimate of how much a mega oil sands project might cost. Clark's meticulous research and recording of details at all three of these pilot plants also enabled him to improve the hot water separation process. Even though other oil sands experimenters had used this process before, Clark certainly played a major role in refining this process. Other work on separation processes in the 1920s was inadequate in comparison to Clark's work. His meticulous scientific approach set him apart from others who seemed to have no method or strategy to their experiments. It was necessary that there was minimal sand in the separated bitumen so that it could be refined further into marketable paving or petroleum products. Clark's superior research throughout the 1920s accomplished more towards this goal of sand free separation than any other work on the hot water separation process that had been done to this point.

Before his career in oil sands research, Clark spent most of his early years around universities. When he was born in 1888, his father was a professor of German at McMaster University in Toronto, where Clark later earned undergraduate and Master's degrees in chemistry. He went on to obtain his PhD in chemistry from the University of Illinois in 1916. After graduating school, he continued his passion for research with the Geological Survey of

Canada and the Mines Branch in Ottawa. He married Dora Wolverton in 1918, and they would have two children, Mary and Malcolm.[6]

Clark became involved in the oil sands in the early 1920's in response to a need to fulfil the vision of Dr. Henry Marshall Tory, one of the founders of the University of Alberta. In 1907, Tory expressed a vision for the school to become a centre to advance the goals of the province.[7] One of the primary goals of the province was to develop its natural resources to help boost the provincial economy. In particular, there developed after the First World War a pressing need to research ways by which the bituminous sands located in the northern half of the province could be developed.

At this time, several factors led to an increased interest in the development of the oil sands. After the war, the agricultural economy in Alberta had taken a downturn and there was a need to diversify the economy.[8] For many years, the province's economy had been dependent on agriculture and it was desirable at this time to investigate ways in which Alberta could diversify its economy.[9] An increase in population in the Prairies also led to an increased demand for energy. For instance, between 1901 and 1911 the population of the province of Alberta rose from 73,022 to 373,943.[10] This increase in turn led to a huge spike in gasoline consumption throughout the 1920s. From 1923 to 1928 gasoline consumption in the province increased from

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[6] Mary Clark Sheppard, introduction to *Oil Sands Scientist* (Edmonton: University of Alberta Press, 1989), 7.

[7] Chastko, 6.

[8] Chastko, 9.

[9] Ferguson, 10.

[10] Chastko, 3.

about 55 million liters per year to approximately 186 million liters.[11] This increase was also part of a larger trend throughout the rest of North America in the 1920s, when there were many changes that influenced consumption. Automobiles were being mass-produced, advances were made in aviation, and oil was being used for heating in homes and buildings. Industrial development also increased dramatically after World War One and expanded the market for petroleum products.[12] The provincially funded Alberta and Great Waterways Railway sparked a desire for development in the oil sands as well. In 1910, this railroad was built between Edmonton and Fort McMurray to promote resource development. The provincial government thus had a desire at this time to make their investment in the railway worthwhile.[13] It was also part of a larger development scheme by the Alberta Liberal administrations between 1905 and 1921. In addition to this railroad, it invested heavily in many other schemes for developing resources. These investments predominately consisted of other railroads and the expansion of telephone services throughout the province.[14] Collectively, these schemes had put the province into considerable debt by the early 1920s without a lot to show for it thus further increasing the desire for the development of the oil sands. On a federal level, Canada's dependence on international oil supplies also created a desire to increase domestic oil production.[15] It was for all of these reasons that Dr. Tory promoted oil sands research and Karl Clark was an ideal candidate to help Tory with this research.

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[11] Donald Wetherell and Irene Kmet, *Alberta's North: A History, 1890-1950* (Edmonton: The University of Alberta Press, 2000), 353.

[12] J. Joseph Fitzgerald, *Black Gold with Grit* (Sidney, British Columbia: Gray's Publishing Ltd., 1978), 55.

[13] Ferguson, 61.

[14] John Richards and Larry Pratt, *Prairie Capitalism: Power and Influence in the New West* (Toronto: McClelland and Stewart Limited, 1979), 18.

[15] Ferguson, 35.

Clark's academic and research intensive background impressed Tory and he decided to offer Clark a bituminous sands-focused research position in 1921 at the newly founded Scientific and Industrial Research Council of Alberta (later known as the Research Council of Alberta).[16] Clark was one of the first two staff members at the Research Council alongside his former co-worker from the Mines Branch in Ottawa, Dr. Edgar Stansfield.[17] Earlier research done on the bituminous sands by Sidney C. Ells and Adolph Lehmann had not satisfied Tory because he believed it did not have the interests of the province in mind. Lehmann's research was limited because it focused on how the tar sands could be used to help manufacture explosives for the war effort.[18] Ells' research was heavily criticized and perceived to be sloppy according to a critical review of Ells' report conducted by Clark and Joseph Keele. They thought highly of Ells' findings but he failed to present them in an organized and easy to understand manner. Clark and Keele had been ordered by the Mines Branch Director, Eugene Haanel, to complete this 32 page review and they attempted to organize Ells' work in a more clear and coherent report.[19] Ultimately, this unfavourable review led Dr. Tory to believe that Ells would not be a good fit at the University of Alberta. [20] It also resulted in animosity between Ells and Clark that would persist until 1945. For the remainder of the time that he spent studying the oil sands with the Mines Branch, Ells remained uncooperative with the University of Alberta and the Research

[16] Chastko, 13.

[17] Rod Macleod, *All True Things: A History of the University of Alberta, 1908-2008* (Edmonton: The University of Alberta Press, 2008), 81.

[18] Chastko, 8.

[19] Ferguson, 27.

[20] Chastko, 13.

Council of Alberta. In addition, he never referenced or credited any of Clark's work in any of his subsequent research publications on the oil sands.[21]

Admittedly, Clark's preliminary research on oil sands separation methods was very similar to Ells' earlier work. The similarity of their work led Ells to accuse Clark of completely stealing his previous work. Historians Ferguson and Chastko were suspicious because Ells' report included a plethora of information about the hot water separation process that was very similar to the information that would soon appear in Clark's early reports for the Research Council of Alberta.[22] They were especially suspicious that Clark stole from Ells because, at that time, Clark had very limited knowledge of the oil sands as his previous position was with the Roads Material Division of the Department of Mines. His limited knowledge was evident in a letter to Dr. Tory in 1920 where he admitted that he did not know enough about mechanical engineering to fully comprehend the complexities involved in a separation process.[23] He had, at one point, worked with some of the chemists in the laboratory of the Department of Mines on separation processes but this was outside the scope of his role and he was told to stop shortly afterwards by his superiors at the Department of Mines.[24] It is possible that Clark copied aspects of Ells' work, but it is worth mentioning the degree to which Ells too was relying on earlier work. The hot water separation process that he "discovered" had been commonly used by mining companies in California since the 1890s.[25] A similar method was also used by the Geological

[21] Ferguson, 28-9.

[22] Chastko, 13; and Ferguson, 38.

[23] Clark to Tory, October 27, 1920, in Sheppard, 107-8.

[24] Clark to Tory, April 22, 1920, in Sheppard, 101-6.

[25] Ferguson, 38.

Survey of Canada in the 1880s during bitumen separation experiments.[26] While Clark should have cited Ells more in his early reports, it is clear that he further advanced and systematically tested the claims that Ells made about the hot water separation process.[27] Although Clark did not know a lot about hot water separation early on, he certainly built on Ells' ideas (which were already known in the field) and laboriously refined the process so that it worked on a larger scale.. Furthermore, Ells' later work differed substantially from that of Clark. For example, in regards to the use of oil sands for pavements, Ells believed that raw sands could be used whereas Clark correctly believed that the tar had to be separated from the sands before the product could be valuable.[28]

Regardless of the degree to which Clark's early work could be considered original, he clearly acknowledged that the hot water separation method was an old method and that it had been used previously in France, Germany, and California.[29] His primary goal was to figure out how to improve this already well known hot water separation process so that it could be used on a commercial scale in the Albertan bituminous sands. This goal was clearly stated in the reports and letters produced by Clark throughout the 1920s. For example, in a 1923 letter, he emphasized that it was his goal to discover knowledge that would allow the bituminous sands to become a profitable resource for Canada.[30] Furthermore, Clark was very confident and optimistic about the commercial potential of the bituminous sands and, on many occasions, declared that it

[26] Wetherell and Kmet, 356.

[27] Chastko, 14.

[28] Clark to S.M. Blair, Trinidad, June 30, 1928, in Sheppard, 159-61.

[29] K.A. Clark and S.M. Blair, "The Bituminous Sands of Alberta, 2, Separation." Research Council of Alberta Report No. 18 (Edmonton: Research Council of Alberta, 1928), Chapter 1.

[30] Clark to Hon. Herbert Greenfield, Oct. 18, 1923, in Sheppard, 132-4.

was almost certain that they would eventually be exploited on a commercial scale.[31] Clark's optimistic mindset is likely a factor that enabled him to continue to work towards an economically feasible method of commercial development despite multiple setbacks that occurred throughout his career. In fact, Clark believed that a separation process was so essential to the potential success of a commercial project that he thought any private business that attempted to create a commercial development without preliminary research would "waste a large amount of good money and end in disaster." [32] Clark also thought that a viable separation process was crucial to ensure that the maximum amount of bitumen could be obtained in the extraction process.[33] Clark was likely aware that lower yields of separated bitumen would significantly hamper the chances of economic success for any commercial oil sands project. An efficient process was essential if they were to produce an economically viable product.

An examination of Clark's letters throughout the 1920s reflected his concerns about the failures and methods used by private business developers. For instance, he was dismissive of the experimental work done by William Hinton, a mining engineer from Toronto. Clark assisted Hinton in securing samples of bituminous sand for his experiments but warned him that his ideas did not align with the research being conducted by the Research Council of Alberta at the time. Hinton's process consisted of adding kerosene to bituminous sand and then adding hot water to the mixture before putting it into a centrifuge.[34] This centrifuge was a rotating container that was supposed to separate the bitumen from the sand but it proved to be ineffective. The feedhole of

[31] Clark to W.B. Brooks, Dec. 12, 1923, in Sheppard, 134-41.

[32] Clark to W.B. Brooks, Dec. 12, 1923, in Sheppard, 134-41.

[33] Fitzgerald, 55.

[34] Ferguson, 69.

the centrifuge was only half an inch wide making it incredibly difficult to feed bituminous sand through it.[35] Clark perceived Hinton to be someone who did "not know anything about tar sand and of course missed the point in everything he did."[36] Clark developed this impression because Hinton claimed that his own unproven method of separation using the centrifuge would eliminate all of the water content from the separated bitumen.[37] Other businesspersons were also critical of Hinton and did not want to become associated with him because they believed that he did not have any ideas that would be useful for developing the sands.[38] In the end, Hinton gave up on his separation process after using only five of the 150 tons he had requested from Clark. Clark's criticism likely discouraged Hinton. He warned Hinton that his process would not work because it differed from the work of the Research Council of Alberta. When Hinton had a separated product in his early trials that contained approximately 25% kerosene, he decided to give up on his experiments.[39] While Clark experienced similar setbacks, he persisted with his experiments nonetheless.

Clark was also unimpressed with the work of J.O. Absher, a private developer from Montana who attempted two unique separation processes in the 1920s.[40] With financial help from the Bituminous Sands Extraction Company, Absher experimented with an in situ extraction method for mining the oil sands near the Waterways region.[41] An in situ method involves drilling

[35] Clark to A.E. Foreman, November 25, 1929, in Sheppard, 175.

[36] Clark to A.E. Foreman, November 25, 1929, in Sheppard, 175.

[37] Clark to Dr. Tory, December 1929, in Sheppard, 183.

[38] Clark to Dr. R.C. Wallace, March 4, 1930, in Sheppard, 198-9.

[39] Ferguson, 69.

[40] Ferguson, 68.

[41] Clark to Dr. R.C. Wallace, February 7, 1930, in Sheppard, *Oil Sands Scientist*, 196-97.

multiple wells and using specialized techniques to extract bitumen located deeper in the ground. Steam is pumped underground through one well to liquefy the bitumen while another well pumps the bitumen to the surface. Once it is brought to the surface, it must go through the separation process. Such a process, if effective, would be significant because the vast majority of the bitumen in the bituminous sands region is located deep in the ground. About 20 percent of oil sands reserves are close enough to the surface to be mined but the remaining 80% can only be accessed using this in situ process.[42] The in situ method was appealing to Absher because it allowed him to avoid mining the sand.[43] One of Absher's methods of separating the bitumen from the sand involved an in-situ process that injected heated steam into a shallow drill hole of approximately 20 to 30 feet to extract bitumen deep in the ground.[44] He quickly abandoned the idea, though, because of the large costs associated with such a procedure. He also tried to set the bitumen at the bottom of the drill hole on fire but ran into difficulties when the piping and casing in the drill hole became damaged.[45] Clark was critical of Absher's scheme because he believed that the formation of the bituminous sands beds prevented any in situ method from being successful.[46] Clark even went so far as to describe Absher's process as "rather hopeless."[47] Although Absher's efforts were forward thinking, the technology was not yet available to

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[42] Canadian Association of Petroleum Producers, "Oil Sands," *Canadian Oil and Natural Gas*, accessed August 2018, http://www.capp.ca/canadian-oil-and-natural-gas/oil-sands.

[43] Clark to Dr. R.C. Wallace, October 1930, in Sheppard, 215.

[44] Ferguson, 68.

[45] Clark to Dr. Tory, December 1929, in Sheppard, 190-91.

[46] Clark to Dr. R.C. Wallace, October 1930, in Sheppard, 216.

[47] Clark to Hon. N.E. Tanner, June 23, 1944, in Sheppard, 341.

develop his approach. In contrast, Clark persisted with an approach that was viable given the technology available at the time. However, to give Absher credit, in the 1950s, extensive interest and work on an in-situ process emerged.[48] Furthermore, in the 21st century the in-situ process of extracting oil from the oil sands has become a major component of the contemporary oil sands industry.[49]

Clark also commented extensively in his letters on the experimental work of Robert Fitzsimmons of the International Bitumen Company. Fitzsimmons was an oil promoter from Prince Edward Island who bought the Alcan Oil Company in 1925 and renamed it the International Bitumen Company.[50] Fitzsimmons' work involved drilling holes into bituminous sand beds deep enough to find a pool of asphalt free from sand that could be tapped using a conventional oil well. He even went so far as to claim, in the summer of 1928, that this drilling procedure would produce 200 barrels of oil over the summer months.[51] After this experiment failed, he decided to model a hot water separation plant after the Alberta Research Council's separation plant that had been run by Clark at Waterways on the Clearwater River. He erected his plant about 90 kilometers to the north of Fort McMurray and named it Bitumount. Although it was similar to Clark's in design, he lacked the proper equipment and chemicals that were integral to the operation of Clark's plant. Because of these shortcomings, his plant required more

[48] K.A. Clark, "Athabasca Oil Sands: Historical Review and Summary of Technical Data," *Research Council of Alberta*, Contribution #69 (Edmonton: Government Printer, 1957), 5.

[49] Government of Alberta, "Facts about Alberta's oil sands and its industry," *Oil Sands Discovery Centre*, accessed August 2018, https://open.alberta.ca/publications/facts-about-alberta-s-oil-sands-and-its-industry.

[50] Ferguson, 70.

[51] Clark to S.M. Blair, Trinidad, June 30, 1928, in Sheppard, 159-61.

labor and produced separated bitumen less efficiently than Clark's plant.[52] Schemes like these caused Clark to lose faith in Fitzsimmons who, in Clark's eyes had no background or education in fields related to the bituminous sands and did not seem to have any sound ideas for developing them.[53] He seemed to be all over the place and apparently advertised 38 different uses for bitumen that included its use as a "therapeutic bath".[54] It is also likely that Fitzsimmons' arrogant and unfounded claims upset Clark. For instance, in September 1930, Fitzsimmons publicized a claim that he had developed a method of separation that could be commercially profitable in the immediate future. This claim attracted lots of attention from interested parties in the United States and in the Canadian press, including the *Edmonton Journal*.[55] By contrast, Clark was more cautiously optimistic and did not sensationalize his results. He understood that this type of hype could be dangerous because when results do not live up to the promise, future investors in the field might be deterred.

Clark also dismissed the work of an English chemist, Ernest Fyleman, and was highly critical of Fyleman's research on separation methods for the bituminous sands in the 1920s. He described Fyleman's method as not practical and accused him of not properly understanding "the real problem" of removing the bitumen from the sand. He concluded that Fyleman's procedure might be able to eliminate a good portion of the mineral matter in the bituminous sand but that it

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[52] Correy Baldwin, "In hot water: An innovative processing technique at the Bitumount plant set the stage for future oil sands operations," *CIM Magazine*, August 17, 2015, http://magazine.cim.org/en/mining-lore/in-hot-water.

[53] Clark to Dr. R.C. Wallace, October 1930, in Sheppard, 217-19.

[54] Bob Weber, "Back to Bitumount: How the Oil Sands Changed Alberta and Canada Forever," *The Globe and Mail*, June 30, 2017, https://www.theglobeandmail.com/news/alberta/back-to-bitumount-how-the-oil-sands-changed-alberta-and-canadaforever/article35528769.

[55] "207 Barrels, Free From Impurities, Ready for Market," *Edmonton Journal*, September 12, 1930; "Edmonton to Get $3,000,000 Plant If Plan Succeeds," *Edmonton Journal*, September 15, 1930; and "North Tar Sands Interesting U.S.; Party Goes North," *Edmonton Journal*, September 16, 1930.

would leave too much sand in the separated bitumen. According to Clark, as a result of this weakness, Fyleman's procedure was not worth the cost of experimentation.[56] Fyleman did not actually conduct his experiments in Albert but Clark did and thus had better knowledge of conditions and materials.

Clark's discontent with other parties involved in oil sand development extended to Thomas Draper and his McMurray Asphaltum and Oil Company as well. Draper's company qualified as the first commercial development in bituminous sand when it opened a bituminous sand quarry in 1922. The goal was to use the tar sand for building sidewalks and streets throughout Alberta. Clark's contention with Draper is evident in a letter that he wrote to Tory in 1923. He felt that Draper was overly optimistic about his scheme and was hostile towards anyone who had opposing views about development of the bituminous sands.[57] Clark was also critical of Draper's excavation method, which involved using a pick and a shovel. He described it as an "exceedingly poor" method, saying he thought excavating could be more effective through the use of steam shovels.[58] It might be relevant that Clark was dependent on bituminous sand supplied from Draper because he offered it a very reasonable price.[59] It would seem that Draper thus made things much easier for the Research Council, but it is possible that Clark's criticisms stemmed from his discovery that Draper's sand was old and dried out. The experiments required fresh bitumen to accurately determine the viability of his process and nothing could be

[56] Research Council of Alberta, *Third Annual Report* (Edmonton: Research Council of Alberta, 1923), 43; and Clark and Blair, "The Bituminous Sands of Alberta, 2, Separation," Research Council of Alberta Report No. 18 (Edmonton: Research Council of Alberta, 1928), Chapter 1.

[57] Clark to Tory, January 9, 1923, in Sheppard, 126-30.
[58] Clark to W.B. Brooks, December 12, 1923, in Sheppard, 134-41.

[59] Clark to Hon. Herbert Greenfield, April 29, 1924, in Sheppard, 141.

determined without the appropriate raw material.[60] In fact, upon observation of a bituminous sand sample, Clark discovered that its water content steadily decreased when it was exposed to air. For instance, Clark watched the water content of a bituminous sand sample drop from 7.5% to 0.5% over the course of several weeks. This fact made it difficult to say with any certainty if their separation experiments could be successful on a commercial level due to the vastly different water composition of dry sand versus fresh bituminous sand. According to Clark, old bitumen was problematic because it was hard to treat with the hot water separation process. His theory was that, as the water content lowered, the sand became harder to treat because it took a longer time to raise the temperature of the water in the bitumen to the level it needed for separation. Criticism of Draper's business also stemmed from the fact that his unseparated bituminous sand products consisted of 85-90% sand and were very expensive to transport. Clark believed that construction companies might not accept Draper's bituminous sand asphalt as a product. It was unlikely that these companies involved in the construction of highways would want to accommodate Draper's bituminous sand asphalt because it differed in significant ways from the traditional products they used.[61]

A review of Clark's correspondence during the 1920s makes it clear that there was significant international interest in the oil sands at that time. He received letters from interested parties in Germany, the Netherlands, and Poland who requested samples of bituminous sand for experimental purposes.[62] Despite the interest, however, Clark did not have high expectations for these experiments. Since he could not send much bituminous sand to these parties, he concluded

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[60] Clark to Tory, December 1929, in Sheppard, 192.
[61] Research Council of Alberta, *Third Annual Report* (Edmonton: Research Council of Alberta, 1923), 46-7.

[62] Clark to Greenfield, April 19, 1923, in Sheppard, 130-32.

that any results their experiments could obtain would be superficial and not particularly valuable.[63] Clark also received letters from a Costa Rican who was interested in any job openings in the oil industry in Alberta. Unfortunately, there were no opportunities due to the lack of development at the time.[64] Nonetheless, it is evident that the knowledge of the potential of the oil sands spread to interested parties in distant places. Letters also arrived from interested parties in Canada. For example, in February 1922 Clark received an enthusiastic letter from a George Ulrich, who sought an opinion about a separation process he had invented.[65] In November 1928, Clark also responded to a letter from R.R. Collard of the Carter-Halle-Aldinger Company in Winnipeg, Manitoba who was interested in a separation method that involved emulsification. Clark was not very optimistic about the success of this scheme but still felt obliged to send him a sample of bituminous sand to test out his proposed method of separation.[66] Collectively, such letters suggest a growing domestic and international interest in the oil sands' potential in the 1920s. This growing interest was likely due, in part, to Clark's willingness to correspond and respond to inquiries and to make inquiries of other experts in the field.

This is further evident in some experimental attempts at commercial development that were recorded by Clark in his 1927 report "The Bituminous Sands of Alberta." Clark noted that Mr. D. Diver from Calgary, Alberta attempted to obtain oil from the bituminous sands in 1920 using an in situ method on a bituminous sand just outside the town of Fort McMurray.

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[63] Clark to Greenfield, April 19, 1923, in Sheppard, 130-32.

[64] Clark to G.P. Humphray, February 7, 1925, in Sheppard, 147.

[65] Clark to George Ulrich, February 15, 1922, in Sheppard, 121-22; Clark to George Ulrich March 29, 1922, in Sheppard, 122-23.

[66] Clark to R.R. Collard, November 20, 1928, in Sheppard, 162.

Furthermore, Clark recorded the attempt made by James D. Tait of Vancouver to use a stream of hot water and drilling tools to create something resembling an oil well in one of the bituminous sand beds. Tait took out a patent on this procedure when he noticed that the hot water resulted in a separation of the bitumen from the sand. In this report, Clark also observed how a Mr. Georgeson of Calgary took out a patent on a similar procedure that attempted to use an in situ method to recover bitumen through the use of hot water along the Horse River in 1924. Many other obscure experiments that did not appear in oil sands historiography were mentioned in this report as well. For instance, experiments conducted by C.E. Dutcher, A.F. Kelsey, W.B. Linday, Roland B. Day, and Emory B. Smith appeared in this report. Ultimately, even though none of these experiments achieved their intended results, Clark concluded that they collectively showed that there was a great interest in the commercial potential of the bituminous sands throughout the 1920s.[67]

As for Clark's own ideas about commercial development, in his 1921 report "The Bituminous Sand and its Commercial Uses" he assertively argued that the economic potential of the oil sands lay in its use as an asphaltic product. He also added that the oil sands were useless for the petroleum industry at this time because of the difficulty of refining the bitumen into sufficient yields of gasoline and oil products. He did admit, however, that as the world's supply of petroleum continued to decrease a market might eventually open up for the manufacture of bitumen into gasoline and oil products. [68] At the same time, however, sufficient data as to whether the bituminous sand could be made into gasoline and oil products was also needed

[67] Clark and Blair, "The Bituminous Sands of Alberta, 1, Occurrence." Research Council of Alberta Report No. 18 (Edmonton: Research Council of Alberta, 1927), 10.
[68] Research Council of Alberta, *Second Annual Report* (Edmonton: Research Council of Alberta, 1922).

because, despite many assertions that it could be made into these products, there was no solid evidence to prove this was the case in the early 1920s. In terms of specific uses for the asphaltic bitumen that was to be produced, he suggested that it could be used to address the "pressing need" to improve the quality of rural roads in the Prairie Provinces.[69] A similar paving method (using bituminous limestone and bituminous sands) had been used for some time in European cities and in California so it was assumed that this type of method would work in Alberta as well.[70] In fact, Clark's early experiments were solely focused on determining whether bitumen could be valuable as a source of asphalt because he believed, at that time, that it could not be refined into a petroleum product.[71]

It was not, however, Clark's goal at this time to make sidewalks out of the bitumen. Experiments with paving sidewalks in Edmonton in 1922 had already shown that the use of unseparated bitumen was too complicated and costly to warrant any further consideration.[72] He proposed instead that it would be best to create an inexpensive way of combining a small amount of an asphaltic product extracted from the bituminous sands to the rural roads in Alberta to create an "improved earth road type".[73] Clark believed this new type of bituminized road would be particularly valuable because it would serve as an "all-weather road."[74] Many Alberta roads were inadequate because when they got wet they became almost impossible to use.[75] Creating a

[69] Clark to W.B. Brooks, Dec. 12, 1923, in Sheppard, 134-41.

[70] Research Council of Alberta, *Third Annual Report* (Edmonton: Research Council of Alberta, 1923), 48.

[71] Ferguson, 16-17.

[72] Research Council of Alberta, *Third Annual Report* (Edmonton: Research Council of Alberta, 1923), 42.

[73] Clark to J.D. Robertson, July 21, 1921, in Sheppard, 108-12.

[74] Clark to Herbert Greenfield, May 27, 1924, in Sheppard, 141-47.

[75] Research Council of Alberta, *Third Annual Report*, 43.

bituminized earth road was the primary goal of Clark and the Alberta Research Council throughout the 1920s because it was perceived to be a critical need for the province.[76] Gravel adequately served the construction needs of other provinces in Canada but a general lack of gravel throughout the province created a unique challenge for Alberta.[77] There were other potential commercial uses for bitumen as well. Those knowledgeable about it thought there could also be commercial value for bitumen as manufacturing paint, varnish, or various waterproofing materials.[78]

In this report, Clark also highlighted the critical importance of a process to separate the bitumen from the sand. A separation process was deemed necessary by Clark because it would significantly reduce the costs of transporting the product. According to his calculations, it would not be economically feasible to transport the excess sand that had little commercial value. This had already been demonstrated by the economic difficulties that Thomas Draper faced in the transportation of his raw tar sand product that consisted of 85 to 90 percent sand. Furthermore, the asphalt and the sand in the bituminous sand in its natural unseparated state did not meet the specifications for asphalt pavements. The sand was too fine and the asphalt was too soft and it required separation and modification to meet the standards of an effective asphalt pavement.[79]

After this preliminary analysis in 1921, Clark began experimentation on a separation process that used hot water to separate the bitumen from the sand. He had dismissed the earlier proposed methods of using solvent because it was not economical. He outlined this in a letter to

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[76] Clark to W.P. Brooks, December 12, 1923, in Sheppard, 134-41.

[77] "Tar Sand Tests Might Solve Big Paving Problem," *Winnipeg Free Press,* August 23, 1924.

[78] Wetherell and Kmet, 354.

[79] Research Council of Alberta, *Third Annual Report*, 49.

Dr. Tory when he explained that it would not make sense to use large amounts of expensive solvents to extract a bituminous product that was not very valuable. It was problematic to use these solvents because serious loss of these solvents would occur without costly equipment installed to reclaim it.[80] These experiments began across the hall from Clark's office in the "tar lab". This lab consisted of a make shift separation apparatus that included wash buckets, milk churns, hosepipes, and a variety of other miscellaneous items. Experiments from this mini lab produced some satisfactory results but it was necessary for a more sophisticated lab to be constructed to get results that were more meaningful.[81] Thus, in order to further experiment with hot water extraction, in 1922 a mini separation facility was constructed at the University of Alberta in the basement of the power plant. While construction was taking place, the McMurray Asphaltum and Oil Company stockpiled two loads of bituminous sand at the university.[82] Clark believed this small separation facility was very important because it would be just as effective as a large one for devising a separation process.[83] He also thought that the small plant experiments would establish a definitive price for the production of separated bitumen and determine whether the hot water process could be profitable on a commercial scale.[84] It was essential to determine if a commercial operation using the hot water separation could be profitable because it was

[80] Clark to Tory, October 27, 1920, in Sheppard, 107-8; and Clark and Blair, "The Bituminous Sands of Alberta, 2, Separation," Research Council of Alberta Report No. 18, Chapter 1.

[81] Sheppard, 21.

[82] Clark and Blair, "The Bituminous Sands of Alberta, 2, Separation," Research Council of Alberta Report No. 18, Chapter 2.

[83] Clark to Tory, November 18, 1921, in Sheppard, 116-21.

[84] Research Council of Alberta, *Third Annual Report, 45.*

believed that no private enterprises would commit to such an operation unless a procedure had already been proven effective in separating the bitumen from the sand.[85]

The plant began operations in the spring and summer of 1923 and separated around 85 tons of bituminous sand.[86] With the help of his new graduate research assistant, Sidney Martin Blair, Clark's early experiments at the plant suggested that the hot water separation process had potential. But after many failed experiments, they concluded that the hot water separation process was simply not practical. Eventually, however, they discovered that when the bituminous sand was put in contact with a heated solution of silicate of soda before being placed into a hot body of water, a complete separation of the bitumen from the sand took place with the sand settling to the bottom of the body of water and the bitumen floating to the top of the water in a light froth. The treatment of the sand with silicate of soda before the hot water separation process was effective because it allowed for bituminous emulsions. In other words, it allowed for the water and oil to mix together in a solution that would become unstable and break down when excessive water was added. This caused separated bitumen to rise to the surface of the water. However, Clark emphasized that the treatment of the bituminous sand with silicate of sodas had to be done carefully in order to ensure that separation of the bitumen did not take place before the bitumen was placed in the hot water. According to Clark, if any premature separation took place it would result in a poor separation of the bitumen from the sand.[87]

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[85] Clark to Tory, November 18, 1921, in Sheppard, 116-21.

[86] Clark and Blair, "The Bituminous Sands of Alberta, 2, Separation," Research Council of Alberta Report No. 18, Chapter 2.

[87] Clark and Blair, "The Bituminous Sands of Alberta, 2, Separation," Research Council of Alberta Report No. 18, Chapter 1.

After a significant amount was produced, the bitumen separated from this plant was tested in surfacing a road near Edmonton. Approximately 60 barrels of separated bitumen was applied to the Fort Trail road near Edmonton. Multiple layers were spread over the loosened soil with excellent results. Over a year later, the road was still in excellent shape even after a long period of wet and rainy weather and heavy traffic.[88]

This mini plant also set an important precedent for measuring and recording data. All aspects of the plant were recorded in a meticulous and organized manner. Clark and Blair measured the amount of power, water, and heat that was consumed, the water temperatures, the weight and volume of the tar sand being used, and the percentages of oil, water, and mineral material in the final separated solution. This data was essential because it indicated which aspects of the plant could be improved and how much the operation cost and it differentiated Clark and Blair's separation operations from other experimental projects in the 1920s.[89] Those other operations, such as Draper's and Fitzsimmons' experiments, did not record and analyze operations data nearly so well. This suggests that the scientific and methodical method being used by Clark and Blair achieved superior results.

Despite the initial success of these experiments, both Clark and Blair acknowledged that they still needed to experiment on a larger scale to prove that the hot water separation process could be effective on a commercial scale.[90] Even though there were advantages related to the location of the plant such as easy access to water and power, several limitations with the small

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[88] "Tar Sand Tests Might Solve Big Paving Problem," *Winnipeg Free Press,* August 23, 1924.

[89] Sheppard, 25.

[90] Clark to W.P. Brooks, Dec. 12, 1923, in Sheppard, 134-41.

size of the plant prompted their desire for larger scale experiments.[91] For instance, the basement room where they conducted experiments had a very low ceiling that produced many difficulties. The inability to store the bituminous sand in the room meant that they had to feed the sand into the basement window and remove the separated bitumen product from the same window.[92] They also had trouble with high heat costs from the plant and their inability to run the plant on a continuous basis. Furthermore, Clark and Blair acknowledged the need to find a site in the bituminous sand area where the sand was easily accessible and of a certain quality that would be beneficial for commercial development. It was their goal to set up a plant beside a bituminous sand area to mimic the conditions of a commercial separation plant. [93]

Before a site in the bituminous sand region was selected, however, the need for larger scale experiments was still more pressing and it led to the construction of a costly new facility in the Dunvegan railyards in North Edmonton in the winter of 1923-1924. The plant was designed and operated by Clark and an engineer, W.G. Jewett, a recent graduate of the mining department program at the University of Alberta.[94] The plant ran for two months before being shut down in October because the cold weather froze the water pipes that were needed for the plant to operate.[95] In total, this new plant cost around $200,000 and its primary purpose was to test the commercial value of their separation process. Once the plant was up and running, the initial estimate was that they could produce the bitumen product for $1.00 per barrel at the Dunvegan

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[91] Sheppard, 25.

[92] Clark and Blair, "The Bituminous Sands of Alberta, 2, Separation," Research Council of Alberta Report No. 18, Chapter 2.

[93] Ferguson, 43; and Clark to W.P. Brooks, Dec. 12, 1923, in Sheppard, 134-41.

[94] Sheppard, 31.

[95] Research Council of Alberta, *Fifth Annual Report* (Edmonton: Research Council of Alberta, 1925), 64.

plant.[96] However, the faster processing speed of this new plant proved to be a great difficulty for their separation process. The plant could separate about one ton of bituminous sand per hour.[97] In one day, the plant could separate more sand than they had in several weeks at the previous plant but the mineral matter in the finished product was considerably higher than it had been previously. In the University of Alberta basement, they had produced a finished product with an average of only 9% mineral matter whereas at the new Dunvegan plant it was 30%. Clark attributed the poor separation to the flawed treatment box designed for the silicate of soda that frequently leaked out the solution. This resulted in poor separation of the bituminous sand due to lack of pre-treatment with a silicate of soda solution.[98]

The difficulties experienced at Dunvegan continued throughout the next few years. Clark acknowledged that in 1925 they were able to separate 500 tons of bituminous sands fairly easily and effectively, but he also noted that there were still many issues with the Dunvegan Yards separation facility. The most significant of these was the fact that it did not make sense to have the bituminous sand shipped over 300 miles from the Fort McMurray area to the Dunvegan Yards in Edmonton. The sand dried as it was transported to Edmonton and was in a different state than it was originally found. This was problematic because it meant that the experiments did not give Clark a definitive answer as to whether the separation process would be effective on a commercial scale in the oil sands region itself. According to Clark, the old and weathered bituminous sand appeared to be much more resistant to the separation process. Clark thus

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[96] Clark and Blair, "The Bituminous Sands of Alberta, 2, Separation," Research Council of Alberta Report No. 18, Chapter 3.

[97] Macleod, 81.

[98] Ferguson, 43.

believed that the poor results they were getting were not representative of the progress the Research Council of Alberta had made with the hot water separation process over the preceding years.[99] Furthermore, Clark had suspicions that the experiments on road construction that the provincial government desired had the narrow-minded objective of promoting the road surfacing potential of the bituminous sands. He believed that it would be more useful to explore new commercial possibilities because the use of the bituminous sand in road construction had already been proven effective in many other cases. As a result of these challenges, Clark was frustrated and felt that over $12,000 was being wasted each year to conduct road construction experiments at the Dunvegan facility.[100]

Laboratory research at the University of Alberta during the winter season, while the Dunvegan Yard plant was shut down, led to solutions to some of these operational problems. During the winter of 1924-1925, laboratory research on the use of silicate of soda revealed that a mixing procedure during this pretreatment phase of separation was more suitable to larger scale operations. In fact, the new mixing procedure made the separation process more time efficient and reduced the average mineral matter content to 7% in the 1925 operational season at Dunvegan. Laboratory work at the University of Alberta in the winter of 1925-1926 led to still more improvements in the pretreatment phase of separation. Throughout the 1924 and 1925 seasons, the concentration of silicate of soda in the pretreatment procedure was typically around 3%. Upon further examination, Clark discovered that a concentration of just 0.3% led to the exact same separation and resulted in a more economical separation process. Improved methods

[99] Clark and Blair, "The Bituminous Sands of Alberta, 2, Separation," Research Council of Alberta Report No. 18, Chapter 2.

[100] Clark to Tory, December 2, 1927, in Sheppard, 156-9.

for setting the temperature and reducing the water content during the separation process were also found. It was determined that the best separation results occurred when the temperature of the hot water during the separation procedure was between 75 and 85 degrees Celsius. Experiments also revealed that the inclusion of salts in the plant water reduced the water content of the separated bitumen from an initial 20 to 30 percent to less than 10 percent. Even though they had made the process more economical, Clark and Blair concluded that the small-scale project at Dunvegan could not provide a trustworthy estimate in terms of the cost and potential profitability of a commercial oil sands operation.[101]

The issues at the Dunvegan facility eventually led Clark to seek advice from other experts in the field. One of his first attempts to get advice involved tours of refinery operations, highway construction sites, and road construction sites throughout Canada and the United States in August and September of 1926. It seems as though the primary goal of this trip was to examine how bituminous sand or materials similar in composition were used in the construction and maintenance of roads. He began his trip in Illinois where he observed the use of road oils on dirt roads throughout the state. He was thoroughly impressed with the roads that were treated with oils and was optimistic that a similar procedure could be conducted to maintain the rural roads in Alberta.[102] After a brief stop to observe roads laid with emulsified asphalt in Indianapolis, Clark travelled to Madison, Wisconsin where he met with Frank Roberts of the State Highway Department.[103] Roberts showed him gravel roads that had been treated with tar and Clark was thoroughly impressed with the quality of these roads as well.[104]

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[101] Clark and Blair, "The Bituminous Sands of Alberta, 2, Separation," Research Council of Alberta Report No. 18, Chapter 2; Ferguson, 45.

[102] Karl Clark, Diary, 1926, entries for August 9-10, University of Alberta Archives, Karl Clark collection, Box 1.

Subsequently, Clark visited with experts at Universal Oil Products in Chicago who asserted that by cracking the bituminous sand product it could be effective as a gasoline. Up to this point, many people in the oil industry had assumed that the cracking process would not be able to refine high yields of gasoline from a heavy oil product such as the bitumen found in the Alberta bituminous sands.[105] Despite this positive news, the stop in Chicago turned out to be a disappointment for Clark, because Dr. Egloff of Universal Oil revealed that the company had no interest in the oil sands as a source of petroleum. Oil prices were relatively low at this time and it was believed that there would be no need to refine a bituminous product into gasoline until world prices rose significantly, which Dr. Egloff did not believe would happen anytime soon.[106] However, even when world prices were low, Alberta still had to pay about four times as much to get imported oil in the 1920s because of large transportation costs. This in Clark's mind justified the need to continue to look for ways to develop Alberta's oil sands.[107]

More disappointing news awaited Clark on his next stop. While in Toronto, Clark visited Imperial Oil and spoke with an assistant manager, C.B. Dean. Dean told Clark that Imperial Oil was not interested in getting involved with bituminous sand research in any way. He explained that since bituminous sand research was intended to be widely available to the public to encourage commercial investment and development it did not make any sense for Imperial Oil to

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[103] Karl Clark, Diary, 1926, entries for August 11, August 13, University of Alberta Archives, Karl Clark collection, Box 1.

[104] Karl Clark, Diary, 1926, entry for August 13, University of Alberta Archives.

[105] Clark and Blair, "The Bituminous Sands of Alberta, 2, Separation," Research Council of Alberta Report No. 18, Chapter 1.

[106] Clark and Blair, "The Bituminous Sands of Alberta, 2, Separation," Research Council of Alberta Report No. 18, Chapter 1; Karl Clark, Diary, 1926, entry for August 16, August 20, University of Alberta Archives.

[107] Paul Chastko,"Developing Alberta's Oil Sands, 1920-2002" (PhD dissertation, Ohio University, 2002), 38.

invest any money towards research. They were in direct competition with every other oil company doing business in the Canadian market and they did not want to make any of their informational discoveries available to their competitors. Dean concluded by advising Clark that any further research on the bituminous sands would probably have to be conducted by the province of Alberta, which had the most to gain from commercial development in the bituminous sands and thus should be the party to make most of the primary investment towards any future gains that could be had.[108]

After brief stops in New York City and Raleigh, Clark descended upon Kentucky to examine roads surfaced with what was called Kentucky road asphalt, which was in wide use across the U.S. Clark believed this material had many similarities to the bituminous sands. Furthermore, his study of Kentucky rock asphalt led him to conclude that the method used to develop it into a suitable road material was very wasteful. Clark thus assumed that the development of a cheap separation process for the bituminous sands would allow it to compete against Kentucky rock asphalt in the American market for road surfacing material. [109]

Subsequently, Clark took a lengthy tour of the California oil industry. He started at the Union Oil Company's offices in Los Angeles and visited its refinery that made gasoline, kerosene, gas oil, fuel oil, asphalt, and road oil. He paid particularly close attention to the equipment used for making road oil and asphalt.[110] Afterward, Clark visited the testing laboratory of the California Highway Commission in Sacramento, where he learned about the oiling of gravel roads in California. However, the oil industry in California did not use the

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[108] Karl Clark, Diary, 1926, entry for August 23, University of Alberta Archives.

[109] Karl Clark, Diary, 1926, entry for September 2, University of Alberta Archives.

[110] Karl Clark, Diary, 1926, entries for September 4, September 7-8, University of Alberta Archives.

bituminous sands to construct these roads due to the exceedingly high prices of producing oil products from the bituminous sands.[111] Clark gained valuable insight in Santa Cruz where he examined various oil treated roads and a bituminous sand quarry. He finished off the California swing of his tour with a stop in San Francisco. In San Francisco, he consulted Dr. Cook, a chemist for the City of San Francisco, about bituminous sands. Cook informed Clark that precautions must be taken when making pavement materials out of bituminous sand because he had observed that bitumen used for pavement materials was frequently spoiled when it was over-heated.[112]

Clark's North American tour of oil facilities concluded at the end of September with a visit to the Imperial Oil Refinery at Vancouver's waterfront. He learned that its refinery frequently experienced troubles with corrosion while attempting to refine California crude oils. He also learned about environmental precautions taken by Imperial Oil, such as, an elaborate procedure to ensure that there was no oil in the wastewater from the refinery before it discharged into the bay.[113]

Following the 1926 tour, Clark continued using the separated bitumen in experimental road construction projects. In 1927, he experimented with the application of a mixture of bitumen, water, and gravel to the St. Albert Trail highway north of Edmonton. He believed it was a success since it seemed to maintain its quality during a long period of wet weather and he was confident that a big market for bituminous road oil would develop in the near future. He thought it was the most cost effective way to construct "all-weather highways" as compared

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[111] Karl Clark, Diary, 1926, entry for September 13, University of Alberta Archives.

[112] Karl Clark, Diary, 1926, entries for September 17-18, University of Alberta Archives.

[113] Karl Clark, Diary, 1926, entry for September 21, University of Alberta Archives.

with much more expensive pavement , which he could not justify for low traffic, rural areas. [114] Furthermore, as Alberta had built hundreds of miles of these gravel roads and the gravel would wear out over time, Clark advocated for the use of bitumen oil to maintain them. According to Clark, no other road oil was present in the Alberta market thus leaving room for bituminous oil to fill that market.[115]

Despite his optimism, Clark's opinion about the St. Albert road experiment changed drastically in 1928. After a year of traffic on the newly constructed stretch of highway, Clark noticed that the mixture of bitumen and gravel did not spread evenly across it. This suggested that more research was needed and a new method to adequately mix the separated bitumen and gravel would need to be developed to justify commercial development of the bituminous sand for use as a road oil.[116] This setback made Clark worried about the future of oil sands research in Alberta and he began to look for jobs in other fields.[117] Simultaneously, as Clark's optimism for commercial development waned, the interest of tar sand promoters seemed to increase as evidenced by the plethora of calls and letters that Clark received throughout the spring of 1928. For instance, Clark received a surprising letter from a Mr. Mckesson of the California Highway Division inquiring about the bituminous sands because some of his acquaintances were considering investing money in a project for developing them.[118] John Gillespie, an Edmonton businessperson who owned a salt plant in Fort McMurray, also expressed interest. Gillespie

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[114] Research Council of Alberta, *Eight Annual Report* (Edmonton: Research Council of Alberta, 1928), 42.

[115] Research Council of Alberta, *Eight Annual Report*, 43-48.

[116] Research Council of Alberta, *Ninth Annual Report* (Edmonton: Research Council of Alberta, 1929), 39.

[117] Sheppard, 37.

[118] K.A. Clark to S.M. Blair, June 30, 1928, in Sheppard, 159-61.

thought fuel oil from the tar sands could be useful and made an offer to the provincial government and the Research Council of Alberta to help fund a separation plant in the Athabasca oil sands region.[119] This increased interest was likely due to the widespread reach and interest in the research that Clark and the Alberta Research Council had been doing on separation processes. All of this research was available to anyone who was interested and requested it from the Research Council or the provincial government. It was also likely that the economic boom of the 1920s made these oil sand promoters more inclined to take financial risks.

After the disappointment of the road experiment and in view of the shortcomings of the Dunvegan Yard separation plant, in 1929 it was decided that the best plan of action for oil sands development would be a joint effort between the federal government in Ottawa and the provincial government in Alberta. The joint task force was officially known as the Bituminous Sands Administrative Committee.[120] This committee was initiated by the federal government as an attempt to "restore national unity" with the provincial governments after the First World War.[121] Once this co-operative plan was put into action, it was determined that it would be best to divide the work between the federal Mines Branch and the Alberta Research Council. The Council handled laboratory studies and the separation process whereas the Mines Branch would be in charge of mining the bituminous sand and the use of the separated bitumen in roadwork. Robert Halpenny of Sterling Collieries decided that the Mines Branch's quarry on the Clearwater River would be the site for the pilot plant. [122] Clark was bothered by this decision because the

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[119] Sheppard, 38.

[120] Wetherell and Kmet, 355.

[121] Chastko, 18.

Clearwater River site was not close to a railway line. If the plant succeeded and proved that commercial development was viable, it would have to be abandoned for another location closer to a railway.[123] Regardless of this, construction work for the new plant, designed by Clark and city of Edmonton engineer J.A. Sutherland, was still carried out. Their design was simply a modification of the Dunvegan plant, dismantled and reconstructed to fit their new design. Once they adjusted the equipment, they set it up again in the Dunvegan yard in August 1929 for a trial run. When it proved to be successful, they dismantled it again and sent the newly modified separation equipment to the new site on the Clearwater River. After the plant was set up in late October 1929, John Foreman supervised the daily operations.[124]

The co-operation between the federal and Alberta provincial government in this instance turned out to be very useful for Clark. With the new arrangement, Clark was able to focus his efforts completely on separation work without having to worry about mining the sands and the practical application of the separated bitumen. In fact, with more time to devote to his study of separation procedures, Clark achieved a breakthrough with the use of salt brine in the plant water. This reduced the water in the separated bitumen that had been as high as 25 percent of the final separated product in previous years. However, this breakthrough in water reduction was not solely Clark's achievement and should also be attributed to Clark's new assistant Dave S. Pasternack, a fully trained chemist who had just obtained his PhD in organic chemistry from McGill University. Clark had hired him at this time by using a portion of a $30,000 research grant he had received for this pilot plant project from the provincial government. Pasternack's

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[122] Fitzgerald, 68.

[123] Clark, Field Diary entry of May 26, 1929, in Sheppard, *Oil Sands Scientist*, 170-4.
[124] Sheppard, 41; and Fitzgerald, 68.

experiments in the winter of 1929/30 lowered the total mineral and water content in the separated bitumen at the experimental lab to less than two percent.[125]

As a whole, the 1920s was a decade of progress in terms of oil sands research. Following the lead of Clark, the newly founded Research Council made great strides towards perfecting the hot water separation process. Some form of success was achieved at all three pilot separation plants they operated. Unfortunately, limited funding from the provincial government and a lack of international interest from oil companies in the oil sands prevented Clark and the Research Council from achieving their goal of promoting private companies to start commercial ventures in oil sands development. Moving forward into the 1930s, decreased funding for governmental research and the Great Depression led to a stagnant period without much progress that further decreased motivation for oil sands development.

[125] Sheppard, 42-45.

The 1930s: Limited Governmental Funds and the Rise of Abasand

In terms of oil sands development, the 1930s appeared promising at the outset. A large volume of bitumen was separated at the Clearwater plant in 1930 and there was a general satisfaction with the performance there. Unfortunately, the impact of the Great Depression eventually hit hard and severely impacted government funded oil sands research in the 1930s. As a result, the provincial government cut all funding for the Research Council of Alberta. This meant that Clark could no longer continue the promising research that he had been working on for over a decade. He still did some consulting work for Trinidad Leaseholds Limited and CM&S Canada but no significant research was conducted by him during this time. Even though there was no government-funded research, there were still some developments in the private sector. Max Ball, a businessman and oil expert from Denver, was working on developing an oil sands lease that he had purchased from the federal government in 1930. His company, Abasand Oils Limited, was conducting research on oil sands technologies at its laboratory in Toronto and also constructing its oil sands separation plant and refinery in the Horse River Valley in Alberta. In terms of significant events, there was nothing much to note in regards to progress towards an economical method to commercially develop the Alberta oil sands.

Although Clark was very optimistic about the joint effort between the provincial and federal governments, by 1930 it was clear that the work was not going as well as he had expected. This was evident in a letter he sent to Dr. Wallace that summer remarking that it had taken much longer than he expected for the plant to get up and running and that the costs were much higher than he had anticipated. He expressed that he was doubtful that they would be able to meet their goal of separating three tons of bitumen per hour and that an additional $5,000 in

funding was needed to complete the separation project already underway. In this letter, he also recommended that the sale of the Alberta Research Council's plant to Max Ball be approved in order to relieve the council of the extraordinary expenses that they had taken on to carry out the experimental project at Waterways.[126]

In the summer of 1930, several other issues arose at the Research Council's plant at Waterways. The primary issue was that the tar sand from the quarry beside the plant contained a problematic amount of soluble salts that made it more difficult for the sand to separate from the bitumen. Eventually Clark was able to find a solution to this problem by washing the sand with cold water before putting it through the plant.[127] In fact, the cold water washing was so successful that it permitted a bitumen yield that was close to 100 percent with a separated bitumen that had less than 1% mineral matter. Despite finding a process to deal with the salts, other issues arose due to the high percentage of clay in the bituminous sand beds at the quarry where the Research Council was mining. The clay content was an issue because it decreased the yield by keeping the bitumen suspended within the plant water. Clark thus determined that some form of mixing equipment needed to be invented in order to deal with this issue. [128] Furthermore, Clark was concerned that even miniscule amounts of lime in the tar affected separation by preventing the water from displacing the oil from the sand.[129] Clark and Pasternack also lamented other issues that arose such as the problems with pressure levels in the boiler, clogged up pipes, and keeping the separation system running effectively. Even though these problems

[126] Clark to Wallace, July 7, 1930, in Sheppard, 201-07.

[127] Clark to Edgar Stansfield, July 30, 1930, in Sheppard, 207-09.

[128] Clark to Dr. S.G. Blaylock, January 16, 1931, in Sheppard, 221-26.

[129] Clark to Norman McLeod, March 15, 1934, in Sheppard, 245-46.

made things difficult, they were still able to keep the plant in full operation all summer and produced approximately 15,000 gallons of good high quality oil that was comparable to other similar heavy oil products.[130] In the winter months, Clark and his team researched some alternative uses of bitumen besides road surfacing. They looked at how bitumen could be modified to produce a rubber like material by treating the bitumen with sulphur. They also looked at how treating the bitumen with heat would affect its composition and various properties.[131]

Unfortunately for Clark and the Research Council, the impact of the Great Depression led to a decrease in funding for oil sands research and the Alberta Research Council. In fact, in 1932 the Research Council was only allotted $20,000 for the year including salaries and all expenses. This resulted in layoffs for the large majority of the Research Council staff and experimental work was greatly reduced. This made things especially difficult for Clark because it was next to impossible for him to run his separation lab plant without assistance. Moreover, Clark was given a mere $285 for the year to carry out his own research related to separation processes.[132] After this severe cut in funds, the Alberta government decided to close the Alberta Research Council in 1933.[133] This closure was particularly significant because the Research Council played an integral part in the province over the preceding years. This was evident by the fact that often times the Premier of Alberta served as the Chairman of the Research Council. Both Premier

[130] Sheppard, 45.

[131] "Extensive Surveys Conducted in 1930," *Edmonton Journal*, October 15, 1930.

[132] Clark to Blair, November 16, 1932, in Sheppard, 242-5.

[133] Wetherell and Kmet, 355.

Greenfield and Premier Brownlee had served as Chairman in the 1920s.[134] It also frequently received a significant portion of the provincial government's budget. For instance, in 1930 it received an $85,000 budget.[135]

The Great Depression also had a severe impact on the Alberta economy throughout the 1930s. In a sense, it ended the "prairie agricultural frontier" because the international demand for agricultural cereal products from Alberta, especially wheat, sharply decreased during this time period.[136] From 1929 to 1932, the price for a bushel of Canadian wheat had dropped from $1.78 to about 32 cents, a result due in part to a large decrease in demand in Europe for Canadian wheat. Demand had decreased because Josef Stalin was heavily promoting wheat exports to Europe from the Soviet Union. [137]

There was also an important discovery that certainly had a negative impact on funding for oil sands research in Alberta. In 1936, a drilling company discovered commercial amounts of crude oil in the Turner Valley oil field, just south of Calgary. It had primarily been used as a source for producing natural gas since 1914. [138] This decreased the chances for commercial possibilities in the oil sands. The crude oil in the Turner Valley was much cheaper and easier to produce than any oil sands project ever would be. This made it increasingly difficult for the Alberta provincial government to justify research in developing a costly alternative source of

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[134] Alan E. Cameron, "Alberta's Research Council was First Formed in Canada," *Edmonton Journal*, October 15, 1930.

[135] Ferguson, 51.

[136] Richards and Pratt, 9.

[137] Franklin Foster, "John Brownlee," in *Alberta Premiers of the 20th Century*, ed. Bradford Rennie (Regina: University of Regina Press, 2004), 91; "Lowest Prices since 1906 Recorded by October Wheat," *Edmonton Journal*, September 20, 1930; and Macleod, 100.

[138] Richards and Pratt, 46.

fuel source especially given the large amount of debt the government had accumulated during the Great Depression.[139] Furthermore, in the years immediately following the Turner Valley discovery, the annual production of crude oil from it continually increased from 2.8 million to 10 million barrels between 1937 and 1942.[140] During the 1930s, there was also an overabundance of oil internationally following new discoveries of oil resources in the United States and the Middle East. This resulted in very low world prices for oil at this time.[141] These changes in the domestic and international oil industry were significant because they justified the provincial government's decision to invest minimally in oil sands research.

The creation of the Oil and Gas Conservation Board by William Aberhart's provincial government in 1938 also did not help to encourage oil sand research projects. This organization was responsible for regulation of the oil and gas industry. Oil companies were wasting lots of natural gas in Alberta during their oil extraction processes and the Conservation Board was to address the issue through increased taxation and regulations that served to infuriate the oil companies.[142] This increase in operational costs for oil companies in Alberta would have decreased the likelihood that any of these companies would want to get involved in a costly oil sands project.

Nevertheless, developer Max Ball became interested in bituminous sands development in the 1930s. Ball was a private consultant and businessperson based out of Denver, Colorado who had previously worked for the U.S. Geological Survey, the U.S. Bureau of Mines, and several oil

[139] Richards and Pratt, 78.

[140] Richards and Pratt, 57.

[141] Wetherell and Kmet, 353.

[142] Edward Bell, "Ernest Manning," in Rennie, 166; and David R. Elliot, "William Aberhart," in Rennie, 141.

companies. [143] He wanted to start a project because he had clients who wanted to refine the separated bitumen product.[144] He first got in contact with the Mines Branch in Ottawa to inquire about development. Staff there were impressed with him and sent Sidney Ells to visit him in Denver to discuss potential development plans in detail.[145] Ultimately, Ells' approval of Ball's project helped his company secure an oil sands lease in the Horse River valley from the federal government.[146]

Afterwards, when Ball visited Edmonton, he also approached Clark for some advice. At this time, he was interested in constructing a pilot separation plant with his business partner B.O. Jones using the McClave process of separation. The McClave process also used hot water and was very similar in nature to the one that the Alberta Research Council had been working on.[147] Due to the similarity of the two processes, Clark advised Ball to wait for the results of the government pilot project at Waterways before committing time and money to any of his own development schemes. Clark honestly believed that, but he also may have been hesitating because he believed that Ball was not very knowledgeable about the oil sands. Even though Clark advised against it, Ball decided to go forward with a development scheme for the oil sands.[148] It is likely that he did this because he was concerned about patent rights and royalties. He probably believed that if his separation procedure had been commercially successful before

[143] Clark to Dr. R.C. Wallace, March 4, 1930, in Sheppard, 197-99.

[144] Chastko, 20.

[145] Sheppard, 46.

[146] Fitzgerald, 70.

[147] Clark to Dr. R.C. Wallace, March 4, 1930; Fitzgerald, 69-73. James McClave was a hydro-metallurgist in Denver, Colorado where he was the president of the Western Research Corporation. He began developing this process in 1921 and created a patent for it in 1926.

[148] Clark to Wallace, March 4, 1930, in Sheppard, 197-99.

the Clearwater River plant it could be much more profitable for his company. Ball and his private enterprise, Canadian Northern Oil Sand Products, Ltd., thus went forward and obtained a permit from the federal government for a lease to conduct a semi-commercial plant on the Horse River in the Athabasca oil sands region.[149]

Significantly, the company finalized the lease with the federal government just months before the summer 1930 agreement between Alberta and Canada by which the rights to the natural resources in Alberta were transferred from the federal to the provincial government. This agreement, known as the Natural Resources Transfer Act, had been a contentious topic since the founding of Alberta in 1905. In fact, shortly after the province officially became a part of Canada there is evidence of animosity towards federal jurisdiction over natural resources in the province. At a convention for the Alberta Conservative party in 1905, Calgary businessperson and lawyer R.B. Bennett proclaimed that the province of Alberta was being taken advantage of by Ottawa and that they were entitled to have control over their own province's resources.[150] Control of natural resources was a point of contention in Alberta, Saskatchewan, and Manitoba because they were the only three provinces to not have this right. All of the other provinces in Canada had control over the natural resources in their respective territories.[151] However, in the instance of the Horse River lease, the federal government was able to use a special exemption in the Natural Resources Transfer Act to permit Canadian Northern Oil Sands Products to use the land. This special provision in the act permitted the federal government to maintain control over an

[149] Excerpt from Clark's Field Diary, September 1930, in Sheppard, 210; and Sheppard, 48.

[150] Richards and Pratt, 17.

[151] Franklin Foster, "John Brownlee," in Rennie, 91.

area in Northern Alberta that included the Horse River oil sands deposit.[152] These federal governmental regulations for obtaining a lease required him "to set up and operate a separation plant of 25 tons per day capacity during a two year development period, which would allow him to solve problems connected with a commercial undertaking." The agreement also stipulated that "at the end of the two years, on undertaking to establish a 500 ton per day commercial plant" that Ball and his company would be granted a lease for a full size commercial plant in the bituminous sand region. It seemed as though Ball was able to keep both the provincial and federal governments content by negotiating with both parties simultaneously. He had planned to purchase the separation plant from the provincial government and had obtained the land lease from the federal government.[153] Unfortunately, in reality, this was not the case because he did not follow through on purchasing the provincial plant. There was plenty of protest throughout Alberta when people discovered this agreement between Ball and the federal government. They thought the federal government wanted to develop the oil sands without the involvement of the provincial government.[154]

Before Ball's plant began operations, Clark noted that the process of separation which Ball was using was very similar to the process developed by the Research Council. He also observed that there were still many problems associated with this separation process such as determining the most efficient excavating machinery to be used, the proper equipment to be used for separation operations, the proper site to set up a commercial plant, and the issue of refining the bitumen into a marketable gasoline product. As Clark predicted, these problems caught up to

[152] Chastko, 20-21.

[153] Sheppard, 48.

[154] Chastko,"Developing Alberta's Oil Sands, 1920-2002," 43-44.

Ball and, by 1931, he had run low on funds due to the Depression and the limitations of his separation method.[155] Nevertheless, Ball's company was still able to manage to stay in business throughout the 1930s.[156]

After the company ran into these financial difficulties, it established its operations in Toronto where it had built a laboratory for testing purposes. During the early 1930s, it had samples of bituminous sand from the Athabasca region shipped via train to this facility in Toronto.[157] It is likely that the company's shipments of bituminous sand were useless for testing purposes. Clark had already proven through his experience at the Dunvegan and Clearwater plants that separation is much more difficult when the sand is transported from the Athabasca region. This failure suggests that Abasand could have benefitted from a closer working relationship with Clark. He could have informed the company about his experience with this difficulty and it would have saved Abasand the immense transportation costs that it would have had to pay to ship the bituminous sand samples from Alberta to Toronto.

Despite his misgivings, Clark also had a lot of respect for Ball when he first became involved with the oil sands. Unlike other private developers of this time period, Ball had an understanding of the complexity and importance of the technology and scientific procedures that were necessary for any commercial development to succeed. He was also impressed by Ball's experience, as well as, his decision to consult A.J. Smith Engineering Company of Kansas City. Clark felt that Smith had sufficient knowledge of separation processes to assess the potential for

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[155] Clark to Wallace, April 8, 1931, in Sheppard, 226-8; Clark to Sidney Blair, England, December 14, 1931, in Sheppard, 228-41.

[156] Clark to Wallace, October 1930, in Sheppard, 211-21; Chastko,"Developing Alberta's Oil Sands, 1920-2002," 44.

[157] Fitzgerald, 71.

refining the bituminous sand. Nevertheless, Clark revealed in a 1935 letter that he still thought Ball was overly optimistic in his hopes for the tar sands. Clark thought that Ball had underestimated the time that it would take to perfect his oil sand separation plant and he thought it was somewhat arrogant of Ball to assume that cracking bitumen into gasoline could be done at a profit with the technology in place at that time. Clark was also critical of Ball's use of the McClave hot water separation process. The process was similar in nature to the one developed by Clark and the Alberta Research Council but had a few significant differences. For instance, the process was wasteful because of the excessively high temperatures used in water and the absence of a method to recycle plant water.[158]

Because of the halt in funding for Clark's oil sands research during the first half of the 1930s, not very much progress was made towards finding a solution that would allow for commercial development. However, on his own time, Karl Clark continued experimenting with bituminous sand in his laboratory and made efforts to find the knowledge to perfect the separation process. With the help of his assistant Pasternack, Clark tried to solve a few problems that had arisen at the Clearwater river plant. One of these involved the presence of large amounts of narcasite nodules in the deposit beside the Clearwater plant. These nodules were basically large iron sulphide stones that caused damage to the separation machinery if they were not removed by operators in a timely manner. The frequent stoppages required to remove these large stones also reduced the total amount of bitumen that could be separated from the sands in a given time period. After some experimentation, Clark and Pasternack concluded that the use of screens

[158] Clark to Wallace, January 1935, in Sheppard, 247-56; and K.A. Clark, "Athabasca Oil Sands: Historical Review and Summary of Technical Data," *Research Council of Alberta*, Contribution #69 (Edmonton: Government Printer, 1957), 7.

in future separation plants would probably solve this problem.[159] They also tried to improve upon the inconsistent separation results from the Clearwater plant. After several tests, they determined that the acidity level in the bituminous sand quarry they were using was negatively impacting their results at Clearwater. By testing the pH levels of the Clearwater sand and comparing it to other bituminous sand regions, they were able to determine that acidity levels did indeed influence separation results. Eventually they discovered that the acidity level could be attributed to the presence of soluble salts in the Clearwater deposit. It was then determined that superior separation results could occur if the acid was neutralized and washed with water before going through the separation process. Specifically, Clark asserted that treatment of the bituminous sand with soda ash should be used to neutralize the acid. The discovery of soda ash was significant because it was cheaper than sodium silicate. It had been used in the years preceding this discovery to treat the sands before separation.[160] This is yet another example of Clark's ability to systematically refine the process through sustained effort.

Unfortunately, after these discoveries had been made, the funding for Pasternack's salary had to be cut in 1932 due to the impact of the Great Depression on provincial government funding. Once Clark began working by himself, he continued experiments to further investigate the role played by air and water in the frothing process of separation. Unfortunately, however, by 1933, all of the bituminous sand samples at Clark's Research Council of Alberta were used up and there was no more money available for Clark to continue research. That year, the Research Council of Alberta officially shut down but Clark was still able to find employment in Edmonton. Due to the close association between the Research Council and the University of

[159] Sheppard, 49.

[160] Sheppard, 49.

Alberta, many of the senior members at the Research Council, including Clark, were hired at the university as professors. Clark's primary role at the university was to conduct research and he was also given a teaching positon in the engineering department. [161]

Fortunately, for Clark, after many years of teaching and experiments in the lab, another significant oil sands research opportunity arrived at his doorstep in 1936. He was granted a one-year leave from his job in Alberta to go to Trinidad to assist the British-based company Trinidad Leaseholds Limited with establishing a method to determine the physical properties of its oil sands holdings. His former assistant Sidney Blair, who was working for Trinidad at the time, offered him this consulting opportunity that required Clark to examine the oil sands operation in Trinidad and conduct oil sands research on behalf of the company in London, England.[162]

Shortly after consulting for Trinidad Leaseholds Limited, in 1938 the Consolidated Mining and Smelting Company of Canada (CM&S Canada) sought Clark's consulting services because its mining operations north of the bituminous sands were in need of fuel. Clark was likely sought out by CM&S Canada because two of its employees, J.G. Knighton and W.G. Jewitt had previously worked with Clark on bituminous sands related projects in the 1920s.[163] CM&S Canada had two gold mines at Lake Athabasca and Great Slave Lake for which it needed approximately one million gallons of fuel per year. The fuel was needed for heating at the mining camps and for operating diesel power plants. Clark was specifically hired by CM&S Canada to assist in experimentation with a separation plant for the bituminous sands that could provide fuel for these northern gold mines.[164] Prior to this, CM&S Canada's vice-president S.G.

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[161] Sheppard, 49-55.

[162] Clark to Professor W.A.R. Kerr, September 4, 1936, in Sheppard, 262.

[163] Sheppard, 65.

Blaylock had kept a watchful eye on oil sands developments in the Athabasca region and at the Research Council but never decided to take any initiative of his own. At this particular time, however, he deemed this research project necessary because the fuel the company was buying for these northern mines was very expensive due to excessively high freight transportation costs.[165]

Clark's consultation project for CM&S Canada sheds further light on the importance of finding a way to refine the separated bitumen in the most economical way possible. As Clark noted in a 1939 letter, finding suitable refining equipment was very difficult. Bitumen was a heavier crude oil than what was typically handled by oil refineries because of its high water content.[166] He thus suggested that they consult a refinery expert to figure out what method could turn the separated bitumen into a fuel that would be appropriate for their purposes.[167] His consulting for CM&S Canada also confirmed his concern that the larger scale separation plants were producing a separated bitumen that was too sandy. This was not an issue at the smaller laboratory plants but it continued to be an issue once operations moved to larger scale plants.[168] In particular, it was an issue in terms of plant efficiency because the separated bitumen that was too sandy went through the whole separation procedure again. Clark thus began to experiment with ways to get the lowest sand content possible in the separated bitumen by using the salt brine plant water that he had used at the Clearwater plant in 1929.[169]

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[164] Clark to Dr. Gustav Egloff, April 11, 1938, in Sheppard, 263-66.

[165] Sheppard, 65.

[166] Clark to Dr. S.G. Blaylock, Feb. 20, 1939, in Sheppard, 268-71.

[167] Sheppard, 65.

[168] Clark to Dr. S.G. Blaylock, Feb. 20, 1939, in Sheppard, 268-71.

Subsequently, CM&S Canada applied for bituminous sands rights from the Albertan provincial government. For approval, the company needed to show that the intended separation process would be feasible. In a letter to the Superintendent of the Mining Lands Division in the Alberta Department of Land and Mines, Clark advocated on behalf of CM&S, explaining his role as a consultant and noting that the proposed separation process had been successful at its pilot -- separation plant in Chapman Camp, British Columbia. He explained that in 1930 the Research Council of Alberta also had success with this procedure at its Clearwater River plant, processing 800 tons of bituminous sand into a separated product with a very low water and sand content.[170] Unfortunately, after the trial runs in the summer of 1939 at the pilot plant, the plans for a CM&S Canada separation plant were cancelled and Clark was sent back home to Edmonton. Clark later found out the company had terminated his consulting contract because it had signed an agreement with Max Ball's Abasand Oils Ltd. Abasand was in the process of constructing its own separation plant in the Athabasca region and had offered CM&S a good price for diesel fuel for its northern mines.[171]

The 1930s was a relatively quiet time in terms of oil sands research. The economic impact of the Great Depression led to widespread cuts in research funding. Fortunately, Clark was able to find employment as a professor at the University of Alberta and as a private consultant. This allowed him to remain in the province. If he had not been given these job opportunities, it is likely that he would have had to move elsewhere to find work and missed opportunities to work in the substantial oil sands related opportunities that occurred throughout

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[169] Clark to F.H. Chapman, May 26, 1939, in Sheppard, 274-5.

[170] Clark to Superintendent of Mining Lands Division, Feb. 2, 1940, in Sheppard, 278-80.
[171] Sheppard, 66.

the following decades. When the government funding dried up, Abasand Oils Limited took over the reins of oil sands research. From the experimental laboratory the company had constructed in Toronto, it worked towards engineering an oil sands separation plant and refinery on the lease it had purchased from the federal government.

The 1940s: Abasand and Bitumount

The 1940s marked the return of significant government research in the oil sands. There were two major experimental separation projects during this period that helped shape future development in the oil sands. The federal government backed the first project when it took over the operations of Max Ball's company, Abasand Oils Limited, and its pilot separation plant in 1943. The separation results at the plant were abysmal and it was generally seen as a colossal waste of federal tax dollars. The failure of this plant can largely be attributed to the lack of experience and knowledge of the personnel that were associated with it. They ignored the expertise and advice of Clark and others who had substantial experience researching oil sand separation processes and operating pilot separation plants. Following the failure of this plant in 1945, the provincial government decided to back an experimental separation plant run by Oil Sands Limited. This separation plant, located in Bitumount, proved to be much more successful. With the help of Clark and other expert researchers at the Alberta Research Council, this plant had an incredibly successful operating season in 1949. The researchers got great separation results and thoroughly impressed members of the Alberta legislature that toured the plant at the end of the season. This led to increased interest in commercial oil sands projects from the provincial government and private oil companies throughout the 1950s and 1960s.

Shortly after Clark completed his work with CM&S Canada, Max Ball and his company, Abasand Oils Limited, began to conduct experimental work at a new bituminous sand plant in the Horse River Valley about one and a half miles from Fort McMurray.[172] Plans had been completed for the construction of this plant in December 1935 but it would take until the fall of

[172] Clark to M.A. Lyons, Deputy Minister of Public Works for Manitoba, Sep. 29, 1942, in Sheppard, 292-99.

1940 for the construction to be fully completed.[173] Despite Clark's strong desire to assist Abasand Oils Ltd. in perfecting its separation process, Ball insisted that he did not want Clark's help at the new plant.[174] On the surface, this appears illogical because the process Abasand used was very similar to the process studied for many years by Clark at the Research Council of Alberta.[175] It may well have been that Ball felt Clark would have tried to take over the operation. Based on his critiques of previous operations, it appears that Clark had strong opinions about how things should be done and Ball probably did not want to have to cater to Clark's demands and criticisms.

Throughout their first year of production in 1941, Abasand experienced many difficulties at its new plant. The bituminous sand the company was separating from the Horse River deposit was very compacted and contained many ironstone modules. This made the separation process more difficult and it negatively affected the quality of the final product. It resulted in much of the separated bitumen being too sandy, which made it very challenging to further refine it into a usable fuel oil. At the end of the 1941 season in November, a fire resulted in irreparable damage to the separation plant, chemical laboratory, machine shop, boiler house, and power plant. Lots of valuable equipment was lost as well. The fire resulted from escaping gas that had ignited, spreading rapidly throughout Abasand's facilities. Ball was not there when the fire occurred as he was attending to business in Denver but he gave assurances that the plant would be rebuilt immediately.[176]

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[173] Fitzgerald, 71.

[174] Clark to Dr. R.W. Boyle, January 9, 1942, in Sheppard, 287-90.

[175] Clark to L.E. Westman, February 16, 1940, in Sheppard 281-83.

[176] "Unable Estimate Abasand Fire Loss," *Edmonton Journal*, November 24, 1941.

Clark expressed discontent with his exclusion from the Abasand plant in a 1942 letter to the acting president of the University of Alberta. In this letter, he expressed his desire for the University of Alberta to set up a laboratory for conducting experiments that could be used to assist Abasand with its separation process at its new plant and he requested that the president try to negotiate an opportunity like this for him.[177] Clark was briefly allowed to examine Abasand's operation in September of 1942 when he was hired by CM&S Canada to do so.[178] The Abasand plant had just recently been rebuilt.[179] CM&S Canada had been investigating Abasand's plant because the company had been commissioned by the federal government to determine if the plant's operations could be moved to a larger separation plant with much greater production capacities.[180] CM&S Canada was also required to find a bituminous sand deposit that was large enough for a 10,000 ton per day plant. Samples of bituminous sand were sent to Universal Oil Products of Chicago as well because that company had many refining experts capable of determining what potential products could be made from separated bituminous sand. CM&S also investigated the use of new mining technologies that would be efficient enough for a 10,000 ton per day separation plant. The company solicited the advice of Clark on this issue and looked at the use of core drilling to mine the sands.[181] CM&S Canada had Clark observe Abasand's plant as well. He noticed that the plant building was incredibly hot and excessive fumes were making

[177] Clark to Dr. R. Newton, June 1, 1942, in Sheppard, 290-1.

[178] Clark to Earle Smith, May 21, 1943, in Sheppard, 317-20.

[179] Sheppard, 71.

[180] Clark to M.A. Lyons, September 29, 1942, in Sheppard, 292-9.

[181] Sheppard, 70-71.

it difficult to breathe comfortably. This made it clear that Abasand was not being economical with its usage of heat.[182]

The federal government was interested in this development because it wanted to determine if the bituminous sands would be capable of supplying aviation gasoline and fuel oil in case it was needed for the war effort.[183] The Japanese had recently landed on the Aleutian islands near Alaska and it was believed that they might be a threat to the western coast of North America.[184] Abasand was chosen for the federal government's investigation because the Oil Controller, George Cottrelle, believed Ball's plant would be the most helpful in determining if the bituminous sands could be commercially developed immediately.[185]

Even though he was presented with an opportunity for some consultation work, Clark was still not satisfied with his minimal level of involvement in the efforts to produce bituminous sands on a commercial level. Consequently, he continued to express his desire for an opportunity to do experimental work to assist with Abasand's separation plant. This desire was evident in letters he sent to W.S. Kirkpatrick of CM&S Canada and G.J. Knighton of Abasand Oils Limited in October of 1942.[186] He specifically suggested to Knighton that a laboratory plant to work on separation procedures be located next to an oil sand quarry. He believed that this was necessary because experimental work on old sand produced very different results from experiments

[182] Sheppard, 71.

[183] Clark to M.A. Lyons, September 29, 1942, in Sheppard, 292-9.

[184] Sheppard, 69.

[185] Ferguson, 101.

[186] Clark to W.S. Kirkpatrick, October 3, 1942, in Sheppard, 301-5; Clark to G.J. Knighton, October 30, 1942, in Sheppard, 309-11.

conducted on fresh sand.[187] Despite his persistence, Clark was not given the opportunity to work with Abasand Oils in 1942; he expressed his frustrations in a January 1943 letter to A.D. Turnbull of CM&S Canada. In this letter, Clark insisted that Abasand's separation operation was doomed from the start and that the whole plant needed to be redesigned.[188]

Fortunately for Clark, by the end of 1942, the Research Council of Alberta was reinstated after a 10-year hiatus. With the help of William Fallow, the provincial minister of Public Works, and the University of Alberta's president, Robert Newton, the Research Council of Alberta was officially brought back to life in December 1942. Nathan E. Tanner, provincial minister of Lands and Mines, was now the chair of the newly revived Research Council. Tanner ensured that Clark had a research laboratory with funds to support his inquiries about bituminous sands separation processes. This permitted Clark to convince his former assistant, David Pasternack, to return to work with him at the Research Council.[189] This was very significant because Clark had not been able to devote as much time to the Research Council as he would have liked because of his obligations as a professor at the University of Alberta.[190] It would have been hard for him to focus on research because of the success he had as a teacher. He was popular among his students because he had a great ability to explain very complicated scientific matters in very easy to understand language. He was also appreciated for his ability to improve the writing of engineering students at the university. Engineers were known for their poor writing abilities and he worked diligently to try to improve their skills by offering an extra writing course specifically

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[187] Clark to G.J. Knighton, Oct. 30, 1942, in Sheppard, 309-11.

[188] Clark to A.D. Turnbull, Jan. 27, 1943, in Sheppard, 315-6.

[189] Sheppard, 72.

[190] Clark to W.B. Timm, Jan.3, 1945, in Sheppard, 357-64.

for engineering students. He later took on more responsibilities when he was promoted to head of the Mining and Metallurgy department in 1945.[191]

Even though these teaching duties remained important, this new funding for the Research Council allowed Clark to spend a significant amount of time researching in the following years. Throughout 1943 and 1944, he looked specifically at improving the separation process and the use of the oil sands as road oil and, again, his discoveries would be important to the industry. In terms of separation, he was able to improve the pulping phase of the process. He discovered that when bituminous sand became weathered it would have to be soaked in water to restore it to its natural state. In its natural state bituminous sand has a film of water separating the oil from the sand. This envelope of water was crucial because its presence was necessary in order to ensure proper separation. Experiments at this time also made it clear that a small amount of "fine clays" were necessary to ensure ideal separation. An absence of these clays would lead to poor separation and too much clay in the bituminous sand was problematic as well. Furthermore, his research studies also definitively established that 85 degrees Celsius was the ideal temperature for hot water separation. This specific temperature created the right sized bubbles and reduced the thickness of the oil, thus allowing for ideal separation conditions.[192]

After several years of fighting to be involved with the Abasand Oils Limited project, Clark was finally granted his wish to help in 1943. At this time, an agreement was made for the Research Council of Alberta to conduct work in its laboratories to assist Abasand Oils in its separation procedure. Ball made this agreement because in December 1942, Clark had apprised

[191] Sheppard, 79.

[192] Sheppard, 78-79.

him of the wasteful heat practices being used at Abasand.[193] Clark expressed the importance of this work to Abasand's General Manger, Earle Smith in a letter emphasizing the importance of research for reducing wasteful practices. According to Clark, Abasand's carelessness in the operation of the plant was reflected in the excessively high water temperatures used to separate the bitumen from the sand. High temperatures were problematic because it unnecessarily raised fuel costs. Clark thus concluded that the co-operation between Abasand Oils Limited and the Research Council would enable everyone to progress further with the separation processes than if they both worked separately.[194] Once this agreement was made, Clark conducted research at the Research Council of Alberta for Abasand Oils Limited from February to May of 1943.[195] A model separation plant was set up at the University of Alberta. At the plant, Sheldon Donvito and E.H. Boomer assisted Clark. Donvito, an Abasand employee and graduate from the University of Alberta, helped investigate the possibility of using the bituminous sand as a road oil for the Alberta Highway that was under construction at the time. Boomer, the head of the Chemical Engineering department at the University of Alberta, experimented with various methods to decrease the viscosity of bituminous sand oil so that it could travel more easily through pipelines.[196]

Unfortunately for Clark, the brief opportunity he had to work with Abasand Oils Limited was squandered when the federal government took over operations of the plant in the summer of

[193] Sheppard, 72.

[194] Clark to Earle Smith, May 21, 1943, in Sheppard, 317-20.

[195] History of Relationships between Abasand Oils Limited and the Research Council of Alberta, in Sheppard, 330-7.

[196] Sheppard, 73.

1943 and terminated the agreement that had been made with the Research Council of Alberta.[197] There was a multitude of different reasons for the federal government to take over operations at Abasand. A major factor was the CM&S consultation report that was completed in the spring of 1943. In its report, CM&S said the Abasand plant could be upgraded to a larger facility capable of producing 10,000 tons of bituminous sand per day.[198] Another important factor was the inability of domestic oil production to meet the increasing demand. At the end of 1941 it was determined that domestic production could only meet 18% of the estimated 64 million barrels of oil that the country needed in 1942. This decrease in the ability of domestic production to meet demand was largely due to the decline in oil production from the Turner Valley area in Alberta. Production there hit its peak in 1942 at 28,000 barrels and steadily declined over the next few years to 20,000 barrels in 1946.[199] This decline was noticed immediately and often publicized in the press.[200]

There was also mounting frustration in exploratory projects for domestic oil. For instance, between 1917 and 1946, Imperial Oil had one discovery and 133 dry drilling holes while exploring for oil in Alberta.[201] This placed increased pressure on C.D. Howe, the head of the Department of Munitions and Supply, to improve the oil situation in Canada. Eventually despite cautionary reports from CM&S Canada and the Geological Survey of Canada, Howe declared that the oil sands could be a source of immediate oil production. Howe was also

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[197] Clark to Robert Bianco, December 2, 1943, in Sheppard, 322-23.

[198] Sheppard, 72.

[199] Pratt and Richards, 44.

[200] "Oil Production Still Runs Behind," *Edmonton Journal*, January 16, 1943.

[201] Pratt and Richards, 44.

inclined to start an oil sands project because he thought it would encourage American investment in oil sands development.[202]

When the federal government's operations at Abasand began, it hired Earl Smith of Canadian Oils in Sarnia to be the supervisor of the new federally controlled Abasand plant. This was surprising because Smith did not have any actual experience in oil sands separation plants. After a few months of problems at the Abasand plant, Smith resigned.[203] During Smith's tenure at Abasand, Clark expressed that he was in the dark as to what they were doing there and wrote in a letter to CM&S Canada "relations are not particularly cordial."[204] George Boyd Webster from the federal Oil Controller's office replaced Smith and then immediately hired the General Engineering Company to take control of the design and operations of the plant.[205] Clark was thus surprised when P.D. Hamilton of the General Engineering Company asked him for advice near the end of 1943. The General Engineering Company was to build a new separation plant for Abasand Oils Limited but, according to Hamilton, "he and his company knew nothing about tar sand separation plants."[206] Despite the consultation from Clark, General Engineering decided to turn to a separation process using mineral flotation cells.[207] The company also experimented with a cold-water separation process.[208]

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[202] Chastko, 26-33 and 35.

[203] Ferguson, 111-12.

[204] Clark to E.O. Lilge, CM&S Canada, Chapman Camp, July 22, 1943, in Sheppard, *Oil Sands Scientist*, 320-1.

[205] Sheppard, 75.

[206] Clark memorandum entitled "Interview with Mr. P.D. Hamilton of General Engineering Company," December 4, 1943, in Sheppard, 324-6.

[207] K.A. Clark, "Athabasca Oil Sands: Historical Review and Summary of Technical Data," *Research Council of Alberta*, Contribution #69 (Edmonton: Government Printer, 1957), 10.

In order to assess the validity of Clark's judgements about the federal government and Abasand Oils Limited, it is important to be aware that many other parties involved felt the same way as Clark did. For instance, Martin Nielsen, the general superintendent of the Abasand plant from the summer of 1942 until January 1944, believed that there was a general confusion in the plant as to what they were supposed to do. Abasand employee Harry Jensen expressed similar sentiments. Jensen, a highly qualified chemical engineering graduate from the University of Alberta, criticized the complete lack of organization among the technical staff at the plant. This issue led many of the knowledgeable staff such as Nielsen and Jensen to leave Abasand and, in 1944, it got to the point where Absand had almost nobody on its staff who had any experience working with bituminous sands.[209] This lack of experience is evident through comparisons of the separated bitumen products processed by Abasand in 1944 with those of Clark and the Research Council of Alberta at the same time. Clark's separated bitumen product had a water content of about 10% water and 5% mineral matter whereas Abasand's separated product had an abysmal separated product of 43% water and 22% mineral matter.[210]

After the catastrophic failure at the federally operated Abasand Oil plant, the provincial government decided to renew involvement with bituminous sand research. This partly stemmed from the fact that the provincial government was becoming increasingly frustrated with the federal government's involvement in the oil sands. The Alberta government believed that the development of the oil sands should be under provincial jurisdiction and that the federal

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[208] Sheppard, 81.

[209] History of Relationships between Abasand Oils Limited and the Research Council of Alberta, in Sheppard, 330-7.

[210] Clark to C.S. Corbett, April 3, 1944, in Sheppard, 337.

government's failure at Abasand was detrimental to future commercial development.[211] This change in mindset was part of the agenda of Ernest Manning, the new premier in Alberta. Manning had taken over from William Aberhart in 1943 and had strongly advocated for provincial autonomy throughout his tenure.[212] This helps explain why he wished Alberta to take over bituminous research from the federal government. The bituminous sands were also appealing to Manning because of his desire to attract foreign investment. His administration was very conservative and business-minded and likely saw great economic potential in the bituminous sands if major oil companies from the United States could be convinced to invest in large-scale development projects.[213] A bituminous sands research project was important because there was a strong desire to determine the cost of producing oil from the bituminous sands.[214] The provincial government's interest became clear when the Alberta legislature in 1945 approved a resolution to spend $250,000 on a bituminous sand plant.[215]

Shortly before the renewed provincial interest, a businessperson from Montreal, Lloyd Champion, bought International Bitumen from Fitzsimmons in 1942. He renamed it Oil Sands Limited, and began trying to operating an oil sands separation plant. Initially, he was interested in using the oil sands as a road oil on the Alaska Highway but, after about a year of struggles at his new plant, Champion looked for some outside help. In the spring of 1944, he hired Martin Nielsen as the engineering superintendent for Oil Sands Limited. He also approached Clark for

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[211] Ferguson, 124.

[212] Richards and Pratt, 81.

[213] Richards and Pratt, 59.

[214] Clark to N.E. Tanner, September 25, 1944, in Sheppard, 352-6.

[215] Clark to W.B. Timm, January 3, 1945, in Sheppard, 357-64.

some advice and asked him to visit the plant in Bitumount. Clark bluntly told Champion that the plant was hopeless and that it would be in his best interest to create an entirely new plant.[216] After frequent disagreements with him about this, Champion eventually realized that he did not have the funding necessary to operate a successful separation plant on his own. This led to an agreement between the provincial government of Alberta and Oil Sands Limited to construct a new separation plant and refinery at Bitumount that could determine how much commercial production in the oil sands would cost.[217] The agreement was made in the summer of 1944 after the Social Credit party won the Albertan provincial election. It stipulated that the government would provide a $250,000 loan to Oil Sands Limited.[218] Clark's role with this new plant was to provide expert consultation regarding the operations of the separation plant.[219] In terms of engineering, Oil Sands Limited gave the contract to build the plant to the Born Engineering Company of Tulsa, Oklahoma.[220] Born Engineering was to base its design off the information regarding building separation plants that been compiled by the Research Council of Alberta.[221] Essentially, the company was to use the information that Clark had gathered regarding the hot water separation process to guide its design of the plant.[222] As preparation work began for the new plant, Clark was very optimistic about the future of the bituminous sands. He expressed this optimism in a letter to Max Ball in February 1945 when he predicted that the company would

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[216] Sheppard, 76.

[217] Clark to W.B. Timm, January 3, 1945, in Sheppard, 357-64.

[218] Sheppard, 77.

[219] Clark to G.J. Knighton, March 3, 1945, in Sheppard, 366-9.

[220] Clark to C.J. Knighton, August 1, 1945, in Sheppard, 372-3.

[221] K.A. Clark, "Athabasca Oil Sands: Historical Review and Summary of Technical Data," *Research Council of Alberta*, Contribution #69 (Edmonton: Government Printer, 1957), 12.

[222] Sheppard, 83.

soon be able to produce oil at a cost of 75 cents per barrel at the new plant.[223] His optimism was also bolstered by the suitability of the site chosen to build the plant. Bitumount had bituminous sand that was easy to mine and of a relatively good grade and high quality.[224]

While Oil Sands Limited was constructing the new plant, disaster struck when the Abasand plant burned down in June 1945. The fire started with a welding torch at the head of the plant, causing the whole plant to go up in flames in a matter of minutes. The flames even spread into a nearby forest resulting in a forest fire. In addition to the buildings, many pieces of machinery and tools, none of which could be easily replaced, were lost in the fire.[225] The fire resulted in the federal government dropping out of its involvement with the Abasand plant.[226] Shortly after the fire, the Department of Mines and Resources tried to include $750,000 in the 1946 federal budget to rebuild the plant. Parliament denied the proposal and many members of the federal house criticized the government heavily for the Abasand venture; the government dropped all further involvement.[227] In total, the government's investment in the Abasand plant added up to approximately $1.9 million.[228] Newspapers across Canada blamed C.D. Howe for this expenditure.[229] The federal government also lost interest in Abasand and the oil sands around this time because of the retirement of Sidney Ells, who had been in charge of federal

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[223] Clark to Max Ball, February 28, 1945, in Sheppard, 365-6.

[224] K.A. Clark, "Athabasca Oil Sands: Historical Review and Summary of Technical Data," *Research Council of Alberta*, Contribution #69 (Edmonton: Government Printer, 1957), 12.

[225] "Abasand Oil Plant Hard Hit by Fire," *Edmonton Journal*, Monday June 18, 1945, 1-2.

[226] Clark to C.J. Knighton, August 1, 1945, in Sheppard, 372-3.

[227] Clark to W.G. Jewett, Feb. 26, 1946, in Sheppard, 379.

[228] Ferguson, 119.

[229] Sheppard, 81.

research for the previous two decades. After he retired in 1945, the federal government did not do any significant oil sands research for the next 30 years.[230] Furthermore, the federal government could not justify investing in the Alberta oil industry when Eastern Canadian consumers already had plenty of access to cheap imported oil at this time.[231] It is important to note, however, that the federal Department of Mines and the Natural Research Council still carried on a few small experimental projects after the Abasand fire. T.E. Warren, D.S. Montgomery, and L.E. Djingheuzian still tested out the cold-water separation process at a small pilot plant in Ottawa. Moreover, Paul Gishler of the federally funded National Research Council in Ottawa tried out a fluidized beds process. Both parties consulted Clark for advice on their experimental separation procedures.[232]

The failure of the Abasand venture led Clark to emphasize to the engineers that they be extra careful in the design of the Oil Sands Limited plant. This was evident in a letter he wrote to Sidney Born of the Born Engineering Company when he emphasized that it needed to ensure it was handling diluent properly in its design of the plant to make sure it avoided the same fate as Abasand.[233] There was a high risk of a fire at the Oil Sands Limited plant as well because of the large amounts of oil that was on the ground throughout the plant at all times. This hazard meant that the staff had to ensure that the plant was always clean with the least amount of oil possible on the floor.[234]

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[230] Sheppard, 53.

[231] Chastko, 58.

[232] Sheppard, 82.

[233] Clark to Dr. Sidney Born, June 20, 1945, in Sheppard, 370.

[234] Bill Drever, "Legislature Party Impressed By North Oil Sands Plant," *Edmonton Journal*, August 26, 1949, 14.

Despite his initial optimism about the Oil Sands Limited plant, Clark expressed his frustration frequently with the long construction process. This first arose in a letter to C.J. Knighton in September 1945, when he seemed concerned about whether the construction of the plant could be finished within a reasonable time. Throughout the entire summer, very little got done in terms of construction and Clark expressed that if they did not hurry up the process that "the plant will not be completed in my lifetime."[235] But by the summer of 1947, Clark announced with certainty that the plant would be completed by the end of the summer season and that the plant would begin operations in the spring of 1948.[236]

Although Clark was optimistic about the Oil Sands Limited plant, it was also the case that there was still not much general interest in bituminous sand development. In 1947, there were no private oil companies interested in its potential. Companies were likely waiting to see the results of the Oil Sands Limited plant before investing any money in bituminous sand development. Additionally, there was very little incentive to try to exploit a cost intensive synthetic oil when cheap imported supplies of conventional oil were readily available to the Canadian market. The availability of these cheap sources of foreign oil is evident in the fact that in 1946 Canada was importing over 90% of its oil.[237] Interest in oil sands development also became less appealing when a drilling crew for Imperial Oil led by Vernon Hunter discovered oil at its exploratory drilling site in the village of Leduc on November 20, 1946.[238] By the start of 1948, there were 30 oil wells at Leduc pumping approximately 3,500 barrels of oil every day--about 10 times more

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[235] Clark to C.J. Knighton, September 18, 1945, in Sheppard, 374-5.

[236] Clark to Ray D. Magladry, July 8, 1947, in Sheppard, 398-400.

[237] Richards and Pratt, 44.

[238] Clark to Ray D. Magladry, July 8, 1947, in Sheppard, 398-400; and Pratt and Richards, 43.

crude oil than the Turner Valley field near Calgary.[239] With the discovery of another oil field at Redwater in 1948, there were approximately 900 million barrels of accessible conventional oil between these two new sites.[240] Additionally, in 1949, four more oil reserves popped up in Alberta at Joseph Lake, Golden Spike, Stetller, and Excesior.[241] This region dwarfed the 800 million barrels of unconventional oil sources known to be in the oil sands region. Not surprisingly, this made the oil sands not very appealing to commercial oil companies.[242]

As the plant was being finalized, a Research Council of Alberta laboratory was constructed beside it to assist in plant operations and to observe and determine whether the plant was a success. According to Clark, the plant would be successful if it were able to accurately determine the cost of marketable oil extracted from the bituminous sands by the hot water separation process. Once this cost was estimated, it could then be said with certainty whether a commercial operation could be successful using the hot water separation process. The determination of the cost was particularly important because four previous plants had been successful in extracting oil from the bituminous sands using the hot water separation process but none of these had been able to provide convincing evidence in terms of cost. The lack of success of these earlier plants had been particularly damaging to commercial development in the bituminous sands because of the large costs associated with constructing these plants. For instance, the federal government spent $1.5 million dollars at the Abasand plant and failed in its attempt to reduce the cost of producing oil from the bituminous sand using the hot water

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[239] Chastko, 71; and Edward Bell, "Ernest Manning," in Rennie, 161.

[240] Chastko, 71.

[241] Chastko, "Developing Alberta's Oil Sands, 1920-2002," 125.

[242] Chastko, 71.

extraction process. In the case of the Oil Sands Limited plant, approximately $1.5 to $1.75 million had already been spent by the fall of 1947 which led to heavy criticism due to the failure of the previous plants and put lots of pressure on Oil Sands Limited to produce successful results at Bitumount.[243]

Even though millions of dollars and a great deal of time had been invested in the hot water separation process, Clark in 1947 began to think that there could be potential in an in situ process. In multiple letters to Max Ball, he stated his belief that in situ work was on the way and that he thought it had the potential for commercial success. As mentioned earlier, an in situ method involves drilling a well and using specialized techniques to extract bitumen located deeper in the ground. It was an intriguing technique because the vast majority of the bitumen in the bituminous sands region is located deep in the ground. Clark told Ball that he was particularly impressed with the work of Leo Ranney, who thought that hot gas could be flowed through the sands in order to conduct the in situ process.[244] Clark also stated that the in situ process would be advantageous because the cost of doing so would probably be lower than mining the sand.[245] Clark was so taken with the process that he recommended that an incoming graduate student, Stan Ward, research whether water flooding could be a potential in-situ method of extraction. (After about two years of researching this process, both of them concluded that it was not a practical method at this time).[246]

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[243] Clark to Hon N.E. Tanner, September 30, 1947, in Sheppard, 409-14.

[244] Clark to Max Ball, November 6, 1947, in Sheppard, 414-18.

[245] Clark to Max Ball, August 11, 1947, in Sheppard, 408-9.

[246] Sheppard, 82-83.

Despite his optimism about the in situ process, the efforts of Clark, Oil Sands Limited, and the Research Council of Alberta were still focused on the construction of the separation plant at Bitumount. In early 1948, Clark remarked that he believed they were getting close to finishing construction and that they would soon be able to operate the plant in the summer season.[247] Originally, it was expected that the plant would have its first trial run in June or July that summer but a warehouse fire on May 24th set back this trial run by a considerable amount of time.[248] This was a major setback because it was very difficult to get the various equipment and materials needed to replace what was lost in the fire up to the plant.[249] Eventually by August of 1948, it seemed like the trial run of the plant was very much a reality. When word of the impending trial run reached the Alberta Research Council, Clark and Pasternack travelled up to Bitumount to observe the first operations of the plant.[250]

Unfortunately, the trial run of the Bitumount plant in September 1948 revealed that the plant had major issues that set back plans to operate the plant by another year. The biggest problem was the screw conveyor that was to be used to remove sand tailings from the plant. It proved to be ineffective and prevented the plant from being able to run efficiently and on a continual basis.[251] The screw was ineffective because it just stirred the sand in the water until it got stuck in the sand tailings.[252] Clark expressed his disappointment with the engineering firm in charge of constructing the screw conveyor and suggested that a new screw conveyor would have

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[247] Clark to G.J. Knighton, February 20, 1948, in Sheppard, 419.

[248] Clark to Sidney C. Ells, November 8, 1948, in Sheppard, 438-42.

[249] Sheppard, 85.

[250] Clark to C.S. Parsons, August 6, 1948, in Sheppard, 430-1.

[251] Clark to C.S. Parsons, September 24, 1948, in Sheppard, 431-3.

[252] Clark to Martin Nielsen, September 29, 1948, in Sheppard, 434-5.

to be designed in order for the plant to begin operations again.[253] It was particularly frustrating for Clark because a similar screw conveyor had limited success at both the Fitzsimmons and Abasand separation plants.[254] Furthermore, Clark also expressed concern with many other aspects of the Bitumount separation plant. In particular, he was very critical of the water-seal bearings he deemed ineffective because they allowed for too much water to enter the tar sand pulp and made the water content of the separated bitumen too high.[255] The changing of the sand bars in the Athabasca River also frequently had a negative impact on the water supply for the plant.[256] Water supply was particularly important because the plant used about 310 gallons of water per minute all of which came from the Athabasca River. If the sandbar cut off the direct supply from the river, water could still be pumped to the plant from further downriver but it would come at a significant cost increase.[257] With all of these difficulties arising in September of 1948 as the winter weather was starting to approach, it was decided that the plant should be shut down until the spring of 1949.

Clark was very frustrated with the plant's shortcomings. In particular, he was upset about not been listened to by the engineers constructing the Bitumount plant when it came to matters of engineering. According to Clark, the engineers dismissed his ideas because he was not an engineer. Clark retorted that they had no experience with tar sand separation plants. Clark had

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[253] Clark to Anthony Gibbon, September 28, 1948, in Sheppard, 433-4.

[254] K.A. Clark, "Athabasca Oil Sands: Historical Review and Summary of Technical Data," *Research Council of Alberta*, Contribution #69 (Edmonton: Government Printer, 1957), 14.

[255] Clark to Dr. Sidney Born, September 29, 1948, in Sheppard, 435-6.

[256] Sheppard, 85.

[257] Bill Drever, "Legislature Party Impressed By North Oil Sands Plant," *Edmonton Journal*, August 26, 1949.

overseen four other pilot separation plants over the years and believed that he had a lot to offer based on his experience in the industry.[258]

As work began again in the spring of 1949, the plant still had many issues that needed to be resolved. Clark believed one of these issues was the head engineer of the Bitumount separation plant, Wilmer Adkins.[259] Adkins was a former University of Alberta graduate in the chemical engineering program and had previous experience in the industry working for both Ball at Abasand and Fitzsimmons at International Bitumen.[260] He also had experience working in Brandon, Manitoba for Anglo Canadian Oils as a refinery engineer.[261] At first, Clark thought highly of Adkins.[262] Once they began running into difficulties with operations, however, Clark changed his opinion and was critical of Adkins for refusing to heed his advice, as well as that of Sidney Born and others attempting to help. Adkins would instead try to do things his own way until he realized that he should have taken the advice of others more seriously.[263] For instance, in July it was discovered that Adkins had received multiple complaints from plant workers regarding troubles with dilution and dehydration in the separation plant but he did not take any initiative to combat these issues until he was confronted by Clark about it.[264] It is difficult to determine, however, to what extent Clark's judgement was related to Adkins' past work with

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[258] Clark to Sidney C. Ells, November 8, 1948, in Sheppard, 438-42.

[259] Clark to Max Ball, November 6, 1947, in Sheppard, 414-18.

[260] Sheppard, 83.

[261] "Crew Hopeful of Success in Oil Sands Plant Tests," *Edmonton Journal*, September 1, 1949.

[262] Clark to Max Ball, November 6, 1947, in Sheppard, 414-18.

[263] Clark to Sidney M. Blair, June 30, 1949, in Sheppard, 444-5.

[264] Diary of Clark at Bitumount during the 1949 Season, Provincial Archives of Alberta 68.15/11.

Abasand, a company that had frequently turned down Clark's offers for help. In this instance, Adkins seemed to be continuing the practice of ignoring Clark's advice.

Throughout the summer of 1949, more issues arose at Bitumount due to the malfunction of various machinery at the separation plant and refinery, such as with the rotary screen in the separation plant, the pump on the flash chamber bottoms, and the fuel pump in the refinery. These issues resulted in frequent, extended shut downs throughout July.[265] This was problematic because one of the goals of the Bitumount plant was to demonstrate that the process was developed to a point where the plant could be run on a continual basis with minimal setbacks to halt production. Another setback occurred at the end of July when an explosion at the plant put a halt on operations for about two weeks. In a letter written by Clark to the Alberta Research Council, he was very vague about the explosion and claimed that no one was seriously injured and none of the machinery was too severely damaged.[266] Clark's diary of the Bitumount plant, tells a different story. In his entry on the day of the explosion, July 30th, he revealed that a welder was severely burned on the face and body and had to be taken to the hospital. Furthermore, he noted that the siding was broken in several places and hanging loose and that insulation inside the separation plant was scattered everywhere. His diary also revealed that the explosion probably occurred because the welder had been cleaning his work area with gasoline.[267] Clark's varying accounts of the explosion are revealing because they show that his letters to members of the provincial government or the Alberta Research Council probably tended to portray his various experimentations in an overly positive light to ensure funding was not pulled.

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[265] Diary of Clark at Bitumount during the 1949 Season, Provincial Archives of Alberta 68.15/11.

[266] Clark to Bert Lang, August 13, 1949, in Sheppard, 448-9.

[267] Diary of Clark at Bitumount during the 1949 Season, July 29, Provincial Archives of Alberta 68.15/11.

Once operations resumed following the explosion, Clark and the others began to prepare for a visit from members of the Legislature of Alberta. This visit was particularly important because all of the parties involved in the construction and operation of the separation plant at Bitumount wanted to prove to the provincial government of Alberta that their investment was worthwhile.[268] As operations progressed throughout August, however, the plant closed on multiple occasions due to problems with various pumps not providing enough suction to carry out the separation properly.[269] Just before the legislators arrived on the morning of August 25th, the plant had a major setback when fuel oil was spilled all throughout the plant. Fortunately, the plant workers were able to clean it up while Adkins stalled the members and it was cleaned up just before they arrived for their tour. The plant was running smoothly when the members of the legislature toured it and they seemed very content with the provincial government's investment and confident that the province should continue to invest in tar sand studies.[270]

Dr. Warren and Mr. Booth from the federal Department of Mines and Resources also came to view the plant in September.[271] They were also very impressed with the Bitumount plant. The successful operations of the plant using the hot water separation process actually made them question why the Department of Mines and Resources was conducting experiments on a cold-water process at the time.[272] While Warren and Booth were visiting, Mr. Dwyer and Mr.

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[268] Excerpts from Clark's Field Diary, Bitumount, August 19-28, 1949, in Sheppard, 449-51.

[269] Diary of Clark at Bitumount during the 1949 Season, Provincial Archives of Alberta 68.15/11.

[270] Excerpts from Clark's Field Diary, Bitumount, August 19-28, 1949, in Sheppard, 449-51.

[271] Diary of Clark at Bitumount during the 1949 Season, Provincial Archives of Alberta 68.15/11.

[272] Clark to his daughter Mary, September 18, 1949, in Sheppard, 451-2.

Anderson of the Husky Oil Company also flew in to view the plant at Bitumount.[273] Sidney Martin Blair, a former staff of the Research Council of Alberta and a consultant petroleum engineer, and Ed Nelson, Vice President of Development for the Universal Oil Products Company, also visited Bitumount in September acting as consultants to the plant. They were also impressed, stating that Bitumount had proven that bituminous sand could be mined and that oil could be extracted from it. They also suggested that the next step was to determine how the pilot separation plant could be turned into a successful commercial business.[274]

After the visits from the members of the Alberta legislature, the federal government, the Husky Oil Company, and the consultants, Clark remarked in a letter to Max Ball that the plant ran very smoothly until it was decided that operations should be shut down for the winter at the end of September.[275] Statistically, the plant at Bitumount in 1949 had showed some of the best results for bituminous sand separation up until that point. During the whole of the 1949 season, the plant separated between 250 and 700 tons of bituminous sand per day, averaging out at about 500.[276] The plant was able to recover about 90% of the oil in the bituminous sand, with particularly low mineral matter content of about 4.9%. These numbers are particularly impressive when compared to numbers from work in the laboratory and at other separation plants. For instance, at the laboratory the experiments suggested that they would probably only

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[273] Diary of Clark at Bitumount during the 1949 Season, Provincial Archives of Alberta 68.15/11.

[274] Clark to his son Malcolm, Sep. 25, 1949, in Sheppard, 454-7.
[275] Clark to Max W. Ball, Sep. 22, 1949, in Sheppard, 453-4.

[276] D.S. Pasternack, G. W. Hogson, and K.A. Clark, "Oil Recovery from the Alberta Oil Sands by the Hot Water Washing Method," *Athabasca Oil Sands Conference*, September 1951; and Bill Drever, "Legislature Party Impressed By North Oil Sands Plant," *Edmonton Journal*, August 26, 1949.

be able to recover about 80-85% of the oil.[277] According to Clark, this was likely due to the aging of the oil sand during lab work in Edmonton. Typically, four to five weeks would pass between the packaging of the oil sand in Fort McMurray until separation in Edmonton. The results at Bitumount thus provided further evidence to suggest that the best separation results occurred with freshly mined oil sand.[278] The mineral content of 4.9% was also substantially lower than the mineral content of 25% in the federally operated Abasand separation plant.[279] Bitumount data also established definitive temperature ranges of 65 to 90 degrees Celsius for the plant water. This was significant because it was a lower temperature than the Abasand plant and thus proved that the separation process could be more economical and fuel-efficient than previously believed. The continual recycling of plant water in a circulating stream also served to conserve heat and water and differentiated the Bitumount process from its predecessors.[280] Despite these successes, the Bitumount plant still did not meet all of the goals it had set out to achieve. In particular, Clark noted that all of the operations of the entire plant had never been able to run continuously at the same time. This was essential because it would allow them to determine the cost and evaluate the economic potential of a commercial development using the hot water separation process.[281]

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[277] Excerpts from Clark progress report on "Bituminous Sand Investigations," September 1949, in Sheppard, 457-61.

[278] D.S. Pasternack, G. W. Hogson, and K.A. Clark, "Oil Recovery from the Alberta Oil Sands by the Hot Water Washing Method," *Athabasca Oil Sands Conference*, September 1951.

[279] Excerpts from Clark progress report on "Bituminous Sand Investigations," September 1949, in Sheppard, 457-61.
[280] D.S. Pasternack, G. W. Hogson, and K.A. Clark, "Oil Recovery from the Alberta Oil Sands by the Hot Water Washing Method," *Athabasca Oil Sands Conference*, September 1951.

[281] Excerpts from Clark progress report on "Bituminous Sand Investigations," September, 1949, in Sheppard, 457-61.

Nevertheless, at the end of the 1949 season, the provincial government decided to limit operations at the Bitumount plant. It was costing the province a lot of money to run and the government did not have enough capital to expand it into a larger commercial size plant.[282] Manning's provincial government was also attacked for the excessive expenses of the plant in 1949. This was evident when the opposition fired many complaints at one of the ministers, Dr. John Robinson, during a March 1949 parliamentary session.[283] The plant continued to operate at a greatly reduced level until 1955, before closing entirely.[284]

The 1940s marked the return of governmentally funded oil sands research. This was partially due to the provincial and federal economies improving after the Great Depression. World War 2 certainly had an impact on oil sands research in this period as well. The scarcity of fuel supplies during the war sparked the federal government to get involved in oil sands research through their Abasand project. The subsequent failure of that project and the post war economic boom encouraged the provincial government to sign a joint agreement with Oil Sands Limited at the Bitumount plant. This had a positive impact on the research career of Clark as it allowed him to become involved in oil sands development again. Eventually, by using the process he had spent many years trying to perfect, the Bitumount plant achieved excellent results and its success later encouraged oil companies to take a closer look at the oil sands.

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[282] K.A. Clark, "Athabasca Oil Sands: Historical Review and Summary of Technical Data," *Research Council of Alberta*, Contribution #69 (Edmonton: Government Printer, 1957), 14.

[283] Chastko,"Developing Alberta's Oil Sands, 1920-2002," 123.

[284] Bob Weber, "Back to Bitumount: How the Oil Sands Changed Alberta and Canada Forever," *The Globe and Mail*, June 30, 2017, https://www.theglobeandmail.com/news/alberta/back-to-bitumount-how-the-oil-sands-changed-alberta-and-canadaforever/article35528769.

The 1950s and 1960s: The Sands Handed Over to Private Interests

The successful 1949 season at Bitumount had a great impact on fostering interest in commercial development in the oil sands throughout the 1950s and 1960s. Since the Bitumount plant proved the hot water separation method was effective it seemed that there was no more need for governmentally funded research. This was evident when the Blair Report was published at the end of 1950 and suggested that a large-scale commercial oil sands project could be profitable given the current state of oil sands technology. This intrigued many oil companies. These companies became even more interested in September 1951 after the first Oil Sands Conference, held at the University of Alberta. Oil company representatives and other interested parties were given a plethora of information about the oil sands and given a tour of the Bitumount plant. This led to many oil sand companies taking out exploratory licenses in the following years. The conditions in Alberta and the world marketplace, however, were still not ideal for developing the oil sands. It was not until 1967 that a commercial oil sands plant started operations.

At the end of 1949, the next step for the province was to determine the cost of producing a barrel of oil from the oil sands using the data obtained from the Bitumount plant. The provincial government hired Sidney Martin Blair to work with the Department of Industries and Labor under the supervision of Minister John L. Robinson to complete this task.[285] The province hoped that Blair's report would ideally discover "weak spots" in the production process at Bitumount. This would allow future research to focus specifically on improving the areas that

[285] "Cabinet to Study Development of Tar Sands," *Calgary Herald*, January 6, 1951.

were holding back progress towards commercial development.[286] Blair worked for about a year analyzing production charts, chemical reports, and cost tables and compiled a 165-page report known as "The Blair Report" for the Alberta government. This included determining the mining, separating, refining, and transportation costs that would be involved in a commercial oil sands operation.[287]

Blair hired an American engineering firm, Fred Mannix Company, to make an estimate on mining costs based on the data that had been accumulated at Bitumount. He hired the Universal Oil Products Company in Chicago to compare the costs of different separation methods, and the company compared the hot water separation method used at Bitumount, the cold-water separation method used by the Bureau of Mines, and the fluidized bed separation method. Results from the experiments at the Bureau of Mines and the National Research Council in Ottawa revealed that both the cold-water separation method and the fluidized bed separation method were much more expensive than the hot water separation method.[288] With respect to refining, Blair consulted Universal Oil again. Prior to World War 2, refining the separated bitumen proved difficult and it was impossible to refine it in an economical way that could justify commercial development of the oil sands. After the war, however, great improvements in refining capabilities made the commercial development of the oil sands more practical than it had been before.[289] Blair concluded that a pipeline that extended from Fort McMurray to Edmonton should transport an unrefined "intermediate product." The Betchel Corporation

[286] Chastko,"Developing Alberta's Oil Sands, 1920-2002," 127.

[287] K.A. Clark, "Athabasca Oil Sands: Historical Review and Summary of Technical Data," *Research Council of Alberta,* Contribution #69 (Edmonton: Government Printer, 1957), 16.

[288] Ibid, 16-18.

[289] "Processing Vast Oil Sands Is Termed Feasible Now," *Edmonton Journal*, January 5, 1951, 12.

estimated the cost of this pipeline and according to their estimates, a pipeline from the Mildred-Ruth Lakes oil sands area near Fort McMurray to Edmonton would cost around $5,000,000.[290] Betchel also stated that to transport oil through this pipeline it would cost about 28 cents per barrel. Once the oil was refined in Edmonton, it would cost about 55 cents per barrel to transport it by pipeline to Superior, Wisconsin.[291] It would be able to reach Superior because of new pipelines under construction. New lines would connect Regina, Saskatchewan to Gretna, Manitoba and Gretna to Superior.[292] From Superior, transportation to oil hungry Eastern Canadian markets would be relatively simple since a pipeline connected Superior, Wisconsin to Sarnia, Ontario.

The government published the highly anticipated "Blair Report" in December 1950. Throughout the year of his research, Blair was constantly harassed by interested parties looking to discern some information about his report. Blair stuck to his commitment to the province of Alberta and kept all of his findings completely secret.[293] He concluded that the oil sands could be developed profitably if produced on a scale of 20,000 barrels per day. A barrel of oil sand oil produced at this capacity would cost $3.10 and could be delivered and sold on the eastern Canadian market for $3.50. The price of $3.50 was determined through consultation with multiple oil companies.[294] This profit of $0.40 per barrel was based on what separated bitumen

[290] "Pipeline to Edmonton Suggested By Engineer," *Edmonton Journal*, January 5, 1951, 1; and K.A. Clark, "The Athabasca Oil Sands," December 1957, 16.

[291] "Processing Vast Oil Sands Is Termed Feasible Now," *Edmonton Journal*, Jan.5, 1951, 12.

[292] "Benefit to Canada Promised By Imperial Pipeline Plan," *Edmonton Journal*, September 9, 1941, pg. 1.

[293] Chastko,"Developing Alberta's Oil Sands, 1920-2002," 129.

[294] K.A. Clark, "Athabasca Oil Sands: Historical Review and Summary of Technical Data," *Research Council of Alberta*, Contribution #69 (Edmonton: Government Printer, 1957), 16.

would bring if refined into a number two fuel oil. A number two fuel oil was valuable because it had many uses, such as being converted into gasoline.[295] Blair also concluded that Clark's research played the biggest factor in the development of this potentially profitable process.[296] Not included in Blair's Report, however, was the fact that producing oil from the oil sands would cost oil companies approximately $0.74 more per barrel than it would to produce oil from conventional sources.[297]

Blair also emphasized the value of the sulphur by-product from oil sands production. He claimed that a $20 million per year sulphur industry was feasible as well. According to Blair, the sulphur by-product could supply the demand for sulphur in all of Western Canada.[298] Sulphur is valuable as a means to produce sulphuric acid, the most used chemical in the world and a vital component to various processes in the chemical and manufacturing industries.[299] Each 1.5 square miles of oil sand contained about 1.5 million tons of sulphur that would yield a profit of 14 cents per ton. This was significant because the sulphur supplies in Texas were diminishing rapidly and 90% of the world's supply came from there at the time. The removal of the sulphur during the separation process was also very costly and it was imperative that some use be made of this expensive procedure.[300] At the same time, however, at no point did Blair suggest that the oil

[295] Forbes Rhude, "Billions of Barrels of Alberta Oil Lie in Sands Awaiting Extraction," *Corner Brook Western Star*, December 5, 1952.

[296] "Oil Province Unlimited," *Edmonton Journal*, January 6, 1951.

[297] Chastko, 88.

[298] "Pipeline to Edmonton Suggested By Engineer," *Edmonton Journal*, January 5, 1951.

[299] The Sulphur Institute "An Introduction to Sulphur," *Learn More about Sulphur*, accessed May 2018, https://www.sulphurinstitute.org/learnmore/sulphur101.cfm.

[300] "Processing Vast Oil Sands Is Termed Feasible Now," *Edmonton Journal*, January 5, 1951.

sands would surpass conventional oil fields in terms of importance.[301] Rather, he stressed that it was possible and not probable that oil sands development could commence in the near future.[302] The Blair Report also served to spike a great amount of interest from big oil companies that was evident in the following year, when the Athabasca Oil Sands Conference was held at the University of Alberta. [303]

Ahead of the conference, a group of employees from the Anglo-Iranian Oil Company visited Edmonton. They arrived in March 1951, shortly after the release of the Blair Report. The purpose of their trip, according to one of their delegates, Dr. D.A. Howes, was "to see if the Blair Report can be believed." Upon arrival, they examined many of the reports by Clark and others about the oil sands. While in Alberta, they also made a visit to the Athabasca oil sands region itself. While touring the oil sands region with Clark and Blair they did not reveal any of the impressions they had gotten from their trip to that point, and this led to speculation that Anglo-Iranian was interested in commercial development.[304] A few months after their tour, a 164-page report prepared by Howes revealed the opinion of the Anglo-Iranian oil company. Howes questioned the validity of Blair's report and argued that his estimates were incorrect. Howes asserted that the crude oil from the oil sands was not that valuable and that, according to his estimates, it was worth $3.06 on the market. This was significantly lower than Blair's estimate of

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[301] Chastko, 85.

[302] Chastko,"Developing Alberta's Oil Sands, 1920-2002," 131.

[303] "Blair Oil Sands Report Praised by Dr. Hume," *The Vancouver Daily Province*, Jan. 13, 1951.

[304] "U.K. Firm's Experts to Study Development of Oil Sands," *Edmonton Journal*, March 19, 1951; "'Big Look' at McMurray," *Edmonton Journal*, March 20, 1951; Chastko,"Developing Alberta's Oil Sands, 1920-2002," 132-133; and "Oil Sands in Alberta to be Studied," *Hamiota Echo*, August 15, 1951.

$3.50. The report also suggested that a commercial producer would lose four cents per barrel of oil sand crude oil.[305]

Despite the negative report from Howes, the international oil sands conference at the University of Alberta turned out to be a major success. Hosted by Blair and Clark in September 1951, the conference saw over 120 people come from a wide variety of interested industries. The majority who attended were oil industry personnel but there were also many representatives from the government, the media, engineering firms, and mining companies. Over the first three days, presentations covered issues related to mining, separating, and refining the Alberta oil sands. Many of these visitors were also interested in hearing about the results from the provincial government's project at the Bitumount plant. The visit also included a two-day trip up to Bitumount for a tour of the plant's facility led by Clark.[306]

The main purpose of the conference, according to Blair, was to make available all of the information known to date about the oil sands to parties that would be interested in future development. This included research presentations from a wide variety of experts. On the first day of presentations, the focus was on the geological origin of the oil sands.[307] Dr. J.C. Sproule gave one of the keynote speeches on this first day. Sproule was a Calgary petroleum geologist and presented a paper on the stratigraphy of the Athabasca oil sand region.[308] The following days of presentations dealt with the challenges that needed to be overcome to warrant commercial

[305] Chastko,"Developing Alberta's Oil Sands, 1920-2002," 133-134; and David Breen, *Alberta's Petroleum Industry and the Conservation Board* (Edmonton: University of Alberta Press, 1993), 444.

[306] Government of Alberta, "The Athabasca Oil Sands Conference," *History Alberta*, accessed February 2018, http://www.history.alberta.ca/energyheritage/sands/mega-projects/setting-the-stage/the-athabasca-oil-sands-conference/default.aspx.

[307] "Mining Industry Experts Called Before Meeting," *Lethbridge Herald*, September 11, 1951.

[308] "Symposium on Alberta Tar Sands Opens, Edmonton," *Lethbridge Herald*, September 10, 1951.

development. Dr. Clyde Berg of Union Oil of California gave one of the more noteworthy presentations of the conference. His talk entitled "Desulphurization by Mild Hydrogenation" emphasized the similarity between the Alberta oil sands and the Santa Maria oil fields in California. He suggested that the method used in Santa Maria to desulphurise heavy crude oil could probably be effective in Alberta as well[309]

The other primary purpose of the conference was to make clear what policies the provincial government had in place for those who were interested in potential development in the oil sands region.[310] Nathan Tanner, the Minister of Mines in Alberta, outlined royalty and leasing policies and emphasized that the province would heavily encourage development in the oil sands region. At first glance, this appeared to be the case. There was relatively cheap rent of $1.00 per acre and a less than 10% royalty that the province required from developers.[311] Upon further scrutiny of the policy, however, it seems as though the province was trying to discourage development in the oil sands. Its policies were stricter for the development of the oil sands than for the province's conventional oil sources, which made it more challenging to develop them.[312] Any company that took out a lease in the oil sands region only had one year to begin building a commercial plant.[313] The terms also demanded that the plant begin operations within five years after the signing of the initial lease. Furthermore, the lease included clauses that required companies to commit large amounts of capital and prevented monopolies by only allowing one

[309] C.F. Steele, "Oil Sands Exploitation," *Lethbridge Herald*, September 15, 1951.

[310] Government of Alberta, "The Athabasca Oil Sands Conference," *History Alberta*, accessed February 2018, http://www.history.alberta.ca/energyheritage/sands/mega-projects/setting-the-stage/the-athabasca-oil-sands-conference/default.aspx.

[311] Chastko, 89.

[312] Chastko,"Developing Alberta's Oil Sands, 1920-2002," 121.
[313] Chastko,"Developing Alberta's Oil Sands, 1920-2002," 136.

lease per company.[314] All of these terms were problematic because they scared away potential development and made it was unlikely that any company would begin building a plant right away. In fact, oil company representatives were on record as saying that the policy on leases and royalties did little to encourage any company from taking the financial risk of trying to exploit the oil sands.[315] At the time of the conference, world oil prices were relatively low and there was an abundance of cheap oil sources available all over the world.

In the aftermath of the conference, there were no immediate attempts at commercial development. This was probably due to the success of the recently discovered oil fields at Leduc and Redwater. Provincial revenues in Alberta increased dramatically from $68.1 million in 1948 to $289.2 million in 1957, predominately due to the production from these two oil fields.[316] The immense cost of a commercial oil sands plant was a limiting factor as well. Clark estimated in 1953 that a commercial separation plant would cost at least $50,000,000.[317] Many oil companies, however, became involved in geological work in the oil sands region. This primarily involved seismic surveying. [318] In fact, there were about 12 exploratory sites in the oil sands region explored by oil companies within a few years of the conference.[319] Many of these companies had

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[314] "Offer Terms for Oil Sands," *Medicine Hat News*, September 12, 1951.

[315] "Good Deal Offered 1st Oil Sand Firm," *Medicine Hat News*, September 19, 1951.

[316] Chastko, 72.

[317] "Oil from Sand in Ten Years," *Medicine Hat News*, June 9, 1953.

[318] Government of Alberta, "The Athabasca Oil Sands Conference," *History Alberta*, accessed February 2018, http://www.history.alberta.ca/energyheritage/sands/mega-projects/setting-the-stage/the-athabasca-oil-sands-conference/default.aspx.

[319] K.A. Clark, "Athabasca Oil Sands: Historical Review and Summary of Technical Data," *Research Council of Alberta*, Contribution #69 (Edmonton: Government Printer, 1957), 19; and "Oil from Sand in Ten Years," *Medicine Hat News*, June 9, 1953.

different ideas for commercial projects. For instance, a private Swedish corporation, Swedish Shale Oil Corporation, hoped to recover bitumen without the labor or expense of mining the bituminous sand. The company had scientists in the region researching an in situ method of extracting bitumen from the sands.[320]

In 1954, shortly after the report and the conference, Clark retired from the University of Alberta Mining Engineering department at the age of 65. He still carried on at the Research Council of Alberta, however, in a part time role until 1963. A surge of interest in oil sands research among graduate students at the University of Alberta also kept him busy throughout the 1950s and 1960s. Interest from oil companies in his expertise kept him occupied as well. For instance, in 1958 he signed a formalized consulting contract with Great Canadian Oil Sands (GCOS), which would later become the first company to operate a large-scale commercial oil sands processing plant. Clark witnessed the beginning of construction on this $24 million plant in the spring of 1965. But he died in December 1966, just nine months before the completion of the GCOS plant.[321]

Since Clark's death, the Albertan community has displayed its appreciation for his work in a variety of different ways. The Dr. Karl A. Clark School, built in 1970, is located in downtown Fort McMurray on Clark Crescent. The Research Council of Alberta is on Karl Clark Road in Edmonton.[322] Since Clark's death, his research has had a lasting impact on the oil sands industry in Alberta. Many oil sands companies use a similar version of his hot water separation

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[320] "Study Cheap Way Tar Oil Recovery," *Medicine Hat News*, March 10, 1952; and "Export Gas and Oil Sands Said Key Alberta's Future," *Medicine Hat News*, April 19, 1952.

[321] "Oil Gambler Dies at 78," *The Brandon Sun*, December 10, 1966; and Sheppard, 87-89.
[322] Sheppard, 90.

process today.[323] Even though there are some minor differences, these modern day commercial operations use many of Clark's findings as the basis for their separation processes. For instance, his methods for the water temperature and bitumen aeration are still followed by plant operators. Oil sands researchers also experience many of the challenges that he faced in separation today.[324]

Throughout the 1950s and 1960s, governmentally funded research on oil sands separation decreased. The results at the Bitumount plant proved that an oil sands project could be profitable and the ideal methods for mining, separating, and refining were made publicly available to any party that was interested in commercial development. Plans were also being made to install the necessary infrastructure to ensure that the finished product could be transported and marketed in Eastern Canadian markets. Even though the government was no longer directly involved at this stage, Clark was still highly valued by interested parties. His research formed the basis of the Blair Report and the Athabasca Oil Sands Conference was a great success in the early 1950s. This was crucial as both of them played an essential role in fostering interest among oil companies in the oil sands. After the interest was created, he also proved to be very useful as a consultant to oil sands companies. This is evident in the role he held with the Great Canadian Oil Sands Company throughout these two decades. It frequently depended on his advice and he certainly played an integral part in the construction of the first commercial sized oil sands extraction plant in 1967.

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[323] U.S. Oil Sands Inc., "Extraction Processes," *Operations*, accessed March 2018, http://www.usoilsandsinc.com/index.php/operations/extraction-process; and J.D. Scott and B. Ozum, "Oil Sands tailings: What Needs to Be Done," *Mining.com*, September 1, 2010, http://www.mining.com/oil-sands-tailings-what-needs-to-be-done.

[324] Jacob Masliyah et al, "Understanding Water-Based Bitumen Extraction from Athabasca Oil Sands," *The Canadian Journal of Chemical Engineering* 82, no. 4 (August 2004), 628-48.

Conclusion

In 2017, production in the oil sands was approximately 2.8 million barrels per day. During that same year, the Alberta oil industry had approximately $26,500,000,000 in capital investments and provided work for about 140,000 people.[325] The oil sands research between 1920 and 1950 served as a major catalyst that eventually led to this scale of production seen in the oil sands today. From the founding of the Research Council of Alberta in 1921 to the first Athabasca Oil Sands Conference in 1951, the research and experimental projects were crucial in the formation of a commercial oil sands industry in Canada. The hot water separation process was a simple process known well before the 1920s but it became incredibly complicated when applied at a commercial scale in the Alberta oil sands region. The research by Clark and his associates at the Research Council of Alberta was crucial to perfecting this process. Through countless hours of experimentation in research labs in Edmonton and at five different pilot separation plants, Clark and his assistants mastered the intricate details of the process. Clark's passion and persistence resulted in impressive results on a semi-commercial scale at the provincially funded Bitumount plant during the 1949 season. These results made it appealing for the Alberta provincial government to investigate whether a commercial oil sands project could be economically feasible and the Blair Report of 1950 concluded that this could indeed be a profitable industry. This sparked an immense amount of interest from oil, mining, and engineering companies that led many of them to purchase exploratory licenses from the Alberta

[325] Government of Alberta, "Facts about the Oil Sands," *Alberta Energy*, accessed March 2018, http://www.energy.alberta.ca/OS/AOS/Pages/FAS.aspx.

government to investigate potential areas for commercial development. Eventually, this led to the Great Canadian Oil Sands Company creating the first commercial oil sands plant in 1967.

In addition to being the catalyst for eventual oil sands industry development, the significance of this research by Karl Clark and early oil sands developers also lies in its connection to present day obstacles and conflicts within the industry. For instance, just as there was in Clark's time, there is still a great deal of animosity between the federal government and the province of Alberta over control of oil sands development. There is the debate about whether the federal government should control access to resources and production and whether provinces or the federal government should control the right to construct pipelines through provincial territories which may disapprove of them. Up until recently, Albertans had been incensed with Canadian Prime Minister Justin Trudeau and his apparent reluctance to push for a pipeline, until a deadline was issued by Kinder Morgan. It was a politically difficult project for him to push given his environmentalist platform and intense resistance from environmental groups.[326] Clearly, his perceived inaction was upsetting to many Albertans, who felt that a pipeline was necessary to keep the oil industry, so critical to the province's economy, from collapsing. Between 2016 and 2017, royalties from oil sands bitumen in Alberta were approximately $1,480,000,000.[327]

This federal/provincial animosity has earlier roots in the conflict over the oil sands between 1920 and 1950. In particular, the Abasand fiasco infuriated the Alberta provincial

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[326] Kyle Muzyka, "Trudeau's 'phase out' oil sands comments spark outrage in Alberta," *CBC News,* January 13, 2017, http://www.cbc.ca/news/canada/edmonton/justin-trudeau-oilsands-phase-out-1.3934701; and Lorne Gunter, "Double Standard for Alberta oil," *Edmonton Sun*, March 14, 2018 http://edmontonsun.com/opinion/columnists/gunter-double-standard-for-alberta-oil.

[327] Government of Alberta, "Facts about the Oil Sands," *Alberta Energy*, accessed March 2018, http://www.energy.alberta.ca/OS/AOS/Pages/FAS.aspx.

government in the 1940s. It was perceived as an encroachment by the federal government on the jurisdiction of the province of Alberta because the Natural Resources Act of 1930 transferred control of natural resources in the province from the federal government to the provincial government. Abasand also dampened interest in commercial oil sands development because of its highly publicized failure. This upset Albertans because their provincial oil sands experts had been ignored by Abasand. They assumed that if the federal government had been assisted by the experts that the experimental project could have been much more successful and would have encouraged oil companies to invest in commercial oil sand extraction plants.

The dominance of international oil companies in Alberta is a common theme in contemporary dialogues regarding the oil sands. According to 2016 statistics, the American oil companies, ConocoPhillips and ExxonMobil, are two of the biggest oil sands companies in terms of oil reserves.[328] During the early development phase of the oil sands, Max Ball's American based company, Abasand Oils Limited, also played a major role. It was the dominant force in oil sands development throughout most of the 1930s and 1940s. American engineering companies played a major role in the construction of oil sand pilot separation plants as well. For instance, the Born Engineering Company of Tulsa, Oklahoma was hired to construct the provincially funded pilot separation plant at Bitumount.[329] This trend of hiring American engineering companies continued in the 1960s and 1970s. American oil companies were able to hire American engineering companies because there were no clear policies at this time on Canadian ownership and content in the Canadian oil sands industry. American firms did not want Canadian

[328] "List of Tar Sand Companies," *Rainforest Action Network*, accessed March 2018, https://www.ran.org/list-tar-sands-companies.

[329] From Clark to C.J. Knighton, August 1, 1945, in Sheppard, 372-3.

companies to assist in development in the oil sands because they would likely take longer to complete the task and lacked the experience of the American companies.[330]

The transportation and infrastructure problems that hindered the early industry and limited the potential commercial success of the oil sands continue to the present day. In his 1950 report, Blair argued that it was necessary for a new pipeline to be built between Fort McMurray and Edmonton in order to make the oil sands profitable. Similar arguments exist today in regards to the creation of new pipelines to transport oil sands products and increase the profitability of the industry. But there is much more backlash now against these pipelines than there was in Clark's era. Critics note that the industry contributes to climate change in two distinct ways, both by producing fuels that release greenhouse gases, and in the processes that extract and produce those fuels in the first place. The oil sands industry is also a major source of air and water pollution. Moreover, the industry is seen to infringe on the land ownership and stewardship rights of Indigenous groups.

All of these concerns are evident in the debates surrounding the extension of the Trans Mountain pipeline. This addition to the already existing pipeline would extend from Alberta to the B.C. coast. Critics fear that a pipeline spill could have a serious environmental impact on British Columbia's rivers, wildlife, and ocean – including harming fish populations that are intrinsic to Indigenous people's diet and way of life. More generally, the pipeline is seen as enabling the further exploitation of the oil sands, and so facilitating further climate change. Advocates for the pipeline, on the other hand, see it has the potential to be economically important for Canada because it will allow Alberta oil to reach emerging markets in Asia where the demand for energy is constantly growing. The federal government recently decided to

[330] David Crane, *Controlling Interest: The Canadian Gas and Oil Stakes* (McClelland and Stewart, 1982), 217-21.

support the Alberta government and financially support the building of this new pipeline extension.[331]

Another continuing trend in the oil sands is the development of new technology. During Clark's era, the focus was on finding new ways to make the mining, separation, and refining processes as simple and cost effective as possible. The ultimate goal was to make the oil sands profitable. In the 21st century, the goal of profit is still the focus of the oil sands industry. However, with growing concerns about the impact of the industry, a demand has arisen for creating new technology that will reduce the environmental footprint of the oil sands. In recent years, alliances have been made between oil sands companies and developers of environmentally focused engineering firms to conduct experiments on new greenhouse gas reduction technology that will attempt to reduce the environmental impact of the oil sands.[332]

Ultimately, Karl Clark's legacy is the dogged persistence and passion that led to the development of an efficient and economical process for oil sands development. His work had a huge impact on the province of Alberta. The rapid development of the oil industry resulted in the agricultural province becoming the wealthiest province in the nation during the latter half of the 20th century and into the 21st century. From the 1920s to the 1950s, Clark was one of few researchers who remained involved throughout the entire developmental period of the industry. Even Ells had retired several years earlier and federal government interest waned with his departure. Clark's persistence and systematic experimentation led to the development of an effective hot water separation process which suggested that commercial development in the oil

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[331] Jeff Lewis, Kelly Cryderman, and Shawn McCarthy, "Trans Mountain: End of the Line?" *Globe and Mail,* April 14, 2018.

[332] Claudia Cattaneo, "Oil Sands the Next 50 Years: Reduce Environmental Impact or Risk Fading into Sunset," *Financial Post*, September 30, 2017.

sands was possible. The sparse earlier historiography of the developmental period has tended to underestimate his contribution. His personal papers and correspondence has provided evidence of his meticulous and systematic contributions. In fact, a modified version of Clark's hot water separation process is still in use today. His work has also demonstrated the critical role that science plays in the development of an industry, a role that political will and entrepreneurial drive could not alone fill.

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