

# Cominco and the Manhattan Project

G. D. ANDREWS

Among the letters delivered to the office of the president and general manager of Cominco in Trail, British Columbia on a snowy February 26, 1941, was one of special significance.<sup>1</sup> Although stamped "secret," the letter seemed innocent enough. It carried a request from the National Research Council of Canada for information on the type of cell used by Cominco in their electrolysis of water process and for information on Cominco's ability to make heavy water. This innocent-sounding note was to launch the company into one of the most remarkable projects of its long history, involvement in the Manhattan Project, the giant engineering undertaking which was to bring forth, in the summer of 1945, the atomic bomb. Nearly two years later, the company would sign contracts with the United States Government to produce a substance called heavy water, but not before some careful bargaining had been conducted on both sides.

As early as 1934, Cominco had investigated the properties of heavy water, and had corresponded with the National Research Council on the subject.<sup>2</sup> But these early investigations did not go far. It took the outbreak of hostilities in Europe in 1939 to focus attention on heavy water because of the research that was hurriedly being conducted into atomic fission.

It will be necessary here to explain briefly atomic fission, and the relationship of heavy water to the process. A nucleus, which is the heart of the uranium atom, fissions, or splits apart, giving off particles called neutrons. These particles leave the nucleus at enormous speeds. For a chain reaction to develop the speed of the neutrons must be moderated so that they can come into contact with other uranium nuclei. And every

<sup>1</sup> O. Maass to S. G. Blaylock, 22 February 1941, *Project 9 — Basis of Agreement, Feb. 1941 to June 1942* — (hereafter cited as *P. 9 B. of A., 1941-1942*). The author wishes to thank the officials of Cominco Ltd. for permission to use the "P-9 Files", and Mr. James Cameron for his assistance.

<sup>2</sup> W. S. Kirkpatrick to Dr. B. P. Sutherland, 19 August 1940. This is a memorandum which summarizes the history of Cominco's investigations into heavy water from 1934 until the then present. *Project 9, 1940-1946*.

time they do come into contact the process of fission, the generation of heat, the potential of power is created. But if the neutrons which are given off during this process are not slowed down, as they are *not*, happily, in nature, a chain reaction cannot result. The high-speed particles simply do not cause fission in the uranium nucleus and are dispersed harmlessly.

How then are the particles slowed so that the potential energy can become actual, so that the enormous power locked in can be released? One means of moderating their speed is by the use of heavy water or deuterium oxide. To understand this, consider a game of marbles. In the centre of a circle rests a massive "steely." The object of the game is to hit the big marble with your shooter and simply slow your shooter down. Unfortunately though, in nature, when a large object is struck by a much smaller one, the smaller is not slowed down. In fact it rebounds at almost its original speed. Now the "steely" in the centre represents ordinary water. If one tried to shoot a uranium neutron through it, the neutron would not be slowed. But if the mass in the centre of the circle was a heavy water nucleus, then things would be different. Because it is closer to the mass of the uranium neutron, the heavy water would slow the uranium neutron down. Thus a chain reaction would be possible because this "slow" neutron is the one that begins this remarkable process.

So heavy water was necessary for a chain reaction to be possible, and heavy water, it seems, was available or potentially available from the Consolidated Mining and Smelting Company, now Cominco.

From the first contact in February of 1941 until the summer, very little more transpired. The National Research Council of Canada, acting for the British Government, had the information they needed and were analysing it before further action would be taken.

In 1939 a committee had been struck in Britain to look into the feasibility of making an atomic bomb. This group, the M.A.U.D. Committee (for Military Application of Uranium Detonation), after two years of study, finally reported in the summer of 1941 that a bomb was in fact possible.<sup>3</sup> But they observed that at least three years would be needed to manufacture the weapon, and that the only possible place to carry out that task would be the United States. Only the U.S. could afford to undertake so vast a project. They had the physical means and the leisure. President Roosevelt accordingly authorized the formation of the Office of Scientific Research and Development (O.S.R.D.), which was to work very closely with the M.A.U.D. group. Dr. Hugh Taylor, a British physi-

<sup>3</sup> Lansing Lamont, *Day of Trinity*, New York, Athenaeum, 1965, pp. 27-8.

cist working at Princeton University was assigned by O.S.R.D. to study areas where heavy water could be made. One such area was Trail.

Dr. Taylor wrote to S. G. Blaylock, the company's president and general manager on June 21, 1941, suggesting that he come to Trail for a tour of the plant and discussions with Mr. Blaylock. Taylor wrote, "... we have come to the conclusion that the most rapid method of reaching a technical output of heavy water . . . at the present time is to make use of the opportunities at the Trail plant."<sup>4</sup> Blaylock informed Taylor<sup>5</sup> in his reply that it would not be necessary for him to visit Trail but that he would have Taylor supplied with all the necessary data on the plant. Subsequent developments were to prove this was an unfortunate decision on Blaylock's part. Much time was lost and a great deal of misunderstanding, frustration, and confusion were the consequences of this seemingly insignificant oversight.

In Trail, research by the Cominco scientists into the feasibility of their undertaking the project went ahead. But in July came bad news. Blaylock wrote Taylor, "We have struck a snag, in that there is a patent on using electrolytic hydrogen cells for heavy water, taken out by a Mr. Knowles in England."<sup>6</sup> This was a serious blow, as consideration of royalties now had to be calculated. For if Cominco were to produce heavy water at a profit, or at least not at a loss, the problem of royalties had to be met. But Dr. Taylor, no businessman, casually replied that the patent could be circumvented. This patent and another were to be constant sources of debate in the negotiations. The problems caused by them were not satisfactorily solved until the eleventh hour.

Meanwhile the first business offer was made on July 23, 1941. On that day Taylor wrote Blaylock the following:

After consideration of various possible alternative methods of promoting the production of heavy water at Trail we have made the following recommendation to the National Defence Research Committee and our recommendation was approved. . . . That 2000 pounds of D<sub>2</sub>O (heavy water) . . . be purchased from the Consolidated Mining and Smelting Company, delivery to be made as rapidly as possible, the whole to be delivered in one year.<sup>7</sup>

The price the N.D.R.C. was prepared to pay was \$5.00 per pound for low-grade heavy water and \$10.00 per pound for high-grade. In an

<sup>4</sup> Dr. Hugh Taylor to Blaylock, 21 June 1941, P. 9, B. of A., 1941-1942.

<sup>5</sup> Blaylock to Taylor, 26 June 1941, P. 9, B. of A., 1941-1942.

<sup>6</sup> Blaylock to Taylor, 3 July 1941, P. 9, B. of A., 1941-1942.

<sup>7</sup> Taylor to Blaylock, 23 July 1941, P. 9, B. of A., 1941-1942.

earlier<sup>8</sup> discussion it had been made clear that the British and American Governments were actually interested in buying 2000 pounds of heavy water a *month*. The interim contract was being offered to test the capacity of the Trail plant. How much heavy water could be produced without alterations? And if alterations were necessary how extensive would they need to be? But it seems that there was another, more subtle, reason for the offer; perhaps it was to test the business sense of Cominco management.

The offer did not take into consideration freight costs, and this obviously would make a considerable difference. The U.S. Government continued to ignore the Knowles patent, and Blaylock realized, if American government representatives did not, that any commercial deal would have to take into consideration royalty payments to the inventor. Also the Cominco management were surprised by the price offered for heavy water. They had recently purchased from the Americans five grams of heavy water at a cost of \$2.50 per gram. It does not take a knowledge of higher mathematics for one to calculate that that works out to \$1,130 per pound! The Americans were offering to buy for \$5.00 per pound what they were selling for \$1,130 per pound.

On August 5, Blaylock took his stand on the offer. In his letter to Taylor he wrote, ". . . while we are prepared to help, we do not feel that we can take the risk involved."<sup>9</sup> And if Taylor missed the point that Cominco was not going to the block over a project whose actual value had not yet been proven, and whose uses were still a mystery, Blaylock made it very clear by concluding, "In other words, we are not prepared to take any loss in this connection." Blaylock asked if the U.S. Government was prepared to pay the cost of adjusting the plant to try out the scheme, and once again returned to the question of patents. Would the U.S. Government take the responsibility for any royalties which may have to be paid? "If so," he went on, "we would then discuss the price to be paid for heavy water." But not before.

That letter had immediate results. On August 13, Taylor replied with the government's new proposal. In this he promised up to \$20,000 for modifications and added, "if the expected increase in heavy water concentrate does not result from the change, it is then proposed that the company extend a credit of \$10,000 to the N.D.R.C. for the purchase of heavy water on such terms as may be agreed upon, based on the efficiency

<sup>8</sup> Dr. B. P. Sutherland to E. A. Colls, Inter-department Memorandum, 10 July 1941, P. 9, B. of A., 1941-1942.

<sup>9</sup> Blaylock to Taylor, 5 August 1941, P. 9, B. of A., 1941-1942.

developed in the modified plant.”<sup>10</sup> Taylor and the U.S. Government obviously wanted to get going and were giving Cominco what they must have thought was a fine opportunity to go ahead. Taylor closed with an added appeal for despatch, “There is a certain urgency in this matter and the Trail operation offers the greatest opportunity for rapid production.”

E. A. C. Colls, superintendent of the chemical and fertilizers department, was called on by Blaylock to comment on this new offer, and Colls recommended that the company should not go ahead until samples which had previously been sent had been analysed for their grade.<sup>11</sup> Colls’ memo to Blaylock, summarizing his view, was sent as the official Cominco response to Taylor’s offer — a rather startling lapse, — as it amounted to a rejection of the offer, while offering no alternative. C. W. Wright, a man very close to Blaylock, thought the offer a good one. But this time his counsel was ignored, and the impression was given to the Americans after this exchange that Cominco was a thoroughly cautious and retrograde concern.

From August until December there was no further word from Taylor. Throughout this period Cominco continued to send samples to Taylor at Princeton for analysis, but he neither acknowledged receipt of the material nor reported on his findings. One wonders if Taylor had lost heart. Certainly he believed the company was not acting in good faith.<sup>12</sup> He had made what he, and indeed what many of the company men, felt was a reasonable interim offer. The company, in his mind, had responded only half-heartedly. To an academic man, an intellectual totally involved in his project, this kind of caution would be unendurable. Taylor complained to his colleagues about the company, but did not communicate his feelings directly to Blaylock.<sup>13</sup>

Thus, negotiations came to a halt. Blaylock concerned himself with other matters, including the important explosives production. And the negotiations with the O.S.R.D. found their own level on the shelf of company priorities. Company personnel became confused and frustrated over the lack of progress. In a note to Blaylock in October, Colls put these feelings of his colleagues into words, “At this time no further word has come through from Taylor on the subject and we wonder whether they are still interested.”<sup>14</sup>

<sup>10</sup> Taylor to Blaylock, 13 August 1941, *P. 9, B. of A., 1941-1942*.

<sup>11</sup> E. A. Colls to Blaylock, 22 August 1941, *P. 9, B. of A., 1941-1942*.

<sup>12</sup> Blaylock to Taylor, 8 December 1941, and G. I. Higson to Blaylock, 8 December 1941, *P. 9, B. of A., 1941-1942*.

<sup>13</sup> *Ibid.*

<sup>14</sup> Colls to Blaylock, 29 October 1941, *P. 9, B. of A., 1941-1942*.

This note spurred the president and general manager to action. He had delivered to him a summary of all that had transpired since August regarding both sampling and contract. But the author of the summary, C. W. Wright, after all his homework was completed was no better informed than Blaylock it seems. He wrote, "I suggested to Sutherland before he left for the East that if he had the opportunity he should try to get in touch with Dr. Taylor and endeavor to determine how this matter stands."<sup>15</sup>

It is not known whether Dr. Sutherland of the research department was able to contact Taylor. But as matters now began to move more quickly it must be assumed that high level meetings were held. There is some evidence to suggest that Taylor had been dropped, or had removed himself, from the negotiations, and that his place had been taken by another physicist, Dr. Harold Urey, the man who had pioneered the exploration of heavy water. Taylor was depressed by his apparent failure to incite the company to rapid action, and possibly had volunteered to step down. Or perhaps higher authority had decreed that he was to be replaced by a more aggressive man. Whatever the reason, Taylor had dropped from sight.<sup>16</sup>

On December 6, 1941, the day before the Japanese attack on Pearl Harbor, Blaylock met with G. I. Higson, a British scientist who was well informed on heavy water work in the U.S. and Canada. It was Dr. Higson who told Blaylock of Taylor's disappointment and fears that the project was proving impossible.<sup>17</sup> Taylor, he said, also felt that perhaps it would be necessary to look elsewhere for heavy water. Blaylock did not like the sound of that and acted quickly.

He wrote a long letter to Taylor which began by stating how surprised he was with Taylor's disillusionment:

I had an astonishing interview with Dr. Higson on Saturday morning last . . . He stated that you had given him the impression that the Consolidated Mining and Smelting Company was not cooperating with you properly in regard to experimental work on heavy water; that you had told us you were prepared to have the work done; that you had a 10,000 credit for this work; and that we had sent you some samples and there was not any heavy water in them. He also said that you could not get any information from me. . . ."<sup>18</sup>

<sup>15</sup> C. H. Wright to Blaylock, 31 October 1941, *P. B. of A., 1941-1942*.

<sup>16</sup> Blaylock to Taylor, 8 December 1941; Higson to Blaylock, 8 December, 1941, *P. 9, B. of A., 1941-1942*.

<sup>17</sup> Higson to Blaylock, 8 December 1941, *P. 9, B. of A., 1941-1942*.

<sup>18</sup> Blaylock to Taylor, 8 December 1941, *P. 9, B. of A., 1941-1942*.

Blaylock then went on to refute these points and to state that the company was not prepared to spend any large amount of money on the work. If the job was to be done the U.S. Government must come up with the cash. Then Blaylock became conciliatory:

I can assure you that we are still willing to proceed with this work provided we get real cooperation, and would suggest that you visit Trail personally . . . as Trail has one of the largest and most experienced groups of electro-chemists that can be found anywhere in the world . . . I do not think anything could be gained by bringing outsiders into the picture.<sup>19</sup>

There are two points arising from this last paragraph. First, the invitation to Trail. One wonders how matters would have transpired if Taylor had visited the Smelter City in early 1941. Much precious time could have been gained if these two men had met earlier. In fact their subsequent four-day meeting did lead to a basis of agreement. In a few days they were to clear up several months' accretion of misunderstanding.

There was also an intriguing reference in this letter to "outsiders". Had the Americans suggested that their scientists be brought into the Trail plant? Was there a question of the contract being let to someone else? Or was Blaylock giving Taylor a vote of confidence over Dr. Urey, who had been touted by Higson, and presumably others, as being a replacement for Taylor? Blaylock was justifiably proud of his engineering and scientific staff which had a high reputation for excellence. He could never have accepted the suggestion that his staff be subject to the decrees of people outside the firm. Probably the reference to outsiders *did* imply that the Americans had in mind bringing in experts to Trail to work directly on the project. The Americans certainly gave advice on the construction of the new plant, but they were never involved directly in the production of heavy water at Trail. Blaylock was to keep the project pretty much a "family" affair.

Taylor finally visited Trail between January 5 and 8, 1942, and the result of his study of the plant was an agreement in principle to go ahead with the project. That was a happy moment for Taylor the scientist and Blaylock the businessman. The essence of their agreement can be summarized in the following points: Cominco would modify its electrolytic hydrogen plant provided it would cost nothing and would involve no loss in production of ammonia (that most important ingredient in munitions manufacture, another of Cominco's war-time ventures); Cominco would expect no profit for this work but at the end of hostilities the plant and

<sup>19</sup> *Ibid.*

the right to use it would belong to Cominco; Cominco would either perform the work itself or have it performed, but in either case would control all personnel engaged in this work. Running through this first agreement was a persistent thread, one that marked Blaylock's influence — that this was to be a Cominco project.

But technically it was not Blaylock who would decide if Cominco was to proceed. This was a matter for the board of directors. So on the same day he drafted the letter to Taylor accepting the offer in principle, Blaylock wrote Sir Edward Beatty, President of the Canadian Pacific Railway, and Chairman of the Board of Cominco, enclosing his letter to Taylor for approval. The letter to Beatty is an interesting one because it raised a point not yet discussed. Blaylock wrote "The British and Americans are very much concerned about a supply of heavy water. The uses that they wish to put this to are apparently closely guarded military secrets."<sup>20</sup> That was very discreet of Blaylock. In fact, while the uses of the product were theoretically buried in secrecy, the engineering and scientific community at Cominco, and probably Blaylock himself, understood that heavy water was a component in atomic research. Also, names like Taylor and Urey were both well known and quickly identified with atomic matters. There was even speculation among a few of the brighter Cominco scientists that a bomb was possible through atomic fission, but whether Blaylock knew of these hunches is not known.<sup>21</sup> Blaylock told Sir Edward that he did not know why the material was needed, and Beatty accepted it at that. The board gave its permission to go ahead.

The fact that the term "heavy water" was becoming something of a give-away prompted a search for a new word to disguise the product and to stop possible rumours and speculation. If Cominco were to go ahead, certain precautions must be taken. One American official who visited Trail was more than a little surprised at the casual manner in which the engineers and administration approached their task and talked about their work. He pointed out that as small a group as possible should be informed and that the name of the product should be changed.<sup>22</sup> The curtain of secrecy began to fall as Cominco moved into the Atomic Era.

Blaylock suggested that the work itself be termed "electrolyte treatment" and the product "electrolyte", and these terms were to remain until October of 1942 when the material was once again renamed, this

<sup>20</sup> Blaylock to Sir Edward Beatty, 8 January 1942, *P. 9, B. of A., 1941-1942*.

<sup>21</sup> Interview with Mr. J. H. Salter, Vice-President, Western Region, 8 July 1970.

<sup>22</sup> Wright to Messrs. Colls, Sutherland, Tiedje and Chapmen, 13 February 1942, *Project 9, 1940-1946*.



time to "Product No. 9" and the project was designated as "Project No. 9". These rather bleak names remained to the end.

Only a small group was "in-the-know", and it was to be a credit to it, and to the ever-expanding circle of employees who later were informed, or who were in from the beginning, that not a single breach of security occurred. The public did become suspicious after the war, and some rather spectacular newspaper stories were written, based on some fairly accurate speculation.<sup>23</sup>

It was not until late July 1942 that talks had proceeded to the point where Blaylock saw that the project was going to be of enormous proportions. The U.S. Government agreed to install the necessary plant facilities at its own expense, the figure for the installation ranging from a low of one million to a high of five million dollars. But now the President of the Company wondered if it was in fact permissible for the Americans to build the plant under Canadian law. Should arrangements be made for permission to go ahead? Should a portion of the "electrolyte" be reserved for Canada? And if the Canadian Government did want some, was it prepared to pay for it?

In a letter to the Minister of Munitions and Supply, C. D. Howe, Blaylock made these questions known. Blaylock's special problem was of course secrecy. He could not tell Howe what specific task was planned, only that it was "very secret research work." This he must have found embarrassing, especially as he was dealing with the man who was privy to more war secrets than any other Canadian. He tried to ease the burden of his embarrassment by stressing that it really was a very big affair, indeed a fabulously big one. He wrote, "It all sounds like a fairy tale but I am sure there is something serious in it."<sup>24</sup>

Blaylock heard from Howe a few days later: "I am familiar with the whole project to which you refer,"<sup>25</sup> wrote the minister. It was unnecessary for Blaylock to play secret-agent any longer. Howe informed Blaylock that the Canadian Government would not require any of the material and concluded his letter by giving the company a free hand in its negotiations. "... go on with whatever representatives of the United States Government may wish you to do in this connection."

On the day that Howe's letter arrived, Blaylock received the "Letter

<sup>23</sup> See Harry Gregson, "Heavy Water Made at B.C. Smelter", *Seattle Times*, 25 April 1948, p. 5.

<sup>24</sup> Blaylock to C. D. Howe, Minister of Munitions and Supply, 28 July 1942, *P. 9, Basis of Agreement, July to November 1942*. (hereafter cited as *B. of A., 1942*.)

<sup>25</sup> Howe to Blaylock, 31 July 1942, *B. of A., 1942*.

Contract" from the War Department of the U.S. Government, which provided for an understanding that the work would get started and that formal contracts would be drawn up in due course. Blaylock signed the document on August 1, 1942.<sup>26</sup>

It would seem that Blaylock could now close that file with some feeling of satisfaction. But this was not to be. Three months of hard bargaining were to follow before a final agreement could be reached, and in this period Blaylock found himself playing again the role of promoter. He had become convinced that the deal was a good one — a better one could not be had — and the sooner it was closed the better. The Board of Directors of Cominco was not so enthusiastic. One director in particular peppered Blaylock with endless and often astute questions, and advised caution throughout.<sup>27</sup> Blaylock agonized over the prospect that the delaying tactics would give the Americans a chance for second thoughts, so finally he wrote "... I have driven a very hard bargain with the U.S. Government — so hard in fact that they figured they might have to get the Canadian Government to take us into camp."<sup>28</sup> The thought that Cominco's operations might be nationalized was an awful one for Blaylock. It must have been just as fearful a prospect for the directors because after that note from Blaylock, the objections were dropped.

Finally, in November, Cominco entered into a contract with the Government of the United States to build a plant to make product No. 9.<sup>29</sup> Briefly the main points were these: the plant would be built at American expense, the actual cost being anticipated at close to two million dollars. Throughout the war Cominco would sell to the American Government, at cost, the heavy water produced. Cominco was expected to keep the plant operational for two years after the war and in that period the U.S. could call on the company to operate the plant for three years on the same basis as they had during the war — that is, on the basis of no profit and no loss. During this period, however, the company would be permitted to sell up to half of its production. After this period the U.S. Government would lease the plant to Cominco, (technically the plant was U.S. Government property, and this is one of the points that the

<sup>26</sup> J. C. Marshall to Blaylock, 31 July 1942, *B. of A., 1942*.

<sup>27</sup> See letters of R. H. McMaster to Blaylock dated 22 September 1942; 8 October 1942; 3 November 1942. See also Beatty to Blaylock, 22 September 1942. *B. of A., 1942*.

<sup>28</sup> Blaylock to McMaster, 13 October 1942, *B. of A., 1942*.

<sup>29</sup> The contract is summarized in several letters which Blaylock wrote in this period. See Blaylock to R. E. Stevert, 26 September 1942; Blaylock to McMaster, 29 September 1942; Blaylock to McMaster, 13 October 1942; *B. of A., 1942*.

directors found difficult to absorb), at an annual rent of 2% of the net profit derived from the operation. Throughout the lease period, Cominco had the option then to buy the plant, and their interests were further protected by the agreement that the U.S. Government would not sell to any other purchaser than Cominco. Originally the plan had been that Cominco would build the plant and would bill the U.S., at cost, for the undertaking. Then after the war the U.S. would turn the plant over to the company. This arrangement had proved impossible to bring about.

A solution was also found to one of the earliest problems to come up in these negotiations between the Government of the United States and Cominco — the problem of patents. There had been three large areas. First, what could Cominco expect for its *own* inventions which related to research into heavy water before its cooperation with the U.S. Government? Second, what provisions would be made for inventions discovered *jointly* by Cominco and the U.S. Government scientists? And finally, what about work which had been done by *others*, inventions which related to heavy water, but which had been done by neither Government nor Cominco people — the Knowles patent was one of these. In the first case Cominco was very generously protected. In the second case the company was granted extremely generous concessions, being given title to all patents in such cooperative work except in the U.S. And finally the Knowles patent and others like it were to be administered by the U.S. Government.

And so we have come full circle. The snag that earliest threatened to sink the vessel of negotiations was in fact one of the last removed, and the company solicitor was able to write Blaylock. "We are particularly pleased with the patent clauses . . ."<sup>30</sup>

Not quite twenty-two months had elapsed since that first secret letter from the National Research Council had been delivered to Blaylock. Since then the company attitude toward the project had changed from one of rather benign contempt to one of full throated enthusiasm. Early faltering, the product of poor communication more than anything, was corrected by a personal meeting between Taylor and Blaylock. From that point on Blaylock was won over to the importance of the work. Did he know about the relation of heavy water to bomb research? Probably not. He was convinced only that this was important war work and that was sufficient for Blaylock. But there was more. Blaylock was a consummate businessman, and he had to answer to a board who were businessmen

<sup>30</sup> A. L. Johansson to Blaylock, 17 November 1942, *B. of A.*, 1942.

too. The heavy water project was a business enterprise. A. L. Johannson wrote to Blaylock, and his sigh of relief can be heard over the years, "After prolonged conferences . . . the form of the contracts was settled, embodying the revisions which were agreed upon at the conferences with you. It may be stated with confidence, that the deal, as it now stands, is the best that can be obtained from the Government."<sup>81</sup>

<sup>81</sup> *Ibid.*