

McCONNELL AND BROCK'S REPORT ON THE GREAT LANDSLIDE AT FRANK, DISTRICT OF ALBERTA, NORTHWEST TERRITORIES

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ABSTRACT

On 30 April, 1903, a day after the Frank Slide, the Superintendent of Mines in the Canadian Department of the Interior instructed two senior staff of the Geological Survey of Canada to investigate the catastrophe. R.G. McConnell and R.W. Brock were assisted at the slide by the surveyor, W.H. Boyd, and the coal geologist, W.W. Leach. They reported answers to Dr. E. Haanel's four questions on June 12, 1903. The condition of the strata before the slide was affected by slight readjustments attendant on mining operations. The slide was due to a combination of causes the chief of which, the structure and condition of the mountain, was aided by exceptional atmospheric and other natural conditions. The north peak and shoulder of Turtle Mountain overhanging the town of Frank are dangerous and there is some possibility of a sudden movement (although the commencement of the movement is more likely to be gradual). Their Report played an important role in the first North American textbook on landslides, in Terzaghi's 1950 review and in the U.S. National Academy of Sciences Special Reports on Landslides. The careful contemporary account of the landslide's impact on Frank is still one of the very few available for risk assessment studies.

RESUME

Le 30 avril 1903, le lendemain du glissement de terrain de la ville de Frank, l'Inspecteur des Mines du Département canadien de l'Intérieur a enjoint à deux employés principaux du Commission Géologique du Canada d'enquêter sur la catastrophe. R.G. McConnell et R.W. Brock étaient aidés au site du glissement de terrain par l'arpenteur-géomètre, W.H. Boyd, et le géologue du charbon, W.W. Leach. Le 12 juin 1903, ils ont répondu aux quatre questions du Dr. E. Haanel. La condition des strata avait été affectée avant le glissement par de petites modifications dues à des opérations minières. Le glissement était dû à une association de causes, la principale desquelles, la structure et la condition de la montagne, était aidée par les conditions atmosphériques et naturelles exceptionnelles. Le pic et le contrefort nord de la montagne Turtle qui surplombent la ville de Frank sont dangereux et un mouvement soudain est possible (bien que le début de ce mouvement soit plus probablement graduel). Leur exposé a joué un rôle important dans le premier ouvrage classique nord américain sur les glissements de terrain, dans la revue écrit par Terzaghi en 1950 et dans les Special Reports de l'Académie Nationale des Sciences U.S. sur les glissements de terrain. Le récit contemporain et détaillé de l'impact de ce glissement sur la ville de Frank est toujours un des rares en existence pour étudier l'évaluation des risques.

1. INTRODUCTION

One of the Frank Slide Interpretative Centre's Commemorations of the Slide Centennial in 2003 is a new edition (Cruden, 2002) of the Federal Government's Report on the Great Landslide at Frank, Alberta published in Part 8 of the Annual Report of the Federal Department of the Interior for 1903 (McConnell and Brock, 1904).

The authors are identified, not on the title page of the Extract, but as signatories to the letter of transmittal of the Report sent 6 weeks and 2 days after the Slide. The phrasing of the letter follows Edwardian conventions of politeness but a closer examination hints at irony.

."Sir, In pursuance of the instructions of the Honourable the acting Minister of the Interior, transmitted through you, we have examined the Frank landslide, and beg to submit the following report thereon.

We have the honour to be, sir, Your obedient servants,"

R.G. McConnell and R.W. Brock, the authors, who were the obedient servants of Dr. E. Haanel, the Superintendent of Mines, are front and centre on the Map that accompanied the Report. This, united with the section across the Map in a single poster, is now available as the first step of the re-publication program (Cruden, 2001).

Figure 1 shows R.G. McConnell on his appointment as Deputy Minister of Mines in 1914. This represents the culmination of a career with the Geological Survey of Canada, which began 35 years earlier shortly after his graduation from McGill University in Montreal with a degree in Geology (Zaslow, 1975, p. 307). Imagine McConnell at his desk in the cramped Survey Offices in Sussex St., Ottawa on Thursday, April 30, 1903. He is planning his summer's field work in the Klondike Goldfields when an urgent letter is delivered which

disrupts his plans. Its author published it later in his Annual Report (Haanel, 1903).



Figure 1. R.G. McConnell, GSC 68776

"April 30, 1903

Messrs. McConnell and Brock –

You are to proceed at once to the scene of the disaster and investigate thoroughly the nature and causes of the catastrophe. If a landslide, determine as carefully as possible the condition of the strata before the avalanche, and the causes which led to the breaking away of the mountain mass, whether due to imperfect or careless mining operations, the explosion of fire damp, exceptionally bad ground, or similar causes, or whether the results were due to the destructive effects of atmospheric weathering or other causes.

Determine with especial care the present physical condition of the mountain, with a view of determining the likelihood of a recurrence of similar destructive phenomena.

Report as soon as possible, consistent with thorough examination, the results of your investigations.

Dr. Eugene Haanel
Superintendent of Mines,
Department of the Interior"

There was little opportunity for discussion of these instructions. Haanel, the Superintendent of Mines, had jurisdiction over mining activities in the North West Territories (Figure 2). He has been appointed to his post 2 years previously by the personal intervention of the Minister of the Interior, Sifton. Sifton's responsibilities included the Geological Survey of Canada (Zaslow, 1975, p. 243).



Figure 2. Dr. E. Haanel, GSC 83752

Furthermore, McConnell knew the country (McConnell, 1886). He had described the coals outcropping along the Middle Fork of the Oldman 20 years earlier under the supervision of the charismatic George Mercer Dawson (Dawson, McConnell, 1884). But Dawson, the lamented Director of the Geological Survey was 2 years dead in 1903, his achievements remembered in places such as Dawson Creek and Dawson City throughout the northwest (Adams, 1901).

The new Director, Robert Bell (Figure 3), had also been active.

"On the 29th of April a rock-slide of considerable magnitude took place from the face of the mountain overlooking the town of Frank, where the southern line of the Canadian Pacific railway enters the Crows Nest Pass through the Rocky mountains. The first telegraphic news of the disaster which reached Ottawa described it as a "volcanic eruption", but those who inquired as to its nature at the office of the Survey were

immediately informed that this was exceedingly unlikely and indeed almost impossible. I telegraphed to Mr.W.W. Leach, who had worked in this locality for the Survey the previous season and who was then in the vicinity, asking him to telegraph me a sufficiently full description of the phenomenon. He complied with my request, and his description was immediately placed at the disposal of the press and printed in the leading newspapers" (Bell, 1903).



Figure 3. Dr. R. Bell, GSC 68775

Leach, however, was only a temporary employee (Figure 4), and Haanel has identified another member of Bell's staff who carried more weight with the mining industry. Our other author, R.W. Brock, had his photograph (Figure 5) taken when he became Deputy Minister of Mines in 1908. He was a younger man, 29 in 1903, but already a Professor of Geology and Mineralogy at his alma mater, Queen's University in Kingston, Ontario. He had graduated from there in 1895 and had spent the next year at Heidelberg University in Germany, acquiring skills that left their marks on the Report (Zaslow, 1975, p 264).

Brock and McConnell had worked together on the development of mines in the Kootenays (Zaslow, 1975, p. 225). Brock was a consultant to Cominco who became major customers for the coke from the Crowsnest Pass. Brock had been working with a young surveyor who was at the beginning of a 40 year career with the federal government, W.H. Boyd (Zaslow, 1975, p. 227). He was just visible in the bottom left hand corner of the Map from the Report (Figure 6).

The two geologists and the surveyor assembled their field gear on Friday and perhaps over the weekend. They had Leach's description, and presumably copies of his report at the printers. The geological sketch section (Leach, 1903) showed the compressed fold he described at a scale of 180 chains to the inch (1:142,560).

The map locates the line of cross-section about E-W through Hillcrest. Much of the geology that McConnell and Brock describe is already sketched for them on the map. They too, distinguish the limestones from the coal measures but report at 1:12,672, over 10 times the scale of Leach's map. The more detailed Map locates the seams that were mined and the trace of the fault they terminate against. Leach's map has the township and range divisions indicated but what appear to be contours are, in fact, form lines, sketching the shape of the country without quantifying it. Boyd has a major task ahead but he has a 4 day train journey to prepare for it.



Figure 4. W.W. Leach, GSC 25982

2. AT THE SLIDE

The three men from Ottawa met Leach on Friday, May 8, a week and two days after the Slide. Trains were stopped at Cowley and they approached Frank from the south, halting perhaps to photograph the Frontispiece of their Report. The townspeople had been evacuated westwards to Blairmore and beyond (Anderson, 1986, p. 77). Haultain, the Premier of the North West Territories, who ordered the evacuation, his advisor, CPR Chief Engineer McHenry and William Pearce, the Chief Inspector of Surveys for the Department of the Interior had returned to their duties. The reconstruction of the CPR line was underway (Report, Plate 3), and presumably the hotels were open to quench the thirsts of the workmen.

The journey to the hotel probably showed enough to confirm Leach's diagnosis so Haanel's first question can be immediately addressed. What was "the condition of the strata before the avalanche"?

The local photographers, Marks and Buchanan, are unlikely to be the source of a dark photograph of Turtle Mountain before the slide (Report, Plate 1). Their photograph of the town of Frank was better; the row of miners' cottages northwest of Gold Creek is clearly visible (Report, Plate 2). The mine was obviously still under construction at the time of the slide (Report, Plate 4).

On then to "the causes which led to the breaking away of the mountain mass". Marks and Buchanan's well-known photograph (Report, Plate 5) of the returning miners dates from the day, Thursday, 30 April, after the Slide. On May 10 (Anderson, 1986, p. 79), Haultain and McHenry met again, the evacuation order and many of the RCMP were withdrawn, the company decided to re-open the mine and some of the miners



Figure 5. R.W. Brock, GSC 201772

were back in town and available for interview. The miners' comments and the photograph contained "nothing that would indicate that the bursting of the last bond, by which the mass was upheld, was caused by movements in the mine" (Report, p. 14).

A forensic examination of the displaced material indicated an extensive sheet (Report, Plate 8) whereas an explosion would produce a crater and elevated rim. Mud had been excavated from the bed of the Old Man River (Report, Plate 11) and deposited among the boulders (Report, Plate 7).

The surface of the displaced material is usually formed by boulders. The boulders (Report, Plate 6) may have produced conical mounds of displaced material (Report, Plate 9). There are no coal measure rocks among the boulders, again suggesting the mine is not involved in the slide. The Section thru' the slide, however, does not identify the former land surface below the beds of contorted rock. These beds, also identified in the Marks and Buchanan photograph (Report, Plate 5), raised concerns about exceptionally bad ground.

These concerns were augmented when the geologists view the ground between North and South (Report, Plate 12) Peak and the steep rock slopes north of North Peak and overlooking the town (Report, Plate 13). They completed their examination of the present physical condition of the mountain by using the mine plans to document the removal of coal from the vertical seam and the dimensions of a typical chamber in the mine (Report, Diagrams 1, 2).

A preliminary report for comment was ready after 2 weeks' work on 23 May (Anderson, 1986, p. 79). To document "the destructive effects of atmospheric weathering or other causes," the geologists leave Frank; the nearest weather stations are at Calgary and Pincher Creek, the nearest seismograph is in Toronto (Report, pp. 14, 15).



Figure 6. W.H. Boyd, GSC 82061

3. THE REPORT

CPR service to the east had been restored on 24 May (Cooper, 1903) and the geologists could be back in Ottawa before the end of the month. A summary of the preliminary report found its way into Pearce's article for the New York – based Engineering News published on 4 June (Pearce, 1903) and Haanel perhaps saw it there for the first time. Only the permissions of the Acting Director of the Geological Survey, and the Acting Minister of the Interior, Sir William Mulock were acknowledged.

Boyd may have required additional time to complete the Map by compiling Township surveys (Woods, 1902) from the Federal Office in Calgary. There, he would have found plans of the former route of the CPR and Gold Creek. The hachuring on the Township survey suggested a way of estimating the volume of the displaced material by reconstructing the pre-slide topographic surface as a staircase with broad treads ascending the valley side. The elevations of the treads could be estimated from the topography beyond the southern lateral margin of the slide.

With this rough estimate of the thickness of the displaced material and an estimate of its area from the map, an optimistically precise estimate, 47,857,820 cubic yards, of the volume of the slide deposits can be made if the rules of multiplication are followed. They were not and there is an arithmetic error of 100 cubic yards in the estimate.

Two significant figures rather than eight are enough to compare Frank to other slides from the Alps (Baltzer, 1880; Reidl, 1877). Elm is interesting (Rothpletz, 1881; Heim, 1882) because the surface of rupture there is about at right angles to the foliation in the metamorphic rocks which were being mined for slates. The slide was about a third of the volume of Frank.

The slide from the Rossberg (Baltzer, 1875; Zay, 1807) which overwhelmed Goldau was larger than Frank. It was a slide largely along bedding, as we now believe Frank was (Cruden and Krahn, 1973). The destroyed village was re-built on the deposits of the slide of 1395 which had buried an earlier settlement (Skermer, 1989, p. 68).

Brock's sources for the information on the Alps look like a tribute to Haanel's German upbringing. The compliment is ironic, all the German language authors were Swiss – except the Austrian, Reidl. Brock also slipped in a reference to a rare book (Zay, 1807) which he was unlikely to have read and which Haanel would not find in Canada.

The report was submitted on June 12 and McConnell left Ottawa on the same day for the Klondike. His annual report devoted a short paragraph to Frank (McConnell, 1903). Brock and Boyd had a few details

to take care of before they left for the Kootenay on 18 June (Brock, 1903). Here then are their answers to Haanel's questions paraphrased from the Report.

- 1) What was the condition of the strata before the avalanche?

Slight readjustments in the lower strata attendant on mining operations.
- 2) What causes led to the breaking away of the mountain mass?
 - a) Imperfect or careless mining operations?

Probably imperfect mining, carelessness unproven
 - b) The explosion of fire damp? No
 - c) Exceptionally bad ground? Yes
 - d) Destructive effects of atmospheric weathering? Yes
- 3) What is the present physical condition of the mountain?

Dangerous
- 4) How likely is the recurrence of similar destructive phenomena?

Always a possibility

4. ECHOES

For many years, McConnell and Brock's Report was the only scientific account in the English language literature of what the Report had named, for the first time, as a rock avalanche. So the Report was identified as an "outstanding paper" in the first North American textbook on landslides (Sharpe, 1938). Sharpe's uncle had published a contemporary account (Stewart, 1903) based on an extended visit to the town in 1903. Sharpe's book was drawn to the attention of engineers and geologists by Terzaghi (1950) who used the Frank Slide to illustrate his ideas about rock creep.

The series of United States' National Academy of Sciences Special Reports on Landslides (Eckel, 1958, Schuster and Krizek, 1978, Turner and Schuster, 1996) saw the Frank Slide increasingly better represented to a world audience. When the International Decade for Natural Disaster Reduction (1990-2000) focused attention on the consequences of disasters, the Report's contemporary account of the impact on Frank was still one of a very few available in English. So Frank featured on the cover of Landslide Risk Assessment (Cruden and Fell, 1997) published under the auspices of the International Union of Geological

Sciences Working Group on Landslides. Canada's deadliest landslide (Evans, 2001) has a contemporary relevance which directs attention to the Federal Government's Official Report (McConnell and Brock, 1904).

5. ACKNOWLEDGEMENTS

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6. REFERENCES

Adams, F.D., 1901. George M. Dawson, Bulletin, Geological Society of America, 13: 497-509.

Anderson, F.W., 1986. The saga of the Frank Slide: Turtle Mountain Disaster, Gopher Books, P.O. Box 9055, Saskatoon, Saskatchewan, 92 p.

Baltzer, A., 1875. Über einen neuerlichen Felssturz am Rossberg, nebst einigen allgemeinen Bemerkungen über derartige Erscheinungen in den Alpen, (On a recent rockfall on Rossberg with a few observations on these phenomena in the Alps) Neues Jahrbuch für Mineralogie, Geologie und Palaeontologie, pp. 914-924.

Baltzer, A., 1880. Ueber Bergstürze, (On mountain collapses) Neues Jahrbuch für Mineralogie, Geologie und Palaeontologie, Band 2, pp. 197-199.

Bell, R., 1903. Rock-slide at Frank, Geological Survey of Canada Summary Report of the Operations of the Geological Survey for the Year 1903, p. 8A.

Brock, R.W., 1903. The Lardeau District, British Columbia, Geological Survey of Canada, Summary Report of the Operations of the Geological Survey for the Year 1903, pp. 42A-81A.

Cooper, T.J., 1903, The Rock-slide at Frank, Canadian Engineer, 7:164-166.

Cruden, D.M., editor, 2001. Map of Frank and vicinity showing Landslide, by R.G. McConnell and R.W. Brock, Edmonton Geological Society, Map and cross-section.

Cruden, D.M., editor, 2002. Report on the Great Landslide at Frank, Alta., 1903 by R.G. McConnell and R.W. Brock, Edmonton Geological Society, 40 p.

Cruden, D.M. and Fell, R., editors, 1997. Landslide Risk Assessment, Balkema, Rotterdam, 370 p.

Cruden, D.M., Krahn, J., 1973. A re-examination of the geology of the Frank Slide, Canadian Geotechnical Journal, 10, 581-591.

Dawson, G.M., McConnell, R.G. 1884, Report on the region in the vicinity of the Bow and Belly Rivers, North West Territory, embracing the country from the base of the Rocky Mountains to longitude 110° 45' and from the 49th Parallel, northward to Latitude 51° 20'. Geological and Natural History Survey of Canada, Dawson Brothers, Montreal.

Eckel, E.B., editor, 1958. Landslides and Engineering Practice, Highway Research Board, Special Report 29, 232 p.

Evans, S.G., 2001. Landslides: in A Synthesis of Geological Hazards in Canada, edited by G.R. Brooks, Geological Survey of Canada, Bulletin 548, pp. 43-79.

Haanel, E., 1903. Department of the Interior, Annual Report, Part 8, Superintendent of Mines, p. 8.

Heim, A., 1882. Der Bergsturz von Elm, (The mountain collapse at Elm) Zeitschrift der Deutschen Geologischen Gesellschaft, Band 34, 74-115.

Leach, W.W., 1903. Geological sketch map of the Blairmore – Frank Coal-fields, Geological Survey of Canada, Map 808.

McConnell, R.G., 1886. Report on the geological structure of a portion of the Rocky Mountains accompanied by a section measured near the 51st Parallel, Geological and Natural History Survey of Canada, Annual Report, New Series, Volume 2, Part D, 41 p.

McConnell, R.G., 1903. Klondike District, Yukon Territory, Geological Survey of Canada, Summary Report of the Operations of the Geological Survey for the Year 1903, pp. 34A-42A.

McConnell, R.G., Brock, R.W., 1904. Report on the great landslide at Frank, Alberta, Department of the Interior, Annual Report for 1903, Ottawa, Part 8, 17 p.

Pearce, W., 1903. The great rockslide at Frank, Alberta, Engineering News, 4990-492.

Reidl, E., 1877, Ueber Bergsturz und Rutschung, (On mountain collapse and mountain rupture) Neues Jahrbuch für Mineralogie, Geologie und Palaeontologie, pp. 914-924.

- Rothpletz, A., 1881. Der Bergsturz von Elm, (The mountain collapse at Elm) Zeitschrift der Deutschen Geologischen Gesellschaft, Band 33, 540-564.
- Schuster, R.L. and Krizek, R.J., editors, 1978. Landslides: Analysis and Control, Special Report 176, Transportation Research Board, National Academy of Sciences, Washington, D.C., 234 p.
- Sharpe, C.F.S., 1938. Landslides and related phenomena: a study of mass-movements of soil and rock. Columbia University Press, New York, 137 p.
- Skermer, N., 1989. Translator, Landslides and human lives, (A. Heim, 1932, Bergsturz und Menschleben, Zurich), Bitech Press, Vancouver, 195 p.
- Stewart, D.A., 1903. A disaster in the Rockies, Canadian Magazine, 4: 227-233.
- Terzaghi, K., 1950. Mechanism of landslides in Paige, S., Application of Geology to Engineering Practice, Geological Society of America, New York, pp. 83-123.
- Turner, A.K. and Schuster, R.L., 1996. Landslides: Investigation and Mitigation, Transportation Research Board, Special Report 247, National Research Council, Washington, D.C., 673 p.
- Woods, J.E., 1902. Plan of Township 7, Range 3, W5M, (3rd edition, corrected), Topographical Surveys Branch, Department of the Interior, Ottawa.
- Zaslow, M., 1975. Reading the Rocks. Macmillan, Toronto, 599 p.
- Zay, K., 1807. Goldau und seine Gegend, (Goldau and its vicinity) Orell, Fuselli, Zurich.

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3. Dr. R. Bell, 68775
4. W.W. Leach, 25982
5. R.W. Brock, GSC 201772
6. W.H. Boyd, GSC 82061