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Roughnecks, Rock Bits, and Rigs: The Evolution of Oil Well Drilling Technology in Alberta, 183-1970. By Sandy Gow. (Calgary: University of Calgary Press, 2005. 674 p., ill., bibl., app., ISBN 1-55238-067-x \$44.95)

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Natural Science in the New World: The Descriptive Enterprise

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though a few sentences later the year is given correctly. A photo caption (p.137) confuses the location of Polymer's manufacturing plant in Strasbourg, France with its marketing centre in Fribourg, Switzerland. The Polymer pavilion at Expo was not "a short distance" (p.157-158) from Habitat; the latter was in Cité du Havre and the former on Ile St. Helene. Finally, as a work of scholarship the book is marred by an overly casual attitude to sources. The illustrations in particular have either no acknowledged source or the not very helpful "National Archives of Canada".

This is not a comprehensive history of Polymer but more a focussed argument about its history. In the end it is a very welcome contribution to the literature on Canadian business and, while an effective study, it may be hoped it will not be the last word on the topic of Polymer.

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***Roughnecks, Rock Bits, and Rigs: The Evolution of Oil Well Drilling Technology in Alberta, 183-1970.* By Sandy Gow. (Calgary: University of Calgary Press, 2005. 674 p., ill., bibl., app., ISBN 1-55238-067-x \$44.95)**

Roughnecks, Rock Bits and Rigs is an encyclopedic, descriptive history of oil and gas field drilling in Alberta from the industry's origins in the late nineteenth century until 1970. Thematically organized, the book includes chapters on petroleum geology, Alberta oil and gas fields and prospecting, companies active in Alberta's oil and gas industry, labor conditions, drilling problems, and hazards. Other chapters focus on drilling technology and methods, including the standard cable tool rig and its evolution, the rotary rig, the components and accessory technologies of the rigs, the development of well instrumentation and logging, in short everything having to do with finding oil and bringing wells into production in the Alberta fields. The book is packed with detailed empirical information on all of these topics, and provides a sense of daily working life and technical challenges in the oil patch and how these evolved over nearly a century. The author draws upon a wealth of archival and primary sources, including oil company records, technical reports, industry journals and newspapers, and memoirs, oral histories, and interviews with key figures in the industry. Given the technical complexity of the oil drilling business (evidenced by the book's thirty-five page glossary of terms), bringing all of this information together in a

systematic way, with numerous explanatory illustrations, and unique historical photographs, is a considerable achievement. *Roughnecks, Rock Bits and Rigs* is sure to become a classic reference in historical studies of oil production in North America.

The book's empirical and descriptive technological focus means that it necessarily leaves some aspects of the oil industry unexplored and unanalyzed. It chronicles the discovery and bringing into production of numerous oil fields, but it does not analyze Alberta oil and gas production from an overarching statistical perspective, apart from one table that lists initial proved reserves annually up to 1970. It also does not provide any systematic historical analysis of the governance of the oil industry in Alberta. Such an analysis would require an extended focus on legislation, its interpretation, and its implementation, as pertaining to exploration and mineral rights, company legislation, environmental legislation, etc. (There is some coverage of safety legislation, however.) The book also does not analyze the economics of the Alberta oil industry in any structured or systematic way, although it does provide numerous empirical insights into oil and gas economics and their relation to broader trends. And it does not discuss in any detail the refining or consumption sides of the industry as they evolved over the twentieth century – what happened to the oil/gas after it left the ground.

The information presented does address several broad issues, however, that are of particular interest to historians of technology and business. We learn a lot about technology transfer and the dynamics of innovation in the oil and gas industry. Gow shows how a multitude of incremental innovations emerged from attempts to grapple with the diverse problems experienced in the field. He shows that the Canadian oil and gas industry depended overwhelmingly on American technology until the 1960s. This resulted from the dominance of American capital, firms, management, and skilled technical labor within the Canadian oil and gas fields, which in turn was a product of the large size and capitalization of the American oil industry. The comparatively free flow of technical knowledge across the border allowed innovative Canadian firms to emerge by the 1970s, and to become internationally competitive. Also, the uniqueness of Canadian geological, climate, and other conditions resulted in technological adaptation for the Canadian context, sometimes leading to significant innovation.

We also learn a lot about the dynamic interactions among firms and between business and labor in the oil drilling industry. Although large American firms predominated in the production of oil and gas in Alberta, the industry always had a contingent of independents, particularly in the decades before the Second World War. The oil and gas industry was

moreover characterized by extensive subcontracting and by the rise of a host of ancillary businesses that provided specialized equipment and tools or services such as well logging or warehousing of spare parts. Finally, we learn much about the structure of the labor forces that built, used, and maintained the drilling rigs, the range of specialties within the work crews, as well as their wages, hours, and working conditions. All in all, this makes for a unique picture of how capital, business, labor, and technology came together and interacted in the Alberta oil patch over nearly a century.

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***“Just Dummies”: Cruise Missile Testing in Canada.* By John M. Clearwater.** (Calgary: University of Calgary Press, 2006. 270 p., bibl., notes, index ISBN 1-55238-211-7 \$34.95)

John Murray Clearwater calls this work the third volume in his “nuclear weapons in Canada trilogy that began with the 1988 book *Canadian Nuclear Weapons* and was followed in 2000 by *U.S. Nuclear Weapons in Canada*” (p.1). That is a bit of a misnomer inasmuch as the two first volumes dealt with the history of actual nuclear weapons that either were located in Canada, or could be used by the Canadian military, or both in the case of the nuclear warheads within Bomarc surface-to-air missiles and Genie air-to-air rockets that were available to the Canadian air force for North American air defence. The cruise missiles that are the subject of this third book were never deployed to Canada. They were tested twenty-three times in Canadian airspace, between 1984 and 1994. And they never were armed, with either nuclear or conventional weapons. They were “just dummies” as Gilles Lamontagne, the minister of national defence, put it in 1982.

Air-launched cruise missiles are released from bombers. They carry small jet engines and wings that allow them to fly like airplanes. During flight their on-board guidance system periodically compares surface characteristics stored in their on-board computers and corrects the track. This means they are highly accurate. The U.S. wanted to test “the cruise” over Canada because, “unique among Western allies, including the United States, Canada has the combination of space, terrain and weather and test facilities suitable for operational testing of the air-launched cruise missile over representative terrain and realistic route length.”

Clearwater’s first two volumes were long on technical detail and citations from primary documents and somewhat short on assessment.