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Western Mining in the Twentieth Century Series

Roy Woodall

AUSTRALIAN GEOLOGIST, 1953 TO 1995:
SUCCESS IN EXPLORATION FOR GOLD, NICKEL, COPPER, URANIUM AND PETROLEUM

Interviews Conducted by
Eleanor Swent
in 2004

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Since 1954 the Regional Oral History Office has been interviewing leading participants in or well-placed witnesses to major events in the development of northern California, the West, and the nation. Oral history is a method of collecting historical information through tape-recorded interviews between a narrator with firsthand knowledge of historically significant events and a well-informed interviewer, with the goal of preserving substantive additions to the historical record. The tape recording is transcribed, lightly edited for continuity and clarity, and reviewed by the interviewee. The corrected manuscript is indexed, bound with photographs and illustrative materials, and placed in The Bancroft Library at the University of California, Berkeley, and in other research collections for scholarly use. Because it is primary material, oral history is not intended to present the final, verified, or complete narrative of events. It is a spoken account, offered by the interviewee in response to questioning, and as such it is reflective, partisan, deeply involved, and irreplaceable.

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Roy Woodall

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PREFACE

The oral history series on Western Mining in the Twentieth Century documents the lives of leaders in mining, metallurgy, geology, education in the earth and materials sciences, mining law, and the pertinent government bodies. The field includes metal, non-metal, and industrial minerals. In its eighteenth year the series numbers sixty-five volumes completed and others in process.

Mining has changed greatly in this century: in the technology and technical education; in the organization of corporations; in the perception of the national strategic importance of minerals; in the labor movement; and in consideration of health and environmental effects of mining.

The idea of an oral history series to document these developments in twentieth century mining had been on the drawing board of the Regional Oral History Office for more than twenty years. The project finally got underway on January 25, 1986, when Mrs. Willa Baum, Mr. and Mrs. Philip Bradley, Professor and Mrs. Douglas Fuerstenau, Mr. and Mrs. Clifford Heimbucher, Mrs. Donald McLaughlin, and Mr. and Mrs. Langan Swent met at the Swent home to plan the project, and Professor Fuerstenau agreed to serve as Principal Investigator.

An advisory committee was selected which included representatives from the materials science and mineral engineering faculty and a professor of history of science at the University of California at Berkeley; a professor emeritus of history from the California Institute of Technology; and executives of mining companies. Langan Swent delighted in referring to himself as "technical advisor" to the series. He abetted the project from the beginning, directly with his wise counsel and store of information, and indirectly by his patience as the oral histories took more and more of his wife's time and attention. He completed the review of his own oral history transcript when he was in the hospital just before his death in 1992. As some of the original advisors have died, others have been added to help in selecting interviewees, suggesting research topics, and securing funds.

The project was presented to the San Francisco section of the American Institute of Mining, Metallurgical, and Petroleum Engineers (AIME) on "Old-timers Night," March 10, 1986, when Philip Read Bradley, Jr., was the speaker. This section and the Southern California section of AIME provided initial funding and organizational sponsorship.

The Northern and Southern California sections of the Woman's Auxiliary to the AIME (WAAIME), the California Mining Association, and the Mining and Metallurgical Society of America (MMSA) were early supporters. Later the National Mining Association became a sponsor. The project was significantly advanced by a generous bequest received in November 1997 upon the death of J. Ward Downey, UC Berkeley alumnus and early member of the mining series advisory committee. His own oral history was completed in 1992. Other individual and corporate donors are listed in the volumes. Sponsors to date include nineteen corporations, four foundations, and 113 individuals. The project is ongoing, and funds continue to be sought.

The first five interviewees were all born in 1904 or earlier. Horace Albright, mining lawyer and president of United States Potash Company, was ninety-six years old when interviewed. Although brief, this interview adds another dimension to a man known primarily as a conservationist.

James Boyd was director of the industry division of the military government of Germany after World War II, director of the U.S. Bureau of Mines, dean of the Colorado School of Mines, vice president of Kennecott Copper Corporation, president of Copper Range, and executive director of the National Commission on Materials Policy. He had reviewed the transcript of his lengthy oral history just before his

death in November, 1987. In 1990, he was inducted into the National Mining Hall of Fame, Leadville, Colorado.

Philip Bradley, Jr., mining engineer, was a member of the California Mining Board for thirty-two years, most of them as chairman. He also founded the parent organization of the California Mining Association, as well as the Western Governors Mining Advisory Council. His uncle, Frederick Worthen Bradley, who figures in the oral history, was in the first group inducted into the National Mining Hall of Fame in 1988.

Frank McQuiston, metallurgist for the Raw Materials Division of the Atomic Energy Commission and vice president of Newmont Mining Corporation, died before his oral history was complete; thirteen hours of taped interviews with him were supplemented by three hours with his friend and associate, Robert Shoemaker.

Gordon Oakeshott, geologist, was president of the National Association of Geology Teachers and chief of the California Division of Mines and Geology.

These oral histories establish the framework for the series; subsequent oral histories amplify the basic themes. After over thirty individual biographical oral histories were completed, a community oral history was undertaken, documenting the development of the McLaughlin gold mine in the Napa, Yolo, and Lake Counties of California (the historic Knoxville mercury mining district), and the resulting changes in the surrounding communities. This comprises twelve volumes, including eight Knoxville District McLaughlin Mine volumes with several interviews each. The remaining four volumes contain the interviews of William Humphrey, Hugh Ingle, Patrick Purtell, and James Wilder.

Future researchers will turn to these oral histories to learn how decisions were made which led to changes in mining engineering education, corporate structures, and technology, as well as public policy regarding minerals. In addition, the interviews stimulate the deposit, by interviewees and others, of a number of documents, photographs, memoirs, and other materials related to twentieth century mining in the West. This collection is being added to The Bancroft Library's extensive holdings. A list of completed and in process interviews for the mining series appears at the end of this volume.

Interviews were conducted by Malca Chall, Fredric L. Quivik and Eleanor Swent.

Eleanor Swent, Project Director
Western Mining in the Twentieth Century Series

January 2003
Regional Oral History Office
University of California, Berkeley

Western Mining in the Twentieth Century Oral History Series

Interviews Completed, May 2006

Horace Albright, *Mining Lawyer and Executive, U.S. Potash Company, U.S. Borax, 1933-1962*, 1989

Frank F. Aplan, *Mineral Education Generalist, Professor of Metallurgy and Mineral Processing, 1951-1998*, 2003

Samuel S. Arentz, Jr., *Mining Engineer, Consultant, and Entrepreneur in Nevada and Utah, 1934-1992*, 1993

James Boyd, *Minerals and Critical Materials Management: Military and Government Administrator and Mining Executive, 1941-1987*, 1988

Philip Read Bradley, Jr., *A Mining Engineer in Alaska, Canada, the Western United States, Latin America, and Southeast Asia*, 1988

Catherine C. Campbell, *Ian and Catherine Campbell, Geologists: Teaching, Government Service, Editing*, 1989

William Clark, *Reporting on California's Gold Mines for the State Division of Mines and Geology, 1951-1979*, 1993

John Robert Clarkson, *Building the Clarkson Company, Making Reagent Feeders and Valves for the Mineral Industry, 1935 to 1998*, 1999

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William E. Colby, *Reminiscences* (California mining lawyer), 1954

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Donald Dickey, *The Oriental Mine, 1938-1991*, 1996

J. Ward Downey, *Mining and Construction Engineer, Industrial Management Consultant, 1936 to the 1990s*, 1992

Warren Fenzi, *Junior Engineer to President, Director of Phelps Dodge, 1937 to 1984*, 1996

Hedley S. "Pete" Fowler, *Mining Engineer in the Americas, India, and Africa, 1933-1983*, 1992

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- Homestake Mine Workers, Lead, South Dakota, 1929-1993*, interviews with Clarence Kravig, Wayne Harford, and Kenneth Kinghorn, 1995
- Lewis L. Huelsdonk, *Manager of Gold and Chrome Mines, Spokesman for Gold Mining, 1935-1974*, 1988
- William Humphrey, *Mining Operations and Engineering Executive for Anaconda, Newmont, Homestake, 1950 to 1995*, 1996
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- James Jensen, *Chemical and Metallurgical Process Engineer: Making Deuterium, Extracting Salines and Base and Heavy Metals, 1938-1990s*, 1993
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- Evan Just, *Geologist: Engineering and Mining Journal, Marshall Plan, Cyprus Mines Corporation, and Stanford University, 1922-1980*, 1989
- Robert Kendall, *Mining Borax, Shaft-Freezing in Potash Mines, U.S. Borax, Inc., 1954-1988*, 1994
- The Knoxville Mining District, The McLaughlin Gold Mine, Northern California, Volume I*, 1998
- Anderson, James, "Homestake Vice President-Exploration"
- Baker, Will, "Citizen Activist, Yolo County"
- Birdsey, Norman, "Metallurgical Technician, McLaughlin Process Plant"
- Bledsoe, Brice, "Director, Solano Irrigation District"
- The Knoxville Mining District, The McLaughlin Gold Mine, Northern California, Volume II*, 1998
- Cerar, Anthony, "Mercury Miner, 1935-1995"
- Ceteras, John, "Organic Farmer, Yolo County"

Conger, Harry, "President, Chairman, and CEO, Homestake Mining Company, 1977 to 1994"
 Corley, John Jay, "Chairman, Napa County Planning Commission, 1981 to 1985"
 Cornelison, William, "Superintendent of Schools, Lake County" (Includes an interview with John
 A. Drummond, Lake County Schools Attorney)

The Knoxville Mining District, The McLaughlin Gold Mine, Northern California, Volume III, 1998

Crouch, David, "Homestake Corporate Manager-Environmental Affairs"
 Enderlin, Elmer, "Miner in Fifty-Eight Mines"
 Fuller, Claire, "Fuller's Superette Market, Lower Lake"
 Goldstein, Dennis, "Homestake Corporate Lawyer"
 Guinivere, Rex, "Homestake Vice President-Engineering"

The Knoxville Mining District, The McLaughlin Gold Mine, Northern California, Volume IV, 1998

Gustafson, Donald, "Homestake Exploration Geologist, 1975-1990"
 Hanchett, Bonny Jean, "Owner and Editor, Clearlake *Observer*, 1955-1986"
 Hickey, James, "Director of Conservation, Development, and Planning for Napa County, 1970 to
 1990"
 Jago, Irene, "The Jagos of Jago Bay, Clear Lake"
 Jonas, James, "Lake County Fuel Distributor"
 Koontz, Dolara, "Environmental Engineer, McLaughlin Mine, 1988-1995"

The Knoxville Mining District, The McLaughlin Gold Mine, Northern California, Volume V, 1998

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 Magoon, Beverly, "Merchant and Craft Instructor, Lower Lake"
 McGinnis, Edward, "Worker at the Reed Mine"

The Knoxville Mining District, The McLaughlin Gold Mine, Northern California, Volume VI, 1999

Robert McKenzie, "McKenzies in Monticello, Berryessa Valley"
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 Ronald Parker, "Resident Manager of the McLaughlin Mine, 1988-1994"
 Richard Stoehr, "Homestake Engineer and Geologist to Senior Vice-President and Director"
 Joseph Strapko, "Exploration Geologist, McLaughlin Mine Discovery, 1978"

The Knoxville Mining District, The McLaughlin Gold Mine, Northern California, Volume VII, 2000

Jack Thompson, "General Manager, McLaughlin Mine, 1981-1988"
 Twyla Thompson, "County Supervisor, Yolo County, 1975-1985"
 Avery Tindell, "Capay Valley Environmentalist"
 John Turney, "McLaughlin Metallurgist: Pioneering Autoclaving for Gold"
 Della Underwood, "Knoxville Rancher, McLaughlin Mine Surveyor"
 Walter Wilcox, "County Supervisor, Lake County, 1979-1995"
 Peter Scribner, "Boyhood at the Knoxville Mine, 1941-1944"

The Knoxville Mining District, The McLaughlin Gold Mine, Northern California, Volume VIII, 2002

Dean Enderlin, "Mine Geologist, Reclamation Manager, McLaughlin Mine"

Susan Harrison, "McLaughlin Natural Reserve"

Raymond Krauss, "Environmental Manager, McLaughlin Mine"

Marian Lane, *Mine Doctor's Wife in Mexico During the 1920s*, 1996

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J. David Lowell, *Using Applied Geology to Discover Large Copper and Gold Mines in Arizona, Chile, and Peru*, 1999

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John Reed, *Pioneer in Applied Rock Mechanics, Braden Mine, Chile, 1944-1950; St. Joseph Lead Company, 1955-1960; Colorado School of Mines, 1960-1972*, 1993

Joseph Rosenblatt, *EIMCO, Pioneer in Underground Mining Machinery and Process Equipment, 1926-1963*, 1992

Paul Schipke, *Mining and Environmental Engineer for Utah-BHP Company, 1972-1997*, 2004

Robert Shoemaker, *Metallurgical Engineer: Union Carbide, Bechtel, San Francisco Mining Associates; Metallurgical Consultant, 1953 to 2000*, 2001

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 Dr. and Mrs. Theodore Craig
 Mr. David Crouch
 Nancy S. and James T. Curry, Sr.
 Stanley Dempsey
 Edward C. Dowling

Elisabeth L. Egenhoff
 Christine Finney
 H. S. Pete Fowler
 Maurice and Joyce Fuerstenau
 Louis R. Goldsmith
 Donald L. Gustafson
 Jayne K. Haldane
 Kenneth N. Han
 Elsie Harris
 Guy H. Harris
 Bonnie, Russell, and Steve Harford
 A.C. and Elizabeth Helmholtz
 James H. Hickey
 Mason L. and Marie J. Hill
 Gael Hodgkins
 Sylvia Hochscheid, in memory of
 Robert E. Hochscheid
 Mrs. Bruce S. Howard, in memory of

Henry Harland Bradley	K. Osseo-Asare
Lewis L. Huelsdonk	George F. Reed
Ruth B. Hume	John J. Reed
Howard Janin	Richard W. Rees
Jack M. Jones	Jane A. Rummel
Alfred Juhl	Robert S. Shoemaker
Evan Just	Joseph H. Siino
Sheila Kelley	Simon D. Strauss
James C. Kimble	John R. Struthers
Kenneth Kinghorn	Virginia Bradley Sutherland, in
Noel W. Kirshenbaum	memory of Helen R. Henshaw
Mr. and Mrs. John T. Knox	Jack Thompson
Nancy H. Landwehr	James V. Thompson
Carl F. Love	Twyla J. Thompson
Plato Malozemoff	John J. Trelawney
Sylvia C. McLaughlin	William I. Watson
Sylvia C. McLaughlin, in memory of	Barbara A. Whitton in memory of William B.
Jay Kimpston Swent	Whitton
Frances B. Messinger	William B. Whitton
D. R. Nagaraj	Sheldon Wimpfen
L. Arthur Norman, Jr.	Roy Woodall
Patrick O'Neill	Judy D. Woodward

In Memory of Catherine C. Campbell

Mr. and Mrs. E. W. Averill,	Fenelon F. Davis
Jr. Richard Friedlander	Richard M. Stewart

In Memory of Langan W. Swent

Marjorie D. Bjorlo	Eleanor H. Swent
Christine W. S. Byrd	Jeannette F. Swent
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Sylvia C. McLaughlin	Regional Oral History Office Staff

In Memory of William B. Clark

Fenelon Davis	John Matschek
Lowell Dygert	Hilda Schramm
Mary G. Freedman	George Shutes
Marilyn Glover	Barbara Vollmer
Virginia Goldsmith	Mary Witt
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In Memory of J. Ward Downey

Willa Baum
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James Jensen
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Gail and Heath Angelo, Jr.
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The Claremont Book Club
Judge and Mrs. John S. Cooper
Professor Emeritus Gregory Grossman
Marily and Thomas Johnson
Remington and Jean Low
Sylvia C. McLaughlin
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Mr. and Mrs. Thomas B. Shaw
Judge and Mrs. John Sparrow
Eleanor H. Swent
T. M. Tobin
Dr. and Mrs. Edward E. Waller, Jr.

RW98-317

ROY WOODALL**PUBLIC LECTURES:**

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- 1980 “Mineral Search and Development for a Sustainable Society”. 50th Jubilee ANZAAS Conference, Adelaide, South Australia, 13 May 1980.
- 1980 “Mineral Exploration in Modern Society”. The Securities Institute of Australia, South Australian Division. 31 October 1980.
- 1981 “The Science and Art of Mineral Exploration - CSIRO's Role in Assisting Mineral Exploration in the Future”. CSIRO Executive Seminar - Sydney, New South Wales. 12 August 1981.
- 1981 “Geophysics in Mineral Exploration - An Australian Company's Experience”. Mining Geophysics Luncheon, Society of Exploration Geophysicists Annual Convention - Los Angeles, 13 October 1981.
- 1982 “Geology and Prosperity: The Impact of the Minerals Industry on Australia's Industrial Growth”. Presidential Address to the Mining and Geology Section of the 52nd of 1982 ANZAAS Conference - Sydney, New South Wales. 11 May 1982
- 1982 “The Discovery of Australia's Mineral Wealth”. Address to Student ANZAAS. Western Australian Institute of Technology, 28 June 1982.
- 1982 “A Philosophy of Mineral Exploration”. Distinguished Lecture to the CSIRO Institute of Energy and Earth Resources - North Ryde, New South Wales, 19 August 1982.
- 1982 “A Matter of Confidence - Lessons from 50 years of scientific mineral exploration”. Fourth JJ Frankel Memorial Lecture - University of New South Wales, 9 September 1982.
- 1983 “Success In Mineral Exploration”. Joubin James Lectures - University of Toronto.
- 1983 Address in reply to the Acceptance of the William Smith Medal Award. Geological Society of London, 8 June 1983.
- 1983 “The Critical Role of Science in Mineral Exploration”. Address to the Science and Industry Forum: “The Scientific Requirements of the Australian Minerals Industry”. Sponsored by the Australian Academy of Science, 1 October 1983.
- 1983 “Success In Mineral Exploration: A Matter of Confidence”. Based on the Joubin-James Lecture: University of Toronto, February 25, 1983. Presented to Western Australian School of Mines - Annual Conference, October 16 1983.

- 1983 “Science and Mineral Exploration Strategy”. Royal Society of Edinburgh. 5 December 1983.
- 1984 “Limited Vision: A Personal Experience of Mines and Scientific Mineral Exploration”. Fourth Mawson Lecture: Seventh Australian Geological Convention. 27 August 1984.
- 1984 “Ingredients of Successful Exploration”. AMIRA Annual Conference. 6 September 1984.
- 1985 “Success in Mineral Exploration: A Matter of Confidence”. Based on the Joubin-James Lecture, University of Toronto, 25 February, 1983. Presented to the Geological Society of Australia, Perth, 4 December 1984.
- 1985 “Times of Change and Challenge: The Period 1950-1985”. Address at University of Western Australia, 15 April 1985.
- 1985 “Lovers of Wisdom”. Occasional Address to the Graduates in Medicine and Science, University of Western Australia, 16 April 1985.
- 1985 “The Challenge of Mining Geology”. Address on the occasion of the Presentation of the Institute Medal for 1984, 25 September 1985.
- 1986 “Gold Exploration: Impact of Changing Geoscience Concepts and Technologies”. Presented to the Centre for Resource Studies Policy Workshop - Queen's University, Kingston, Ontario, 7 October 1986.
- 1986 Address on Accepting the Society of Economic Geologist's Silver Medal for 1986, San Antonio, Texas, 12 November 1986.
- 1987 “Australian Gold Industry In A World Context”. Presented at the 1987 Petroleum and Minerals Review Conference, Sponsored by the Department of Resources and Energy - Canberra, 18-19 March 1987.
- 1987 “The Role of Mineral Exploration Towards 2000 AD”. Keynote Address at ‘Exploration’ 87 Conference - Toronto, Canada, 28 September 1987.
- 1988 “Gold In 1988”. Keynote Address at the Bicentennial Gold ‘88 Conference - Melbourne, Australia, 16-20 May 1988.
- 1988 “Gold in Australia”. Address at Australian Bicentenary Meeting - London, 10 October 1988.
- 1990 “Mineral Exploration and Mineral Development for a Sustainable Future”. Gal-trell Lecture: Address to Year 11 and 12 High School Students, Australian Mineral Foundation, 26 June 1990.
- 1990 “Successful Minerals Exploration Management Strategies for the 1990s”. Lecture given at the Bundesanstalt für Geowissenschaften und Rohstoffe (BGR), Hannover, Germany, 10 October 1990.
- 1991 “WMC1s Australian Mineral Exploration: Yesterday, Today and Tomorrow”. Keynote Address, W.A. Geoscientific Technical Conference, Kalgoorlie, 17 October 1991.

- 1991 “The Challenge of Mineral Exploration in the 1990s”. Lecture given during AusIMMIAIME Distinguished Lecture Tour in U.S.A. (Denver, Salt Lake City, El Paso and Albuquerque), September and November 1991.
- 1992 “Empiricism and Concept in Successful Mineral Exploration”. Keynote Address given at 11th Australian Geological Convention in Ballarat, Victoria, 20 January 1992.
- 1992 “Empirical and Conceptual Exploration Strategies and the Discovery of the Olympic Dam Copper/Uranium/Gold Deposit, South Australia. Keynote Address at The Institution of Mining and Metallurgy Conference titled “Geology in Europe and Beyond”, Nottingham, United Kingdom, 22 April 1992.
- 1993 “Mineral Exploration in a Borderless World”. Keynote Address at the Conference on Mining Investment in Namibia, Windhoek, Namibia, March 1993.
- 1993 “The Third Dimension: A Geoscience Challenge for the 21st Century”. Keynote Address at the Australasian Institute of Mining and Metallurgy Centenary Conference, 2 April 1993.
- 1993 “The Multidisciplinary Team Approach to Successful Mineral Exploration”. Keynote Address at Society of Economic Geologists International Conference “Integrated Methods in Exploration and Discovery”, 17-20 April 1993.
- 1993 “Our WMC Heritage”. Address to WMC's Executive Development Programme, Perth, Western Australia, April 1993 and July 1993.
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- 1994 “Observations of a Mine Geologist”. After-dinner address at the Third Geology Symposium - Kalgoorlie, Hannan's Club, Western Australia. 26 May 1994.
- 1994 “Exploration: The Life-Blood of a Mining Company”. Address at Diggers and Dealers Forum 1994, Kalgoorlie, Western Australia, 12 July 1994.
- 1994 “Making it Western Mining”. Australasian Science, The University of Southern Queensland. August, 1994.
- 1994 “Earth Sciences And The Future Of The Mineral Industry”. A contribution to the SEGUSA Charles Meyer Symposium “Maintaining comparability of Mining and the Environment” - Seattle, Washington, 25 October 1994.

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- 1995 “Outside the Square”. Ian Clunies Ross Memorial Foundation.
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- 1995 “Olympic Dam 20th Anniversary Address”. Olympic Dam, 30 July 1995.
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- 1996 “Mining and the Community: A Growing Relationship”. Address to launch the Chamber of Mines and Energy of Western Australia Booklet, Kambalda, Western Australia, 3 April 1997.
- 1996 “Can Major Companies be Successful Explorers?” University of Tasmania, 21 August 1996 Vancouver, 23 October 1996. Stanford University, 6 November 1996.
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- 1998 “Creating Wealth: The Essence of a Successful Mining Professional's Life”. The 22nd Sir George Fisher Lecture. The Australasian Institute of Mining and Metallurgy, North Queensland Branch, Townsville, Friday 3 July 1998.
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INTERVIEW HISTORY—Roy Woodall

Roy Woodall was recommended in 1986 for the series on Western Mining because of his prominence as an exploration geologist who located in Australia three world-class mines in new types of ore bodies: the Kambalda nickel deposit, the Yeelirrie uranium deposit, and the fabulous Olympic Dam copper-uranium-gold ore body. The first advisory committee named to the oral history series included Professor Charles Meyer, who had guided Woodall's graduate work at the University of California-Berkeley in 1953, and who named him on the first list of potential interviewees. After Meyer's untimely death, his widow continued to put forward the name of Roy Woodall; he was also recommended by other advisors and friends of the project.

Correspondence was conducted between Berkeley and Adelaide, both by mail and e-mail, for a number of years before consent, funding, and a suitable occasion came together for conducting interviews, in January 2004. Western Mining Corporation provided initial funding for the oral history. Seven interviews were conducted, January 21-28, 2004, all but one in the Hearst Mining Building at Berkeley. Construction noises from the outside were constantly in the background. The fourth interview was videotaped at the Regional Oral History Office in The Bancroft Library, under better sound conditions.

Roy Woodall came to the interviews armed with the results of several months of preparation. Earlier, he had supplied me with twenty-nine pages of documentation, in three columns: year, significant events, and people's names; as well as six pages listing lectures and publications. He carried three-ring binders with tabbed copies of correspondence, charts, maps, and reports, to which he referred throughout the interviews. On the desk he spread out a large chart with columns and rows marked with colored dot stickers of various sizes; these represented different minerals and deposits, ranged according to date and degree of success. At top and bottom of the chart were post-its with further information.

This may sound confusing or restricting, but in fact, it made the interview flow easily and coherently as he moved from one topic to another. I seldom needed to interrupt him, but when I did, he seemed to welcome my questions and diversions.

His Australian "accent" must be mentioned. Except when he was most excited, I think he consciously pronounced words as I would. He sometimes translated Australian terms into American English: station into ranch, for example. As a lecturer experienced in many countries, he spoke clearly and fluently.

He made much of the fact that he was not basing his recollections on "selective memory," but on "facts," as substantiated by documents.

Consequently, this oral history is rich in concrete details about the very important mineral discoveries which were made under his direction, and which have contributed so much to the creation of new wealth in Australia, as well as in other locales. He seemed to direct many of his comments to a young person in the future who might be considering a career in economic geology. He emphasized aspects of character as well as scientific and technical competency, as he charted the growth of Western Mining Corporation from 1955 to 1995, during which time it became an acknowledged example of corporate excellence.

The interviews were facilitated by Professors George Brimhall and Douglas Fuerstenau of the University of California-Berkeley faculty.

The Regional Oral History Office was established in 1954 to augment through tape-recorded interviews the Library's materials on the history of California and the West. Copies of all interviews are available for

research use in The Bancroft Library and in the UCLA Department of Special Collections. The office is under the direction of Richard Cándida Smith, and the administrative direction of Charles B. Faulhaber, the James D. Hart Director of The Bancroft Library, at the University of California, Berkeley.

Eleanor Swent
Interviewer/Editor

July 2006
Regional Oral History Office
The Bancroft Library
University of California, Berkeley

Interview with Roy Woodall:
 Interview 1: January, 21, 2004
 [Begin disc 1]

01:00:00:02

Swent: We're beginning an interview with Roy Woodall, and this is January 21, 2004. We are in the Hearst Mining Building on the campus at the University of California. So, Roy we will just begin at the beginning, have you tell us where you were born.

01:00:00:31

Woodall: I was born in the city of Perth, in the state of Western Australia in 1930, and was one of four children. The 1930s were Depression years, and so I grew up in a family that during those years knew poverty. The emphasis of our parents was to do the best for the children, and my older brother became a schoolteacher as a result of a government subsidy for university education in mathematics. When I had completed three years of high school, it was regrettably necessary for me to leave school and find work. I had just had my 16th birthday.

I obtained employment with the West Australian government Public Works Department as a junior clerk in the country water supply division. This was very fortunate because it was there that I became accustomed to the work of engineers. They were responsible for the building of the big reservoirs in Western Australia for water supply and for the maintenance of water supply in the many small country towns, especially in the agricultural districts.

I had to make a decision quite early as to whether I should study for the public service examination, which was essential if you wanted permanent employment with the government, or complete my high school education and gain what was called the "Leaving Certificate," which required a public examination after five years of high school. I decided to try to complete the Leaving Certificate by going to night-school. If successful, it would then give me the additional opportunity to go to university—you would call it "College"—should I decide to leave my job with the State government. So, while I worked with the Public Works Department during the day, I went to the Perth Technical College during the evenings, after work. And over two years, I completed studies in mathematics, physics, English, geography and geology, sufficient to gain admission to university. And it was the engineers who encouraged me to take that course, rather than just remain in the clerical stream of the Public Works Department.

01:00:04:07

Swent: Had your father done anything in engineering?

01:00:04:17

Woodall: No, my father had worked with the Great Western Railway company in England prior to migrating to Australia, but not in engineering so much as in the business of parcel dispatch and signal control. He expected that when he came to Australia his qualifications would be accepted. But Australia was very heavily unionized, and they would not accept his qualifications, so he ended up with low-paid work in the Shell Oil Company's store at Fremantle, the main port for Western Australia. In fact, he was out of work for several years in the Depression, and the family was supported by

“Government Sustainance,” government issued food stamps to support families in poverty.

01:00:05:06

Swent: Were both your parents born in England?

01:00:05:07

Woodall: Yes, they were both born in England.

01:00:05:17

Woodall: The years of night school, where I completed my last two years of high school education, were very important. The teachers had to cover two years of academic work in one year while only having us for a few hours two to four nights a week. They were very carefully selected teachers, brilliant teachers. And whereas an ordinary child would spend two years full-time studying mathematics before sitting the “Leaving Certificate” examination, we were taught for only one year, perhaps three nights a week. One of the most influential men who taught me during those night school years was a Dr. Tiller, a graduate in geography from Cambridge University, England. And geography being very closely linked to geology in the sense of landscape forms, earthquakes, river systems, and the maritime environment, caused me to develop an interest in geology. So I studied geology at night school as well, in part because I enjoyed having Dr. Tiller as my teacher.

Having gained the “Leaving Certificate”, the public accreditation necessary to be accepted into the University of Western Australia, I resigned from the Public Works Department. Fortunately, at that time the University of Western Australia was a free university, the only one in the whole of Australia. It had been heavily endowed by Sir Winthrop Hackett, the wealthy owner of Perth’s daily newspaper, and so there were no fees. And the Commonwealth Government provided what were called “Commonwealth Scholarships” for selected students, which gave me a small living allowance. This allowed me to start a university education.

01:00:07:49

Swent: This was also in Perth.

01:00:07:53

Woodall: This was in Perth at the University of Western Australia. It is a beautiful campus, not unlike Stanford campus in architecture. In those days, the head of each department, the top professor, always taught first-year subjects. And that was important for me because although I had not studied chemistry at school, at all, I was able to enroll in first year chemistry because Professor Bayliss, a brilliant teacher, started from the beginning and assumed no previous knowledge of the subject. Another important professor was the professor of geology, Professor Prider, and those two gentlemen got me so excited about chemistry and geology that at the end of first year I couldn’t decide whether I wanted to be a geologist or a chemist. So, I decided to carry the full load of second year chemistry, both inorganic and organic, as well as a full load of geology in the second year of my studies. It meant that I was able to delay the decision whether to be a chemist or geologist, whether to study chemistry or geology in my final year.

01:00:09:28

Swent: I assume this was very unusual for a student to carry a load like that.

01:00:09:35

Woodall: Yes, and I had to continue with second-year mathematics to be able to study second-year chemistry; but that set me up in a very good position for my third year, the last year of the Bachelor of Science degree. And as you know, I chose geology over chemistry. It was a difficult choice, but what probably persuaded me to choose geology were two things. The first was the opportunity not to be laboratory bound. You could do laboratory work in geology, but you needed also to get out into the field and observe the rocks in their natural setting. And the second reason was my fascination with the mining industry, which was so linked in importance to the whole history of the economic development of Australia, much as it was to the development of the United States. Why was it important? Because it generated so much true wealth: wealth that the nation didn't know existed until the ore deposits were discovered. Wealth that saved many of the state governments of Australia from going bankrupt in the early colonial days. Wealth that saved the country in the Depression years when gold mining became a very important form of employment and support for families. Wealth that had made a tremendous impact on the whole economy of Australia, and still does.

01:00:11:39

Swent: And how was this felt in Perth? The mining was quite a ways away.

01:00:11:54

Woodall: Perth is away from the mining towns, but there was such a history of mining being important to the national economy and the prosperity of Western Australia, I didn't have to remind people of its importance. West Australian mining was entirely gold mining at that stage, and in fact, nobody believed there was any other mineral commodity in the state worth mining, except for a little coal. The country had been prospected for at least seventy years, and all of worth that had been found in a million square miles was gold. So, that's the background of my career. It is important to remember that I joined the mining industry in a huge state of a million square miles, where everybody believed that it was well endowed with gold, but nothing else. If you wanted to find lead or zinc or silver or copper, you were advised to go into the eastern states of the country which had a wonderful history of wealth creation from mining these commodities, dating from the early 1840s. In fact, some parts of eastern Australia produced sixty percent of the world's copper in the 1850s and 1860s, and Broken Hill, also in eastern Australia, was one of the world's richest silver-lead-zinc mines.

01:00:14:12

Swent: What was Bendigo?

01:00:14:11

Woodall: Bendigo is a famous gold mining district, dormant when I graduated, but still one of the world's great gold deposits.

01:00:14:23

Swent: Kalgoorlie was booming. When was Herbert Hoover in Kalgoorlie?

01:00:14:34

Woodall: Hoover came to Kalgoorlie at the beginning of the twentieth century, in the early 1900s. He was a mining engineer with a British consulting company called Bewick Moring, and they sent him out to examine a newly discovered gold deposit north of Kalgoorlie called the Sons of Gwalia. He recommended investment in the prospect and it became

quite a famous mine, and he was asked to be the first mine manager. There are quite a few legends of Herbert Hoover's time in Western Australia where he was a very prominent citizen on the goldfields. People like to remember that link between Kalgoorlie, the Sons of Gwalia mine, and a subsequent President of the United States. The house the company built for Hoover at the Sons of Gwalia Mine still exists, and now provides historic bed-and-breakfast accommodation.

01:00:15:53

Swent: And California of course. Although he went to that other university.

01:00:15:58

Woodall: Oh, he went to Stanford? Of course!

01:00:16:06

Swent: That is quite a story.

01:00:16:09

Woodall: So, there was a lot of local legend and knowledge about wealth creation and the importance of mining. You might ask why was mining so important in Australia from its foundations in the 1800s right through to when I graduated in '53? It was because vast areas of Australia are either semi-arid or arid. It's not like the United States where there is so much land that is wonderfully productive for agriculture. There are some very productive areas, but relative to the size of the country, which is as big as the lower 48 states of the U.S., vast areas could never be developed for wealth creation from agriculture. It had to rely on something else, and that something else was mining. So that helps explain why to be associated with mining in the 1950s was to be associated with a very important part of the national economy and industry.

01:00:17:30

Swent: You graduated with honors.

01:00:17:32

Woodall: After a three-year Bachelor of Science degree, if you maintained good grades, you had the opportunity to do one year of research, equivalent to a master's program in the U.S. And if you did that well, you were granted your Bachelor of Science degree with Honors. It's a system inherited from our English university heritage.

01:00:18:11

Swent: And your high school term was five years whereas ours is generally four, and then your bachelor's was only three.

01:00:18:17

Woodall: You are more advanced in mathematics and chemistry and things like that when you enter an Australian university than students are when they enter an American university. So you start your university education at a more advanced level, having reached a reasonably competent level in science. Towards the end of my honors year I was approached by a small Australian gold mining company, Western Mining Corporation (WMC), which was mining gold in Western Australia, to see if I would join their geological staff. I had worked for them as a student on two occasions during my university course—during summer vacations. On the first occasion, I worked on their mines in a gold mining center called Norseman, and the second time, I worked on mines

at Coolgardie. And what impressed me about the company was their emphasis on top-class science, especially in the application of geology to mineral exploration. The company was established in 1933 with a philosophy and strategy to use the newly emerging sciences of geology and related geochemistry and geophysics to find new gold deposits. It was a company based on the idea that if you applied good science to exploration, you would be successful. My starting salary was £19.17.6 (nineteen pounds, seventeen shillings and six pence) per week.

01:00:20:36

Swent: You say newly emerging science. What was emerging at that time that hadn't been there before?

01:00:20:44

Woodall: The newly emerging science of structural and mining geology was pioneered in the 1930s at Harvard University by Professor McLaughlin. So when Western Mining was established they enlisted the assistance of Professor McLaughlin to advise on strategy and how best to establish a geology department. He selected the geologists that came to Western Mining Corporation in Kalgoorlie and set the standards. People who came with McLaughlin were Hugh McKinstry, John K. Gustafson, F.S. Miller, H.S.C. Connolly and Haddon King, geologists who all became famous in their lifetimes. Donald H. McLaughlin was the most famous, having successfully rejuvenated the Homestake mine in South Dakota through careful geological mapping and innovative interpretations. Dr. McLaughlin was also responsible for sending Hugh McKinstry to the Hollinger mine in Canada to rejuvenate that mine, also through careful geological mapping and innovative interpretation.

01:00:21:47

Swent: And John Gustafson?

01:00:21:49

Woodall: Yes, especially John Gustafson. He did some famous mapping around Kalgoorlie. He set the mapping standards but Professors McLaughlin and McKinstry had quite a lot to say about early strategy. H.J.C. Connolly, who had done a lot of excellent mapping at the Hollinger mine in Canada, brought with him an assistant, Haddon King, and Haddon went on to become one of Australia's most decorated, influential and successful mining geologists.

01:00:23:31

Swent: That was King?

01:00:23:29

Woodall: Yes, Haddon King. And so, I could see when I was working as a student, I was working with a company that was founded on science. The chairman and managing director of the company were also interested in geology and the board of directors expected you to use the best possible geology to find more gold mines. So what an exciting sort of company to join!

01:00:24:03

Swent: What was new in the geology these people did?

01:00:24:07

Woodall: The careful mapping of the sequences of rocks. Early mining geology involved just mapping the lode and following the lode, and where it's faulted or broken, trying to find its extension. But not much interest was shown in the rocks around the lode. The McKinstry-McLaughlin team, in places like Lead in South Dakota and Hollinger in Canada, showed that if you mapped the sequences of rocks that contained the ore, you would find many of the clues as to why the orebody was there and where you might look for extensions. And they brought that strategy to Kalgoorlie. They remapped the Kalgoorlie field; and other areas that the company was interested in, and unlocked the structure of both lodes and host rocks.

01:00:25:17

Swent: Were there any mechanical devices that made this possible where it hadn't been possible before?

01:00:25:23

Woodall: No, only proper use of observational skills, recognizing the different rock units and their sequence.

01:00:25:30

Swent: Using a hand lens?

01:00:25:30

Woodall: Yes, a hand lens and very careful mapping in great detail, especially observing the sequence of formations: which was top, which was bottom. They also recommended trialing aerial photography which had its birth in the First World War. So in the 1930s Western Mining brought out a plane from England, and pilots, and they flew many areas of West Australia's gold mining districts with aerial photography. It was probably the world's first regional aerial photography survey to aid mineral exploration. The hope was that from the air photographs, they would be able to extend their understanding of the rock successions and the structures that they were observing in detail in and around the mines, and suggest areas where there might be other gold deposits that were concealed by soil and younger rocks. As an investment, it failed. The reason it failed was that the Australian landscape is incredibly old. It's been almost flat for at least sixty million years, so the rocks you are interested in, the older rocks, are mainly covered up by younger sediments, soils and sands. Despite the fact they took many valuable aerial photographs, they couldn't really see the rocks below the soil horizons. If you photograph mountain country, of course you can see the rocks because they are all exposed. The lack of exposure was the reason for the failure of the aerial survey, but it was very pioneering. They also pioneered the emerging science of geophysics.

01:00:27:57

Swent: I was just going to say, is this before geophysics?

01:00:28:01

Woodall: No. The importance of geophysics had already been recognized in the famous gold districts of South Africa. There, rocks hosting the gold deposits had different magnetic characteristics, and if you surveyed the magnetics of the area in detail, you would be able to trace the mineralized rocks beneath barren cover. So although certain rocks didn't outcrop, you knew where they were because of their magnetic response. This was very important in South Africa. Huge wealth was created by geophysicists extending

the known geology of the famous Rand Goldfields into concealed terrain. WMC trialed the use of gravity and magnetic surveys at Kalgoorlie. Gravity surveys involved measuring differences in the earth's gravity field because where there are heavy, dense rocks, the gravity measurements are slightly higher than where there are less dense rocks. Gravity surveys gave the first evidence that the rocks of Kalgoorlie's famous gold deposits extended south of the mines beneath lake sediments and unmineralized strata.

In 1949 WMC also brought out Dr. V.P. Sokoloff. I am not too sure where he came from. He was a Russian geochemist and he tried to measure minute amounts of gold in the soils to try to find gold deposits that didn't show at the surface where there was extensive soil cover. He failed because he didn't have a reliable analytical technique. He was, however, "on the right track" as we did develop the right analytical techniques forty years later. We can now do what Dr. Sokoloff tried to do in the late 1940s before he had the technical means.

They're the sort of adventurous ideas that gave birth to Western Mining Corporation. Let's map the rocks like they mapped the rocks at Lead in South Dakota with such success. Let's map the rocks like they were mapping them in the Canadian gold districts with such success in terms of finding extensions of gold deposits. Let's trial aerial photography. Let's trial geophysics and geochemistry. The geochemistry and the geophysics and the aerial photography were being applied to areas where their application was really difficult, but that was the philosophy of the company. Let's be at the cutting edge of the application of science and new technology.

01:00:31:13

Swent: What jobs did you have with them in the summer vacations?

01:00:31:17

Woodall: Both jobs were on the mines going underground and mapping the host rocks, lodes, and faults.

01:00:31:28

Swent: So you were doing mining geology.

01:00:31:29

Woodall: Yes, mining geology, and in fact, the company's philosophy was that even if you wanted to be a mining engineer, you also had to first work as a geologist on a mine. That's how strong was the emphasis on geology in the company. You just couldn't come and be expect to be promoted as a mining engineer unless you had spent two years in the geology department.

01:00:31:59

Swent: That's different from some other companies. Not every company does that.

01:00:32:47

Woodall: That had the wonderful advantage that mining engineers who subsequently became mine managers understood the work of the geologists and respected it. Of course, the geologists had to earn their keep too by finding extensions of the gold deposits, which they usually succeeded in doing. In fact, during my first university vacation, doing summer vacation work at Norseman, I was able to see the beginnings of a major new,

North Royal gold discovery, discovered by people applying geology to the search for ore. Men like Haddon King had pioneered such work at Norseman.

01:00:32:50

Swent: How deep were these mines?

01:00:33:01

Woodall: Not deep by world standards, but what should we say? Mainly 1,000, 1,500 feet. Not deep!

01:00:33:02

Swent: But they were all underground mines; this is before the huge open pit mining.

01:00:33:13

Woodall: Oh yes, and my first job when I joined Western Mining was to map the shallow shafts and workings of the early prospectors on the famous Coolgardie Goldfields. Two men would lower me down on a rope, down, say, twenty, or thirty or forty feet, far enough to access the old diggings of the early miners, and to map the rocks. The emphasis was “You map the rocks, Roy, and do it carefully!” After that, I was moved to Kalgoorlie, where I also worked underground. Now, Kalgoorlie is a very, very famous gold deposit, but very, very complicated. There is not just one lode; there are hundreds of lodes. There is not just one fault breaking up the lode system, there are probably ten or twenty faults. So solving the lode-fault problems was very complex, and could only be achieved as a result of very careful underground mapping. And that mapping which I had to do in 1954 and early 1955 was done using a carbide light. The mine was still not equipped with electric battery-operated head lamps. And I can assure you, trying to map a winze with a carbide light, where water is dripping down threatening to extinguish the flame, where you are hanging onto a ladder with a notepad trying to record the lode structures, required a fair amount of tenacity and innovation.

01:00:35:14

Swent: Right, I am interested—what were you using? You said a notepad? Colored pencils? Or what were the mechanics at that time?

01:00:35:20

Woodall: Oh, just pencil and paper.

01:00:35:21

Swent: Colored pencils?

01:00:35:22

Woodall: Perhaps! You subsequently brought your notepad into the office and added the colors in ink. There was so much water dripping down on you. If you used any ink underground, it would be a mess.

01:00:35:40

Swent: Okay, so you were using pencil and a notepad underground and then at the end of the day you—

01:00:35:44

Woodall: You came up, you put the color onto the maps, and interpreted the evidence to assist the next phase of exploration and development.

- 01:00:35:46
Swent: What were the maps made of?
- 01:00:35:49
Woodall: They were on linen.
- 01:00:35:47
Swent: Linen.
- 01:00:35:52
Woodall: And to make a copy, you had to take it outside, and expose it to the sun with the light sensitive paper beneath. Then you brought the light sensitive paper in, washed it with a developing solution and that made a copy.
- 01:00:36:09
Swent: It's a lot easier now.
- 01:00:36:14
Woodall: Nowadays, everything is entered into a computer, and you just press a button and you get a brilliant copy.
- 01:00:36:18
Swent: What were you wearing? What were your clothes that you were wearing when you worked?
- 01:00:36:26
Woodall: Just overalls.
- 01:00:36:28
Swent: Denim and I guess boots.
- 01:00:36:33
Woodall: We called them khaki overalls.
- 01:00:36:36
Swent: Bib overall kind of thing?
- 01:00:36:37
Woodall: Hmm?
- 01:00:36:36
Swent: With a bib like a farmer's overall or—?
- 01:00:36:42
Woodall: Something like that, yes.
- 01:00:36:44
Swent: Hat, what kind of hat?
- 01:00:36:44
Woodall: Hard hats.

- 01:00:36:45
Swent: You did have hard hats.
- 01:00:36:47
Woodall: Oh yes, we had hard hats.
- 01:00:36:48
Swent: With the carbide lamp fastened—?
- 01:00:36:53
Woodall: The carbide light was held in your hand, otherwise you couldn't see the rocks. Well, eventually we had electric cap lamps.
- 01:00:37:03
Swent: What kinds of boots or shoes?
- 01:00:37:03
Woodall: Oh, proper boots. Safety boots. Yes.
- 01:00:37:07
Swent: You did have them.
- 01:00:37:09
Woodall: But, when you look at some of the old photographs of some of the early miners, they had felt hats and candles.
- 01:00:37:18
Swent: Was there much attention paid to safety?
- 01:00:37:25
Woodall: Yes, but nothing like what it is now. Fortunately, I was not allowed to go underground at Kalgoorlie without a shift boss. Quite early in my underground days in Kalgoorlie, I was underground with a shift boss by the name of Tommy Brooker. And we were walking along a drive, or drift, as you would call it, and Tommy said, "Roy, let's get out of here." I didn't know why, but it transpired that he could smell fuses burning and realized a miner was widening the drift further along and had charged up some stripping cuts. But the miner hadn't posted a sentry to stop others from coming in. I don't know what might have happened if I hadn't been there with the shift boss because I wouldn't have known the danger. An interesting follow up to that occurred in my first summer vacation while at Berkeley. I worked on the Sullivan mine at British Columbia, but I was not allowed to go underground until I knew what every person underground did and every possible source of danger or activity. Two weeks of solid study before I was allowed underground! So I learned there what a real good safe mine consisted of. Now days, there is a great emphasis on safety and training, and so there should be. The mines in Australia now have excellent safety records. Some will go sometimes several years without a lost time accident.
- 01:00:39:52
Swent: That is amazing. Now it has become a very safe industry.

- 01:00:39:56
Woodall: Yes, but it required upper management to take safety seriously and insist on people being properly trained and work practices to be of the highest standards so that safety became more important than production.
- 01:00:40:21
Swent: How much were you paid for these summer jobs?
- 01:00:40:29
Woodall: I can't remember what I was paid for my summer jobs, but my starting salary with Western Mining when I graduated I think was about £20 a week or about \$2,000 per annum.
- 01:00:40:52
Swent: A year.
- 01:00:40:55
Woodall: Year.
- 01:00:40:53
Swent: This was in '53.
- 01:00:40:59
Woodall: '53.
- 01:00:41:04
Swent: Two thousand dollars a year. That was wasn't too bad in '53. Anyway, you were happy to get it I am sure.
- 01:00:41:17
Woodall: Absolutely.
- 01:00:41:22
Swent: When you were working in the summer at these jobs or when you took your first job, did they provide any kind of housing? Were there staff bunkhouses or anything?
- 01:00:41:31
Woodall: As a student they provided what you would call bunkhouse accommodation, for which they charged a small amount for meals at the camp mess. When I was employed after graduation, they provided an unfurnished house, free of charge.
- 01:00:42:02
Swent: Free.
- 01:00:42:04
Woodall: Yes, but it was very basic.
- 01:00:42:05
Swent: But you didn't have to pay for it. Did the company provide utilities? Did they have their own water supply, or what did they do for water and power?
- 01:00:42:11
Woodall: They normally also provided free water and power.

- 01:00:42:26
Swent: So part of the enterprise was to have a power plant.
- 01:00:42:28
Woodall: Yes, at Norseman, but in Kalgoorlie it was a public facility. They paid the power bill and the water bill.
- 01:00:42:34
Swent: What about health care?
- 01:00:42:41
Woodall: No, that was your own responsibility.
- 01:00:42:39
Swent: Of course, Kalgoorlie was a pretty big town, wasn't it? It had doctors and so on.
- 01:00:42:49
Woodall: Oh yes. But—
- 01:00:42:50
Swent: It wasn't an isolated mining camp by any means.
- 01:00:42:57
Woodall: No. And it was common for most people to belong to a health care system where you paid so much a week or so much a month.
- 01:00:43:13
Swent: Oh really.
- 01:00:43:13
Woodall: It was often just taken out of your pay, and that provided you essentially with free health care. It was called the Goldfields Medical Scheme. Almost everybody belonged to it; the miners as well as the staff.
- 01:00:43:33
Swent: Goldfields Medical Scheme, okay. Did you have to have a physical exam before you were hired?
- 01:00:43:45
Woodall: Only a regular x-ray to make sure you had no lung diseases, because the early miners suffered from a disease called silicosis. So, any sign of tuberculosis or any other lung problem could prevent you from being allowed to work underground.
- 01:00:44:12
Swent: They called it miner's consumption.
- 01:00:44:14
Woodall: That's right.
- 01:00:44:14
Swent: What about smoking?

- 01:00:44:19
Woodall: There was no prohibition of smoking. In fact, all of the miners I worked with smoked.
- 01:00:44:23
Swent: Underground?
- 01:00:44:28
Woodall: Underground as well as in what we called the crib room, you know, the lunchroom. The miner's lunch in Australia was always called the "crib", a Cornish miner's term. So over in the crib, men would be smoking and yarning.
- 01:00:44:55
Swent: Things have changed a little bit haven't they?
- 01:00:44:56
Woodall: Oh yes!
- 01:00:44:54
Swent: Were you a smoker?
- 01:00:45:03
Woodall: No.
- 01:00:45:02
Swent: Really?
- 01:00:45:02
Woodall: Only occasionally after wild parties when we would smoke cigars.
- 01:00:45:09
Swent: That may be why you stayed so healthy.
- 01:00:45:12
Woodall: Maybe, I am not sure! We now know it was a very dangerous habit, which we have only just recognized.
- 01:00:45:18
Swent: A lot of miners used to chew tobacco also.
- 01:00:45:21
Woodall: No, chewing tobacco was never common in Australia.
- 01:00:45:24
Swent: Oh really? Just smoking.
- 01:00:45:26
Woodall: Smoking pipes and cigarettes.
- 01:00:45:31
Swent: So, you started as a junior geologist. Was there a progression from where you started?

01:00:45:39

Woodall: I started as a junior geologist in 1953, on the 20th of April 1953 in fact. But I had already made up my mind that I wanted to do a higher degree, but only after I had some experience in the industry. I had the opportunity to do a Ph.D. straight after my honors degree at the University of Western Australia, but I chose to first get out in the industry. In 1954, I wrote to probably the top six universities in the United States, to see if I could get a scholarship to study for either a master's or a doctorate degree. I chose the United States because of Western Mining's historic link with Harvard University and the fact that the U.S. was famous for its contribution to mining geology and had a history of the application of mining geology. The United States was also famous for its mines, and not too far from Canada where there were also a lot of famous mines.

So I wrote to most of your top universities including Harvard, Princeton, Yale, and the University of California, Berkeley to ask about scholarships. I received quite a lot of encouraging replies but before those applications had got very far, I received a letter from a San Francisco group of people called the English Speaking Union. A lady called Mrs. Bayliss had been to see the Dean of Graduate Studies at Berkeley because the ESU provided an annual scholarship. One year, they would bring a New Zealander to Berkeley, and the next year they would bring an Australian, and they were due to bring an Australian to Berkeley in 1955. When Mrs. Bayliss had a discussion with the Dean of Graduate Studies, he said, "Here's an interesting application from someone in Australia." So she took my resume over to San Francisco, to the next meeting of the Board of the English Speaking Union, and they decided to offer me their one-year scholarship. I knew a little bit about California and how important this university was, so I accepted and didn't worry about any other university.

01:00:49:08

Swent: Of course.

01:00:49:11

Woodall: It turned out to be a wonderful choice for two reasons. I found out when I came here there were two wonderful professors. Professor Ed Wisser in the Hearst Mining Building had extensive knowledge of mines in Mexico and the Philippines, and in the geology department there was Professor Charles Meyer, who had extensive experience with the Anaconda Company. He was probably one of the most famous mining professors this country has ever produced. Both Meyer and Wisser were very strongly linked to industry, even though they were now in academia. They arranged my coursework here so I could get the best from the mining department in Hearst, and the best of earth sciences over in, I think, Bacon Hall, where geology was based. Coming to Berkeley was one of the most important decisions I have made in my life, and I stayed very, very close to Charles Meyer, right up until his most untimely early death in 1987: 32 years of a wonderful, stimulating, professional friendship.

01:00:50:36

Swent: He was one of our first advisors to this oral history project. He was on our first advisory committee.

01:00:50:39

Woodall: Ed Wisser, unfortunately, died even earlier, probably because he was a heavy smoker, but they were both just wonderful men. Both tried for ten years to attract me back to

Berkeley to complete a doctorate, and join the faculty. Chuck wanted me to replace Ed Wisser in Hearst Mining, and we can talk later on about why I didn't take the course.

01:00:51:18

Swent: This might be a good place to stop, I think. Just getting you to Berkeley.

01:00:51:26

Woodall: Well, this is the easy part. [laughs]

01:00:51:27

Swent: Oh right, it is a good place to stop, and then next time we can pick up with your Berkeley experiences if that's all right?

01:00:51:37

Woodall: That's all right.

Interview with Roy Woodall
 Interview 2: January, 22, 2004
 [Begin disc 2]

02:00:00:02

Swent: Yes, we are beginning the second interview. This is January 22, 2004. Roy Woodall and Eleanor Swent in the Hearst Mining Building, and yesterday we stopped when you had just started working for Western Mining Corporation in 1953.

02:00:00:36

Woodall: In 1954, I started to look for a place to do post graduate studies—we have recorded that I received this offer of a scholarship from a group in San Francisco called the English Speaking Union (ESU), and that, as I recall, was \$1,000 for one year. So I immediately applied to the Fulbright Organization for a travel grant. That organization was set up to sponsor and encourage student exchange between Australia and the United States: and they offered scholarships, full scholarships, and travel scholarships. They approved a scholarship for me, which gave me the money I needed to travel to the United States. With the English Speaking Union scholarship, I was hoping that I would be able to afford to live there.

Prior to leaving, I had become engaged to a young lady, Barbara Smith, and I didn't wish to go away and leave her. I wanted her to have the same opportunity of the Berkeley experience that I was now going to have. I believed I could afford to keep us both in Berkeley as, besides the ESU Scholarship, the University notified me that I would also be awarded a Teaching Assistantship, for which I would be paid \$1,500 per year. We ran into some problems because Barbara was only nineteen, and then the legal marriage age without parental consent was twenty-one. The only way I eventually persuaded Barbara's parents to approve our marriage was as a result of the intervention by the WMC manager in the Kalgoorlie office who was in charge of all WMC's mining operations in Western Australia. His name was Mr. Frank Espie. He was a very famous man. He had worked in Burma, in charge of mines there up until the Second World War. When the Japanese invaded Burma, he successfully evacuated all women, children, and men by walking them out carefully through the jungle through to India. It was a dramatic and famous trek. And he was that sort of a leader. He succeeded in persuading Barbara's parents and we were married on May 21, 1955, but I sailed for North America via England a week or so later without her. I mention Mr. Espie because within two years I was going to have to make a decision as to whether I would return to Western Mining. And of utmost importance to me were the men I would be working for, some of whom I had already met by working with Western Mining as a student.

I had met the founder of the company, a Mr. W.S. Robinson: quite a famous Australian financier, who spent much time in London, as, at that time, it was much easier to raise finance there. That is where he raised the finance to establish Western Mining in 1933. It was Walter Case of Case Pomeroy in New York who advised Robinson that the geological department should be established by McLaughlin if it was to use the best science available. So Robinson recruited Professor McLaughlin from Harvard University, who then delegated responsibility to Professor McKinstry and a team of famous and very successful North American geologists: Dr. John Gustafson, Dr. Miller, Dr. H.J.C. Terrance Connolly, and Mr. Haddon King. They all had had success doing very detailed mapping and structural interpretation at the Homestake mine in South

Dakota and the Hollinger gold mine in Ontario, Canada. As a result, they found major ore extensions to these deposits.

W.S. Robinson told McLaughlin and McKinstry that he didn't want them to recruit geologists that would just tell him just what the rocks were. He wanted geologists that would tell him what those rocks meant and what possibilities for ore discovery they suggested. Now that was a very farsighted type of philosophy! "Don't give me geologists that will tell me what is; tell me what may be," were Robinson's words, and then he would make the decision as whether to back their recommendations with finance. So that was the philosophy established in '33 as a basis for WMC exploration. It was still very much alive in the company when I was about to leave in 1955. It was fully endorsed by the Chief Geologist at the time, Mr. Don Campbell, whom I admired. He was an excellent structural geologist. And of course, I also admired the then chairman, Mr. Gordon Lindesay Clark as well as Mr. Espie. Mr. Clark was subsequently knighted and became Sir Lindesay Clark. Both he and Mr. Espie were giants in their professions but still compassionate, highly disciplined and fully supportive of W.S. Robinson's edict, "Go use science. Don't tell me what is, but you tell me what may be."

So with the help of Frank Espie, I was able to marry Barbara. I was granted a special privilege by the Fulbright Association: they allowed me to travel through Canada on the way to Berkeley, which meant I could look at some famous mines in Canada and the US on my way. I arrived in Berkeley ahead of Barbara.

02:00:08:11

Swent: Where did you visit in Canada?

02:00:08:14

Woodall: In Canada I visited the mining operations at Noranda, Kirkland Lake, Timmins and Sudbury. I then went on to visit the Homestake Mine at Lead, South Dakota and Butte, Montana.

02:00:08:21

Swent: So how did you come?

02:00:08:23

Woodall: Well, I took a boat from Fremantle in Western Australia to London, and then Liverpool to Montreal. And in Montreal I was met by a representative of a metal trading company who took me under their wing and organized the tour through the mines in Canada.

02:00:08:57

Swent: What time of year was this?

02:00:09:08

Woodall: This was July, August.

02:00:09:10

Swent: Nice time to be there.

02:00:09:14

Woodall: Yes, July, August 1955, on my way to Berkeley to start the September semester.

02:00:09:26

Swent: What did you learn from visiting Sudbury and Noranda?

02:00:09:30

Woodall: I learnt what great mines really looked like, and what people were doing to gain the maximum amount of wealth from them by careful mapping and mining, and what they were doing about trying to find extensions so that the mines had the maximum production life. As a geologist, you just cannot see enough rocks; you just cannot see enough mines; you cannot see enough in your learning period.

02:00:10:21

Swent: Was the geology there at all similar to what you had seen in Australia?

02:00:10:31

Woodall: Very similar rocks, but different in some ways. We hadn't found anything like the copper, copper-zinc and nickel ore bodies that had been found in Canada, but in general the rocks were the same. And this was very important because it convinced me at an early stage that similar rocks in Western Australia should be prospected for more than just gold. The rocks look the same, so why weren't there nickel deposits in Western Australia? Why weren't there copper deposits in Western Australia? So it was a very important tour, and a very good prelude to coming to Berkeley and being exposed to two of the most knowledgeable mineral deposit professors in the world.

02:00:11:43

Barbara came across the Pacific from Sydney to San Francisco in October, by ship, and naturally it was a very happy occasion when she arrived on October 23. I hadn't seen her since our honeymoon in May. Prior to her arrival, a group of ladies that looked after international students were very kind, helping to find accommodation that I could afford. I couldn't afford accommodation near the campus, but they eventually found me a one-room "apartment" equipped with a small bathroom, a bed, a small kitchen stove above a garage at 236 Hillside Avenue, Piedmont. The problem was it was about five miles from campus, and I had to then solve the problem of how to travel. Many of the young high school students in that area had new cars. All I could afford was a bicycle, and so I rode my bike from Piedmont to Berkeley campus; that was the means of transport for me.

02:00:13:23

Swent: About five miles I think isn't it?

02:00:13:26

Woodall: About five miles it was.

02:00:13:35

Swent: That's a good ride.

02:00:13:30

Woodall: Whereas nowadays, riding a bicycle is thought to be just the thing to do, riding a bicycle then, when you are an adult, was very unusual and seemed to be an event of amusement to local children. Later on, when I was lecturing at the university, the high school students thought I was a big laugh. Never mind, we lived cheaply, and Mrs. Cotton, who owned the house from whom we rented the one room above her garage, was very kind to us. Barbara arrived, and we realized quite early that she was pregnant, and we were

excited about that. We had faith that we would be able to survive financially, and we settled into this little room which I had repainted prior to her arrival.

Time at Berkeley was dominated by attending lectures, mainly from Professors Wisser and Meyer and doing research under Professor Ed Wisser. I had a room in the basement of the Hearst Mining Building. Professor Wisser had extensive knowledge of ore bodies in Mexico, Peru and the Philippines. He was able to describe them and what he thought were the important ore controls, and why those ore bodies were where they were. Even more exciting were the lectures by Professor Charles Meyer, who not only described many great ore bodies, but especially the great porphyry copper deposits of the United States and Chile. He had first-hand knowledge from having worked in Anaconda's research laboratory in Butte and had written some classical papers on such deposits. He was also a very competent chemist, and what he taught was not only how to carefully document the mineralogy and chemistry and petrology of an ore body and its environment, but challenged us to think about what the mineral assemblages were trying to tell us about the chemical systems that had caused these ore deposits to form. And this was all new to me. He directed us naturally to some of the seminal papers that were coming out at the time about how to interpret the chemistry and origin of ore systems. And he would challenge us to always think about the rocks, their composition, and their minerals, their alteration and what all these observations were trying to tell us about ore-forming systems and processes. What they were trying to tell us was important in terms of where you might find other ore deposits of similar importance.

02:00:17:22

Swent: How do you do geologic research? We think of research often as test tubes and microscopic slides and so on. What do you do when you do research in geology?

02:00:17:41

Woodall: It's mainly carefully documenting the mineralogy of all the rocks in and around the ore body, and in the environment of the ore district.

02:00:18:08

From that information you must make the very difficult judgment as to what these mineral assemblages and rock assemblages might mean in terms of ore-forming processes. Now, to make that interpretation, you have to do laboratory experiments or have access to the results of such experimental research. You observe certain minerals, but at what temperature might they have formed? What are the stability fields of those minerals—the temperature conditions under which they would form, and the chemistry of the fluids that were affecting the rocks at that time. Now, it was very early days in the development of valid theories of the genesis of the type of minerals you find in ore deposits. Charles Meyer and his team at Anaconda had made great progress in this direction, and his graduate students were at the cutting edge of that research. He attracted many outstanding students to work with him at the time I was there. They were trying to elucidate the chemical conditions that had resulted in the mineral assemblages observed in an ore environment, first recording the mineralogy and then interpreting the mineralogy in terms of the genesis of the system.

02:00:20:24

Swent: So you are dealing with minerals from an ore body, so you know that there's the gold or whatever you are looking for is there, and you are trying to find out—

02:00:20:28

Woodall: Why it's there.

02:00:20:30

Swent: What sort of equipment did you use?

02:00:20:38

Woodall: I didn't do any actual laboratory experiments.

02:00:20:38

Swent: I am trying to think, there are all these fancy electronic things now.

02:00:20:54

What kinds of analytical things were there available then?

02:00:21:19

Woodall: The main ones were using pressure vessels in which fluids and minerals of a certain composition would be placed to see what happens when the vessels were heated in a furnace. It was research trying to replicate in the laboratory the conditions deep in the earth under which those minerals would have formed. It is not an easy thing to do, but they did make some very important progress.

02:00:22:20

Swent: You said you were not actually doing this. There were technicians doing these kinds of things?

02:00:22:29

Woodall: No, other students were doing most of this kind of research.

02:00:22:31

Swent: But you had to understand what they were doing of course.

02:00:22:35

Woodall: Well, that was part of what Professor Meyer in particular would lecture us about. We had to understand what they were trying to do to solve the problems. Under what conditions could these minerals have formed? What temperature? What pressure? What were the compositions of the fluids within the environment where these minerals actually did form?

02:00:23:01

Swent: Meyer's specialty was copper. Were you dealing with other minerals as well?

02:00:23:05

Woodall: The emphasis with Chuck Meyer was copper because that's what he knew most about. He had studied the Butte ore system in great detail, and was extending that to the porphyry copper deposits of the U.S. and Chile, trying to understand their genesis. And that's what his Ph.D. students were also charged to do: to study an ore body, document the minerals, and then interpret what those minerals were trying to tell us about the conditions under which they formed. Their task was to run the experiments necessary to try and duplicate what they thought would be those conditions and to see how accurate their understanding was. It was a very complex aspect of physical chemistry with which they were wrestling, because it is very hard to duplicate the conditions deep in the earth.

You have to use vessels that allow you to duplicate the high pressures in the earth, the high temperatures in the earth, when you are never sure how complicated the solutions are in the earth. You can only experiment with relatively simple systems, and hope that this will lead you to understanding complex systems.

02:00:24:54

Swent: Did you get into physics at all, or was it mostly chemistry?

02:00:24:58

Woodall: Mainly chemistry. I was an observer to these experiments and a student learning from Professor Meyer about how important this type of work was. And it convinced me that if you really wanted to run a first class minerals exploration department in the modern era of the 1950s, you had to do what they were doing in the Anaconda organization at the time, which was very, very careful documentation of the mineralogy and petrology of an ore body and its environment.

02:00:26:04

Swent: Did you have any sense of any difference, if there was any, between the Harvard group and the Berkeley group? Were they approaching things from any different perspective?

02:00:26:14

Woodall: I was not well informed as to what was going on outside of Berkeley. See, I was only a student at Berkeley for sixteen months, nineteen months in total. During the summer vacation I worked up on the Sullivan mine in British Columbia, so it is a pretty short time and a tremendous amount to absorb from men like Professor Ed Wisser and Professor Meyer. Just understanding what they already knew about ore bodies was itself a major task. On top of that, I had to learn from them what they were still finding about the genesis of those ore bodies: why did they contain certain minerals and what research work they were doing to try to resolve the conditions of formation. And the theory was, or rather the hope was, that if you could understand fully the system that created an ore body, you would have a much better chance of predicting where to find another one. So that was all very consistent with what the founder of Western Mining wanted people to do. He wanted them to tell him carefully what "is", but then also say what those minerals and what those conditions meant, or at least, what they might mean, in terms of where to explore. I should add that the value of studying under Professor Ed Wisser was different than studying under Professor Meyer. Professor Wisser's great strength was his intimate knowledge of a wide variety of ore deposits in Central and South America, and the Philippines.

I had a difficult decision to make by the end of 1956. I started to write a series of "impressions" back to the company that I had left. I wrote to the chairman, Mr. Clark, and told him that I had a vision of establishing for Western Mining a first class minerals exploration team that would be focused not just on gold, but also on the search for base metals, copper, lead, zinc and nickel. We would need to have top class scientists, who would need the time to carefully collect all the known information on the mineral deposits already known in Australia, to study them, to understand their mineral compositions, the alteration patterns around them, and the types of rocks in which they occurred. The hope would be that we would be able to gradually understand more about the physical chemistry of the genesis of ore deposits and where we might go to find other important deposits.

I would like to quote from a letter I sent to Mr. Clark on May 5, 1956 to elaborate on this important outcome of my studies in Berkeley under Professor Meyer.

“I am writing to you to inform you of a very interesting study which I have made while here and to draw your attention to an important development which is likely to influence the Australian mining world in the not too distant future.

While I have been studying here at the University of California I have had the privilege of working under a brilliant Anaconda man, Dr. Chas, or Charles, Meyer. He is a professor in the geology department and also a top consultant in that company’s exploratory organization. Under him I have been studying the porphyry copper deposits and related base metal districts.

There is a belt of Late Cretaceous and early Tertiary igneous activity which follows the eastern border of the Pacific Ocean from Chile to Alaska. It contains many of the great metalliferous deposits of the world and forms the fabulous mineral belt of western South America, Mexico and the western United States. This geological distinct belt actually surrounds the Pacific Ocean. With considerable geologic similarities it swings down through Japan, the Philippines and New Guinea and finally disappears into the Antarctic continent by way of New Zealand. There does not seem to be any real reason why it should not contain such outstanding yet unique copper deposits as Chuquicamata Chile, Sonora District mines, the porphyries of Arizona and Nevada or Bingham, Utah, on the eastern side and be essentially barren elsewhere.

Firstly, this belt of unknown mineral wealth passes very close to the sphere of Western Mining Corp’s operations. It may in fact just touch the most easterly portion of the Australian continent. New Zealand, New Caledonia and New Guinea are in any case not so far away. Secondly, these porphyry copper deposits, although mineral prizes second to none, are not very obvious in their surface manifestations. Unless you were looking for them and understand them it is quite conceivable to walk right over one which actually outcrops, and not realize the fact. In other words they may well exist on our door step. Thirdly, Anaconda is looking towards Australia. To the imaginative and the adventurous there lies a relatively poorly prospected, highly favorable mineral belt close to Australia, if not actually in Australia.”

The response was:

“Roy, this is just what we hoped you would come back and say, but we are a little company, we don’t have a lot of money. We can only do this probably in joint venture with somebody who is a—another company that is much wealthier.”

I sent similar messages off to the Chief Geologist, Don Campbell, and he was supportive and forwarded his views on to the head office in Melbourne where Mr. Clark

resided. And then, while I was away, he wrote a very important document to the head office.

02:00:30:05

Swent: This is Campbell?

02:00:30:11

Woodall: Yes, this is Campbell. He wrote to the Chairman of the Company, Mr. Clark on the 8th of June 1956 which was subsequent to me sending my own vision statements across. And he said,

“In view of all this, I feel we need a first class intelligence department, headed by a geologist of real capacity. (I have Roy Woodall in mind at present.)”

So, that was very encouraging. I didn't see this letter until much later, so I didn't know initially that there was good support for me, back in Australia from Mr. Campbell. But I knew I was learning a great deal, and that the whole science of understanding ore bodies and their genesis was at a very early stage. It wasn't just a matter of forming an intelligence department that would understand where ore deposits were found and what they consisted of, but you would have to have geologists that would stay in touch with the emerging science that was trying to interpret how these ore deposits were formed. We needed a better understanding of the whole process of ore genesis. How important was structure? How important was the composition of the fluids? Where did the metals come from? Where did the energy come from to drive the system to form the ore body? It was at that early stage that I had to make a choice as to whether I continue at Berkeley to complete a doctorate and so become more competent myself in the whole chemistry of ore systems, which is what Chuck was driving at with his research, and then join Anaconda. It would have meant becoming part of what was the most exciting exploration and research group probably that existed at the time, to whom wonderful men like Chuck Meyer consulted, a company headed up by a man like Reno Sales. What an exciting opportunity! I knew I could have that opportunity! The other opportunity was to go back to this little company called Western Mining Corporation, where I knew the chairman was excited about what we might be able to do. It was a very difficult decision, but I did go back, to a large extent as a result of advice from Chuck. “We can't teach you much more,” he said. “Go back to Australia and find ore deposits.” So in April 1957 I left San Francisco by ship for Australia, with my wife Barbara and two children.

02:00:33:38

Swent: With a growing family.

02:00:33:44

Woodall: By that stage, we had two Americans.

02:00:33:51

Swent: No need to ask what Barbara was doing then.

02:00:33:54

Woodall: The second child was born only a month before we left the United States and we were never unhappy about that. Barbara, herself, had had a wonderful experience, meeting

wonderful, caring, interesting people, traveling with me throughout the Western U.S., being with me in Canada, and of course, learning to be a mother while she supported me emotionally, and even found time to do my typing.

02:00:34:06

Swent: What were the names of your first children?

02:00:34:08

Woodall: The first child was a girl whom we called Jennifer Anne, and the second child was a boy we called John Paul.

02:00:34:15

Swent: Nice names. And they were just about a year apart I guess.

02:00:34:22

Woodall: That's it. Well, there you go. So we left the United States after a wonderful nineteen months, having learnt an incredible amount from the top mining geology professors of the time, fired up to try to take that vision and competence back from Berkeley to Australia. I was absolutely convinced, especially after having seen the great ore bodies in the Pre-Cambrian of Canada, that there had to be ore bodies of a similar type in the rocks in Western Australia; there had to be ore deposits there other than gold deposits.

02:00:34:31

Swent: The "what" rocks?

02:00:35:19

Woodall: Similar, the same rocks!

02:00:35:19

Swent: Same rocks.

02:00:35:24

Woodall: They couldn't just be gold-bearing when the same rocks in Canada contained deposits of gold, nickel and copper, zinc. At least that's what Berkeley taught me! Berkeley also taught me that there was enormous mineral wealth on the eastern side of the Pacific, from Alaska through British Columbia, the western states of the United States, Nevada, Arizona, down to South America, Peru, Chile. And the same geology and mineral wealth ought to exist on the western side of the Pacific, Japan, Philippines, New Zealand, Indonesia, even perhaps on the eastern side of Australia! We didn't have quite the same geology in Australia, we seemed to have missed out on the very young, exciting, mineral bearing rocks that you find in Nevada and Chile, but there was still just a chance that we might find porphyry coppers in Eastern Australia in slightly older rocks. This in fact turned out to be the case but they were found by other companies, not WMC.

02:00:36:50

Swent: I was thinking you are dealing with two entirely different kinds of terrain.

02:00:37:01

Woodall: Absolutely.

- 02:00:37:02
Swent: Sudbury and Kalgoorlie are flat and these other areas that you are talking about—
- 02:00:37:06
Woodall: The terrain was totally different in Australia, and that became very important later on, once I tried to find ore deposits that I thought should exist there.
- 02:00:37:20
Swent: At that time, I am trying to place it, the tectonic plate theory was generally accepted, was it?
- 02:00:37:34
Woodall: Yes it was. It was accepted.
- 02:00:37:34
Swent: But it was new so—
- 02:00:37:39
Woodall: It was new. It was strongly supported and advocated by a very famous Australian professor of geology, Professor Carey. He traveled the world, trying to convince the leaders in academia, who so influenced geological thought, that continental drift was real. But because it didn't suit a lot of people's ideas, and what they had written so much about, it was violently opposed, especially in the U.S. Eventually truth had to prevail, and so continental drift was accepted and lectured about, and we had to take that into account in trying to explain why there could be this very exciting ring of young mineral deposits all around the Pacific. They were known mainly on the East side, why shouldn't they also exist on the West side? So, I went back to Australia hoping I would be able to set up some form of Anaconda-type of geological department where the emphasis would be on very careful documentation of the structural setting, mineralogy and petrology of ore deposits. And where there would be backup laboratory facilities so you could have scientists working along side field geologists, helping them explain the origin of what they were mapping, and helping them explain what they mapped might mean in terms of where to look for ore.
- 02:00:39:52
Swent: Does that do justice to the Berkeley period?
- 02:00:39:54
Woodall: I think that's about all I can say.
- 02:00:39:57
Swent: I think it does. Have you kept in touch with—I know you have kept up with some of the friendships that you made during that period.
- 02:00:40:15
Woodall: I corresponded with Chuck Meyer and Ed Wisser a great deal in the 1960s. In 1965 Chuck asked me again to consider returning to Berkeley to complete a PhD and perhaps replace Professor Wisser on the faculty. I kept in touch with Charles Meyer for 30 years until his death in 1987. I visited him almost every year, even after he and his wife Virginia left Berkeley and moved to Sedona. We naturally talked geology, and where the world of geology was heading in trying to understand why great ore deposits form. I also made very good friends with Dr. John Hunt who was one of Chuck's Ph.D. students

at the time and has done wonderful things for the mining industry in Chile. And other people we kept in touch with were people we met, or whom Barbara met, as a result of being the wife of a student. Local Berkeley people were very kind to us, and we made some of our best friends in those times.

02:00:41:30

Swent: So, it was the fall then of 1956 when you returned?

02:00:41:32

Woodall: No, April '57.

02:00:41:37

Swent: April '57 when you returned. Okay, should we move on?

02:00:41:43

Woodall: We can move on.

02:00:41:43

Swent: All right, I think we should. Do you want to take a bit of a break? I do!

02:00:41:49

Woodall: Oh, you need a bit of a break?

02:00:41:50

Swent: Yes, let's just take a break!

We are now back in business and back in Australia in Western Australia.

02:00:41:57

Woodall: Well, when I came back, they appointed me as assistant to Mr. Don Campbell who was in charge of all exploration on the company's mines and all regional exploration. Mind you, the regional exploration programs were minimal because the company was not very profitable. It had a very small amount of surplus cash.

02:00:42:46

Swent: You have mentioned the date 1933 a few times. WMC was a new company, it just had formed in 1933.

02:00:42:52

Woodall: Absolutely. It was a new company, and because of its emphasis on scientific exploration, some of it expensive, they nearly went bankrupt. It was only because of the discovery of high-grade gold ore at the mines at Norseman, which Haddon King and Don Campbell were responsible for finding, that the company survived.

02:00:44:00

Swent: That was before your time, of course. What were some of the other companies that were in that area at the time? Were there older more established companies in the same field?

02:00:44:16

Woodall: There were some very well established companies, dating back to the 1890s, that were still working parts of the Kalgoorlie gold field, but they were not interested in exploration. Then there were other Melbourne based companies who were real

competitors; BHP, North Broken Hill, and Consolidated Zinc. When I returned in 1957, almost the only exploration of a regional nature that was being done in the whole of Western Australia was being done by Western Mining, although there were the beginnings of interest in the possible potential for other commodities, especially iron ore. So I came back with the title of Assistant Chief Geologist, very hopeful that we would be able to approach mineral exploration in a very scientific way: careful documentation by geological scientists who were in touch with the best geological scientists in the world; people who were trying to understand how ore bodies formed and how to search for them using the best sciences.

To give you the “picture” of my vision for WMC, let me quote from a document I wrote towards the end of my stay at Berkeley which I sent to Don Campbell, WMC’s Chief Geologist.

MINERAL EXPLORATION

An appraisal of the problem of mineral exploration

1. On a prospect an attempt can be made to interpret its geometry which entails a determination of the structural locus of the ore body. Pertinent data is as follows: width of mineralization, strike, length, shape in plan, dip and plunge, its relationship in space to the surrounding rock.
2. Sample the visible outcrop.
3. Consult old production records and reports if some attempt has previously been made to mine the occurrence.
4. Consult any earlier reports dealing with the geology of the occurrence or previous attempts to test its extensions.
5. Determine the mineralogy of the ore. How does it compare with other similar occurrences which are of economic value? What does it tell us of the genesis of the deposit? Similarly, what are the gangue minerals?
6. What is the type of alteration present and what is its areal relationship to the ore minerals? What is its genetic significance?
7. What is the nature of the associated igneous intrusions?
8. What are the characteristics of mineral prospects of this type in this and other regions?
9. What is the tectonic pattern of the region and how do producing mines in the area relate to this pattern?

02:00:45:39

Swent: I would like to ask how much you were paid, if you don't mind saying?

- 02:00:45:48
Woodall: I wish I knew. I don't know what my salary was, but it wasn't very much: the company was "ideas rich but cash poor".
- 02:00:45:55
Swent: And what was the office setup? Where were you, and what sort of office were you working in?
- 02:00:45:58
Woodall: The office was in Kalgoorlie, the original office of the British company, Bewick Moring, in fact the office in which Herbert Hoover sat before moving north to the Sons of Gwalia mine at Leonora.
- 02:00:46:10
Swent: In Perth.
- 02:00:46:13
Woodall: In Kalgoorlie.
- 02:00:46:13
Swent: In Kalgoorlie.
- 02:00:46:13
Woodall: The corporate head office was in Melbourne where the Board met, but the operational office was Kalgoorlie because the focus of the company was looking for gold and managing gold mines in Western Australia.
- 02:00:46:36
Swent: So, what sort of physical office was it?
- 02:00:46:38
Woodall: It was just like a big house. Very simple, but it had one big room with one big table in it, and that's where the general superintendent Mr. Espie sat. I think that was the table at which Herbert Hoover had once sat when he was a consultant for Bewick Moring.
- 02:00:46:58
Swent: Did you have your own separate office?
- 02:00:47:02
Woodall: Yes, a very simple office it was. Very low key.
- 02:00:47:09
Swent: You were conversing with all these other people during the day?
- 02:00:47:17
Woodall: Oh yes, it was just a very friendly place; like a small family.
- 02:00:47:21
Swent: And you lived near by? Was your home near?
- 02:00:47:23
Woodall: Yes, just a mile or so away. But we had no research equipment at all. There wasn't even a microscope in the office. Coming from Berkeley, where everything was the best for

identifying minerals and the best facilities for trying to duplicate how minerals might form, I had nothing, only a hand lens. I subsequently borrowed a petrological microscope from the nearby School of Mines.

02:00:47:59

Swent: And maps: And a room filled with maps I suppose.

02:00:48:04

Woodall: Yes: that's it! And there were many government and old WMC company reports. One of the points that I hope I have emphasized is that I had learned the importance of carefully gathering data from the literature about what was already known about ore occurrences. Many geologists had gone before and made valuable observations. Some of the information was in government reports, some in WMC reports dating back to the 1930s.

There can be a lot of valuable information in old company and government reports, observations by previous geologists, even though they might be what some might think of as very elementary observations. Anyway, I hadn't been back long when there was interest in looking for bauxite, and one of these reports proved valuable.

02:00:49:16

Swent: Why?

02:00:49:19

Woodall: Because of the rapidly expanding market for aluminum, there was interest, worldwide, in finding new deposits of bauxite, the crude ore from which you make aluminum oxide, which is called alumina, the feedstock for aluminum smelters.

02:00:49:50

Swent: I am trying to think what the situation was at that time. Was the Japanese market just beginning to open up?

02:00:49:59

Woodall: Yes, but the Japanese were mainly interested in iron ore for their steel industry. The worldwide aluminum market was starting to boom and the technology of smelting and making aluminum metal was much more advanced as a result of the war and the need for aluminum for airplane construction. It was also realized that it was very valuable for construction of trucks and railway wagons because it was lighter than steel, but could be made quite strong. People started to use aluminum for soft drink cans; people started to use it in kitchens and all over the place. So there was a great interest in trying to find bauxite deposits from which you could make alumina, which could then be shipped to the aluminum smelters around the world. And an Australian company Consolidated Zinc, which actually was set up by WMC's founder, W.S. Robinson, had made a major bauxite discovery in northern Australia. "Conzinc" was a company making a lot of money mining lead-zinc-silver ore at Broken Hill. Like several companies after the Second World War, they expanded their exploration departments, and they discovered this big bauxite deposit in Queensland at a place called Weipa. And Mr. Clark, the Managing Director and Chairman of WMC, wrote to Mr. Campbell and said, "Where else could bauxite occur?" He realized that bauxite might form a useful diversification for the company away from gold because gold mining was not getting us anywhere as a result of the low, fixed price of US\$35 per ounce.

Mr. Clark reminded Mr. Campbell that bauxitic laterites were known near Perth in Western Australia. Don Campbell showed me the letter and said, "What do you think, Roy? What do you know about these bauxitic laterite deposits near Perth? After all, you studied at the University of Western Australia nearby." I knew a little about them, but I did what I thought was the only smart thing to do. I looked for information in the literature, and I came across a report: Report (No. 24) by the Bureau of Mineral Resources, a federal organization like your United States Geological Survey. They had examined those deposits, confirmed that they were bauxitic, but uneconomic because they were low-grade and had a high content of silica.

Silica was known to be detrimental in a bauxite deposit because to extract aluminum oxide from bauxite, you had to dissolve the ore in caustic soda, and caustic soda is a most expensive ingredient in the alumina refining process. Silica was known to consume caustic soda. What people were really saying was that silica in clay minerals goes into solution in caustic soda. I knew that, maybe I learned it at Berkeley. I am not too sure where I learnt it, but I knew that was so. But something was being overlooked! What was important about the bauxitic laterite near Perth was how the silica occurred. I found this Bureau of Mineral Resources report, and it reported the silica in the laterites near Perth occurred almost entirely as quartz, not in clays. Well, I said to Mr. Campbell, "There is no reason why these deposits shouldn't be excellent bauxite because the quartz is just a diluent and it should not dissolve in the refining process, it should not consume caustic soda, and if removed, will enhance the grade."

02:00:55:44

Swent: Just a what?

02:00:55:44

Woodall: It is not going to consume caustic soda.

02:00:55:46

Swent: Right, but you said it is just a—

02:00:55:49

Woodall: Diluent, i.e. a mineral that just dilutes the grade but does not affect the ore's behavior in a treatment plant.

02:00:55:52

Swent: Okay.

02:00:55:55

Woodall: Quartz dilutes the grade, but it should not increase the cost of the treatment process by consuming caustic soda. Well, within one year under Mr. Campbell, Western Mining proved up one of the biggest, most economic bauxite deposits in the world.

02:00:56:28

Swent: What was the name of it? Was it given a name?

02:00:56:31

Woodall: Well, it occurred in what's called the Darling Ranges, named after the Colonial Governor of New South Wales at the time of the establishment of Western Australia as a British colony in 1829. And so, the deposits were called the Darling Range bauxite

deposits. To find the money to assess the deposits by drilling and sample analysis Mr. Clark approached two sister companies, Broken Hill South and Broken Hill North, again, companies set up originally in the 1930s by W.S. Robinson. They joint-ventured the project with WMC to help us with the finance. The other important issue was the environment in which the bauxite occurred. It occurred in the only really heavily forested part of Western Australia, where there was a valuable timber industry, and where most of the city's water supply came from. It was also an area where a fungus disease, phythopthora, had already been introduced inadvertently, I believe from South America, and it was a serious threat to the eucalyptus forests.

I mention that, because from day one, Mr. Clark, the chairman of the company, emphasized that this had to be the most environmentally perfect exploration and mining operation that had ever been conceived, otherwise, the government would never allow us to mine the deposits. Due to the best possible environmental management which was insisted on, mining is still going on there, even expanding. As a result of the research financed very generously from the mining of those deposits, there have been major breakthroughs in how to rehabilitate areas that have been deforested and areas that have been affected by fungal disease. The bauxite from these deposits now produces, and has done for many years, the cheapest alumina in the world. It's the most profitable alumina operation in the world, but to get to that stage, we had to get a big partner. We had the deposit, but we knew nothing about how to refine the bauxite, and a key step to bringing the deposits into production was a joint venture we formed with Alcoa, Aluminum Company of America. They came in as a major joint-venture partner. They brought in the technology to build the refineries and to handle all the marketing.

02:01:00:28

Swent: I understand it takes a huge amount of power, doesn't it?

02:01:00:32

Woodall: No, not to make alumina. It takes a large amount of power to smelt the alumina into aluminum. But we were in the business of making alumina, not aluminum. And it is still one of the great alumina producing operations in the world. So within twelve months of returning to WMC I helped make a major "discovery" simply by referring back to an old government report and because I had some knowledge of the chemistry of mineral behavior in a solution of caustic soda. And I am quite sure I must have absorbed that information while talking to the people here in Berkeley who were experimenting with minerals and their solubility. So a very unusual spin off benefit! Nothing to do with understanding the genesis of ore bodies, just understanding a bit more about the chemistry of minerals.

02:01:01:52

Swent: And a thrilling beginning to a career.

02:01:01:57

Woodall: It was a very exciting thing for the company. It transformed WMC.

02:01:02:01

Swent: Yes, indeed, and for you.

02:01:02:04

Woodall: I didn't have much to do with the subsequent evaluation of the deposit, and that was to some extent a big disappointment. Don Campbell took over the subsequent assessment drilling and exploration program and did a fine job but the main disappointment was that instead of being allowed to set up an intelligence department and to examine the opportunities for other base metal explorations in Australia and to start recruiting top scientists to work with me, I was sent into far off northern Western Australia to a place called the Tarraji River, where a prospector, Bill Rogers, financed by Western Mining, had found some copper shows. So forget about world-class research departments or intelligence departments, Roy, off you go to remote, northern Western Australia with a small group, with your own tents, in a country that was not inhabited. So we established a tent camp and start examining those copper deposits.

My first visit to Tarraji was in 1957, shortly after arriving from Berkeley; I established the camp and ran the exploration all through 1958. The Tarraji project lasted three years and failed. The copper deposits were too small, but it did have one benefit. It gave me the opportunity to experiment with geochemical prospecting, and that came about because I knew I had to do something out there that was a bit innovative. The prospector had already found all the outcrops. The question was: "Was there a major deposit that did not outcrop?" I thought if we ran a geochemical program on the stream sediments and soils, I would be able to find a major deposit if it existed, concealed by soil.

I went to Canberra where the Federal Bureau of Mineral Resources had its headquarters to visit a man called Dr. Haldane. He was a chemist interested in developing analytical techniques that you could use out in the field. The idea was, collect a sample of soil or sediment, and immediately do some tests to find out if it was copper anomalous or barren. In other words, do what the gold prospectors used to do, looking for specks of gold and follow the trail up the river until you find the source. Test the sediments for copper, and if you find where the copper in the sediments is richest, follow that up and find the hidden source. So we developed a very interesting method of testing for copper and lead and zinc in the field. Crude but effective, and it was based on taking a sample, getting sufficient of it in a solution, and then adding dithizone or cuproene that are colour-responsive to the presence of those metals. It's called a colorimetric method of analysis.

Another benefit of being assigned to the Tarraji River project was the opportunity to have my first experience of running a geophysical program. It so happened that in 1957, a Yugoslav immigrant arrived in Kalgoorlie looking for work. He was obviously very intelligent. He said he was a geophysicist, but we had no way of knowing how much geophysics he knew because he could hardly speak English. His name was Anton Triglavcanin. Initially, we just employed him as a draftsman until he could speak English well enough to tell us what he really knew, and he turned out to be a brilliant geophysicist. And so Anton and his wife, Mary, came with me in 1958 and lived in a tent camp in the wilderness where he experimented with some of his geophysical techniques.

So that was the Tarraji copper exploration project, which kept me busy for the first couple of years after I returned from Berkeley, but not doing what I wanted to do and what I thought I came back to WMC to do.

02:01:07:51

Swent: You mentioned that Anton's wife was with him, but where was your family at this time?

02:01:07:57

Woodall: Barbara was in Kalgoorlie in 1957, where we had the barest of furniture in our company house and no curtains. I was absent for long periods of time, especially in 1958.

02:01:08:10

Swent: Well, she had family there, did she?

02:01:08:11

Woodall: She had family there, that's correct.

02:01:08:16

Swent: Not just the children.

02:01:08:15

Woodall: Her mother and father lived in Kalgoorlie. What made a big impression on Barbara and me was that when I was away on this remote exploration venture for up to three months at a time, the managing director and chairman of the company, Mr. Clark, when he visited Kalgoorlie, would always call to see her and ask her how she was managing and if there was anything the company could do to make life a little easier for her. And this is the wonderful thing about a small company run by professional engineers interested in science, and who are compassionate and understanding. You just love to work for these people. This became very important because I was getting offers to do other things.

My old professor at the University of Western Australia, Professor Prider contacted me because he wanted to establish a much more vigorous emphasis on economic geology in the Geology Department, and he wanted me to join the faculty. And that wasn't the only offer I had to join academia. Chuck Meyer was keen for me to return to Berkeley, as was Professor Wisser, and the Professor of Economic Geology at Adelaide University contacted me and asked me whether I would apply for his position, which he was vacating. All of these opportunities were very attractive in their very own different ways, but what kept me loyal to this small mining company, was their philosophy and my hope: use good science, even if you have very little money, and you will be successful. However, nothing kept me more loyal than my admiration for Mr. Clark, Mr. Espie, Mr. Don Campbell and another man that came into my life then, Mr. Brodie-Hall, who replaced Mr. Espie as the General Superintendent of all of our operations in Western Australia. Mr. Espie and Mr. Brodie-Hall were mining engineers.

02:01:11:57

Swent: When you were out at Tarraji, how were you communicating with the office in Kalgoorlie?

02:01:12:00

Woodall: Very rarely. The only communication was through the Flying Doctor Radio Network. Years earlier, a famous man called Rev. John Flynn decided that although it was important to preach the Gospel, it was just as important to care for people. And he got himself a pilot's license and trained as a doctor. He established a radio network with all of the early pastoralists living in remote areas: people in what you would call remote

ranch homesteads. If a woman's child got sick, she would call up on her radio and ask for guidance as to what she should do. And if it was serious enough, John Flynn would get in his plane and fly out to the remote homestead and either care for the child himself or bring the child back to the hospital. It was the world's first outback aerial medical service, and it is still very much part of Australia's outback culture and scene. Extremely valuable, they have many planes now and many doctors, but their early, fairly crude radio network was the only way we could communicate from the Tarraji River camp. It took a whole day to go from the camp to Derby, the nearest town, to get provisions, which we did every second week. All meat was obtained by shooting the wild cattle that were roaming the country. We almost lived off the land, in a way.

02:01:14:22

Swent: Is that when you began your experience with aborigines?

02:01:14:29

Woodall: No! There were no aborigines in that area at all. They had all left and gone into the towns, long before, so we had no contact with aborigines. I did later on.

02:01:14:43

Swent: But not there.

02:01:14:53

Woodall: No! When I came back to Kalgoorlie I handed over management of the Tarraji Project to a Mr. Don Reid who had just returned from studying in the U.S. He returned with an American wife, Donna, and they left for the remote "bush" camp in the Tarraji river valley. There, being an artist, Donna painted many scenes of the camp and environs, and with Mary Triglavcanin provided the gentle, female, touch to a rough, remote camp, made only of tents.

continue Interview 2: January, 22, 2004
[Begin disc 3]

03:00:00:02

Swent: All right, back in business.

03:00:00:09

Woodall: My responsibility for the Tarraji copper project was handed over to Don Reid in the latter part of 1958, and I went back to Kalgoorlie and spent more time as Mr. Campbell's assistant. In 1960 I had the opportunity to make my first real recommendation to the company. I was asked to look at a deposit of talc on a farm called Coodawa, in Western Australia, near the small agricultural town of Three Springs. I went to examine the deposit and realized that this was something important. Even though the talc market was not large, like the iron ore market or the copper market, talc was still a valuable mineral, and I realized I was looking at a very unusual, but very important type of talc deposit, and I recommended that the company acquire equity, i.e. part ownership, and take over the mining.

03:00:01:54

Swent: What is the chemistry of talc? What is it?

03:00:01:57

Woodall: Talc is a hydrated magnesium silicate; and this talc was extremely pure. It was very valuable in the paper industry for coating and in making certain ceramics, and although the business that resulted from WMC's acquisition was small, it was very profitable. That deposit is still in production almost fifty years later. It's a very unusual deposit in that it had been formed by aqueous fluids, water-fluids, converting ancient, dolomitic carbonate reefs into pure hydrated magnesium silicate, which is talc. You can still see, in the talc, the original form of the coral reefs from which the dolomite formed. A fascinating deposit! Small, highly profitable, and my first real recommendation. But all this was still a long way from what I had hoped to be doing for the company i.e., setting up a first-class intelligence department and gathering information on Australia's copper, lead, zinc, and other base metal deposits that might occur and assessing the potential for new discoveries. I wanted to find out what could be learned about the deposits that had already been found, and to make judgements as to where we might go intelligently exploring for base metals, including nickel.

03:00:04:20

Swent: You were probably learning something, however, from these endeavors.

03:00:04:28

Woodall: Yes, but I was not permitted to pursue this strategy. What I was doing was so different from what I thought I came back to do.

I had another opportunity to do something special in 1962, when I was asked to examine a dormant gold mine in Kalgoorlie called the Mount Charlotte gold mine. Now, the famous Kalgoorlie Golden Mile deposit is quite different from Mount Charlotte. Mount Charlotte is just a stock-work of quartz veins, and the gold is quite coarse and often visible. It was the gold that the original prospectors found and that attracted prospector interest to Kalgoorlie in 1893. Many companies had owned the

Mount Charlotte mine and had tried to assess its grade, and most had decided that it was uneconomic. I was asked to have another look at it, and it became clear to me that the sampling by previous owners had been incorrectly carried out. I recommended a program of pattern drilling from the mine openings that were still accessible and were within the ore body to properly assess its grade. I had assistance from a top statistician from Melbourne University by the name of Dr. Joseph, and another experienced mining geologist Mr. John Haycraft.

03:00:07:23

And that testing program lasted well over a year—

03:00:07:39

Swent: Excuse me, where is the Mount Charlotte mine?

03:00:07:40

Woodall: Right in Kalgoorlie.

03:00:07:41

Swent: Right in Kalgoorlie.

03:00:07:42

Woodall: Right near the main street of Kalgoorlie.

03:00:07:48

Swent: Excuse me for interrupting.

03:00:07:50

Woodall: From drilling we estimated the grade of the Mount Charlotte ore body. Our mining engineers now had confidence in the grade estimate and considered for the first time a type of bulk mining which would be economic using big equipment and a new haulage shaft.

03:00:08:29

Swent: Still underground?

03:00:08:30

Woodall: Still underground. Now, I mention that because this mine became absolutely vital ten years later when gold mining almost stopped completely on the famous Kalgoorlie field. For several years only the Mount Charlotte mine survived. And the grade of that mine was assessed correctly by me in the period of 1962 to '63.

03:00:09:03

Swent: And the price of gold at that time was—?

03:00:09:01

Woodall: Thirty five dollars U.S. an ounce.

03:00:09:10

Swent: Fixed.

03:00:09:13

Woodall: And at times, it was even less in Australian dollars because the Australian dollar at one stage was worth US\$1.20. The price of gold in 1962 was only thirty-one Australian dollars per ounce.

Now, a very major setback occurred to my vision in March 1962 while I was doing this work on the Mount Charlotte mine. Mr. Don Campbell, who was the Chief Geologist and my boss, my immediate boss, made the decision that he would be the person to go and look for base metal deposits and be responsible for almost all base metal in Australia, and I, Roy Woodall, would stay in Kalgoorlie, and look after geology and exploration on the Company's gold mines and surrounding areas. Don wanted to go to Perth where living conditions were much better, especially as his wife was not so well. So on March 9, 1962, he wrote to the Managing Director, Mr. Bill Morgan, that he would remain responsible for most of WMC's base metal exploration program, and Roy Woodall would stay in Kalgoorlie, and in Mr. Campbell's words "Direct geological work, development and exploration of Gold Mines of Kalgoorlie and at Central Norseman, and be responsible for prospecting for all metals and minerals in that area in conjunction with regional mapping and the investigation of gold occurrences." So, although I was not prevented from looking for minerals and metals other than gold, my area of influence was restricted and I was to manage all the geological work on four major gold mining operations and carry out such gold exploration as we could find money for. So you might say, my wings were clipped. And that was my situation in 1962.

03:00:11:30

Swent: Did you have any way of discussing this with him?

03:00:11:38

Woodall: No. Well, I suppose there was, but I was still fairly junior.

03:00:11:47

Swent: You were just given your assignment.

03:00:11:55

Woodall: However, it didn't stop me trying to convince people that the gold bearing areas of Western Australia might be prospective for other metals, and making known my views as to how a base metal exploration program should be carried out and supported by research. It was the same year that I established what was to be one of the features of WMC's geological department over the next twenty or thirty years. I encouraged a study leave program—you might call it a sabbatical program—for my geoscientists. The idea was that our best geologists, our best geophysicists, and best geochemists should be given the opportunity, at least once during their career or perhaps every ten or fifteen years, to go back to centers of academic excellence in research and science to upgrade their skills. They would be assisted financially, the amount dependent on how important their studies and research might be to WMC, but as a minimum, they were to receive at least travel costs and half-salary for one year.

continue Interview 2: January, 22, 2004]
[Begin disc 4]

04:00:00:04

Swent: I am sorry to have interrupted you. You were saying that you wanted to encourage this program of study leave.

04:00:00:18

Woodall: I thought it was better to recruit geologists and geophysicists or geochemists after their first degree, and have them work with me in industry for two or three years before considering post-graduate studies, like studying for a doctorate degree. Then they'd be focusing their research on what we would consider to be real problems, rather than problems suggested to them by their professors. The first person to benefit from that was Richard Mazzucchelli, and he went to the Imperial College of Science in London, which at the time was the foremost academic institution in geochemical exploration technology.

04:00:01:26

Swent: How many geologists did you have working with you?

04:00:01:31

Woodall: At that stage, it would probably be about twenty, by the time you count those working at mines: twelve were working on the mines and eight in exploration. I had no real exploration budget except what came from the mine managers. I don't think I had anybody working with me entirely on regional exploration.

04:00:02:08

Swent: So you were in a house in Kalgoorlie, sitting at the table where Hoover had sat.

04:00:02:13

Woodall: Well, the boss Mr. Brodie-Hall was at that table, I was next door.

That's when I was officially promoted to Assistant Chief Geologist. That promotion was sort of some salve for the wound, you might say. I was not doing what I thought I had come back from Berkeley to do, although there had been some success with the purchase of equity in that important talc deposit, and the reassessment of Mount Charlotte was a positive contribution. I then started what turned out to be a very important program, the complete remapping of the Kalgoorlie gold field and its southern extension. Now, you will recall—

04:00:03:20

Swent: You've lost your microphone again.

04:00:03:40

Woodall: You will recall that McLaughlin's men, headed up by McKinstry, had John Gustafson and F.S. Miller remap the Kalgoorlie gold field in the 1930s. They dramatically improved the understanding of the field. They mapped the rock succession without the assistance of microscope or any sophisticated mineral identification equipment. They concentrated on the stratigraphy, as defined by slate units, and they did a wonderful job of defining the structure of the field. When I started to remap the field in the 1960s,

assisted by a young Kalgoorlie School of Mines graduate, Guy Travis, we borrowed a microscope from the Kalgoorlie School of Mines, and started to do what I am quite sure Chuck Meyer would have been pleased to see happen. We started to examine the rocks and described their mineralogy, and this led to a completely new understanding of the host rocks of the Kalgoorlie goldfield, as it then was written up in technical papers. And our description of the rock sequence at Kalgoorlie is still as valid today as it was when we did the mapping over forty years ago, which is good to know.

The work also identified the type of alteration that was surrounding the Kalgoorlie gold deposits and it identified the host rocks which were most favorable for the deposition of gold. It strongly supported a program that Don Campbell had started earlier to try to find a southern extension of the Kalgoorlie goldfield where the prospective rock succession plunged away to the south under barren rocks. We argued that if you followed that rock succession to the south, we might find a complete repeat of the famous goldfield which would have been a fantastic prize. The project was called the Kalgoorlie South End Project and had been funded initially by Western Mining and other associated companies, known as The Collins House Group, after the name of the office they shared on Collins Street, Melbourne. The finance came by way of a public company "Kalgoorlie Southern Gold Mines". The project had stalled, but this remapping confirmed that this South-End Project still had considerable integrity, and should be reactivated if we could find the money.

04:00:07:09

Swent: Would this involve deep drilling?

04:00:07:11

Woodall: Very deep drilling: diamond drilling deeper than anyone else had ever attempted: diamond core drilling all the way down to depths of nearly nine thousand feet.

04:00:07:32

Swent: Whereas, up until then, people had been drilling just a few feet?

04:00:07:43

Woodall: Most diamond drilling was to less than a thousand feet. On the Kalgoorlie Southern Project drilling was necessary to depths of five thousand and six thousand feet and this required new technology; it was only justified because of the potential prize, another multi-million ounce, high-grade, gold deposit.

04:00:08:02

Swent: Did you run into any recalcitrance about drilling so deep?

04:00:08:05

Woodall: No, we had a lot of confidence in our drilling technology, but we didn't have the money. It wasn't until 1966 that Consolidated Mines Selection Co. Ltd. of South Africa and Newmont Mining Corp. of the U.S.A. joined the project and financed drilling for three years.

04:00:08:41

Swent: Were you involved at all in getting the financing?

- 04:00:08:42
Woodall: I was involved in convincing them it was a good project, very much so.
- 04:00:08:50
Swent: Anglo-American is a South African company, is it not?
- 04:00:08:56
Woodall: Yes, a big South African gold mining company.
- 04:00:08:55
Swent: Newmont is an American company. Where were you talking with them?
- 04:00:09:02
Woodall: In Kalgoorlie.
- 04:00:09:02
Swent: They came?
- 04:00:09:04
Woodall: They came to Kalgoorlie; I explained what we had learnt about the Kalgoorlie goldfield as a result of the remapping. We showed them the results of the previous drilling, which Don Campbell had been responsible for and encouraged. We recommended that exploration continue further south down the plunge of the system. We did find some gold, including one narrow extremely high-grade zone, of typical "Golden Mile" mineralization, in fact, nine inches which assayed 20 ounces of gold per ton. Extremely tantalizing, because how could you go out into the "wilderness" and drill a hole and find high-grade gold if exploration was not at least getting close to success. But, the price of gold was still low, only thirty Australian dollars per ounce, and the cost of mining was rising rapidly because of inflation. So, in 1971, Newmont and Consolidated Mines Selection decided to abandon the project and it is still abandoned. But, in my opinion, the search for a major extension of the famous Golden Mile deposit at Kalgoorlie is not over. Perhaps that nine inches of mineralization which was so rich, and was classic Golden Mile gold-telluride mineralization, will be the catalyst for a new attempt in the future.
- 04:00:10:23
Swent: That was just before the price went up.
- 04:00:10:30
Woodall: Just before the price went up. Western Mining disposed of its interest in the Kalgoorlie Southern Gold Project. It was a technical success, but by then, it had not yielded an economic discovery.
- 04:00:11:06
Swent: What does a multi-disciplinary exploration team involve?
- 00:11:14
Woodall: It involves the integration of all aspects of geology, describing the minerals and rocks. Describing the stratigraphic succession, the structures, integrated with geophysics and geochemistry. You can't make geophysical measurements just by looking at rocks. You need to measure the magnetic properties of the rocks, and their density. What's their electrical conductivity? Then integrate all this data with the rock geochemistry. Many

rocks all look the same, but one must ask: do they have different amounts of minor metals that you cannot see or key alteration minerals that may indicate a favorable environment. What is the mineralogy and the geochemistry of the altered rocks? The task is to integrate the best of the different aspects of geoscience: geological work, geophysics and geochemistry.

04:00:12:23

Swent: And this was what you were recommending?

04:00:12:20

Woodall: All the time. That's what WMC's founder W.S. Robinson would have said, "Use the best science, and then you have more chance of being successful in mineral exploration."

04:00:12:46

Swent: I had gotten the idea somewhere that you also included economists and lawyers in your team.

04:00:12:59

Woodall: Much later.

04:00:12:57

Swent: And not in the geology department.

04:00:12:56

Woodall: Much later.

I was asked to write a report on what we might do to try and find other gold mines in the area that I had responsibility for. Written in October 1963, it was regrettably not a very smart report. It recommended doing the best geology, but geological mapping had its limitations as so much of the country around Kalgoorlie did not outcrop. So there was a limit to how much geology you can do. Therefore, I chose geophysics, this new science, that helps us look in areas where there is no outcrop. I was hoping that perhaps there would be enough sulfide in the gold deposits we're hunting for that hidden lodes would show up on a geophysical electrical survey. Or perhaps this ore deposit we are looking for would show up by doing detailed soil analysis, looking for traces of gold or arsenic, using the best geochemical techniques that my friend Richard Mazzucchelli was learning about at the Imperial College of Science. Good ideas, but what I didn't realize at the time was just how difficult it is to use those techniques looking for gold in the flat, ancient, Australian landscape. One major handicap was the limited sensitivity of the gold analytical techniques we had at that time: perhaps 1 gram per ton or one part-per-million (ppm), so Richard's research focused on trying to use arsenic abundance as a guide to gold as arsenic is usually associated with gold mineralization.

I always realized that much of the goldfields of Western Australia was soil covered, with very little outcrop of unweathered rocks, but I didn't appreciate for probably ten years just how complex that surface blanket was. I regret in hindsight that I didn't include the detailed mapping of the soil profiles, i.e. the regolith, in the work I was promoting in terms of remapping the Kalgoorlie goldfield and its extensions. I was using the best geological science where I could see the rocks, but where I couldn't see the rocks, I did not map the regolith. If I had, I might have understood that vast areas

were not only concealed by soil, but also young sediments. Everything is very clear in hindsight. The Australian landscape, especially the goldfields region of Western Australia, has been flat as a tabletop for at least 60 million years, maybe 100 million years. On that old land surface are sediments which were deposited as far back as the Permian glacial period. There are other sediments deposited in the Cretaceous and valleys dissected in the Tertiary and now infilled with sediment.

We were naively trying to use geophysics, electrical systems, which were still at an early stage of development. Geochemistry was also still at an early stage of development. I wish now I had said: “the secret of success in gold exploration in this environment is not only to very carefully map the outcropping country, but to very carefully map the concealed country by drilling holes through surficial cover in concealed terrain in order to study and understand the nature of that cover.” The drill holes would not necessarily have to be very deep, perhaps ten, twenty, thirty, or one hundred feet, just deep enough to sample the surficial cover, to identify the Tertiary river systems, to locate where the young sediments were deposited as far back as Permian. When the gold boom struck in the 1980s, that was the information we needed and could have had fifteen years earlier if we had set about mapping the regolith as a major project in the 1960s and 1970s. It would have been very adventurous. It may have been difficult to sell to management, but that’s what we should have done. We might then have discovered how gold moves in the weathered zone, how it is not as immobile as was generally thought, how, in the Australian, semi-arid-weathering environment it can go into solution, be leached from the near-surface zones, and be redeposited as a supergene enrichment blanket at depth. The importance of this will become evident later. As for geochemistry for gold, the only analytical techniques we had in the 1960s had a detection limit of about a 1 g/t, i.e. one part-per-million. We subsequently found out that we needed to be able to detect a few parts-per-billion to effectively explore.

Meanwhile, between 1962 and 1963, things were not going very well in my relationships with my boss and mentor, Mr. Campbell. All of the operations that were in Western Australia were under the control of Mr. Brodie-Hall (“Brodie”). He was the mining engineer and the boss, called the General Superintendent of Operations in Western Australia. He was not only a very senior executive but from January 1962 a director, i.e. a member of the Board. Mr. Campbell never got on very well with “Brodie.” I think in an attempt to foster good relations between these two senior executives, Mr. Campbell was also appointed a director. So although they are now both company directors, “Brodie” was the executive director with ultimate financial responsibility for all the mines and all the exploration in Western Australia and Don Campbell could never accept this. In November 1962 Don wrote a proposal to the Managing Director, Mr. Bill Morgan, also a mining engineer, and asked “for authority to establish an autonomous exploration department with headquarters in Perth”. And back came the reply from “Brodie”

“Dear Don, I have given a lot of thought to your proposal that an independent exploration department should be set up in Perth and put down my thoughts in the attached notes. You will see that I have been unable to find any points in favour of such a proposal.” (20th November, 1962)

Despite this rebuke Mr. Campbell was determined, and by March 1963 had made arrangements to rent independent office space in Perth. A rift thus developed that never

healed. And it affected my relationships with both “Brodie” and Don. Don Campbell was my professional boss, being chief geologist, but the money came from “Brodie”. Now I got on extremely well with “Brodie” and he was very supportive of everything I wanted to do. Meanwhile Don felt that all my requests for exploration finance should be made to him. “Brodie” thought otherwise, he seemed to admire the way I went about the remapping programs, and he embraced my belief that there ought to be other deposits around the goldfields other than gold deposits, and that I ought to have some base metal exploration budget. He also didn’t believe all the base metal exploration money should be spent in Eastern Australia, where all the big base metal mines had so far been found: Mt. Isa, Broken Hill, Cobar. But Mr. Campbell wanted to devote the base metal exploration budget mainly to the eastern states of Australia, and be responsible for the financial management of all exploration.

04:00:24:19

Swent: Where were Mr. Campbell and Mr. Brodie-Hall?

04:00:24:23

Woodall: Brodie was in Kalgoorlie, Don Campbell in Perth, where he had moved in 1962. I wrote most of my memoranda to Brodie, as he was in charge of Western Australia, but always sent Don Campbell copies of correspondence to keep him informed.

04:00:24:43

Swent: So you were sort of caught in the middle, as it were?

04:00:24:46

Woodall: Sort of, yes.

While all this unpleasant conflict was in progress, I busied myself with gold exploration, especially in and around the gold mines at Kalgoorlie and Norseman in particular. I also started a project to extend our knowledge of the geology to the south of Kalgoorlie, along the line of major faulting and signs of mineralization. For locating outcrops we used prints from the old air photographs WMC had taken in the 1930s and by 1964 the mapping had extended 30 miles south of Kalgoorlie, just north of a location called Red Hill, which was soon to become famous. I was also still requesting support for base metals exploration in the goldfields of Western Australia, as shown by the following memorandum to Brodie:

“Kalgoorlie, W.A., 14th September, 1964.

Memo to: Mr. L.C. Brodie-Hall, General Superintendent

From: R. Woodall

Base Metal Exploration in the Western Australian Goldfields

The greenstone areas of the West Australian goldfields display all the geological features thought to be essential for base metal ore occurrences....

.... The belt of country approximately 150 miles wide from Norseman to Meekatharra, a distance of 500 miles, is similar in size and geology to the

Precambrian greenstone province of the Sudbury-Kirkland Lake-Timmins-Noranda area of Canada. The striking difference is in the number of base metal deposits in the Canadian province: copper, zinc, and nickel deposits, and the apparent absence of comparable deposits in Western Australia.

The lack of any base metal find of major importance in the Western Australian goldfields has been taken as evidence that base metal ore deposits do not exist in this region but this deduction is not valid without some qualification. One of the favored environments for base metal deposits in the Canadian Precambrian is in the sedimentary-acid volcanic rock successions adjacent to areas of basaltic and doleritic rock. At Kalgoorlie, for example, this would be in the Black Flag Beds. Such rocks on the Western Australian goldfields are poorly exposed, and typically form broad alluvium-covered valleys and salt lake depressions between lines of hills composed of the basaltic and doleritic greenstones. Where the sediments and acid volcanics are exposed, they are usually deeply oxidized. In other words, basaltic and doleritic rocks which are the favored host rocks for West Australian gold mineralization, form the main un-oxidized rock outcrops. Thus, if base metals are preferentially concentrated in the adjacent poorly exposed sedimentary-acid volcanic rocks, then gold finds will predominate over base metal finds irrespective of the relative abundance of each.”

I believed some base metal exploration effort was justified in the Western Australian goldfields and I requested the following financial resources:

<u>Cost/Year</u> ‘	
	(Incl. O’head & O. & M. Charges)
1 geologist	£4,000
1 junior draughtswoman	1,500
2 field assistants	4,000
2 vehicles	800
Analytical capacity (A.M.D.L.?) 10,000 determinations	1,000
I.P. surveys over specific targets	
3 months @ 1,400/month	5,200
Vacuum or Gemco drilling	
3 months @ 1,000/month	3,000
Diamond drilling	
2 months @ 1,500/month	<u>3,000</u>
	<u>£22,500</u>

What I was saying in September 1964 was no different from what I learned from touring those Canadian mines in 1955 on the way to Berkeley. Now, ten years later, I was still saying the same thing, namely:

“The striking difference between the West Australian goldfields and the Canadian Archaean province is the absence of base metal deposits of any size, in Western Australia. The lack of base metal deposits of major importance has been taken as evidence that sizeable base metal deposits do not exist in Western Australia., but that deduction is not valid.”

“The favorable environments for base metal deposits in the Canadian Precambrian is in the sedimentary and acid volcanic rocks. In Western Australia such rocks are poorly exposed and even where they are exposed, they are even difficult to identify because they are very deeply weathered. And any contained base metal showings are likely to have been leached out of the outcrops by the intense weathering.”

I mentioned that one area showing promise for copper was at an old mining area north of Kalgoorlie, called Eulaminna. Copper mineralization had been discovered there in the early part of the 1900s.

I am referring to this report—

04:00:27:28

Swent: Yes.

04:00:27:31

Woodall: A report dated 18 September, 1964. Here is the text. It is important! It explains my continuing enthusiasm and requests for base metals exploration in the goldfields of Western Australia.

You see, in much of the flat Australian inland you get a few hills and then ten or twenty miles with no outcrop at all, and then another small row of hills. On the hills you find the gold mines, but between the hills you don't see ninety percent of the rocks because they are concealed by soil and alluvium or are so deeply weathered that they are very hard to identify. Any sign of copper or lead would have been leached out of the outcrops long ago. But the geology is so similar to the Canadian Archean; it ought to be prospective. So I asked for a small budget to start a base metal exploration program in the goldfields of Western Australia with an annual budget of £22,500, i.e. about \$40,000.

04:00:29:15

Swent: Pounds?

04:00:29:12

Woodall: Twenty-two thousand pounds a year.

04:00:29:20

Swent: Why pounds?

04:00:29:19

Woodall: That was the currency. We went decimal later on.

We went decimal and converted to dollars in the sixties, but it was pounds before then. Now, what I am going to tell you next is very important! There was a period of about a month when everything changed. There was this conflict between Brodie and Don

Campbell. There was me, still trying to get a miniscule base metals exploration budget, trying to convince people to realize that I ought to be looking for more than just gold! And then, nine days later I wrote another letter to Brodie. It is one of the most important letters I ever wrote, and it changed everything for me, and everything for the company.

04:00:30:22

Swent: Although Mr. Brodie-Hall was just ten feet away from you, you were writing letters?

04:00:30:24

Woodall: No, sorry. He had now moved—beg your pardon. He had now moved to Perth, too.

04:00:30:36

Swent: Of course, you still might write to get it on the record.

04:00:30:43

Woodall: So, on 23 September 1964, I had important news for Brodie in support of my request of 14 September for a small base metals exploration budget.

Confidential

23rd September, 1964.

L.C. Brodie-Hall, Esq.

Western Mining Corporation Limited,

Fourth Floor, Cecil Building,

6 Sherwood Court,

PERTH. W.A.

Dear Brodie,

As you will no doubt be discussing base metal exploration while you are in Melbourne, I think you will be interested in a prospect I visited on Monday.

A prospector brought in several specimens of gossan from the Red Hill area, thirty-five miles south of Kalgoorlie, near the north shore of Lake Lefroy. Similar material had been brought in to Bill Symons some time ago and the presence of nickel was confirmed.

The four samples the prospector brought me averaged 0.9% Ni and a sample sent to A.M.D.L. for complete spectrographic analysis showed about 0.5% Cu as well as nickel, abnormal molybdenum and tellurium (each at least 100 times normal) and a few penny-weights of silver.

The material is leached gossan, and it can be expected that in the sulfide zone the nickel and copper will both be higher. The high tellurium content is typical of nickel-copper sulphide deposits.

The lode outcrop (i.e. the gossan) can be traced for 1,200 ft. It may not be continuous, but could be. It is, unfortunately, only narrow (3 to 4 ft. true width) and dips flatly at 20 degrees to 40 degrees.

I am not suggesting that I have found an orebody, but the occurrence is of great interest. It was opened up 60 years ago for gold and finding none, the prospect was abandoned. It confirms my belief that the country is not prospected for base metals. Even if this lode was 10 ft. wide and 2,000 ft. long it still would have been left.

I would like you to spend a morning having a look at the occurrence some time. It is fair warning that we should not spend all our effort looking for base metals in the “fashionable” areas of Eastern Australia while we have good “hunting grounds” in our own backyard and still very little competition. The grass always looks greener on the other side of the fence.”

I went back to the prospect, and five days later wrote to “Brodie” again.

“During a short visit to the prospect, I traced the lode outcrop for a total of twelve hundred feet, and I think the mineralization is likely to be continuous over this length, although surface concealment prevents continuous observations. The lode occurs in ultramafic rocks, and there is evidence of sulfide mineralization over a true width of three to four feet. The lode dips flatly at twenty to forty degrees. The nickel-copper content of the primary sulfide ore can only be guessed, but it is likely to be higher than in the gossan, which is well leached. A thorough reconnaissance of the area is warranted, as other gossan outcrops may occur. Geological mapping may also define the control of the lode already found and show up-extensions.

I could achieve something useful if I could use two geological students in the area during the summer vacation period. The cost of a three-month programme would be as follows:

Wages – 2 students incl. wages overheads	£700
Camping stores	150
Travelling: 2,000 miles @ 1/6d	150
Analysis at A.M.D.L. 4,000 determinations @ 2/6d	500
Supervision and Drawing Office charges	<u>500</u>
	<u>£2,000</u>

If a programme of work is approved, an application should be made immediately for a Temporary Reserve to cover the 20 square miles of Crown Land involved. If this reserve is granted we should then open negotiations with the Hampton Company regarding a reserve over their Location 48.

R. Woodall

c. Mr. J.D. Campbell

04:00:36:18

Swent: This is I guess what we would call “staking a claim” in America.

04:00:36:38

Woodall: Fortunately, Mr. Bill Morgan, who was now the Managing Director and the Chairman of the company, Mr. Lindsay Clark, took this letter very seriously. Don Campbell was keen but wanted to immediately get a joint-venture partner to finance the evaluation of the Red Hill gossans, i.e. to sell part of the ownership! Neither Mr. Clark nor Mr. Bill Morgan wanted to do this! And, in retrospect, it just shows that I did have the confidence of the chairman and managing director back in Melbourne for the type of work I was trying to do. If we had brought in a partner we would have given away “for peanuts” the most important base metal discovery in Western Australia up until that time.

04:00:37:25

Swent: Where did Brodie-Hall stand on it?

04:00:37:24

Woodall: Very supportive. That request for a small amount of money to employ a couple of summer students was made on 28 September. Less than one month later, in October, other important events occurred. Senior representatives of Newmont and Anglo-American visited Kalgoorlie, talking to the company about exploring for base metals in joint-venture with Western Mining. Why talk to us? Because we were established in the area. We knew the country, we knew the politics. We knew something about the geology. The idea was that we should do this as a three-way joint-venture. The discussions were very intense. We believed our local knowledge would be very valuable to such a project and therefore argued that WMC should not have to contribute financially in the early years. Newmont thought otherwise. Someone you will know, Dr. Arthur Brant, was in the group that came.

04:00:38:40

Swent: He was with Newmont.

04:00:38:36

Woodall: He was with Newmont. Dr. Hal Norman from Newmont and Bob Searles also came. Senior people from Anglo-American in South Africa also came, including Toby Antrobus. On 9 October I took Hal Norman and showed him the Red Hill gossans as evidence that this was not just gold country.

Western Mining had no money of any consequence for exploration but thought our local knowledge was valuable. We wanted Newmont and Anglo-American to pay for the first few years of exploration, to give us a free-carry because of our knowledge, because of our local presence. But they would not agree. They believed their skills in geophysics and knowledge of Canadian mineral districts was of equal value. They clearly did not consider the “Red Hill” gossan outcrops of much significance. They could have had a share of what was to follow very shortly. I mention this because this was regarded as gold country. It had been explored since the 1890s for gold. Thousands of prospectors had been over the country. Many mining companies had been exploring the country.

They had only ever found gold: so this supposed nickel occurrence in “gold country” was not considered of particular importance.

04:00:40:26

Swent: You find only what you are looking for!

04:00:40:27

Woodall: The “wisdom” at the time was: go look for nickel where Sudbury-like rocks occur. They are not Precambrian rocks. They are not Archaean rocks. They are Proterozoic norites. So, if you want to find nickel sulfides, you go to the Proterozoic, where there are norites, because the best nickel sulfide deposit known in the world at that time was at Sudbury in noritic rocks. So, where are the noritic rocks at Red Hill? None! They considered that what I showed them was something of scientific interest only.

04:00:41:19

Swent: And these were geologists that you were talking to?

04:00:41:25

Woodall: Disbelief.

04:00:41:33

Swent: Amazing.

04:00:41:36

Woodall: It’s a classic example of how fixed the human mind can be on what it thinks it knows and not doing what W.S. Robinson advised, “Tell me what you know, but also tell me what may be.” See, up till then, nobody in the world had ever found anything remotely like economic nickel sulfides in the Archean, and never in these sorts of rocks. This was “gold country”, or if you could find acid volcanic rocks, you might find copper and zinc, and if you found norites you might find nickel. So Newmont went off and did its own thing. At the same time, Selection Trust was starting to show some interest in looking for copper-zinc because of the Canadian Precambrian model and were starting to explore for base metals in the West Australia.

04:00:43:07

Swent: Were the people from Anglo-American also geologists?

04:00:43:11

Woodall: Yes, some were.

04:00:43:06

Swent: The experience in South Africa—

04:00:43:15

Woodall: Mainly experienced in gold and copper but not much in nickel.

04:00:43:20

Swent: Well, that’s what makes history so interesting isn’t it? Lost opportunities.

04:00:43:31

Woodall: Even my boss Don Campbell was only lukewarm, for on 31 December, 1964, Don, WMC’s chief geologist and director of the company, wrote to the managing director.

“I think we should remember that the best base metal projects are likely to be in Eastern Australia and that we should have time to con this field more thoroughly before getting too heavily involved in Western Australia.”

04:00:44:06

Swent: Reconnoiter.

04:00:44:06

Woodall: To look over. But, you see, I had the samples, I had had them analyzed. Samples from a lode at least twelve hundred feet long. I knew the outcrop was from nickel sulfides. I told them so! A book that Professor Chuck Meyer made me buy, Goldschmitt's *Geochemistry* was important. I had looked it up to see what were the characteristics of magmatic sulfides: sulfides that come out of magmatic rocks like nickel sulfides. And it said, “They are often anomalous in nickel, copper, tellurium and silver.” So Mr. Goldschmitt's *Geochemistry* told me that this gossan was derived from magmatic sulfides. It wasn't just some strange surface enrichment of nickel that might have come from nickel-rich silicates, for example, like you do get in lateritic nickel deposits. Anyway, the summer was just starting and the students down there were mapping, and we had a £2,000 budget (i.e. \$4,000 dollars) to spend.

04:00:45:52

Swent: It must have been terribly frustrating for you.

04:00:45:58

Woodall: Well, as you see, things were getting strained between myself and Don Campbell. I wrote to Don also in December and said I believe it is desirable to commence reconnaissance exploration in Western Australia. Remember now, I had these ironstone outcrops, i.e. outcrops that I was convinced were gossans. I believed they were leached outcrops of nickel-copper sulfides and I quote from that letter to Don:

“I believe it is desirable for us to commence general reconnaissance in Western Australia. The aim of this would be to assess the significance of the many known base metal showings and to acquire a better understanding of conditions of concealment and surface leaching. As this work need only involve minor expenditure, perhaps five thousand pounds a year for a field geologist, it's probably within the company's capacity. Certainly nothing further of value can be obtained from the literature.”

I appealed for a small amount of money.

04:00:47:45

Swent: Would you have sent copies of this to other people as well?

04:00:47:49

Woodall: Yes, to the Managing Director, Mr. Bill Morgan, to Mr. Brodie-Hall, and to a man that was emerging as a leader for the company, Mr. Arvi Parbo, who became managing director later on.

04:00:48:11

Woodall: I wrote a memorandum to Mr. Brodie-Hall on 7 January, 1965.

“Following the curtailment of negotiations in Melbourne with Newmont Mining and Anglo-American on the formation of a joint-venture to prospect the West Australian Precambrian shield for base metals, I accompanied Doctors Brant and Whiteside on a field reconnaissance trip through Leonora and Norseman districts. I believe Doctors Brant and Whiteside appreciated Western Mining’s position much more clearly after these discussions in the field.”

That’s the 7th of January. One week later, I advised my boss the chief geologist, Mr. Campbell:

“Red Hill nickel-copper prospect. Mr. Morgan has requested an estimate of expenditure necessary to test the nickel-copper prospects in Red Hill reserve.”

Mr. Morgan never wanted to joint-venture the prospect.

I wrote to Don Campbell again on 20 April subsequent to the expenditure of the £2,000 to report the results of the mapping by the two summer vacation students.

“The nickeliferous gossan, reported in my memorandum of the twenty-eighth of September, occurs at the base of an ultrabasic sill, which in turn, overlies basaltic lavas.”

“The gossan contains anomalous copper and tellurium, as well as nickel, and this suggests that the sulfide mineralization from which the gossan has been derived, is a primary segregation from the ultrabasic intrusion. Its occurrence at the base of the intrusion is in accordance with classical geological concepts. The extent of the lower contact of the ultrabasic sill,” (I thought it was a sill at the time) “is shown on the accompanying plan. It defines a domal structure and outcrops for a distance of approximately thirteen miles. Although the contact is only occasionally exposed, nickeliferous gossan exposures at locations A, C and D can reasonably be regarded as expressing at least one mile of mineralized contact.”

04:00:51:36

Swent: What kind of structure?

04:00:51:39

Woodall: A domal, i.e. a dome-like structure. As the result of just two young university students working their summer vacations we now had about thirteen miles of favorable contact to test, and we are all getting pretty excited. My memorandum to Mr. Don Campbell continued:

“Much of the contact is completely concealed, and it is reasonable to expect that the development of sulfides on the contact is much more extensive than the isolated gossans we have discovered. The only practical way to find out the nickel content of the sulfide minerals below the gossans is to drill the contact below the level of weathering at a number of locations.”

I also recommended that we use our recently acquired, induced polarization, electrical geophysical system and also run a magnetic survey at a cost of £2,500, and drill six holes: six-diamond drill holes at a cost of £9,000. I requested a budget of £11,500.

04:00:53:18

Swent: So your students were just doing mapping and sampling.

04:00:53:23

Woodall: Just one day later, 21 April, 1965, the man who was to become managing director and chairman of the company was asked to comment. This was Mr. Arvi Parbo. He was asked by the general superintendent, Mr. Brodie-Hall, to look at the possible economics of a nickel sulfide discovery at Red Hill, a location I had re-named Kambalda after a near-by, abandoned gold mining townsite. One of his statements in his reply to Brodie was contained in a memorandum dated April 21, 1965.

“Any opinion I can offer at this time, is affected by complete ignorance of the mode of occurrence of nickel ore at Kambalda (if it occurs at all).”

Such was the extent of unbelief despite the evidence I was presenting. I wrote again to Don Campbell, one week later, 30 of April.

“We have established that at Kambalda, there is widespread nickel mineralization associated with the base of an ultramafic sill. The surface expression of the Kambalda nickel mineralization is in places green siliceous material called prase (green massive quartz).”

04:00:55:51

Swent: Called what?

04:00:55:47

Woodall: Prase. Dr. Toby Antrobus, from Anglo American passed an interesting comment. He told me that in Africa, the surface expression of nickel sulfide in ultrabasics is at times simply siliceous moss agate, which is something very similar to prase. Just little bits of information helpful to me in trying to convince people that the weathering of a nickel sulfide deposit can create most unusual outcrops, not necessarily iron-or nickel-rich. They are sometimes very siliceous, silica-rich, siliceous outcrops, very different from what people thought ought to be the weathered expression of any sort of sulfide deposit. Why? Because this land has been under weathering for probably 60 million years. Cretaceous weathering, early Tertiary weathering, recent weathering. On 31 May 1965 my boss wrote, showing real interest.

“I am writing a note to Mr. Morgan, the managing director, suggesting that we go into the Kambalda prospect on a somewhat larger scale than you have suggested. It is possible that the work will be done in partnership with North Broken Hill.”

04:00:57:44

Woodall: I only wanted £11,500 pounds, i.e. \$22,000, and Don was prepared to give part of whatever might be found, to someone else, for example, to North Broken Hill, for the sake of £11,000. But Mr. Bill Morgan said no! “We are going to drill this ourselves. We

are not joint-venturing it to anybody.” This was a welcome vote of confidence in my scientific judgment and recommendation, and a set-back for Don.

Now, Mr. Parbo was starting to replace Mr. Brodie-Hall as the man in charge in Western Australia, the man who controlled the money, and I recommended to him that we apply for 840 square miles of exploration tenement and warned that we may need another 3,000 square miles to cover the regional potential—if this really proved to be a major nickel sulfide discovery.

As a diversion, in July of 1965, I had to write to Professor Wisser, and apologize for the fact that I had been a bit slow in replying to Chuck Meyer’s request to come back to Berkeley, do a Ph.D. and join the faculty.

04:00:59:46

Swent: By then it was too exciting in Australia to think of leaving.

04:00:59:53

Woodall: When I left Berkeley—the reason I didn’t do the doctorate straight after my Master’s was as much on the advice of Chuck Meyer as anybody. To do a doctorate, I had to spend a year gaining competence in a foreign language. He said, “Roy, go back and go find ore bodies,” and that plus my admiration for the people I was going back to was the critical factor. But Chuck really did want me back, eventually, which was nice to know.

04:01:00:36

Swent: Did he ever come over to visit?

04:01:00:37

Woodall: Yes.

04:01:00:39

Swent: But not at this early date?

04:01:00:43

Woodall: He came out to Australia in 1960.

04:01:01:00

Swent: Oh, he did come early.

04:01:01:06

Woodall: Yes! And in a letter to Professor Wisser to congratulate him on receiving an honorary LL.D. degree from “Cal,” dated 8 July, 1965, I wrote,

“In my case in particular, your news also prompts me to think in retrospect of Chuck Meyer’s visit to Kalgoorlie, and his invitation at that time to return to Berkeley for doctorate work and perhaps a place in your empty chair”.

Chuck wanted me to replace Ed Wisser. Chuck came out quite often afterwards.

04:01:01:53

Swent: Yes, I knew he did come out later.

04:01:01:59

Woodall: The mapping over the summer of 1964/65 confirmed that there were thirteen miles of contact that had to be explored. We did some induced polarization geophysics, and Anton Triglavcanin confirmed the presence of sulfides. I have mentioned Anton with respect to my Tarraji exploration. He was the Yugoslav geophysicist. I went on vacation in January 1966, having appointed a Mr. Dick Elkington to look after the drilling which had now commenced at the “discovery of gossan.” When I came back from vacation, he showed me nine feet of solid nickel-copper sulfides from the first hole, drill hole KD-1: massive pyrrhotite carrying pentlandite and chalcopyrite from 478 feet to 487 feet. The intersection assayed 8.3 percent nickel.

04:01:05:02

Woodall: What happened then? We rewarded the prospectors as I had promised: they were given £25,000, an amount which surprised them. They did not expect nearly as much, and a nickel boom erupted. Selection Trust switched from looking for copper and zinc to looking for nickel, and they found the Perseverance deposit north of Kalgoorlie. I made up a suite of samples of the different types of gossans you might find, some of them very heavy in iron oxide, some of them very siliceous, and presented them to the Prospector’s Association of Kalgoorlie, so the local prospectors would know what to go and look for. Maybe it was a dumb thing to do as I gave away a competitive advantage, I suppose. One deposit just north of Kalgoorlie, Scotia, was found by a prospector as a result.

04:01:06:03

Swent: Why do you say that might have been a dumb thing to do?

04:01:06:07

Woodall: Well, I was just educating and encouraging competitors, wasn’t I?

04:01:06:15

Swent: Or partners.

04:01:06:13

Woodall: I tried to get on well with prospectors. Another prospector discovered the Mount Windarra deposit, probably also as a result of being shown what to look for.

The Mount Windarra discovery started what was called the Poseidon Boom. Poseidon was the name of the company the prospector was working for, and Poseidon shares went from a few cents—we were now on decimal currency—to over \$200. Then Anaconda came in and staked all the ground to the south of Kambalda and found the Redross deposit, and the Wannaway deposit. And suddenly, the whole goldfields area was alive with drills and geologists and there were many discoveries. We immediately started to develop Kambalda, and within eighteen months, we were exporting nickel concentrates.

04:01:07:44

Swent: Only a year and a half?

04:01:07:44

Woodall: And the concentrates went to Sherritt-Gordon, the Canadian nickel mining and processing company. We developed a town at Kambalda where you could be dismissed

from employment if you removed any natural vegetation taller than about three or four feet without the resident manager's permission. All car parks had to be established without the removal of any trees. This was long before there was any pressure on mining companies to be environmentally responsible. It is still a leafy, if somewhat arid and run down mining town, still very much occupied, and the mines are still working.

04:01:08:54

Swent: It has been legendary.

04:01:08:58

Woodall: Kambalda has produced over a million tons of contained nickel metal from a group of mines. Nickel varies in price as you probably know, but if it averaged US\$ 4 a pound, that's \$8,000 a ton, and that's eight billion dollars worth of new wealth that Australian people didn't know existed before 1966. And how close it was to not being supported or sold out to other companies for a "song".

There was nearly a problem though. The first hole intersected nine feet of 8 percent nickel. The next hole nearby was barren. The third hole was also barren. The fourth hole was barren, and then we drilled three fantastic ore-grade intersections in a row. This is an important point. One of the most important things to reflect on, is how important it is to have the confidence of the people above you. You can see how they were having trouble believing, and, with very little money, and how easy it would have been, after three dud holes, for them to say, "Okay, this is only of scientific interest. This is nothing economic. We've got one intersection and he drilled three more holes nearby and he can't find any more. He's like that, you know. This is Roy Woodall doing scientific things." But they didn't. They never went back on their offer to finance six drill holes. We did get some encouragement beneath another small gossan exposure some miles away, but it was very deep, 1,300 feet deep. That was a big help, confidence-wise. We might well have walked away from the discovery site if people had been faint-hearted and didn't have confidence in what I was trying to do. And I am going to repeat that same story with the discovery of an even much more valuable ore deposit later on, with exactly the same result.

04:01:12:17

Swent: And I was thinking also how many jobs were created. How many—what is the size of the town of Kambalda?

04:01:12:28

Woodall: It's not a big town, but there were all these other discoveries, and Western Mining immediately committed itself to a nickel refinery to make pure metal. And then, immediately after that the company built a smelter. And so, we had all the processing facilities and eventually, all the other nickel discoveries fell into Western Mining's lap: Perseverance that Selection Trust found; Mount Windarra, which Poseidon found; the Mount Keith deposits; and the Anaconda deposits. It is hard to estimate how many people were employed but it's also the flow-on effect you need to consider. You are asking me how many people? There were people not just working on the mines, but working in the smelter, working in the refinery. Remember also all the policemen, the school teachers, the shopkeepers, the public servants that provided the services around the towns of Kambalda, Kalgoorlie and the mining camps elsewhere, and those building

houses, schools etc. Kalgoorlie is a beautiful town now, helped very much by the nickel business. Also later by the gold business.

04:01:13:58

Swent: Well, I have heard the rule of thumb, that for one miner, one production worker creates fifteen other jobs.

04:01:14:07

Woodall: It's at least that, and I have some statistics on it, which I used in a series of lectures that I started to give after the Kambalda discovery. That sort of logic and argument wasn't so important in those early days. It became very much more important in the 1980s when people started to question why you needed a mining industry.

04:01:14:44

Swent: But you weren't dealing with that at this time?

04:01:14:48

Woodall: No, we created a new industry. We found a type of ore deposit that had never been discovered anywhere else in the world in rocks that were essentially unknown in the world. They were called komatiites.

Interview 3: January, 22, 2004
[Begin disc 5]

05:00:00:09

Woodall: Not only were the Kambalda nickel sulfide deposits the first of their type ever found in the world, and the first economic nickel sulfide deposits found in Archean rocks, they were associated with a very strange ultramafic rock, which became known as a komatiite. These rocks had a very strange texture. I had seen the same rocks when I was a student working for Western Mining at Coolgardie in the summer of 1950/51. The local mine geologists called them “spinifex-textured” rocks. Now there is a spiny desert grass, called spinifex that grows in inland Australia, and the textures in these dark rocks were that of a dark matrix with spiny, pale, intersecting patterns in it, not unlike spinifex grass. Now if I had really been smart, I would have asked myself why do these rocks have this strange texture. And if I had had any metallurgical knowledge I would have recognized it as a typical quench texture, the texture that you get when you quickly cool metals, or slags from a smelter. But I had never seen these textures in metals or slags, and I knew nothing about metallurgy. If a metallurgist had seen the texture, I think it would have been recognized for what it was, straightaway.

Subsequent research has proved that these unique rocks were lava flows that were unusually common on the surface of the earth in the Archean around 2600 to 2700 million years ago. And unlike most lavas, they erupted at extremely high temperatures, probably in the 1400 to 1500 °C. At Kambalda, they probably erupted under a shallow sea, and were immediately quenched. And so exactly the same textures developed in these rocks as you get when you take a 1500 °C metal or slag from a smelter furnace and chill it rapidly. We didn’t know that at the time, but that’s what we eventually found out about these very strange rocks.

There is still some debate as to where these strange high temperature lavas acquired their sulfur to form nickel sulfides and that debate is still on-going in the geological science world. One theory is that the magmas came from quite deep in the earth, hence their high temperature, and they carried with them molten nickel-copper sulfides in the melt. Once the lava flowed out on the surface, the droplets of molten sulfide settled out on to the bottom of the flow. Other scientists argue that when these extremely hot lavas came out on the earth’s surface, on to a sediment-basalt basement, the super-heated komatiite melt eroded sediments and basalt in the ocean floor. Now komatiites themselves contain a nickel, and any sediments would contain sulfur as sulfides. Thus some believe that the melting of the ocean floor on which the komatiites were flowing changed the composition of the melt, sulfur from the sediments being incorporated into the hot molten lava. There nickel and copper sulfides formed from the nickel and copper already in the molten lava. It is the alternative hypothesis! The debate is unresolved! But komatiites are certainly very unusual rocks. By studying these rocks, we have learnt quite a lot about a type of Archean volcanism about which the scientific community had no previous knowledge.

05:00:05:42

Swent: So, this is different from the rocks at Sudbury?

05:00:05:44

Woodall: Very different, totally different. Nothing like them at all. Over the next seven years, we found another ten typical komatiitic nickel sulfide deposits, and that provided the basis for the Western Mining nickel industry, and the justification for building a refinery and smelter and so forth.

05:00:06:20

Swent: So you were proved right.

05:00:06:24

Woodall: There is a little story I would like to tell you, which is further emphasis on how important it is to always check the old literature. I think I have indicated before that I had the very highest respect for Mr. Gordon Lindesay Clark, who was the founding manager-director of Western Mining and its chairman for many years. He was not only a gentleman but a wise person, always interested in what young scientists were trying to do.

05:00:07:02

Swent: He's the one who visited your wife.

05:00:07:03

Woodall: That's the man. Now, while researching for this oral history, I came across a letter he wrote in June 1953. This was just a couple of months after I joined the company. He had ideas! I will just quote from a letter he wrote to the company's chief metallurgist, a Mr. Penrose.

“I suggest that you have a look at an article on rare elements on page thirty-two of *World Mining*. I think we should use an infrasizer, and get concentrates from all of our gold mines, and have them examined to see if there are any elements present. In other words, maybe there is something in the ores other than gold.”

And the letter goes on, and gets more interesting!

“When we are having any analysis made of ores, will you include nickel? I have always thought there might be some nickel areas in the west.”

Now, that was written to the company's chief metallurgist, Mr. Penrose, and as far as I know, with negligible response.

Now, if Mr. Clark had asked a geologist whether there was any reference in the literature to strange minerals in gold mines, he could have found the Kambalda nickel deposits before anyone else. There was a volume published at that time called *The Minerals of Western Australia*, by a government geologist, Mr. Simpson, and if you look up pentlandite, the ore mineral that contains the nickel in most nickel ores, it is recorded as being present in the Red Hill gold mine. That person could then have gone straight to Red Hill in 1953 and found those gossans. So there, a bit of correspondence and a note in a government report that was never acted on.

05:00:09:37

Swent: There was one word there I missed. Infrasizer?

- 05:00:09:41
Woodall: Infrasizer. [spells].
- 05:00:09:47
Swent: That's a new word to me.
- 05:00:09:49
Woodall: It is used by metallurgists to concentrate very fine particles that are heavier than gangue minerals like quartz. The things you find out when you dig around in historical documents!
- 05:00:10:06
Swent: That's wonderful. [laughs]
- 05:00:10:07
Woodall: The initial discovery at Kambalda was made in January 1966. We found three more nickel deposits in '67 and another six in the next few years. Now, 1967 was my tenth year after returning from Berkeley. I had made up my mind that if I was going to remain a useful geological scientist in industry, and not just an operating type out of touch with science, I should not work the tenth year, but go on a sabbatical. Well, the company was rather pleased after the Kambalda discovery because the shares increased one hundred times in value, so when I asked if I might have leave during most of 1967 to upgrade my knowledge of ore deposits and skills, they allowed me to go on full pay! I had by then met people from the Newmont and Anglo-American companies with mines in Africa and so I decided to go first to Southern Africa to update my knowledge of the great ore bodies on that continent: the great gold deposits of the Rand, the great diamond mines and deposits of copper and copper-lead-zinc in West Africa. The company's response was overwhelming. "That's a good idea, we will help you fix that up." So I went to Africa as a guest of Anglo-American and Newmont and I learned so much about many types of ore deposits that I had never ever seen; and some of them, the world's greatest, including the great chromite and platinum deposits. Anglo-American and Newmont personnel were my generous hosts.
- 05:00:12:22
Swent: What about uranium?
- 05:00:12:24
Woodall: There was uranium being recovered from the South African gold deposits, but I didn't focus too much on that.
- 05:00:12:37
Swent: Did you say chromite?
- 05:00:12:41
Woodall: Chromite and platinum. South Africa has the biggest gold deposits, the biggest platinum and chromite deposits, and some of the biggest diamond deposits. We might talk about that later on.
- 05:00:13:01
Swent: That's what you were trying to find out.

- 05:00:13:07
Woodall: So I came back from that trip, and thought about the rest of the year. I decided to revisit mines in North America now that I had more experience. I thought I would gain much more from visits to the famous mines of Canada and the Western United States than I did en route to Berkeley in 1955. Again the company said they would pay for the trip and they paid for my wife and family also. So we set off in the middle of 1967 for Canada. Gosh, I have to get this sequence right. Sorry about this pause, I have just got myself a bit mixed up about travel plans.
- 05:00:15:01
Swent: Well, that's understandable. You have done a lot of traveling. You must have had quite a family by now?
- 05:00:15:06
Woodall: We had eight children.
- 05:00:15:12
Swent: And they were all with you.
- 05:00:15:08
Woodall: We set off for North America together; that's right. By train from Kalgoorlie to Melbourne, and there the managing director, Mr. Bill Morgan, met the train himself, and his wife, with chauffeur-driven cars to take me, the young geologist, to the head office to have lunch and meet some of the directors, and my wife and children, to be with Mrs. Morgan.
- 05:00:15:40
Swent: Was this the first time you had been there?
- 05:00:15:48
Woodall: I think it was, and the managing director's wife came and took care of my wife and eight children and looked after them until late in the evening, gave us dinner at their home, then took us to the railway station to catch the night train from Melbourne to Sydney.
- 05:00:16:17
Swent: It must have been quite an entourage.
- 05:00:16:28
Woodall: And from Sydney, we flew to San Francisco en route to Berkeley.
- 05:00:16:45
Swent: You must have had to stop—
- 05:00:16:47
Woodall: Oh yes, there weren't direct flights at that time.
- 05:00:16:52
Swent: You stopped in Fiji and Hawaii, I expect.
- 05:00:16:54
Woodall: Yes, Fiji, Honolulu and San Francisco. And we rented a house at 1506 Josephine Street, Berkeley. Then, I left the family and went up to Canada to visit mines, and then

subsequently my family joined me up there, where we established a base in a log cabin on Lake Nippising, North Bay. I visited more mines and eventually traveled down with the whole family on the day before Thanksgiving in 1967 to have Thanksgiving dinner with Chuck and Ginny Meyer at Butte, Montana. Then we came back to Berkeley and in December we caught a boat back to Australia celebrating Christmas onboard ship. So, that disposed of 1967 very pleasantly and I had learnt a lot.

05:00:18:29

Swent: I am sure. You didn't take the family on the African jaunt?

05:00:18:35

Woodall: No, I went on my own to Africa but brought the family to North America.

While in North America I received a very unpleasant letter from Don Campbell, the chief geologist and my boss; it was dated July 7, 1967. He seemed to be of the opinion that I had purposely bypassed him by writing directly to Brodie on several occasions, which I had done but I had either sent him copies of all correspondence or discussed matters with him beforehand. He told me I had "betrayed his trust" and had resigned! So I came back as the chief geologist in charge of everything, and life was different thereafter.

05:00:19:39

Swent: How was it different?

05:00:19:46

Woodall: Well, the company now was a favorite on the stock exchange. It was now easy to raise money. The Board wanted to dramatically keep up the pace of nickel exploration and were still interested in gold and we knew Western Australian geology better than anyone else. I know that Don Campbell had been keen on Eastern Australia, but we didn't have a presence there, and I was never allocated any resources to study the mineral districts there. So the best place to expand exploration was in Western Australia where we already had a presence and knowledge of the geology. There was plenty of land: a million square miles. So I established the system of regional bases, exploration bases. Very small, often with just one good resident geologist with one or two field assistants, sometimes two geologists.

05:00:20:58

Swent: What was new about this? You had geologists scattered about before.

05:00:21:06

Woodall: Yes, but they were all working out of Kalgoorlie before. Now they were being domiciled, resident, 300, 400 or 800 miles away, in small, isolated towns. The philosophy or strategy was; let's get our good geologists close to where the mineralized districts are. There they are much more likely to become very familiar with the geology, familiar with any prospectors that might be in the area, and feel that this was their province, where they were fully responsible. It was a matter of giving them responsibility, and motivating them to be good explorers. One of those bases was at a town about 200 miles north of Kalgoorlie called Leonora, others at Meekatharra and Wiluna, and a fourth in northern Western Australia at Wittenoon.

One of the things I had been interested in all along was the potential for using aboriginal people to be prospectors. The problem in 1967 was that aboriginal people did not even have citizenship. They were in the care of what was called the Native Welfare Department, but they were people naturally suited for work in the bush. That was their “bailiwick” where they felt most comfortable. They had excellent vision. The problem was, whenever they found any interesting rocks, they would bring them into a local town, and some white prospector would go out and stake the claim for himself. So you see, there was no incentive for them to ever become prospectors. So I went to see the Native Welfare officers whom I knew very well, and I said, “Look, we have got to protect these people’s interests if we want these men to be good prospectors. We have got to protect them when they find something of interest.” So we agreed that if ever they found any interesting rocks, they would bring them into the Native Welfare offices and then to Western Mining who would protect their title and make some arrangement with them, a business arrangement. The first opportunity came in 1966 when aborigines found copper in the Warburton Ranges – but more of that later. Let me first tell you about a gold find in 1967. Aborigines found gold north of our exploration base at Leonora at a place called Goanna Patch. Do you know what a goanna is?

05:00:24:09

Swent: A lizard.

05:00:24:08

Woodall: Yes, a reptile that digs burrows. Well, these goannas had been burrowing into the soil and had unearthed quartz containing gold, and small nuggets of gold which the aborigines had found, probably when chasing a goanna to have it for dinner. So I got a white prospector who was very sympathetic towards the aboriginal cause, and we said, “Let’s try to mine this discovery in partnership, the company, you, the prospector-miner, and the aboriginals.” And we did that for about two years: mined the gold ore and treated it in a nearby treatment plant, and shared the revenue.

05:00:25:03

Swent: What kind of mine? Was it an underground?

05:00:25:04

Woodall: Very shallow underground. Aboriginal workers were not very keen on going underground, so the white prospector did most of the mining and we shared the gold we produced. When it looked like we couldn’t make it a profitable operation this way, I asked the geologist in charge of the Leonora base, Jim Lalor, to report on the exploration prospects of the Goanna Patch.

Jim will turn up again later on in the story. I asked him to report on this deposit, as to whether we should put some real money into exploration there. Back came his report in May 1968. “This gold prospect is too small,” and listen to this. “and the country around the prospect is so heavily concealed with soil and alluvium.”

05:00:26:27

Swent: Words coming back to haunt you!

05:00:26:30

Woodall: Yes, if only we had taken this report seriously, for learning how to explore for gold in such flat, heavily soil-covered areas was the secret to many gold discoveries in the

1980s. I myself had not focused enough on this complicated flat landscape to understand the nature of the soil profile. How deeply were the rocks weathered? How deep was the soil profile and what was the nature of the concealment? Could the concealment completely hide gold, or would some of the horizons in the soil profile perhaps give a clue to the presence of gold at depth if you sampled certain horizons? Could we somehow get a clue as to what was down in the concealed mineralized rock? Maybe you have to sample a Cretaceous horizon or the early Tertiary horizon. But we knew nothing! Back came the report. It is just a small gold occurrence and the country is flat with practically no outcrop, so don't waste any money here. That was the discovery which could have led us to what became in the 1980s, and remember this report was in the 1960s—the highly prospective Yandal Gold Belt. Twelve million ounces have already been discovered there. A missed opportunity: but remember, in the 1960s, gold mining was not very profitable with the price fixed by the U.S. government at US\$35/ounce.

05:00:28:11

Swent: It wasn't turned down

05:00:28:15

Woodall: We didn't understand the importance of mapping and studying, scientifically, that layer of debris that had been deposited on the Precambrian since perhaps the Permian and understanding what parts of the weathering profile you could sample to get a clue as to what was buried beneath the soil cover. Remember, however, that our techniques for analyzing for gold in the 1960s were crude by comparison with analytical methods available in the 1980s, and the price of gold was low.

Now, back to the first good thing that happened because of my association with the aboriginal people. In 1965 they found very rich copper in the Warburton Ranges in remote Western Australia, and by rich, I really mean very rich. The specimens assayed 60% copper and contained 60 ounces of silver to the ton. It was so rich, we could mine it, put it into bags, truck it a thousand miles to the coast, and ship anywhere for smelting and still make a profit, even if sent to Germany. It was a copper occurrence similar to the famous copper deposits of Michigan, a very famous copper mining district, so we took this discovery seriously.

05:00:30:02

Swent: Northern Michigan.

05:00:30:09

Woodall: Yes! So we took this discovery very seriously.

The invitation to become involved came from Mr. Harman of the Native Welfare Department.

The following extract from a letter from Mr. J Harman, Superintendent with the Native Welfare Department, to the Commissioner of Native Welfare gives the background to my visit to the Warburton Range area from 19th to 30th July, 1965.

“On 17/6/65 a discussion was held with Mr. R. Woodall, a Senior Geologist with Western Mining Corporation regarding the copper deposits at Warburton

Ranges. These deposits are within a Native Reserve and have been worked spasmodically by the natives of the area and on occasions assisted by the Projects Officer from Laverton. It has been evident that the mining of these deposits has suffered and the safety, training and organization of the native labourer has been unsatisfactory because there is little or no supervision. Some aspects relating to safety and mining methods were adversely reported by a Mines Department Inspector following a recent visit.

It is suggested that the mining of these deposits could be effectively arranged by inviting the assistance both in staff and equipment of a reputable mining firm under an agreement satisfactory to the natives and this Department. A similar arrangement was made in respect of gold mining at Goanna Patch, although in that case it was not a Native Reserve.

The Western Mining Corporation are interested in copper deposits and have agreed to allow Mr. R. Woodall to undertake an extensive geological assessment of the known deposits and the area generally.”

We decided that we would send to this remote aboriginal community, five hundred miles from Kalgoorlie, out in the desert, a complete mining party of four people: a registered shift boss so mining would be legal and able to conform to the Mining Act regulations, and three good miners. We mined the rich veins the aborigines had found, and we cut a three-way deal with the aboriginals. We said, “A third of the revenue is yours, a third of the revenue is for the mining party, and a third of the revenue is for Western Mining to compensate for the cost of the equipment and supplies which we supply.” Now we mined there for four years and prospected the area. Eventually we decided that even though the deposits were very rich, they were too small to be profitable in that very remote locality. We carried out extensive exploration in the district, looking for larger deposits, but failed. It was however a very well managed program: our geologist-in-charge lived in a comfortable mud-brick house which the aborigines helped us to build, and we had a well equipped mobile analytical laboratory on site. We employed aborigines and trained one to be a laboratory assistant. During the visit I was accompanied by Mr. Harman, Mr. S. Bridgeman, (who was a Projects Officer with the Native Welfare Department), and a native guide. I was shown the Wingelina nickel laterite deposit, several copper deposits in the Blackstone Ranges, and the copper deposits of the Warburton Ranges.

05:00:31:23

Swent: Why did you need to send the ore to Germany? Weren't their processing plants closer?

05:00:31:31

Woodall: There were copper smelters in Eastern Australia but we got the best price from German smelters.

You might say the Warburton project was a failure, but it turned out to have a very interesting outcome, a very interesting development. One of the geologists who went out there was a young man, Douglas Haynes. Douglas was a young, enthusiastic, brilliant geologist and wanted to go on study leave to complete a doctorate. Now my philosophy of recruitment was: “Come and work for a short while, and then when you are experienced and you know really what the science of exploration really needs, then

go and do your postgraduate studies”. Now Doug was a very loyal Australian. He didn’t want to do his study at an overseas university; he wanted to study in Australia. So, he went to our top university, the Australian National University, to do a Ph.D. He took as his research project the question of where the Warburton copper had come from. It was in these rich veins in basalts. He wrote to me quite soon after he had gone to Canberra, I think it was 1968, and said, “My very preliminary conclusion is that these basalts contain a certain amount of copper in the structure of the minerals, in magnetite, for example. And when these basalts become oxidized by exposure to hot oxygenated waters, the magnetite gets converted to hematite. Now whereas magnetite can contain copper in its crystal structure, hematite cannot. So the copper becomes released into the oxygenated waters and available to be deposited in these rich veins. This is to be my doctorate study, and I am going to work on it and see if this idea has validity.” His research resulted in a very important scientific breakthrough.

While on the subject of copper, I need to go back to 1967. During my visit to Southern Africa I was taken to the famous copper deposits of what was then Rhodesia and Zambia, which are all in shales. It is one of the world’s greatest copper districts, rivaling the great deposits of Western United States and Chile. But instead of being in porphyries, like the copper deposits of the Western United States and Chile, the copper deposits were in shales, but incredibly rich. They extend for miles: an enormous copper resource. So I came back, having seen this, very excited. Why hasn’t Australia got similar deposits? And lo and behold, a prospector in northwestern Australia, near a town called Wittenoon, brought in samples of shale with copper. So we established a base at Wittenoon and launched the Fortescue Copper Project, an exploration effort that lasted ten years. Here we were with the opportunity, perhaps, to find another great “Rhodesian copper belt.” We equipped the Wittenoon base with an assay laboratory and extra geologists and over a period of ten years, we prospected a huge area because these copper-bearing shales extended over many many miles. Vast areas! But after ten years we failed to find economic copper grades. A sad end!

05:00:38:06

Swent: Sad.

05:00:38:03

Woodall: That’s bad enough, but there is a much sadder story to tell that relates to our Wittenoon exploration base. Remember, I wanted to establish these bases so the geologists would be close to prospectors; if a prospector found something of interest, he would likely come into our local office rather than contact some other company in the distant state capital cities. Now this will make you cry!

05:00:38:34

Swent: Except I know there is a happy ending later.

05:00:38:36

Woodall: Well, in this case there wasn’t a happy ending for WMC! In 1971, a prospector brought in other copper samples into our Wittenoon base, where David Barr was in charge; the samples were not from where we were exploring, they came from the Great Sandy Desert to the east of Wittenoon. The area, just like the name suggests, was sand dunes and desert. But they were copper samples all right. So David went out to inspect the prospect, and true, there were very interesting sequences of Protozoic sediments and

remember, the great Rhodesian copper belt deposits were in Protozoic sediments. So David carried out reconnaissance, and sampled these outcrops. There were not a lot of outcrops and the copper grades are quite low grade. David suspected that even the better grades were the result of surface enrichment, that is, the outcrops had been enriched by weathering. So, the copper deposits were considered of no economic interest. He was absolutely correct! The copper content of the samples was subeconomic, but, and here is the tragedy, the samples contained gold and he didn't assay for gold. One year later, Newmont went out there, assayed for gold and discovered the giant Telfer gold deposit which contains at least twelve million ounces of gold in gold lodes which contain some copper, enough copper to be a useful byproduct.

05:00:40:36

Swent: That is a sad story.

05:00:40:40

Woodall: You see, it's another case of human failure. I should have been more alert, more involved. Perhaps with two of us examining the outcrops we would have not been so blinded by our focus on copper and our desire to find another "Rhodesian Copper Belt".

05:00:40:45

Swent: Just not looking for the right thing!

05:00:40:47

Woodall: Still, we were so excited about the potential for a Rhodesian copper belt. We had established a copper-shale sequence already in the district that went for miles that we were exploring and we were only in the middle of our program. Here is another occurrence many miles away. We had copper in our eyes. Moreover, gold wasn't worth much at that time either, only US\$35 per ounce, and the area had no history of gold mining. But even at US\$35 per ounce, gold is valuable enough if the deposit is rich enough and big enough. Telfer was economic even then, and at today's high gold price, the Telfer deposit is a jewel. The company that now owns the deposit, Newcrest, is going to dramatically increase the production in the next few years. A big investment! I don't know how many more bad stories you can cope with! We missed it!

05:00:41:47

Swent: Well, that's okay.

05:00:41:47

Woodall: The importance of the aborigine's discovery of gold at the Goanna Patch was misunderstood through our lack of understanding of the weathered, soil environment. The copper-stained Telfer outcrops were misunderstood because we went looking for copper and didn't assay for gold. I don't know how long you want to go on today, but not too much longer, I hope. But I will just tell you one more story.

05:00:42:03

Swent: Okay, let's finish this. I was going to say this is the beauty of oral history because these stories don't get written up in the literature as a rule.

05:00:42:13

Woodall: It was my habit to give my family two vacations a year. Now summer in Australia is, of course, in December and January, when the school vacation is a long break. In summer we would go to the south coast and camp on the beaches.

05:00:42:32

Swent: Where is this?

05:00:42:35

Woodall: South of Kalgoorlie, at a place called Esperance. That was our main summer holiday. The schools also had a two-week break in August, which is in the wintertime, when the desert is cool and often flowers, if there has been a little winter rain. So each August we would go for a two-week camp into the arid interior. The children just loved this type of holiday almost as much as the summer camping by the beach. Well, our tenth child was born in April, 1971, but we still set off in August that year for the heart of Western Australia. North of our Meeketharra exploration base is a lovely place where we knew there would be pools of water along otherwise dry water courses which flow after summer rains. We camped at a place called Cattle Pool, a very pretty pool in an otherwise dry river bed on what we call a sheep or cattle “station,” what you would call a ranch. The pool was a mile or so from quite a large hill, called Mount Augustus, which rose about 2500 feet above the level of the plain. It was not a mountain but because the area is mainly so very flat, any elevated point gets called a “mountain.” We pitched our tents, by the pool, eight children in tents, Barbara and me in a tent. The two youngest, including our new-born baby still being fed by its mother and his two-and-a-half year old brother, Geoffrey, were put to sleep in the back of our station wagon. It was a beautiful moonlit night, full moon probably. I woke up at sunrise ready to light the fire, and make what we call billy tea, rather like campers in America would make early morning coffee. I got the fire going, put the billy on—a billy is just a tin can, in which you boil the water.

05:00:45:25

Swent: We know that from Waltzing Matilda.

05:00:45:24

Woodall: I put the billy on the fire to boil the water to make the tea, looked in the back of the station wagon and there is the baby but, horror, no Geoffrey! I woke Barbara. I immediately thought that Geoff had got out of the car when he saw the first morning light and had gone to the pool, been attracted by the water. I went to the pool but couldn't find him. I went back to the car and noticed that his teddy bear was missing. We now thought that if he had fallen into the water, the teddy bear would float. No teddy bear! Panic! I drove ten miles to the nearest station homestead; what you would call a ranch homestead. I raised the alarm that I had lost a two-and-a-half-year-old boy in the desert. The people in the homestead immediately sent out an emergency call over the Flying Doctor Radio Network to alert all other homesteads that there was a lost child. So, many came, some from fifty miles away, to help with the search. The wife of the owner of the pastoral property, said, “We have a woman here, who is very good at tracking—an aboriginal woman. She was taught to track animals for hunting, I think she should come. So she brought Mary along and, like a lot of aboriginal people, she was very shy. She looked around the camp and she found footsteps in stony ground where we couldn't see anything, and she set off with my wife. Meanwhile, the rest of us had broken up into different search parties and gone off in different directions. We came

back early afternoon, and no one had seen any sign of the child. But Mary had tracked him now for over a mile, walking very slowly, never stooping, convinced the child had headed west. If we had been intelligent, we might have realized that that was direction the moon had been before it disappeared below the horizon. If Geoff had woken he probably would have walked towards the moon because it was the only light he could see. But when you are in a state of shock you don't necessarily think very intelligently.

Now quite desperate, we started the afternoon search. At this stage, I had brought in a helicopter from the south to aid the search. All of my children were helping in different search parties. By this time, Mary had followed Geoff's tiny tracks to a fence line that was between the flat country and Mount Augustus, this big rocky hill. Mary had often said after examining foot prints which to us were invisible: "Little fella frightened, scared by something." She would say this because of the type of impressions she saw in the stony ground, little footsteps which we couldn't even recognize, tracks of a barefoot two-year-old in stony desert ground. Then she said, "He get through fence." So then, everybody grouped at the base of this hill, and we formed a long line of people including my children; slowly we walked some hundreds of feet high up the face of this quite steep, rocky hill. And at five o'clock in the afternoon, David, one of my boys, spotted Geoff, asleep with his teddy bear in the shadow of an overhanging rock. The people in the helicopter could never have found him; he was hidden and he was asleep. Obviously he had walked most of the night and all day, and exhausted, had fallen asleep in the shade of this rock. Now, here is the heart-wrenching finale. When we came back early afternoon for a break, everybody took an orange from a big crate of oranges we had with us, but the aboriginal woman took two oranges.

05:00:51:17

Swent: One for the boy and one for herself.

05:00:51:16

Woodall: That's it.

05:00:51:22

Swent: She knew she would find him.

05:00:51:27

Woodall: You guessed it! Critical observers might have said, how greedy, that's what you might expect! Well, the helicopter landed and we took Geoff back to camp. He had walked three miles barefoot. Now, when a child can walk three miles from any point before he collapses, you then end up with thirty-six square miles in which to search, looking for something which is two foot high and barefoot. What an awful thought! Now, here is the really heart-wrenching bit, when Mary came back to camp, she put one orange back in the box. She said, "That was for the little fella."

05:00:52:55

Swent: I am sure you were all in tears.

05:00:52:54

Woodall: So 1971 was a year in which we had one tragedy, but we might have had two! One of our geologists missed finding Telfer, and we nearly lost a boy. But thank God for the tracking skills of an aboriginal woman, Geoffrey was found in time, because if we hadn't, he would have walked again that night, and then....

- 05:00:53:21
Swent: Well, he would have been dehydrated, wouldn't he?
- 05:00:53:24
Woodall: Maybe that's where we should leave this interview.
- 05:00:53:28
Swent: That probably is a happy ending to stop on. I am sure you were all in tears by the time you found him, weren't you?
- 05:00:53:36
Woodall: Absolutely.
- 05:00:53:35
Swent: Oh my, what a dreadful thing to go through.
- 05:00:53:40
Woodall: And the tragedy is, those tracking skills are lost. There is no encouragement for the aboriginal Australians to keep up their tracking skills because they don't have to hunt anymore.
- 05:00:53:52
Swent: No incentive.
- 05:00:53:56
Woodall: No incentive.
- 05:00:54:02
Swent: All right well—
- 05:00:54:01
Woodall: Well, in the next session we—we've already talked about two world class discoveries, bauxite and Kambalda, and we are going to talk about two more which occurred in the next five years.
- 05:00:54:18
Swent: Lots of good stories. Okay, now I think we are all right for time: let's talk about the Yeelirrie discovery!
- 05:00:54:34
Woodall: Well, come 1970, we were asked if we could find a uranium deposit. As we wanted to use the best science, I allocated the job to Dr. Eric Cameron, a very bright graduate from England whom I had recruited. He went away and did what a good scientist should do. He researched the literature to find out where uranium had been found and where and why it might concentrate into economic grades and therefore where he might recommend we look for it in Australia.
- 05:00:55:26
Swent: Excuse me, you said someone asked you to hunt for uranium. Where did this request come from? From the government?

05:00:55:31

Woodall: No, from the WMC board; from the Managing Director, Mr. Bill Morgan and that great man, Mr. Gordon Lindsay Clark, who was the Chairman.

05:00:55:52

Swent: I was thinking perhaps it had come from outside.

05:00:55:57

Woodall: No! WMC had made an earlier attempt in the 1950s, almost before my time to find a uranium deposit. But anyway, now I was asked to look for uranium and Eric was told to go and approach it from a scientific point of view. He came back and said, "Look, there are two known major types of uranium deposit. One is associated with Proterozoic conglomerates, and deposits of that type have been found in Canada. Another type of deposit has been found on the Colorado plateau in the U.S. These are called rollfront deposits. They occur in porous sandstones where water percolating down through sandstone has leached out the small amounts of uranium. The water which percolates down from near-surface is oxygenated and able to leach the uranium; it becomes a dilute mineralizing solution. As it moves to a greater depth in the sandstone it comes in contact with a reducing environment and at that interface, the uranium that's in the oxidized solution precipitates at the contact with the oxygen-poor zone, i.e. at the "front," between those two environments. As this system continues, this uranium-rich "front" rolls on down-dip and gets bigger and richer, hence the name of this type of deposit.

There was quite a lot of interest from other overseas companies in looking for uranium in Australia, so we formed a joint venture to look for conglomerate-type uranium deposits in Northern Western Australia. But Eric also pointed out that the flat semi-arid landscape of the goldfields, which had been undisturbed since at least the Permian, had in it well-defined Tertiary river systems that were now completely filled with unconsolidated sands. They were once broad valleys two or three or four hundred feet deep, but once the wet climate terminated, they became filled in with sediment. So, Eric postulated they might contain rollfront deposits, like those still forming in Colorado. Well, no one had thought about this before. Eric studied regional magnetic and radiometric maps produced by our Bureau of Mineral Resources, like your USGS. The objective of the Bureau of Mineral Resources surveys had been to fly the area and record the magnetic characteristics to help identify and correlate the rock successions. But, as it didn't cost any more to put a radiation detector in the plane, they also recorded the presence of radiation. When Eric acquired these maps and overlaid them on maps of the buried Tertiary streams, he found radiometric anomalies coincided with some of the buried valleys. But the equipment in the plane was rudimentary, and didn't discriminate between the different wavelengths of gamma radiation; hence, we could not tell if the radiation came from thorium or uranium or potassium. Eric quite rightly said, "We need a more sophisticated detector, so we can discriminate between the different types of radiation, to see if any of this radiation is actually coming from uranium".

05:01:04:41

Well, we alerted our regional geologists, those out in the more remote regional exploration bases, as to what Eric was doing and what he was looking for. We also bought radiation detecting equipment which could discriminate between the different types of radiation. Our geologists at the various bases helped him locate places where

these infilled old river systems did in fact exhibit anomalous, distinctive, uranium radiation. But we had to wait some months before we were able to stake claims in these areas due to problems with administrative backlog in the Mines Department. When we were permitted, we staked claims at a place called Nowthana and drilled there. Lo and behold, they didn't find black pitchblende in the sediments like you would find in the Colorado type uranium deposit, they found yellow carnotite, associated with a calcareous deposit called calcrete. Carnotite is a hydrous oxide of potassium, vanadium, and uranium. We kept this secret because there were other areas where we also wanted to explore. And when we were able to stake these other areas, one of which was Yeelirrie, and the geologist went out there with a drill, the road followed a fence line and, surprise, surprise, there was yellow carnotite at the surface in the cuttings from where holes had been dug to put in fence posts. Now a pastoralist, years before, while digging those holes, might have picked up the material and said, "I wonder what this is, it's a funny looking material," and found the first uranium carnotite deposit in the world.

Swent: Yellow rock.

05:01:04:43

Woodall: Anyway, obviously no one had checked what this yellow material was that lay on the surface. We drilled the Yeelirrie anomaly, and it proved it to be a world-class uranium deposit. Again, it was the first time anyone had ever discovered a carnotite uranium deposit in calcrete. No one, anywhere in the world, had ever found such a deposit before.

05:01:05:08

Swent: That's unique.

05:01:05:08

Woodall: So again, it was a unique discovery, our second discovery of a new ore deposit type, the Kambalda nickel deposits being the first. Immediately the Yeelirrie discovery became known, everybody else started to look for calcrete-type uranium deposits. Many small occurrences were found, but never one the size of Yeelirrie. Now that deposit is still unmined and the reason it's unmined is that a few years after the discovery of Yeelirrie, in 1972, we found another deposit called Olympic Dam, which contained copper, uranium and gold. It was much more economic to bring that deposit into production. Moreover, there was a limit to how much uranium you could sell on the world market. So Yeelirrie stays there to this day, waiting for a market and political approval for its development. And the story of the discovery of Olympic Dam is perhaps for tomorrow.

05:01:06:22

Swent: For another day. You said there were political reasons why you delayed in staking this claim or getting the permit.

05:01:06:32

Woodall: The government put a ban on further applications for exploration licenses called temporary exploration reserves. Part of the reason was that the nickel boom had completely saturated their capacity to handle the administration of new claims. So they said, "No more, stop until we catch up on this whole business of administrating the Mining Act." So there was a temporary ban on "claim staking".

05:01:07:17

Swent: It had nothing to do with the particular mineral you were exploring?

05:01:07:24

Woodall: No. But Yeelirrie remains unmined today because of a rather foolish government policy which limits uranium mining in Australia.

05:01:07:28

Swent: I see. Well, perhaps that is a good place to stop then.

Interview 4: January, 23, 2004
[Begin disc 6]

06:00:00:08

Swent: This is Friday, January 23rd, and we are continuing an interview with Roy Woodall. We are meeting in an office in the Bancroft Library building at the Regional Oral History Office. We talked about Yeelirrie yesterday, and I guess today we are ready to move on to your next big achievement.

06:00:00:45

Woodall: Lee, before I start talking about what was the most important discovery we made—other people have rated it the most significant mineral discovery of a decade or more, which was the discovery of the Olympic Dam copper-uranium-gold deposit—before I do that, I'll just mention other issues and events. The success we were having with mineral exploration brought to Kalgoorlie, in 1974, some important Federal Government politicians, including a senior cabinet minister. They were interested in promoting the more efficient use of the nation's energy resources, and they had a vision of a national system of natural gas pipelines, so that wherever there was for example, a natural gas discovery, the whole nation could benefit from it. Now, in the United States you had this because you have 270 million people or more. We had, at that time, only fifteen million people in an area the same size as the U.S. It was a grand vision, and the minister in particular, tried to recruit me to become a senior Federal Government employee in Canberra and assist with various aspects of mineral resource discovery and utilisation.

06:00:02:48

Swent: Who was the minister? Do I have his name?

06:00:02:56

Woodall: The minister was Rex Connor, but it was his senior assistant Mr. McFarlane, who approached me through a Mr. Bob Sorby. I offered to meet Mr. McFarlane but not long after this encounter there was political turmoil as to how the project was to be funded and the whole scheme collapsed. It was a bold scheme but badly timed.

06:00:03:12

Swent: We haven't talked about the government. What government was in?

06:00:03:19

Woodall: A Labor government was in power then, and that's a bit like your Democrats, whereas what we call the Liberal government is more inclined to deal with issues on the lines of the Republican party.

06:00:03:35

Swent: It is always confusing for us that the Liberals are more conservative.

06:00:03:39

Woodall: So I declined that opportunity. I felt I could do more good for the country by staying with a company that was strongly supporting exploration and where we were finding potentially wealth-generating, major ore deposits.

I want to mention something else before we get on to the discovery of Olympic Dam because we have already talked about the deficiencies that I now perceive in our early 1960s and 1970s gold exploration. You might remember it was related to the fact that the Australian landscape is for the most part very flat, and it has been like that for probably 100 million years. On that landscape are the remnants of many episodes of weathering and sedimentation. So although the concealed terrain looks simple with just a soil cover, we now know there may be sediments left by Permian glaciers, Cretaceous rivers, Cretaceous weathering, Tertiary weathering and quite recent marine transgressions. So we have a very complicated near-surface environment. Geologically the zone is called the regolith. That's the environment between the grassroots and the beginning of fresh rock. In retrospect, when I first realized how complicated the regolith was, I should have started a program of trying to understand it in a scientific way and mapped its regional changes. In time, such an understanding would have been very valuable and given us a strategic exploration advantage. I will go into that a little more, later in this interview, but I also want to suggest how important it is for geologists in the exploration business to be aware of what's going on in the processing side of the industry.

In 1973, the U.S. Bureau of Mines published a report authorized by Rosenbaum, the research director of the Bureau of Mines and authored by Potter and Salisbury. They reported on research which showed there were new, novel ways to use cyanide to extract gold from its ores. It was called the carbon-in-pulp (CIP) or carbon-in-leach (CIL) process and it was particularly attractive for ores containing clay minerals. Clay makes it difficult to filter the crushed ore in order to separate the gold-enriched liquor prior to the precipitation of the gold from the pregnant solution using zinc powder. The importance of this is that the traditional method of treating gold required the separation of a clear liquid from the fine ground ore. This isn't too difficult if you are talking about gold in a hard rock like quartz, but if you are talking about oxidized ores where there is a very high clay content, it is very difficult to separate the clear liquid. This research into the alternative CIP process was, I think, first carried out by the Russians.

06:00:08:21

Swent: It was pioneered at Homestake; I have to mention that!

06:00:08:24

Woodall: Was it?

06:00:08:25

Swent: In Lead, South Dakota.

06:00:08:30

Woodall: Is that right? There was an early reference to the process in the Russian literature. The process involved adding granular carbon in some easily recoverable form to the pulp, you didn't have to make a solid-liquid separation as the gold was absorbed on to the carbon, which is then recovered. It not only decreased the cost of the whole process, it meant you could process difficult, clay-rich ores. Well, that research was ignored by Western Mining. If they did know about it, they never talked to the geologists about it.

When I inquired about how important it was to have fresh water or low-salinity water in the treatment of gold ore, I was told that fresh water was absolutely critical. Again the

advice I received was wrong. Now Australia is very short of low-salinity water, especially in the inland, which is arid or semi-arid, so we geologists, with our naïve understanding of metallurgy, thought that the best place to look for gold was where there was relatively low-salinity water available and to look for ores essentially devoid of clay minerals. Others found you could use hypersaline water—water that was saltier than the sea—in the gold processing plant, provided you used what was called carbon-in-pulp or carbon-in-leach technology, and by avoiding the filtering process to produce a clear liquor, you could also treat soft, clay-rich, easy-to-mine, near-surface oxidized gold ores. This dramatically changed what to look for and where to look. Lack of this information early in the gold boom of the 1980s was for us, a very serious disadvantage. I wanted to get that in the record!

06:00:11:27

Swent: I think this has often happened when there has been a gap between the exploration people and the processing people.

06:00:11:35

Woodall: We talked yesterday about those “strange spinifex-textured” rocks that we found associated with the nickel sulfides. If only I had done a little metallurgy, I would have recognized those textures as quenched textures, and said “Wow, this is a quenched texture in lava that’s been very hot,” and I could have probably written one of the most seminal doctorate theses! A missed opportunity.

06:00:12:04

Swent: Well, you took advantage of many of them.

06:00:12:06

Woodall: Well, several of my geologist’s reports in 1970s document how they were assigned the task of assessing our quite extensive exploration tenements for gold, and in each case they got it wrong! They were assuming that you could use electrical geophysical systems on the assumption that there would be enough sulfide in most gold ore bodies to give a response, or you could use fairly simple, surface-based geochemical exploration without highly sensitive analytical techniques for gold. They were sampling soils at the “grassroots,” often in areas where the mineralized bedrock was covered by tens or sometimes a hundred meters of complex remnants of 60 million years of weathering and sedimentation. Often they concluded there was a possibility of small discoveries of oxidized ore, but ores that would be difficult to treat and thus uneconomic unless high-grade, because of the clay and water problems I have described. Wrong! If only we had known about carbon-in-pulp technology and the possible use of hyper-saline water in a gold ore treatment plant! And we were ignorant of the complex regolith, which in retrospect, I should have, as the leader of the team, known about. I should have done what I had done with the outcropping geology back in the sixties, mapped it, made a major corporate project out of it, and given us a technical edge over competitors. The mapping of the outcropping rocks gave us a major competitive edge in the sixties. We could have had a similar advantage in the gold boom of the eighties, but we didn’t.

My very good friend and mentor Mr. Brodie-Hall, whom I have mentioned, became Chairman of the West Australian State Committee of the Commonwealth Scientific Industrial and Research Organization, which is always referred to as CSIRO. It is a

famous, well funded, Federal Research Organization, covering all disciplines. Their scientists have made wonderful breakthroughs in applied science not only in things related to mining: breakthroughs of pharmaceuticals and engineering for example.

06:00:15:33

Swent: Would this be somewhat similar to our Academy of Sciences?

06:00:15:39

Woodall: If the Academy of Sciences was multi-disciplinary research, it could be.

06:00:15:48

Swent: It seems to me it is somewhat similar, at least.

06:00:15:47

Woodall: The CSIRO scientists work directly for our Federal Government, whereas I think your Academy of Sciences passes money out to people in universities and to persons not employed by the Academy of Science or the U.S. Government. That's the difference.

06:00:16:07

Swent: Oh, yes, I see.

06:00:16:03

Woodall: The CSIRO is an organization of Federal government employees, scientists and their laboratory assistants in many well-equipped laboratories all over the country, doing pioneering work in agriculture, metallurgy, engineering and pharmaceuticals. They are famous for some of their discoveries. It is all to do with applied science. How do we take scientific discoveries in fundamental research and apply them to the benefit of industry and the nation?

Now, we all had great admiration for the CSIRO because of their great work, and my mentor, Mr. Brodie-Hall, became chairman of this Western Australian State Committee of CSIRO. State committees were set up to suggest projects for study. Brodie and I decided to recommend the CSIRO study the regolith in the goldfields. So in 1975 I wrote a report for Mr. Brodie-Hall pointing out how complex the regolith in the goldfields might be and detailed the type of research needed to help the exploration people understand it. From a national point of view, I did the right thing because the CSIRO eventually made it into a major research project.

Eventually they took up the suggestion and in the subsequent years, especially in the 1980s, some of their most highly regarded and highly accredited geological scientists made breakthroughs in this whole subject of the nature and origin of the complex Western Australian regolith: how it had been formed, how metals had moved or not moved and how, therefore, you should explore in different parts of Western Australia. It was research I should have been doing myself in the 1960s and 1970s, but I did not, and then gave the idea away. I gave the idea away to the CSIRO, and then all our competitors had the advantage of the results when the gold boom of the 1980s started.

06:00:19:50

Swent: The price of gold was still low?

06:00:20:06

Woodall: The gold price in '75 when I wrote that seminal research recommendation was U.S.\$160.00 an ounce. In '76 it dropped to U.S.\$125.00, and that's when Western Mining got into real trouble with its Kalgoorlie gold mines and made another bad decision to abandon gold mining in Kalgoorlie. Homestake came along and saved the day financially but, in retrospect bought our Kalgoorlie gold operations for "peanuts". But see, the price had been \$160.00, it then went down to \$125.00 and people thought, "It's not really going to go up, is it?" But, in 1979 it was \$307.00 an ounce and in 1980 the average price was \$612.00 an ounce, and it peaked at U.S.\$800.00 an ounce.

Once the gold price rose to such levels there was money in abundance for the small innovative companies to explore. And what did they do? They didn't worry about science, they just said we're "gonna" drill anywhere there are signs of gold. They pattern-drilled areas where there was any sign of old gold diggings; hundreds and thousands of holes were drilled through this complicated regolith and they found a lot of gold. They found a lot of gold in the clay-rich oxidized zone because of what they were learning from the CSIRO research. We once thought gold was immobile; you know we make jewelry out of gold because it never dissolves in the bathtub or anywhere else and appears so stable. We now know it was not stable in the many environments in Western Australia during the complex, long history of climate changes and deep weathering. Put a little bit of salinity and oxygen in ground waters and it will dissolve gold.

As a result, the upper layers of so much of this flat, semi-arid land was leached of gold. And what's more, down perhaps anywhere between ten feet and perhaps one hundred feet, the gold was re-precipitated. It's like the famous porphyry copper deposits of Nevada, Arizona and Chile where the weathering process created leached outcrops and, at depth, enriched supergene ore. As a result, a lot of easy money was made from mining oxidized gold ore by open pit mining. Supergene gold zones, blankets of enrichment of gold in the regolith, became a source of instant wealth for the many small entrepreneurial companies that descended on the goldfields once the price of gold hit U.S. \$300.00 an ounce, as it did. Often not much science was used, but they knew the surface soils could have been leached and they found a lot of gold at depth, just by drilling holes. By the 1980s, everybody knew about carbon-in-pulp and carbon-in-leach technology. Everybody knew about the fact that you didn't need low-salinity water. This gold boom, this "explosion" in the number of small companies' activity exploring the goldfields, dramatically increased competition and reduced the areas available for exploration by WMC.

06:00:24:22

Swent: Western Mining did get in on some of it, however.

06:00:24:25

Woodall: We eventually got back into the act in 1981, and we will come to that because I have skipped over a most important discovery.

06:00:24:36

Swent: All was not lost.

06:00:24:35

Woodall: Yes, I want to talk a little more about gold exploration. We made a major break through in gold exploration when our chemists developed a technique to detect just a few parts-per-billion of gold.

But back to copper exploration! Yesterday I mentioned that I had a very bright geologist working for me called Douglas Haynes who wanted to study for a doctorate degree. I was keen on all my bright young geologists going back to university for additional studies after they had worked for two or three years. Douglas chose to go to the Australian National University, and he chose to research how the rich copper ores in the Warburton Ranges, which the aboriginals had found, were formed. He thought his research might result in the discovery of another “copper-belt” such as the rich Rhodesian and Zambian Copper Belt. So he went to the Australian National University to tackle the problem. He developed the idea, as I mentioned yesterday, that once basalts which contain small amounts of copper, locked up in the mineral magnetite, become oxidized, the magnetite changes to hematite and as the hematite crystal structure can’t tolerate copper, the copper goes into the solution and becomes a potential ore-forming fluid. Douglas wanted to confirm that concept with his research.

Secondly, he pointed out that if you have an abundant source of copper-rich fluids, and if they are moved into a sedimentary environment where shales are forming in reducing conditions, the copper will be precipitated and could form an economic copper deposit in the shale, just like the “Copper Belt” ores of Africa.

When Douglas came back from study leave in 1972, to work with me in Kalgoorlie, he said he wanted to look for a shale-hosted, stratiform copper deposit in Australia. I mentioned Doug was a very loyal Australian. He was all for promoting Australia, and he wanted to help us discover a great copper deposit for Australia. I was very supportive because we had been trying to find a major copper deposit for the company since my adventure in the Tarraji River Valley in 1957. We had tried several times and failed. I have already mentioned the Fortescue Project, operated from our Wittenoom base where Douglas had spent time.

06:00:28:17

Swent: I have it.

06:00:28:15

Woodall: Douglas decided to help us solve the problem by exploring for copper bearing shales where there was more chance of an adequate copper source; there, we could expect much richer grades. So we discussed this in Kalgoorlie and I agreed that Douglas could study the whole of the Australian continent, looking for places where there was evidence of good source rocks for copper. In other words, don’t look for the shales first, that was a mistake we had been making. Look first for places where there could be a good copper source, such as oxidized basalts, then find the shales.

I recommended we focus first on the state of South Australia. There he found evidence of basaltic rocks that had been oxidized, and that was the clue he was looking for. The Geological Survey of South Australia was very supportive and had good regional data available, which was not necessarily true of all the states of Australia. Quite quickly, we focused on South Australia.

06:00:30:01

Swent: This is a different terrain, isn't it?

06:00:30:04

Woodall: Different to Western Australia, geologically. South Australia had quite a history of very profitable copper production in the 1800s, and for several years produced sixty percent of the world's copper. So we knew it was "copper country," and here was Doug, now quite confident that there was scientific evidence that it was a good environment to explore for copper. Oxidized basalts would source the copper, and shales, somewhere, would host a giant world-class, shale-hosted copper deposit!

I should also mention that about 1970-71, I had in my employment not only Douglas, but several other really top exploration scientists. One was a geophysicist called Hugh Rutter, another a Canadian graduate, Dan Evans, and a third was a much older man Dr. Tim O'Driscoll. All teamed up to help. Dan and Tim moved to Adelaide, the capital city of the state of South Australia. Hugh Rutter worked from Melbourne, but spent a lot of time in Adelaide, and Douglas domiciled in Canberra but spent much time also in Adelaide. They became the search team.

I delegated general management responsibility to Jim Lalor who was based in Melbourne in charge of Eastern Australia exploration. This left me with more time to devote to the Company's emerging petroleum exploration and international exploration. Dan Evans was the local team leader, Douglas the geologist, Hugh Rutter the geophysicist, and Tim O'Driscoll, the structural geologist.

In South Australia, in the southern part of the state, Douglas found evidence of oxidized basalts in old drill holes and in outcrops. But, further north, more than half of the potentially favorable Proterozoic rocks are completely concealed beneath younger sediments or desert sands. Now Douglas argued correctly, that the best place to go looking for this copper deposit was where he had found oxidized basalts. Geophysicist Hugh Rutter accepted this, but when he got hold of some regional magnetic maps he pointed out that what we are looking for should have a geophysical response, like a magnetic and gravity high. Basalt is a heavy rock, heavier than sediment or granite and it should show as a gravity anomaly and probably a magnetic anomaly. Hugh studied regional geophysical maps produced by the Federal Bureau of Mineral Resources and pointed out that there were magnetic and gravity anomalies where Douglas was interested in exploring and where copper had already been found: for example, at a place called Mount Gunson, but there were much bigger anomalies further north in the desert where the bedrock is concealed by wind blown sand, beneath which are Cretaceous and Cambrian sediments. So quite rightly Hugh said to Douglas, "Maybe the biggest pile of these basalts you are looking for are not where you have found them in an outcrop or old drill holes, but further north in the desert." Well the next question was how deep is the barren, young sedimentary cover? The answer was, we're not too sure. There was some bore hole information which suggested that the depth of barren, cover rocks could be perhaps up to 1,000 feet or more. Well, should we go looking for ore deposits beneath such deep barren cover? Hugh Rutter, the geophysicist said, "Yes, we should! If you want big piles of basalts we should explore where you are most likely to find them, but you will have to drill to establish if they are oxidized, as the theory demanded." Tim O'Driscoll was, in my opinion, an outstanding Australian geoscientist. His interest was in deep-earth structures which locate mineral and petroleum deposits.

He thought along the same lines of logic as petroleum explorers. They would tell you that you need a source rock to generate fluid hydrocarbon, either gaseous or liquid, and you need pathways so that the fluids can move from where they are sourced to where they can be trapped. In petroleum they are often trapped in anticlines or stratigraphic traps. The same principles could apply to the formation of a major mineral deposit. Douglas had quite clear ideas as to where the copper was going to be sourced from. You had to find large accumulations of basaltic rock, and they had to be oxidized to release the copper. That's fine, but then there would have to be pathways between where the copper was sourced and where it might accumulate as a copper deposit. In Doug's mind, the "trap" would be in a shale; in the reducing environment of a shallow sea. Tim was quite open-minded about how the copper-bearing solutions might be "trapped" to form an orebody; he was focused solely on finding structures which could be pathways for fluid migration.

We are now talking about 1974. Here we have a group of brilliant, intensely devoted exploration scientists, all not necessarily living in Adelaide, but all meeting and comparing ideas and writing memorandum and almost every month perhaps a new idea.

The man I haven't yet mentioned, who was part of the team, was this older man, Tim O'Driscoll. He's the pathway man. He said, "I don't care what sort of copper deposit you are looking for, but I will tell you this, no matter the source of the copper, no matter whether you are going to trap it in the shale or some other way, you are going to need pathways for fluid migration."

Tim studied the structural setting of the area, and despite the cover of barren rock, he was able to identify what he considered to be major structures, some of them almost transcontinental in size. And so the geophysicist said, "Well, here are the potential piles of basalt for Douglas to drill into to see if they are oxidized." And Tim O'Driscoll came along and said: "Well, there might be all of those piles of basalt, but the only ones where I think you are going to have enough structure and permeability for fluid transport to get the copper from the source into wherever it is going to precipitate, is where strong structures intersect the interpreted, buried basalts." So a combined strategy was accepted by the team. "This is going to be how we are going to find this famous world-class copper deposit. We are going to use Douglas' theory of looking for basalt piles, we are going to drill them to make sure they are oxidized, we are going to drill them only where the geophysicist gives us the best chance of them being large basalt piles, not too deeply buried by the barren Cretaceous and Cambrian sediments and where Tim O'Driscoll says that there is going to be enough fracturing to form permeable fluid migration pathways."

06:00:41:22

Swent: I am interested in how they were talking to each other? Were they working out of the same office? Or were they exchanging ideas by—?

06:00:41:31

Woodall: They were not necessarily in the same office all the time, but they were communicating and coming together regularly, in review sessions, all through 1974.

06:00:41:44

Swent: Where were these sessions?

- 06:00:41:43
Woodall: In Adelaide.
- 06:00:41:43
Swent: In Adelaide.
- 06:00:41:48
Woodall: And some were in Melbourne because Jim Lalor and Hugh Rutter had their offices there.
- 06:00:41:59
Swent: Were they going out in the field together?
- 06:00:42:01
Woodall: There was nothing to see! Once they decided that they were going to go up north in the northern part of the state, all you would see would be sand dunes.
- 06:00:42:07
Swent: So this was all theoretical, scientific—
- 06:00:42:12
Woodall: No, it was not just theoretical exploration, that is not the correct word.
- 06:00:42:18
Swent: Scientific?
- 06:00:42:22
Woodall: Scientific, yes! It was certainly applied science. A geophysical response to find basalts, structures to provide pathways!
- 06:00:42:49
Swent: Who was doing the geophysical work?
- 06:00:42:48
Woodall: Hugh Rutter. He was geophysicist.
- 06:00:42:53
Woodall: All this work was done “in house”, very confidentially. A wonderfully talented team fired up, and with my full support.
- 06:00:43:07
Swent: Very expensive exploration? You had to get authorization to do this work?
- 06:00:43:15
Woodall: No, we had independence as an Exploration Division: our own budget.
- 06:00:43:57
Swent: Where was the copper that you said was mined in an earlier century?
- 06:00:43:59
Woodall: Oh, that was from the famous South Australian copper deposits of Burra, Kapunda, Moonta and Wallaroo, very rich deposits. Look at these maps. Now this is Lake Torrens, a dry salt lake. Here is Lake Torrens now enlarged, and here is a copper deposit that was

also called Mount Gunson. It was also very poorly exposed, but at least it wasn't buried under 1,000 feet of barren sediment, or it would never have been found. Hugh Rutter pointed out that this deposit tended to prove Douglas' theory. There was a gravity anomaly, and a magnetic anomaly at Mount Gunson, probably as a response to piles of basalt at depth, basalts that were probably oxidized in order to form this copper ore body.

North of Mount Gunson is the extensive barren Cretaceous and Cambrian cover, and the sand dunes, where there is nothing to see at the surface but Hugh Rutter the geophysicist says, "Look, there is Mount Gunson but, look at all these gravity and magnetic anomalies further north. You are foolish to explore further south, Douglas; go where there are likely to be much large piles of your source rocks." Then Tim chimes in: "you need pathways for fluid migration". In the same months as Hugh was doing his research Tim was doing his. He commented: "Well, if you want pathways, I can see pathways at Mount Gunson, so it proves my theory too. It is not enough to find piles of oxidized basalt to source the copper, you have to have major fracture zones to form an ore body. If you want to find an ore body, you have got to follow the pathways, the fracture zones, and here are the best fracture zones I can point out for you, drill near them in preference to drilling anywhere else."

Well, in 1975 we acquired extensive exploration tenements and it was agreed that we would drill the best structural targets that overlie the best magnetic and gravity geophysical targets. They drilled such a position first. The target was under 1,000 feet of barren sediments, and they intersected thirty-eight meters of very highly hematitic, fractured rock. And remember the theory was: if you want a copper source you have got to have your basalts oxidized to hematite to release the copper! That's the first step to confirm a favorable ore environment. So this hematitic rock, which was difficult to identify as it was so altered, was sent off for analysis to demonstrate that it was in fact altered basalt, oxidized basalt, leached of copper and therefore a good source rock. But, the assays came back showing it was enriched in copper; it assayed 1% copper!

You can only take theory so far, but by applying a multi-disciplinary exploration strategy you overcome weaknesses in your theory and increase your chances of your success. For example, without the work of Tim O'Driscoll, our structural man, we may well have drilled barren magnetic and gravity anomalies and been disappointed as many subsequent explorers were. Instead of that, they were a good team, they respected each other. They agreed that they had to work together and take each scientist's opinion into account. We had to drill where the gravity, magnetics and structures were best, and that was how the discovery drill hole, RD1 was located.

06:00:50:08

Swent: RD1.

06:00:50:09

Woodall: RD1 yielded thirty-eight meters which assayed 1% copper, but, it almost missed the ore body!

06:00:50:17

Swent: It was right on the edge!

06:00:50:16

Woodall: Right on the edge! Each of the follow-up holes were equally deep and expensive, each probably costing \$100,000. The second hole was on another target. That hole was barren. The third hole was back near RD1 but was also barren. The fourth hole was also barren. The fifth hole had a similar width of mineralization to RD1 but low grade, which, under 1,000 feet of cover was not economic. I think nine companies out of ten would now have stopped drilling and abandoned the project, their management saying: "This is just desert. There is no outcrop, so exploration is expensive. You have found some strange altered rock, but it contains only 1 percent copper, it is down 1,000 feet, it is costing about \$100,000 to drill each hole. "You guys are crazy scientists, we have to make money for our shareholders. Stop!" But nobody in WMC's head office or on the board thought like that nor ever tried to stop us. This team of explorers were just part of a much larger team that had already found a world-class uranium deposit of a type that no one else had ever found in the world, had already found the first world-class Archean nickel deposit, a type of which no one else ever found in the world, and a team that had contributed, by their scientific knowledge, to the recognition of those Darling Range bauxite deposits, which were now starting to be seen as major revenue generators, producing the world's cheapest alumina.

How important is confidence; confidence between the board, the managing director and the explorers drilling expensive holes out in the desert where you can't even see anything but sand dunes; explorers getting only mediocre results? But then it got worse. The sixth hole was barren. The seventh hole was barren. The eighth hole contained only fourteen meters at 1.2 percent copper. The ninth hole was worse, a few meters of 1 percent copper. But then, "Eureka," RD10 intersected 170 meters of 2.1 percent copper with a very significant uranium bonus and a gold bonus. And look, the hole was still a kilometer or more away from the real orebody. How often have explorers, doing the best science, doing innovative exploration, got to where we were and were just off target. This is the best example you will ever see of the problem of exploring for concealed ore bodies beneath hundreds or thousands of barren rock. Now, there is no doubt in my mind that in the United States and Canada and Australia there are many great ore bodies still to be discovered, but once they get covered up by thick sequences of barren rock, they are hard to find, even when you have got the best scientists working for you. Many explorers have in all probability nearly made a discovery but failed to persist, even when there is scientific evidence indicating that they should persist.

Now, we still don't know how big this Olympic Dam deposit is. It is an orebody measured in billions of tons. It's the world's largest concentration of uranium. It contains as much gold as the famous Kalgoorlie goldfield, Australia's largest, probably at least 30 million ounces of gold. Where did all this copper, uranium and gold come from? It's in the top ten copper deposits of the world. It's a jewel, and it's such an exciting mineral discovery: the first of its type ever found in the world, like Kambalda was a first, like Yellirrie was a first.

That's the story of its discovery. People say, "Wow, how much did it cost?" Well, it cost ten holes, so perhaps it cost us close to one million dollars, but remember, all of our earlier copper exploration endeavors which cost nearly \$30 million. Scientific mineral exploration is the learning experience. We started looking for copper in shale and learned a little. We did more copper exploration for shale in the Fortescue project and realized some important factor was missing. We then explored in the Warburtons and

failed but we learned something there about sourcing copper. And then, after thirty million dollars of expenditure, we discovered one of the world's great ore deposits, the limits of which we are still trying to find. And, if you want to know more about it, ask Kathy Ehrig. Thanks to George Brimhall, here at Berkeley, I recruited one of this university's most brilliant geological graduates, Kathy Ehrig. She will be with us on Sunday night. She is the research geologist on site at Olympic Dam who knows more about this deposit than any other living person, and she is brilliant.

06:00:57:20

Swent: Good for her.

06:00:57:25

Woodall: Well, you think that would be the happiest story you could ever hear.

06:00:57:31

Swent: It has been happy so far.

06:00:57:33

Woodall: The discovery of this confirmed with hole No.10 in 1976.

06:00:57:41

Swent: When did you hear about it?

06:00:57:42

Woodall: Well, I was being informed of progress all the time.

06:00:57:44

Swent: You were where?

06:00:57:49

Woodall: I was still in Kalgoorlie.

06:00:57:50

Swent: In Kalgoorlie. You had a telephone call?

06:00:57:51

Woodall: Lots. But it was no accident that we kept on drilling. We were finding rocks that were so highly altered, and incredibly brecciated. We were finding a huge breccia pile, highly altered with showings of copper. It was exciting. Where else can you find cubic kilometers of high brecciated rock? This place had been subjected to enormous energy release. The rocks were so altered, with hematite everywhere and other strange minerals. We had found something that had to be important. We didn't confirm how important until hole No. 10. But believe you me, from a geological point of view, there was no doubt that we had to keep drilling. We had found something very significant. But you have got to remember the people back in head office, in Melbourne who were providing the money and, perhaps thinking, we may be just crazy scientists! So, you can see, that by the end of 1976, we were really just a charmed group of explorers. Other companies started to ask: "Why is WMC continuing to find world-class ore bodies in the most difficult places and each the first of their type found in all the world?"

continue Interview 4: January, 23, 2004
[Begin disc 7]

07:00:00:09

Swent: My father was in charge of the early carbon-in-pulp research at Homestake.

07:00:00:16

Woodall: What year was that?

07:00:00:20

Swent: I remember him coming home and talking about it in the fifties when they were experimenting in developing coconut shells and other things as sources for the carbon. Eventually they got the carbon from the Philippine coconut shells, and it was a very exciting development.

07:00:00:39

Woodall: I'd like to comment further on the team of scientists who made the Olympic Dam discovery possible.

07:00:00:48

Swent: Okay.

07:00:01:08

Woodall: Of all the science that went into the discovery of Olympic Dam, the concept of oxidized basalts sourcing copper, nobody questions. The fact that gravity and magnetic anomalies could locate buried piles of basalts, nobody questions. The fact that a scientist can locate deep basement structures, when the basement rocks are covered by 1,000 feet of younger sediments, on top of which are sand dunes, so many find unbelievable. So I want to tell you more about Dr. Tim O'Driscoll, who in my opinion, is one of Australia's top earth scientists. They say his work is flukey, even impossible! How could a basement structure be seen in sand dunes over barren younger sediments? Well, this is the ore body (referring to a diagram map), and that's the position of the structure that he predicted in 1974. The orebody is also elongated along the structure. How can you not believe it? Now comes the tragedy.

The Olympic Dam discovery was the most famous in Australia for a hundred years; everybody wanted to talk about the discovery. They talked to Douglas Haynes, "Well, I took the company to South Australia and it was my idea in the first place: without my foresight there would not have been a discovery!" That of course is true! Someone else goes and talks to Hugh Rutter, and Hugh describes how he drew attention to the importance of gravity and magnetic anomalies, which is true. So Hugh says, "without geophysics there would not have been a discovery," which again is true. When someone talks to Tim O'Driscoll, he says "Yes, I was involved." But what Douglas, Hugh and Tim say gets written up not as "I was involved, you know, and made a valuable contribution", but as "But for me, there would never have been a discovery!"

Then one of the most skilled, successful exploration teams disintegrated. The subsequent years of unpleasantness exhausted Tim O'Driscoll. Jim Lalor tried to keep some balance in the debate and he wrote a very important report on the discovery based solely on the written record (WMC K Report 2792). Jim's thesis was, "If it was not

written down it didn't happen." He did his best "to pour oil on troubled waters." The sad fact is that none of the persons involved in the discovery of Olympic Dam were involved in the discovery of another major ore body during their twenty years of subsequent exploration. Douglas did contribute to the discovery of two other deposits, one a copper deposit, but one which the company sold because it was small. He also contributed to training a whole generation of young geologists in how to think scientifically about exploration strategies. But no more big discoveries! Why? Because this big discovery would not have been made without the contribution of all three scientists, headed up by very intelligent team leaders in Dan Evans and Jim Lalor.

A multidisciplinary approach to exploration for concealed ore deposits is absolutely critical. If you try to do it on your own as a geophysicist or on your own as a geologist or as a structural geologist, your chances of success diminish dramatically. If only that team had stayed together and said, "Here we are. Let's not argue about who found the Olympic Dam deposit, we all helped and we know how to find major ore bodies under concealment. Let's go do it again!" They would have had an open checkbook, and I believe they would have been successful again.

07:00:07:14

Swent: And you were also known as the discoverer of the Olympic Dam.

07:00:07:17

Woodall: Well, that's to some extent a misnomer. I agreed to send Douglas on study leave. I supported his recommendations when he returned with the "source rock" concept and encouraged him to explore first in South Australia. I was very supportive of everything the team was doing, and especially encouraged Tim O'Driscoll to work on the project. The fact that I had been responsible for other discoveries by WMC up to that time, is perhaps my most important contribution to the discovery. I had built up a high level of confidence at Board level and with senior management. So, when we said "This is exciting, these are very favorable rocks and we need to keep drilling despite only low-grade or barren intersections," nobody questioned the decision, especially the people who provided the money. Many people say, "Well, Roy Woodall, you found Olympic Dam." Of course I didn't. Ted Whenan the driller found it! But it was the team working under me, and who were my responsibility, that found Olympic Dam: they told Ted where to drill. Yes, I provided encouragement and guidance: how much encouragement and how important was the guidance, I can't remember.

What I had to say at various meetings was rarely recorded. But I can tell you this, there is no doubt that we were very excited about the rocks we were discovering. And there was no way that we were going to let the drilling stop. We believed you just don't find such huge piles of highly brecciated and highly altered rock, anomalous in the metal you are searching for, without being very close to a major discovery. This is as it proved to be!

07:00:09:15

Swent: Do you think there are others to be found?

07:00:09:17

Woodall: There have to be. I have demonstrated how close we were to even missing this one: and it is huge.

07:00:09:27

Swent: There maybe another one next door.

07:00:09:30

Woodall: There are hundreds of drill holes in this area now but the prospective area is very large. At least one other similar deposit has been found; it is called Prominent Hill, and there has been another recent intersection of similar mineralization of ore grade at another location. And do you know what I think has reduced the chances of success? It's lack of belief in the importance of structure, and disbelief that you can predict the presence of deep structures, even when the basement rocks that are prospective are covered by a thousand feet of barren sediments. But it has been done. I have shown you how the ore body sits exactly where O'Driscoll predicted a controlling structure would be.

07:00:10:23

Swent: What has happened to O'Driscoll? Is he still working?

07:00:10:24

Woodall: He has retired and he is very sick. [He has died since this interview was recorded.] I am trying to preserve his records. There will be a special volume coming out in about twelve months to highlight Tim's contribution to science. After he officially retired from the company I gave him a room, drafting facilities, and secretarial support. I said, "Tim, you have got to write up your career, all you have learned, and publish a book." He started life as a geologist in the mines of Broken Hill. The Second World War interrupted his geological career when he was a navigator on the U.S. Catalina flying boats used for reconnaissance and anti-submarine patrols in the Pacific. When he came back he worked for Selection Trust for a while, and then he asked to come and work with me, which he did for twenty years. He has published several very seminal papers, but many of his ideas are not preserved in book form. Unfortunately, he never got beyond writing the first four chapters of his book; he became a victim of Parkinson's disease and dementia. Several of his "disciples" that believe in his work are now compiling technical papers which reflect Tim's work. And one job I am supposed to do when I go back to Australia is make a contribution.

07:00:12:58

Swent: I also wanted to ask, how, from the corporate point of view, do you reward the people who come up with discoveries like Olympic Dam?

07:00:13:09

Woodall: No monetary award at all! The people that worked for me never ever suggested they should receive a monetary award for making a discovery. I should also mention that during all the time between 1967 when Don Campbell retired and left me with the problem of running the exploration until I retired in 1995, I devoted probably a third of my time to recruitment. I perceived it to be my most important function. You have got to recruit the right people. The right people are not necessarily the brightest scientists; they are the people that are motivated to find ore bodies, with personalities ideal for teamwork. They are people motivated to be good scientists and to use good science. They don't want to be in academia, but they want to be working for a company where they are encouraged to keep up to date with the science that they are in love with.

"Come and work with me, then! And if you put in two or three good years of service, I will send you off on study leave somewhere of your choice. We will

pay you half-salary while you go. If you are very good, we might even pay all of your salary, especially if the research you are doing is relevant to our exploration programs. I want you to keep up to date. Come and work for me and I will help you be the best scientist you will ever be.”

If any of those people I interviewed said, “What will you pay me if I make a discovery,” I probably would never have hired them. If their main concern was what their salary would be, again I doubt if I would give them a job, for if that was their main interest, they should go work for someone else. Our business was to use science to create wealth for our shareholders who pay our salaries, and for a country’s citizens—in our case, Australian citizens, or when in Brazil, for Brazilian citizens. Exploration is all to do with creating wealth and making this world a much more prosperous place. There has always been great interest in why Western Mining could make all these big discoveries and no one else was so successful.

07:00:16:09

Swent: I think that’s an understatement.

07:00:16:15

Woodall: Recruitment was one of the keys. Encouraging staff to be good scientists was another. Conzinc-Rio Tinto was one company that worked hard to discover our “secret code.” They engaged the management consultants of McKinsey and Company, to find out what that secret was. So McKinsey were asked, and were granted permission, to interview exploration people and management from fourteen companies that were exploring in Australia. It was agreed that the interview material would be kept confidential. For example, they couldn’t divulge what BHP people said, or what Western Mining’s people said, but they could compile the information and put out a report with no reference as to the source of their information. Their report commenced thus:

“Nearly \$100 million goes into mineral exploration in Australia each year. Many individuals companies invest over a million a year, and a handful of companies as much as four million or five million. For some companies, the returns have been extraordinary, Western Mining being the best example. For others the investment a failure.” The report went on to try to identify the factors that made such a difference to the outcomes.

The team was headed up by a man called Robert Waterman, and one of his young assistants was Michael Darling. Now I have been doing some work with Michael Darling, and he told me an extraordinary thing. “Do you know, Roy, what was one of the dominant things that Waterman discovered during that investigation? It wasn’t just the brilliance of the scientists, although that was necessary, it was the culture of the company that made the big difference. Was the Managing Director interested in exploration and was the Chairman? Was the Board interested in what the geologists were doing out in the field, often living away from their wives or with their families in remote little towns, totally committed? That was the culture!” It was not a culture where the geologists were interested in bonus payments, but just to be good scientists, contributing to the national good. They were working in a company where they had the highest respect for their team leaders, their regional managers, their exploration manager, and the managing director of the company. Our managing director, Mr. Bill Morgan with his wife, would come out from the best suburbs of Melbourne to some of

our most remote locations, wherever our geologists were exploring as would Brodie, and Arvi Parbo. We traveled in small planes, out to these remote places, and Mrs. Morgan, for example, would sit with the young geologist's wife, who probably had two little children, and talk to them, encourage them. This was the culture that bred success. What did Waterman do? He talked to Tom Peters about this "discovery" of the importance of culture and they investigated U.S. companies and wrote a management best seller "In Search of Excellence." And Michael Darling told me that the catalyst for that book was what Waterman learned from studying the successful mineral explorers in Australia like Western Mining's Exploration Division. Isn't that interesting?

07:00:20:39

Swent: Yes it is.

07:00:20:38

Woodall: And to sum up: I am just going to emphasize how critical was this link of confidence between the Board, the Managing Director, and me, the Director of Exploration, and the confidence I had in my regional explorers, the confidence the regional explorers had in their technical field assistants, and then the mutual trust and respect that follows. No bitterness, no power struggle, just total conviction that we were a great team and we were going to succeed and we were going to help each other. There it is.

07:00:21:52

Swent: What was the size of your company at this time? How many people were you supervising and managing?

07:00:21:57

Woodall: In 1970 I had responsibility for about 70 geoscientists, in 1980, 105, and by 1990, 175. I should tell you that I built up the geoscience group as a "geological guild," like the old guilds of the craftsmen of the Middle Ages, stone masons, weavers, silversmiths, goldsmiths etc. Every geologist, whether he or she be in exploration in the field, in research, or working underground on a mine, was part of the guild. I recruited them, I watched their development, I approved any study leave they might be given, I arranged any transfers after effective consultation with the individuals, their colleagues and those they served. They were my team and I was their team leader. The team included geologists, geophysicists and geochemists in mines or out on regional exploration. Each year, at least once a year, I would sit down with their various managers and say, "Now, about Lee. Lee's been at Kambalda nickel mine now for three years, she has been on underground work. How is she responding?" "Oh, she's doing a great job." "Is she happy to stay there?" "Well, she has asked if she could have some experience in gold." "Well, would she like to go to a gold mine or gold exploration?" "Well, she doesn't care as long as it's concerned with gold mineralization instead of nickel, she just wants to learn something about gold orebodies." So, we would say, "Lee needs to be transferred." And we would go through perhaps one hundred people, like that. On the last day we would say, "Right, we have these vacancies here, here, and here, and we have two vacancies on gold mines, and Lee wants to go to a gold mine, so we will move her there. Now, we have to fill her place at the nickel mine: now who are we going to replace her with? Well, we have two good graduates joining us, one from Berkeley, one from Melbourne, why don't we put the one from Berkeley at the nickel mine, it's a good initial training environment." That's how we worked it out. Every year, every geologist, geophysicist, and geochemist knew that their career would be looked at, and if they had

a desire to be an explorationist for five years, or do research or go on study leave, it was considered and we worked it out with the various Regional Exploration Managers and Chief Mine Geologists. And it was part of the culture, and it was so valuable. I will tell you later on that this valuable culture and geoscience guild was destroyed because other people wanted power. There is sad news to come.

07:00:25:08

Swent: Were you dealing at all with aboriginals at Warburton?

07:00:25:15

Woodall: Yes, as I have explained, and we had close contact with aboriginals at the Goanna Patch “mine.” Only in the seventies did aboriginals gain citizenship; it was an unfortunate part of Australian history. For years they were considered to be wards of the state, i.e., unable to care for themselves. After they gained citizenship and voting rights, they appealed for land rights. “This is our land! You invaded us, you took it all from us! Give it back to us!” There were accusations of massacres. In fact, many of the aboriginals died not from massacres but from diseases brought to Australia by the early settlers: smallpox, measles, influenza, like happened in most historical cases when one group invaded another. Most of those invaded were not killed by guns, but disease. However, they were a depressed, uneducated group of people for so long. We had to start caring for them and take responsibility for their perilous state. So land rights became quite an issue and companies tried to accommodate the impact in a compassionate and sensible way.

The situation now in Australia is quite reasonable, but we did go through a period where extremists on both sides got all the media attention. If an aboriginal group wasn’t keen on negotiating reasonable terms to allow exploration on their land, extremists often intervened and then nothing would satisfy them. Then frustrated mining people would start saying, “These aboriginals shouldn’t have these rights at all. This is just an unreasonable imposition on business and the nation. The minerals belong to the government and the people, they don’t belong to the aboriginals.” The two sides now work much closer together, but it was a contentious issue for many years. It took quite a while for reason to prevail. It required patience and care to negotiate reasonable agreements with the aboriginals, but it was important, as vast areas of Australia are now aboriginal lands. You can’t go into those areas to explore without first negotiating an agreement with them.

Now, let me tell you something very interesting. In 1995 about the time I retired, Western Mining became interested in a nickel prospect in Central Australia, on aboriginal land—east of Warburton. Now the aborigines of Warburton remembered that the company had treated them well in the 1960s during that Warburton copper exploration project, so in the 1990s Western Mining had much less trouble getting permission to explore than many other companies. And I have now heard from people close to the aboriginal people at Warburton that they regard those few years when we were working with them, mining copper and sending it away and sharing the revenue, as the best years of their interface with the mining industry. They were wards of the state, they didn’t have citizenship, but they remembered that they were treated well, and with respect. They remembered those days as happy times with the mining industry. Now, the only contact they often have with the mining industry is through lawyers, negotiating complex deals, which they don’t understand.

07:00:31:04

The aboriginal people at the Warburton settlement have established what I have yet to see, but am told, is an outstanding art gallery. The first art exhibition there was a record of the mission days, those years when the missionaries went out there to try to help them with health care, education and Christianity. The aboriginal community at Warburton still think so highly of their mission days, that those days were the subject of their first art exhibition. And the subject of their current second art exhibition is the “mining days” with Western Mining. Yes, there has been antagonism between mining and aborigines, but there is also goodwill and happy memories. I was invited, in 2002, to participate in the opening of that art exhibition!

Swent: Oh, just recently.

07:00:31:03

Woodall: Almost forty years since I was out there working with those people. They have long memories. Quite recently I called into an aboriginal aged care center in Kalgoorlie and there was an aboriginal man in a wheel chair. I said, “Hello, how are you?” He said, “fine.” I said, “Where are you from?” He said, “Warburton.” I said, “Oh, I used to go to Warburton.” He said, “I know.” I said, “I used to go to Warburton to help your people learn about mining and worked with a man called Tommy Simms.” He said, “I know, I remember you and Tommy Simms is my uncle.” These people remember these things for a very long time, sometimes as much as forty years; happy memories!

07:00:31:57

Swent: I understand you play the didgeridoo.

07:00:32:00

Woodall: No, but I have tried.

07:00:32:04

Swent: You don't? Somebody told me that you do.

07:00:32:06

Woodall: Oh, I have a didgeridoo, but I can't play it properly. It's just a bit of legend.

07:00:32:13

Swent: Okay, you do have one.

07:00:32:14

Woodall: Yes, I have one, which the Warburton aborigines gave me. So, back to the gold business. How are we doing for time?

07:00:32:30

Swent: We are okay.

07:00:32:33

Woodall: What time's my lunch appointment?

07:00:32:40

Swent: I think at twelve.

07:00:32:44

Woodall: Okay. Let's talk about gold. Western Mining had the opportunity to own all of the famous Kalgoorlie goldfield, one of the great gold deposits of the world. One way or another they ended up with half of it in 1975. In 1976 the price of gold had risen a little, but Australia was suffering severe inflation. The price of wages and salaries was escalating; costs were going up and the great mines of the Golden Mile were uneconomic, and the operating company was \$3 million in debt.

07:00:33:41

Swent: And this was before Olympic Dam.

07:00:33:42

Woodall: It was about the same time, 1975 in fact. Olympic Dam was found in 1976. Back at Kalgoorlie, the operating company Kalgoorlie-Lake View (KLV) was \$3 million in debt, and couldn't pay its bills. Mr. Brodie-Hall was chairman of the Company and he appealed to the government for financial assistance to keep the operations going in the hope that the price of gold would rise, which of course, it did.

07:00:34:29

Swent: Excuse me, you mentioned a consortium; was Western Mining working in the consortium?

07:00:34:31

Woodall: Western Mining owned half of the operating company KLV, the Poseidon group owned the other half. When I said Western Mining could have had the lot, I believe they could have bought out Poseidon if they really wanted to; i.e. if they believed in the future of gold. But the operation was losing money and the market for nickel and its price were in decline. But the Board and the senior executive of WMC didn't believe in gold like Homestake did and Mr. Brodie-Hall did. Brodie was a lone voice at Board level. Brodie appealed to the government for financial help to keep the men employed but their reply was: "No, if it's uneconomic, close it down, Brodie! We are not in the business of supporting uneconomic industries." Then along comes Homestake, with whom we had had good relations in the past. They believed in the future of gold and they agreed to buy half of the KLV operation, 48 percent, by putting in \$3 million in cash so the company could pay all the bills. They also agreed to provide up to \$5 million in finance to continue development of the mines to ensure there would be ore available to keep the operations in business, i.e., to make sure mining continued. Well, that agreement was signed, I think, in December 1975 and came into effect in February of '76. Homestake had paid \$3 million and guaranteed another \$5 million to acquire half of one of the world's great gold deposits which nobody else wanted.

07:00:37:00

Swent: I think John Gustafson was president then, wasn't he?

07:00:37:07

Woodall: I think he was.

07:00:37:07

Swent: And of course he had had extensive experience in Australia.

07:00:37:08

Woodall: He had done the early mapping of the field in the thirties.

- 07:00:37:12
Swent: At Broken Hill?
- 07:00:37:15
Woodall: Yes at Broken Hill, but also at Kalgoorlie.
- 07:00:37:21
Swent: So again the geologists were showing their confidence in their work.
- 07:00:37:38
Woodall: Well, let's recap. When in 1976, Homestake acquired their 48 percent of the great Kalgoorlie goldfield, gold was US\$125 an ounce. It was marginally higher in 1977 at \$150. It was marginally higher again in 1978 at US\$194. Meanwhile, they saw the benefit of continuing the operation of the Mount Charlotte mine, which you might remember, back in 1963, I had, with the assistance of two other people, confirmed the grade and showed that it could be an economic operation. And so, by closing the uneconomic mines on the famous Golden Mile—the heart of the deposit—and continuing operations at Mount Charlotte where mining was modernized and low-cost, the business became cash positive, even with these slight increases in the price of gold and Homestake didn't need to contribute any more money. In 1979, the price of gold jumped to \$307 and then in 1980 to average US\$614 per ounce, and peaking at US\$850 per ounce. So, Homestake never had to contribute a dollar of that additional five million. They got the whole 48% of one of the world's biggest gold deposits for \$3 million. What a bargain! Good luck to them. They were prepared to take the risk! They believed in gold! Our senior people didn't. So, there's another sad story.
- 07:00:39:42
Swent: That's interesting, because you said earlier that Western Mining had been only interested in gold, and then they became enraptured by these other metals.
- 07:00:39:54
Woodall: That's right. You see, the founder of the company was W.S. Robinson, a gold believer.
- 07:00:40:01
Swent: And it was separate from a company in the east?
- 07:00:40:09
Woodall: WMC was formed just to explore for gold in Western Australia. They formed a sister company called Gold Mines of Australia to explore for gold in Eastern Australia, but Gold Mines of Australia never really found much. Western Mining didn't really find a lot either in their first 30 years, but they found enough to stay in business and to gain part control of the Kalgoorlie gold fields through Gold Mines of Kalgoorlie.
- 07:00:40:34
Swent: And for a long time, all they wanted was gold!
- 07:00:40:37
Woodall: The initial managing director and subsequent chairman of WMC, Gordon Lindesay Clark, was also a great believer in gold. But he retired in 1974, and the chairmanship was taken over by Arvi Parbo, who had also been the managing director since 1972. Arvi, a wonderful man, wonderful Australian, had done great things, but he was not a believer in gold. That's the difference.

Mr. Clark, Sir Lindesay Clark as he became, was always keen on amalgamating the Kalgoorlie goldfield operations in order to develop a big open cut mine, instead of the expensive, underground, narrow vein mining operations. With the price of gold as it was in the 1960s and the 1970s, it just wasn't possible. And of course, in those days, you couldn't even buy the type of big trucks you can buy now which make such a big impact on the economics of open pit mining. Now if you go to Kalgoorlie, you see a huge open cut, and they are producing lots and lots of gold and they are making lots and lots of money. It was a Sir Lindesay Clark's vision, but he never lived to see it. The people he handed the baton over to didn't believe in gold and sold out of Kalgoorlie for peanuts.

Now WMC's Exploration Division, despite the fact that we didn't do all the things we should have done to maintain a competitive advantage in the gold business, did start to make major gold discoveries in the eighties. We eventually understood the complexities of the regolith, 10 years later than we should have, and we developed new methods of analyzing for gold, down to one part-per billion (1ppb) and we did build up a new gold division for the company. That was in the 1980s.

Now another diversion! We had found Yeelirrie in 1972, Olympic Dam in 1976, and we were regarded as one of the best exploration groups of the world. As a result, perhaps, we were approached by the British company, Central Electric Generating Board, to help them find uranium. Dr. Eric Cameron, the brains behind the discovery of the Yeelirrie deposit, suggested that a good place to find uranium was in northern USA—in the state of Michigan, for example—but generally in the Great Lakes region. They agreed to fund the exploration program. So we took our first tentative steps into the world of international exploration. We didn't find anything, but we didn't stay very long.

07:00:44:26

Swent: Elliott Lake had already been discovered.

07:00:44:29

Woodall: Yes, but that was north of the border.

07:00:44:32

Swent: On the other side of the lake.

07:00:44:34

Woodall: We didn't stay there long because it was such beautiful country we were not too sure that anybody would want us to find a uranium mine there. There are other places where we could go and look. Another equally interesting thing also happened about that time. In 1977, one year after the confirmation of the Olympic Dam discovery, Brazilian government employees came out to Australia to visit Western Mining's head office. They wanted to see if they could buy an interest in the Olympic Dam discovery because Brazil was short of copper, and they wanted to obtain a more secure supply. They were told: "It's not for sale." So they said, "Well, would your geologists come to Brazil and look for copper for us? Do your geologists think that we might have copper deposits?" Our reply was, "You ought to have some big copper deposits and if you fund the exploration, we will come and do the work for you in joint-venture." They said, "Why don't we talk about this." So, they invited a group of us to visit Brazil where the government controlled the economy and controlled the import of all types of commodities.

07:00:46:24

Swent: Was this a Brazilian company or a government organization?

07:00:46:23

Woodall: Government. At that time, most of Brazilian industry was under the control of the government one way or another. They were serious in inviting us to Brazil and we made a major technical mission in August of 1978, the idea being; "Let's discuss how we can reach agreement for you to provide the money and we the science and the technology." Unfortunately we didn't get very far because we came up against people's egos, you might say. It is really hard for a group of government geologists in Brazil to say; "Yes, those Australians will be much better at finding copper than we are." We were up against the human problem of pride. The high government officials who wanted the copper were very keen to do some sort of a deal, but the senior ministers in Brasilia had to do the right thing and ask their own geological organization for advice, and, I expect they probably said, "Yes, they are a bunch of clever guys, but we are just as clever anyway."

We also had another idea. Our nickel business was in trouble; the market was difficult and the price wasn't very good, either. It just wasn't easy to sell nickel. So, we said, "We have got another idea. Brazil imports its nickel, almost all of its nickel. You have a big steel industry. If you buy our nickel this will increase the revenue for our company, and then we will finance the exploration for nickel in Brazil, perhaps in joint-venture with you." So, that was another idea. We also looked around and said, "What other countries import nickel that are very mineral-rich and might have their own nickel deposits?" We thought, "Why not Mexico?" So, with one or two experts, we visited Mexico with the idea of talking to the Mexican government. "You import nickel. Buy our nickel instead of another company's nickel and then we will come to Mexico to explore for nickel and then you may become independent of imports." We said the same thing to Yugoslavia as we had said to Brazil. It was innovative economic management which the Exploration Division promoted, but it never got off the ground. But we did end up with money to explore in Brazil and I will tell you about that next time we meet.

07:00:50:06

Swent: Another time, okay.

07:00:50:09

Woodall: This was the beginning of our international adventures. And also the beginning, from my point of view, of my need to further delegate responsibility for Australian mineral exploration. No longer could I keep in close contact with what was going on in each exploration teams.

07:00:50:38

Swent: And of course we need to talk about petroleum too, which we haven't gotten to at all.

07:00:50:41

Woodall: That's right. Petroleum was gradually becoming more important, and also required more of my time.

07:00:50:54

Swent: So, this—

07:00:50:57

Woodall: Just on that subject. We are finishing up this session in 1979 when our minerals exploration budget was \$6 million and our petroleum exploration budget was a million dollars. Within five years, the combined exploration budget was \$100 million.

07:00:51:30

Swent: That's a big leap.

07:00:51:34

Woodall: Well, in terms of management and responsibility, it was a very big leap.

07:00:51:37

Swent: Yes, indeed. Well, I think that's a good place to stop.

Interview 5: January, 26, 2004
 [Begin disc 8]

08:00:00:07

Swent: This is Monday, January 26th, and we have moved back to the Hearst Mining Building. Roy, just to pick up on a little item from earlier, the Whenan Shaft at the Olympic Dam; you might tell me where that name came from.

08:00:00:32

Woodall: Whenan was the surname of the driller who did the early drilling at Olympic Dam, and, of course, drilled the discovery hole. His name was Ted Whenan and he and his lovely wife, Shirley, were quite prepared to go in their small caravan, out into the remote desert areas of Australia, and drill for the Exploration Division. He was an excellent driller and a real gentleman. The tradition of naming mine shafts after the person in charge of the diamond drilling when a discovery was made goes back to the 1960s when I had the opportunity to drill those inconspicuous iron-rich outcrops near the abandoned Red Hill Gold Mine: the district which was subsequently renamed Kambalda. The driller there was a man called Jack Lunnon. Jack also was an excellent driller and prepared to go anywhere for us, even into very remote areas. Without supervision, he would do exactly what we asked of him. So the first orebody we found at Kambalda, I named the Lunnon Shoot, and then the mine shaft to develop the orebody was called the Lunnon Shaft. From then on, we discovered ten or twelve separate ore-systems in the Kambalda district, and each time we named the new orebody after the lead driller on shift when the drill first went through the orebody. It always seemed to me to be a much more interesting thing to do than calling orebodies by numbers or naming them after people who had nothing to do with the discovery.

08:00:03:00

Swent: Excuse me, is this unique to Western Mining?

08:00:03:04

Woodall: I think it is. The fact that nobody ever stopped me doing it is also indicative of the wonderful relationship I had with the Chairmen of the Board and the Managing Directors. They never questioned this and perhaps thought it was a good policy too. Why not recognize the people who devote their whole working life to going out into the remote desert and arid areas, drilling for Western Mining! After all, most exploration ventures fail; so they would have many disappointments. So, when they did succeed, they naturally got excited like we did. The drillers were as much part of my Exploration Division family as the best geologists, and just as critical. So when we discovered the great Olympic Dam ore body and it was developed by a shaft, I persuaded management to call the shaft the Whenan Shaft.

If the politics had been right, in other words, if you could have trusted the politicians to allow you to spend over a billion dollars and then keep to their promises and not dramatically increase taxes as soon as you spent all your money, we would have developed a huge open pit at Olympic Dam, despite the fact that the ore body was under 1000 feet of barren rock. In terms of long-term economics, that would have been the smart thing to do. But the idea of investing such a large amount of money on a deposit that contained uranium and for which we had only just got permission from the South

Australian government to develop the deposit by one of the Labor politicians deserting his own party to vote for us, did not appeal. The Labor party at the time, was “anti-uranium” when we were trying to develop the Olympic Dam orebody, i.e. getting permission to mine. The Liberal Party, the more conservative pro-uranium party was in power, but they didn’t have a majority in the parliament. The South Australian Parliament debated as to whether we should be given permission to develop the Olympic Dam orebody, knowing that it had uranium in it. One of the Labor politicians bravely went against his party politics, crossed the floor, and voted with the Liberal Party. That resulted in an act of Parliament being passed which gave us permission to mine the Olympic Dam deposit. Now, that’s how delicate the politics were: how fragile the approval. So we developed the orebody, via the Whenan Shaft, as an underground mine, which required much less up-front capital expenditure than an open pit mine.

08:00:06:48

Swent: I think your state politics are somewhat different from ours in the United States. They have much more control.

08:00:07:02

Woodall: Well, the minerals in Australia belong to the states. The Federal Government does not own the mineral rights: that goes back to the early colonial days. So in South Australia we had this very fragile political environment, and obtained parliamentary approval to develop this big deposit by the skin of our teeth. If you have a choice of investing huge amounts of money, probably more than a billion dollars to develop a huge open pit or the opportunity of develop an underground mine for much less capital, what do you choose?

08:00:07:49

Swent: The less expensive.

08:00:07:49

Woodall: Yes, the less expensive. So you don’t put the company, and the shareholders’ money, at great risk. The deposit was developed as an underground mine, and therefore they had to have a shaft. When they sank the first shaft into the ore body, almost miraculously, they accepted my advice that it ought to be named after Ted Whenan. Subsequently, I suggested the next two shafts be named after the first and the second chairmen of the company, who had both died. I thought that was appropriate because they were the brains behind the whole philosophy of using science to find ore bodies. So that’s the story of the Whenan Shaft, and it’s the last time that any Western Mining Corporation shaft or mine access was named after a driller.

08:00:09:06

Swent: Very good. Is Mr. Whenan still alive?

08:00:09:13

Woodall: No, he died a few years back.

08:00:09:14

Swent: But he had the pleasure of knowing that a great mine had his name.

08:00:09:18

Woodall: Oh yes, and his picture is up on site. We tend to forget how important in exploration are those people that are prepared to do the work the scientists plan out in remote areas, often under considerable hardship, away from their families. In Ted's case, his wife went with him, but that's unusual.

08:00:09:43

Swent: Well, I think we have come up to what you seem to think is a watershed time, the decade of the eighties.

08:00:09:52

Woodall: The 1980s was a watershed. It was a decade when we did make some important discoveries, but it was also a decade when, in retrospect, I can look back on some of the decisions that were made, and see clearly they were wrong decisions. Some events, which affected the company adversely, were not of our geoscientists' making, and were also most unfortunate. It was also a time of change in the management of the company. From the founding of the company in 1933 to 1987, the managing director, in other words, the most powerful man in the company in terms of determining policy and strategy and the hiring of senior executives, had been a technical person and always a mining engineer. It was very much a philosophy adopted by the founding father, W.S. Robinson. Also, from WMC's formation, the strategy had always been to grow as a result of exploration success. Therefore there had always been a vigorous, well funded, well managed, scientifically directed exploration effort. From 1987, the managing directorship which mining engineer Arvi Parbo had filled since 1972 was handed over to Mr. Hugh Morgan, a talented lawyer. He was the son of Mr. Bill Morgan, an engineer, who was the Managing Director from 1963 to 1972. Now Hugh, a lawyer, was also skilled in financial matters. Maybe every major company, once it becomes big, with very large assets, moves from technical top-level direction to management by people skilled in law and finance, and maybe that is in the best interest of shareholders, but it certainly makes a difference in terms of relationships between the technical and scientific arms of the company and top management. So this time was a watershed.

08:00:13:12

Swent: You said that was in 1986?

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Woodall: At the end of 1986, or just at the beginning of 1987, Sir Arvi Parbo handed over the role of managing director to Mr. Hugh Morgan.

08:00:13:21

Swent: So that would have been down the road a bit.

08:00:13:20

Woodall: Yes, but I want to talk about the 1980s in general as a watershed decade. It was the decade when the managing director changed from being a technical person, a mining engineer, to a lawyer, and when the company changed from having a chairman whose almost sole concern was Western Mining Corporation, to a chairman with other important responsibilities with less time for WMC business and far less accessible to the exploration people. And I think I have already mentioned before in this interview how critical I believe it is to have that unbroken line of confidence and trust between the board, especially the chairman, the top executives and the explorers, and how important

it is for the explorers to have unbroken trust and respect back up the line to the Board and senior management. Well, if the chairman is now rather busy with two or three other companies, the explorers don't see the chairman very often, and that starts to weaken that critical confidence-respect link. For example, the chairman no longer has time to actually go to the areas where the explorers are exploring and to get to know them more personally, to encourage, and gain confidence in the ideas they are applying, and to comment on those ideas and corporate strategy. And so, the confidence link starts to weaken. Contrast this with the 1960s, when Mr. Bill Morgan, an engineer, is the managing director, and he and his wife, Margaret, make themselves available to visit our geologists, and their families, even in remote exploration bases.

08:00:15:36

Swent: And of course, if he is not a technical person?

08:00:15:38

Woodall: Yes, you are referring to Mr. Morgan, the managing director from 1987. A non-technical leader needs a lot of education and thus needs to spend more time with the explorers. While Arvi was chairman we still had a technical person at the top, but one who became less available. So the decade of the eighties was a time when I saw the breakdown of what I perceived to be such a critical aspect of a successful exploration company, the unbroken link of confidence from the chairman, the board, the managing director and the explorers, and an unbroken line of respect from the explorers back up to the executive and board. The links became fragile and, at important times, were broken.

08:00:16:31

Swent: You have also spoken about what we call the cross communication, and I noticed in your notes here, you mentioned this in-house proprietary method for detecting gold. Was your Exploration Division keeping in close touch with the company's metallurgists, the mineral processors?

08:00:16:59

Woodall: Unfortunately not.

08:00:17:09

Swent: Communication being thwarted horizontally as well as vertically? Maybe not thwarted: perhaps that is too strong a word.

08:00:17:28

Woodall: I don't think the metallurgical department in Western Mining was as devoted to staying at the cutting edge of technology and science as the explorers were, and I think as events showed, they were often very slow to adopt new practices.

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Swent: There were new technical advances at that time.

08:00:17:58

Woodall: There were very important technical advances, especially the development of carbon-in-pulp and carbon-in-leach technology for extracting gold, and using saline water in gold-ore treatment plants. WMC was slow to adopt these methods.

08:00:18:09

Swent: You mentioned atomic absorption spectroscopy. And that, I think, was new, wasn't it?

08:00:18:27

Woodall: Yes, there were a lot of developments in automatic, accurate analytical equipment. The one we focused on was atomic absorption spectrophotometry, which was developed in Australia, in the 1960s by the Federal Government's research organization we have spoken about, CSIRO, the Commonwealth Scientific and Industrial Research Organization. What we developed, in-house, in the early 1980s, was a method of detecting very minute amounts of gold, down to one part per billion. This was the result of in-house research which we didn't share with others. It gave us a chance, probably the first chance, to do effective geochemical exploration in the flat, soil-covered environment of West Australia's goldfields. I have mentioned before how complex we subsequently found the near-surface environment, i.e., the regolith, to be. It is such an ancient land surface! It's not just a matter of collecting soil samples or stream sediment samples and looking for significant quantities of gold. The soils and sediments are so deeply weathered and leached, in some cases, for up to sixty million years, that often the traces of gold in the surface soils are extremely minute. And to be able to detect one part-per-million gold wasn't adequate. The amount of gold in soils over a deposit was often so small, even the old prospectors could not detect its presence with their most sensitive gold panning. Our new technique gave us the opportunity to carry out effective geochemical exploration for gold in the difficult West Australian environment. Now, other companies had developed other equally sensitive techniques, so we didn't have a significant technical advantage, we just had a method of staying with the competition. But that was critical. It resulted in the discovery of the St. Ives goldfield in the 1980s. In the 1970s we were mining nickel sulfide ore in the Hunt Mine named after Mr. Hunt who was the driller at the time of discovery, and lo and behold, while mining high-grade nickel ore, we came across quite large areas of very visible gold. So the geologists naturally got very excited about this because Kambalda had not been considered a significant gold district.

08:00:22:23

Swent: Where is St. Ives?

08:00:22:22

Woodall: St. Ives is a short distance, about ten miles south, from Kambalda. Since 1966, we had explored over twenty or thirty square miles in the St. Ives area and we had discovered many nickel deposits. Then during the 1980s, we went over this same country again and found a large number of gold deposits, which were hidden beneath barren or heavily leached soils. Why? Remember, originally the prospectors went to Kambalda, then called Red Hill, in the early 1900s, and found gold, but very little gold. We went back there and found significant nickel deposits. Finding very rich specimens of gold in a nickel mine really excited the geologists who were always more visionary than the mining engineers. When the geologists said, "Let's go and really start exploring for gold," the nickel mine manager said, "No way! My performance is based on producing nickel and your job is to find nickel, not gold." So gold exploration was delayed, until 1980 when we made the first of a series of major gold discoveries, in fact ten in the next ten years. Changing the mine manager's mind in 1980 was helped by the price of gold rising to US\$800 per ounce.

08:00:24:12

Swent: Oh my.

08:00:24:15

Woodall: So although, for several years, the enthusiasm of the local mine geologists to look for gold was dampened shall we say, it was not completely suppressed. Eventually one of our geologists, Barry Goss, took a drill into a St. Ives district and found the Victory gold deposit.

Now between Red Hill or Kambalda and the St. Ives district, was a large salt lake, just a flat area of salt-encrusted lake sediment where you could see nothing of the bedrock. Barry went to the south of this salt lake where there were sand dunes and small gold diggings, to what was called the Victory Gold Mine, and he started to drill. And he found that Victory was no squib, but very significant. Now you might ask, why were these deposits called the Victory, and then Defiance, and then Revenge? Well, Victory was the name of an old mining claim. Barry Goss, like me, didn't like the idea of naming orebodies by numbers: No.1, No.2, etc.—you had to be a bit more enterprising and colorful. So he started to call them after the British ships in the Battle of Trafalgar, a very famous sea battle between the British and the Spanish. He was motivated, I suppose, by the fact that the “Victory” was Nelson's ship, Nelson being the Commander of the British fleet. Another important ship was the “Defiance.” So from then on, every gold discovery we made in the St. Ives district was named after ships at the British Trafalgar fleet. And when we found more orebodies than there were British ships in the Battle of Trafalgar, we started to name them after the Spanish ships. This illustrates the very colorful nature of the people that worked for me and made up this exciting, successful, WMC Exploration Division.

Well, over a period of ten years we found ten separate gold deposits in the St. Ives district and when I retired our reserves totaled six million ounces. I would expect by now, because of continuing exploration, St. Ives is at least a ten-million-ounce ore district. And it was hidden from the early prospectors by this complex regolith which I have described to you. The surface expression of these deposits was often just a few parts-per-billion of gold in soil. But, drill through that leached zone, a zone with negligible gold, and you find supergene blankets of enriched gold, gold that's been leached from the surface and then re-precipitated. And these supergene gold-enriched zones became the gems in the Western Australia goldfields, where everyone else was exploring. These zones were relatively close to the surface, they were flat-lying and thus ideal for open pit mining, and the ore was easy to treat now that carbon-in-leach technology using saline ground water had been a proved processing technology. I mentioned before, that the gold price escalated dramatically in the 1980s. In 1980 it peaked at US\$850 an ounce and every entrepreneur and mining company in Australia and from overseas descended on the West Australia goldfields. They were not interested in science! They just acquired drills, and drilled and drilled and drilled. As it turned out, that was the smart thing to do. To try to sort out the science of the regolith was very difficult, but to bring in a drill and just pattern-drill anywhere where there was any signs of earlier gold mining turned out to be a very effective way to explore. Many, many gold deposits were found that way.

As I mentioned before in this interview, if in the 1960s and 1970s I had realized how complex the regolith of the goldfields was and that gold was leached from the surface, and had devoted a decade to mapping it, we would have had a competitive edge in the 1980s. Instead of that, our only advantage over competitors was our large holding of exploration and mining tenements, many acquired for nickel exploration. It was very

difficult to acquire exploration ground in the gold boom of the 1980s. We did use science in our exploration, applying our low-level gold detection system which our own chemists had developed, allowing us to detect a few parts-per-billion gold in the soil. This often led us to the supergene rich “blankets” at depth and then the primary lodes beneath those “blankets.” So, that was one of our most exciting and most successful exploration ventures in the 1980s.

08:00:30:31

Swent: Who owned the land where you had your leases? Whom were you leasing it from?

08:00:30:36

Woodall: The government.

08:00:30:36

Swent: The Western Australian government.

08:00:30:40

Woodall: Yes, the state governments owned all the mineral rights in Australia except in very selective areas, where, in early colonial days, mineral rights were granted by the government to private owners, but those areas were relatively small.

08:00:30:54

Swent: So you were having to deal with several state governments.

08:00:30:59

Woodall: Oh yes, a very time-consuming task.

The other thing I want to mention about the 1980s is that, for various reasons, we were encouraged to become more international. And the first real opportunity we had was in 1980. Now, I have mentioned that when we had found the bauxite deposits in the Darling Ranges of Western Australia, which by the 1980s were well developed and producing the cheapest alumina, i.e., alumina oxide, in the world. The operation was the most profitable part of the giant Alcoa Company. Naturally, we had close and very amicable relationships with Alcoa, with whom we had formed the joint venture to develop the deposits.

Well, the story starts with Arvi Parbo, WMC’s Managing Director, who was on the board of Alcoa, and was traveling with Alcoa’s most senior executive en-route to visit Alcoa’s bauxite mining and alumina refineries in Brazil. Arvi was in Alcoa’s private jet with Alcoa’s President, Mr. Joe Bates and flying over the vast Amazon jungle. I guess they were chatting about many things, and they looked out at this vast forest-covered section of Brazil, and Arvi must have said, “I bet there are a lot of big orebodies down there;” or maybe it was Joe Bates who said it. Which ever way, the thought was expressed that perhaps Western Mining’s Exploration Division might be able to find these big orebodies “down there.” Alcoa was just really a single metal company, a company based on the aluminum industry, but this discussion seeded the idea that perhaps they should have a second arm, perhaps they should also produce copper as it would make the company less vulnerable to variations in the price of aluminum. So, during that flight, the idea was conceived that as Alcoa was making big profits in Brazil, but was having trouble repatriating those profits, perhaps those profits could be used for exploration in Brazil, looking for copper. So in 1980, Western Mining’s Exploration

Division was asked if we would explore in Brazil for copper, financed by Alcoa, but with WMC having equity in any discoveries: i.e. discoveries shared fifty-fifty with Alcoa. We would provide the science and technology and the smart explorers and Alcoa would provide the money. So that's how we first became involved in a significant international exploration venture.

We had the opportunity in 1983 to take over management of a famous gold mine on the island of Viti Levu in Fiji. That mine, the Emperor Mine at Vatukoula, was based on a multi-million ounce gold deposit found in the 1930s. Early in its history it was incredibly rich, but now it was struggling with low grades and high costs. We took over management and within two years found the rich, million ounce, Prince William ore body. So this helped our morale considerably, and helped us to believe that the 1980s might also be a gem of a decade. We were finding gold. We were finally able to compete with the entrepreneurs in Western Australia's goldfields, explorers who were less interested in science but had lots of money for drilling. We had cracked the secret of how to find gold in this leached, ancient landscape and were now also having a lot of success. And here we were going overseas with a major American company financing all of our Brazilian exploration. This made us feel very proud.

08:00:37:45

Swent: Was this enterprise in Fiji? Was this an Australian company? The Emperor Gold Mine?

08:00:37:53

Woodall: The company's name was the Emperor Gold Mining Company, and it had its headquarters in Sydney.

08:00:38:17

Swent: It had nothing to do with Alcoa?

08:00:38:20

Woodall: Nothing. It was quite a separate venture. The history of the Emperor Gold Mine is itself a fascinating story, but we shouldn't go into that now.

08:00:38:30

Swent: We won't go into that here, I guess.

08:00:38:35

Woodall: I know that the first geologist that visited the discovery site in the 1930s was astonished to find visible gold in the outcrop. His report describes the abundant filaments of visible gold, "wire gold" all through the weathered rock, and he must have been the most conservative geologist ever because he is reported to have said, "I think this is a very interesting prospect."

08:00:39:06

Swent: I presume the rocks are volcanic in Fiji.

08:00:39:08

Woodall: Yes, all very volcanic, and very young volcanics, geologically speaking.

08:00:39:09

Swent: So that's different!

08:00:39:08

Woodall: It's a totally different geological environment to the Archean of Western Australia which is an ancient volcanic environment. So Fiji was exciting for our geologists. We had experience looking for, and finding, ore bodies in the Archean, where the rocks are 2,600 million years old. And here we were looking at rocks and ore bodies that were just perhaps one million or two million years old, seeing the processes that formed the gold deposits still active. So, it was very exciting stuff, and to be so successful within two years was also exciting.

08:00:39:59

Swent: Happy times.

08:00:39:58

Woodall: Yes, until I would say 1984, when we suffered, over the next decade, a succession of set backs. By contrast, the early 1980s was for me, personally, a time when I seemed to receive an abundance, perhaps an over-abundance of personal recognition. I began to receive a succession of awards.

08:00:40:24

Swent: I noticed that you began your lecturing and writing in the 1980s also.

08:00:40:33

Woodall: Yes, I gave eleven important public lectures in ten years. Some of them I thought contained quite important messages.

08:00:40:54

Swent: We might explore that topic just a little bit. Generally we think of the academics as the ones that do this kind of thing, and you had elected not to go the academic route, and yet here you are doing something very academic.

08:00:41:17

Woodall: Yes, my last invitation to become an academic was in 1974 when the Professor of Economic Geology at Adelaide University, Professor Eric Rudd, was considering retirement. Well, if I haven't emphasized it enough, I want to emphasize it again, that I made a personal commitment, that although I was not in academia, I was not going to become an out-of-touch scientist. I went to a lot of trouble to make sure that the best of the geologists and geophysicists and geochemists that worked for me also did not become out of touch with their science. I ran a study leave program which I have already described. I would have to go back to records to find out how many of my geoscientists I sent overseas for advanced studies, but at least fifty. So I had very close contacts with universities as I would not delegate responsibility for recruitment. That meant that I had to go visit universities. And I did not like going to universities and saying to the professors and heads of the departments, "I would like to come and interview all of your good students, and I would like to be there a week," without offering something in return. So I would always offer to give a lecture or two. And I suppose I got known as somebody who knew something about exploration, and was running a different type of exploration department which was very successful and was employing the best science. The Exploration Division was still devoted to our founder's proclamation, "Use the best science to find those orebodies the early prospectors couldn't find." So there was a lot of interest in what I had to say, and I suppose I got known as being available and an interesting speaker.

I also found it a very useful discipline because I would never offer to give a lecture on a subject that wasn't of interest to me. So if I said, "All right, I will give that lecture in three months time," it meant that I had to do a lot of reading to catch up on any new scientific developments, make sure that I was updating my knowledge so that the lecture itself was based on up-to-date knowledge. Visiting universities and talking to students and staff also gave me an opportunity to learn.

08:00:43:38

Swent: You have a long list of publications.

08:00:43:44

Woodall: Yes, and they nearly all relate to lectures I have given. I think it was very good for me professionally. It was very good for me as a scientist because there is no better discipline, in my opinion, for a scientist to have to lecture to bright young students because they ask some cutting-edge questions. So you give a lecture and you realize where the weak points are in your logic. You are encouraged to further upgrade your knowledge and skills. So these lectures, although they took a lot of time, were very valuable in maintaining the image of a company committed to scientific exploration. Preparing the lectures was valuable to me and to the staff in terms of keeping our science and technology up to date, but they did take a lot of time.

Perhaps here I should reemphasize that we were now exploring internationally. I was having to devote a lot of time to public lectures and recruitment; we are now talking about an Exploration Division employing nearly 150 scientists in minerals exploration and mine geology, and this was the time I was asked to take the Company into petroleum exploration. It meant that I had to delegate much more responsibility for the day-to-day decision-making for the mineral exploration in Australia.

I gave that responsibility initially to Jim Lalor in 1980, and he filled the role until 1988, when he left to manage operations, mining, and exploration in North and South America. Jim had managed exploration in Eastern Australia since 1973, and although he failed to recognize the potential for copper-gold mineralization in the Cadia Belt in New South Wales, he made a significant contribution to the team that discovered the giant Olympic Dam deposit. David Harley took over responsibility for Australasian exploration in 1988.

During Jim's reign (1980 to 1988) only one small copper deposit was found, the Nifty deposit, a small nickel deposit (Blair) and a small gold deposit (Yandan). In David's period of responsibility for exploration in Australia and the Philippines two very significant discoveries were made, the Ernest Henry copper-gold deposit in Queensland (1991) and the giant Tampakan copper-gold deposit in the Philippines (1992), but both were the subjects of subsequent tragedies.

I would still meet at least twice a year and talk about strategy with the Australian explorers, but you can't say to someone, "Right, now you are responsible for exploration in Australia," and then not let that person make the decisions: you must give a free rein. And mistakes were made! Exploration in Eastern Australia turned its back twice on the copper-gold occurrences in New South Wales, which became known as the rich Cadia Belt of copper-gold deposits. It is now the centre of some of the most profitable mining operations in Australia. Twice our geologists reviewed the

opportunities, twice they noted the occurrence of low-grade copper-gold mineralization, but never did the persons in charge follow up those leads. So we missed the Cadia discoveries. I am getting on to the sad parts of the 1980s.

From 1955 to 1966 we operated on a miniscule exploration budget of about \$150,000 per annum but found the world-class Kambalda nickel field. From 1967 to 1979 the average regional exploration budget was about \$14 million and we found another two world-class deposits: the Yeelirrie uranium deposit and the giant Olympic Dam copper-uranium-gold deposit. After 1979 the exploration budget was doubled, but major discoveries in Australia essentially evaded us throughout all the 1980s, the “terrible 1980s,” except at St. Ives.

08:00:47:29

Swent: I was just looking here and I see that the first mention of a lecture was in China in '78. That was the early days in China.

08:00:47:49

Woodall: My public lecturing began in the 1960s, gathered momentum in the late 1970s. But as for China, that's another interesting story. A Chinese government organization responsible for gold mining visited our head office in Melbourne, and asked if we could provide them with technical guidance to aid their search for, and the mining of, and the processing of gold ore bodies. So our managing director at the time, Arvi Parbo, said, “What's in it for my shareholders?” And they said, “Well, we could form a joint venture, and if we make discoveries, we can share the benefits of whatever discoveries are made.”

08:00:48:51

Swent: That was really quite amazing for China.

08:00:48:51

Woodall: That's it. So I put together a multi-disciplinary team: geologists, geophysicists, a mining engineer, and a metallurgist, and off we went, in 1980, on a lecture tour of China. Now before we went, we spent a lot of time writing a manual on aspects of exploring for gold, mining gold, and treating gold ores. And this was translated into Chinese. So we gave them a volume that really told them all we knew about how to find gold, how to mine it, how to make money out of processing gold ores—all in good faith. We took this document to China, and for about a month we traveled China lecturing. We went to some very remote places in China, as well as giving a number of very key lectures in Beijing. What happened? Well, they were delighted: and felt that we had done a superb job.

The next thing that happened was a request for a visit by a delegation of Chinese professionals from their gold industry. They said: “We would like to bring out a technical mission because your people have told us about how they think we should explore, mine, and process but we would like to just see it all in practice.” It was like maybe they didn't believe us! So we agreed that a technical mission should visit. They visited many of our operations, and we lectured again in a more practical sort of way. They went away but, before long, they sent another message: “Look, we have another group of professionals we would like to send out. We would like them to come out and also see how you explore for gold, mine and treat gold ores.” So another group came

out. After subsequent visits, eventually Arvi, the managing director, had had enough. I think he must have banged the table and said, "It's enough! We got into this because it was supposed to be of some benefit to my shareholders as well as you, and so far you haven't offered us equity in any gold deposits." Then all communications stopped! Perhaps the people we were dealing with didn't really have the political power to allow a foreign company to own any equity in gold deposits in China.

08:00:51:53

Swent: Or the economic structure to do it.

08:00:51:56

Woodall: If you did mine gold in China, in those days you had to sell it to the Chinese government at a discount. It is only recently that China has really, you might say, privatized its gold industry. We were too early! It must have been politically impossible to do what the technical people had promised. The technical people I am sure were honest in their intent. They wanted to form a fair joint venture, but the politics didn't allow it at that time.

08:00:52:26

Swent: But they learned a lot from you.

08:00:52:27

Woodall: Oh, I think so. Because years later, some of the people that I met, had made further contact and showed considerable admiration for us. It was nice to know that at least we did a good job as scientists, but we didn't do much for our shareholders. But these were some of the things that started to take so much of my time. You made a comment earlier about me giving lectures, some of them quite similar to lectures normally considered the role of academics.

08:00:53:13

Swent: I didn't mean that as a putdown.

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Woodall: No, it wasn't a putdown at all! The awareness of our emphasis on science, on scientific training and my visibility in the academic environment resulted in me being offered fellowship in the prestigious Australian Academy of Science. I was already, from 1977, a fellow of the Australian Academy of Technological Sciences and Engineering that recognizes contributions to the application of science and the economic impact of that application to the nation, and the community. That was 1977. Now in 1988, I was offered fellowship of the Academy of Sciences; a very elite body. They only elect a handful of new fellows each year, so it was a very special honor. Also, in 1983, I had already been honored by the Geological Society of London. They awarded me their William Smith Medal, named after that most famous early British geologist, the father of geology. In 1986, the Society of Exploration Geologists, the prestigious U.S. based society for exploration geoscientists, awarded me their Silver Medal, and then in 1988, the American Institute of Mining, Metallurgical, and Petroleum Engineers awarded me their prestigious William Lawrence Saunders Gold Medal, an honor which was also awarded to Herbert Hoover, before he became President of the U.S.

08:00:55:57

Swent: That's a tremendous honor.

08:00:56:03

Woodall: Yes it was! You said I was not an academic, that is true, and I think I was doing things that the academics in a university geology department were not able to do because they were focusing on more narrow fields of science, and were not as knowledgeable of mines and mineral exploration. I was more interested in issues like, here is a giant ore body, why did it form here? Why are there only two or three major gold deposits in three million square miles of Australia? Why are these concentrations of valuable metals so rare, so unique? Therefore, what should we do to document them scientifically before they are destroyed by mining? This I saw as our responsibility and by doing this, we gained information which made us even more successful in exploration.

08:00:57:09

Swent: Very few people are able to make that cross-over.

08:00:57:17

Woodall: Moreover, very few geologists on mines are given the opportunity to do scientific documentation along with the practical aspects of their work. Because I had responsibility for the geologists on the mines as well as the geologists in regional exploration, I could influence what they did. Keeping the mine managers “on-side” and happy was important, and they were always happy if the work we were doing, for example, the scientific documentation of the ore bodies, resulted in new discoveries. But we regarded it as an important responsibility, in its own right, i.e., describing the mine environments in scientific terms.

We were mining unique geological features and thus destroying them. We had a scientific responsibility to see that there was a sound, factual, scientific record of what those ore bodies were like. Even if we couldn't explain how the deposits were formed, perhaps another generation of geologists would be able to look back on our descriptions and say, “Oh, if that's how they were, this is now how they probably formed.” But if there was no record of what we were mining, how could future generations of geologists evaluate their ideas? They will be asking, “What were the Kambalda nickel deposits like; what were the St. Ives gold deposits like, or what was the great Olympic Dam deposit like?” And I will tell you now, Lee, some of the best scientific work going on in the world in terms of describing and wrestling with the problems of how ore bodies are formed is still going on right to this day, for example, at the Olympic Dam mine, and is in the hands of one of the best graduates from this university, Kathy Ehrig. So what I am talking about is something that is very dear to my heart, and it is perhaps because of my total commitment to this scientific work on the mines that the Australian Academy of Science elected me to be one of their Fellows.

01:00:22

Swent: I think they are much more exclusive than our National Academy of Sciences.

01:00:25

Woodall: They are very exclusive. I know because I served on their selection committee for four years and know how tough it is to be elected. But here I was, not even an academic, and I am one of a few people who is both a fellow of the Academy of Technological Science and Engineering and a Fellow of the Academy of Science. I feel so honored!

01:00:49

Swent: Tremendous.

01:00:48

Woodall: I must have had friends in the right places somehow.

08:01:00:52

Swent: Oh no. [laughs]

08:01:00:53

Woodall: But quite seriously, we cannot over-emphasize the importance of scientific descriptions of ore deposits. And it is our responsibility, the responsibility of mining companies. No one else can do it! While our geologists are working on a mine, they are the persons to see all aspects of the deposit and they must leave a record of what they see. The exposures they see won't be available ten years hence! And I think if you ask me what was perhaps the most important thing I have done in my career, it has been to encourage this mine-site documentation: the importance of leaving as a legacy the good descriptions of ore bodies on which future geological theories can be soundly based. And it is still going on at the Olympic Dam mine. People are writing and publishing about the Olympic Dam deposit in the academic world and their views are often wrong because they don't have the facts. The facts are being generated by geologists who see the deposit every working day, not during a few brief visits.

08:01:02:08

Swent: You think people have written incorrectly about it?

08:01:02:14

Woodall: If they don't know the facts, their visits and research efforts brief, how can they write true descriptions and develop valid hypotheses? I don't want to be too critical of academics for I know they are under pressure to publish. They have to publish to maintain prestige! And they can't say, "I am going to study this ore body for ten years, to really understand it before I write a paper." Now, that's what Professor Chuck Meyer would have said. He would not write about a deposit he did not fully understand. He didn't care about the scramble to publish! Often I have seen academics visit a mine, collect a bag of specimens, and away he or she would go and write a paper! Now how could they compete with a geologist that's everyday going underground, looking at the ore body, recording it and doing this for two or three years? How can an academic, no matter how smart that person may be, compete? The bag of rocks collected may not even be representative of the ore body. In two or three days on site and a few weeks in a laboratory, he or she is trying to compete with the knowledge of a smart young geologist who sees the deposit everyday. So what the young geologist writes has high integrity, but what the visiting academic will write, may, despite the very best intentions, be incorrect, in fact, it may be very misleading, especially to the students that read the results of this visit in the technical press.

08:01:04:17

Swent: Where have these been descriptions by your geologists been published?

08:01:04:22

Woodall: In various journals, but the current research at Olympic Dam has not been published.

08:01:04:25

Swent: All right.

08:01:04:27

Woodall: I am not aiming this gun at any particular person. I am just saying that the system whereby people in academia are required to publish to maintain status, to write about ore bodies, describe ore bodies and speculate on their genesis, is suspect unless they work hand in glove with the people on the mines who have at hand, the results of very detailed scientific documentation. High quality documentation was the case on all of our mines while I was in charge, and after I left, and quality scientific documentation is still going on at the famous Olympic Dam mine, that I do know!

08:01:05:16

Swent: Well, it is such a special mine that everybody wants to write a paper about it, I suppose.

08:01:05:18

Woodall: It's a special mine, and I am very proud of the fact that its description is in special hands by someone who's on site, who's thinking about it seven days a week, who has now been there ten years. How can an academic compete with that Kathy at Olympic Dam? Ten years, total commitment to describing, understanding, thinking. Smart academics who wrote about our nickel mines actually came and wrote joint papers with our geologists, and those papers had scientific integrity! But when academics just collect a bag of rocks and go off and do their own thing, they are running a great risk of misleading the scientific community they are paid to serve. I am a bit of a radical on this issue, because it is so important! Perhaps I was quite popular as a lecturer, as a result.

08:01:06:45

Swent: It might have made you unpopular!

08:01:06:48

Woodall: Well, if I was unpopular I was never invited back, and that would never bother me because good recruits don't come from such academic enclaves.

08:01:06:54

Swent: Well, that's a fair warning.

08:01:07:00

Woodall: I think I have covered all the high points of the 1980s. I am not too sure how long I should dwell on the low points. I've already referred to the small number of discoveries in Australia after I delegated management for regional exploration, even though we doubled the budget.

08:01:07:10

Swent: We need to mention the low as well as the high.

08:01:07:21

Woodall: An early 1980s set-back was Alcoa's withdrawal from funding our exploration in Brazil. I guess it all started about 1983, when Alcoa, who was funding our Brazilian exploration, said, "We want to withdraw from this joint venture. We've decided that we are not going to move from our focus on aluminum, and therefore it doesn't make sense for us to fund copper exploration in Brazil." This decision was made even though we had a vision that there were great copper ore bodies to be found in Brazil. So we lost

their financial support for exploration in Brazil, and they officially withdrew in 1985. We tried to find someone else to finance Brazilian exploration. I was told that it wouldn't be difficult to influence financial people in London, for example, or New York, especially if we were already exploring in Brazil.

08:01:08:41

Swent: Brazil itself had no exploration?

08:01:08:43

Woodall: Brazil was doing a lot of exploration through its government agencies, but we felt that we had a special edge in looking for copper. In fact, we thought we could compete technically with anyone in the business of exploration. So we were confident we had something to offer. Remember, we had an exceptional track record! So I went to London and to New York, talking to people who had access to finance for investment saying, "Here we are. We are good at finding orebodies. Look at what we have done. We need someone to come and financially support us in Brazil. We have the technical expertise, we have high-integrity ideas, but we need investors who will back us." We got encouragement, but never any money! In the middle of all this, another set-back, nickel wasn't very easy to sell. The market was tight, and prices were low. The company wasn't rich. Then another setback! It involved the results of a meeting with Dr. Hugo Dummett, who was working for Superior Oil at the time.

08:01:10:31

This was before he joined BHP as exploration manager. I met him at a conference. He said, "Roy, are you looking for diamonds?" I said, "We have a diamonds exploration program in Australia. We started it in 1979, and here we are in 1985 and we have not been successful." "What's the problem, Roy? You guys are supposed to be good."

The problem is Australia's ancient landscape again. The land surface is flat, and there are very few rivers to concentrate the heavy minerals, the "indicator minerals" which are the best guides to the kimberlites that contain the diamonds. The landscape except in Northern Australia, as we found out from gold exploration, is deeply leached. It leached gold and also changes the character of the "indicator minerals." They become highly oxidized, difficult to identify, and almost impossible to trace to their source even if you find them. We started what I think was a very well managed diamond exploration program in Australia, but, so far, we have failed. I know diamond mines are hard to find, but they are particularly hard to find when you are trying to find them under a complex ancient land surface where you have elements of weathering and sedimentation from the Permian to the Tertiary. Suppose a kimberlite pipe exists in southern or central Australia subjected to erosion by glaciers in the Permian, so all the "indicator minerals" are spread out away from the deposit. Then follows a different period of erosion in the Cretaceous, perhaps a very wet period when a river picks up those "indicator minerals" and it spreads them in another direction. You find "indicator minerals," you may even find small diamonds, but to track them back to their source becomes a very difficult task. So the regolith again beat us. If I had started a regolith study much earlier, maybe the diamond exploration in the eighties might have had a chance of being more successful.

Anyway, I met Hugo Dummett, and he said, "I know a group of prospectors up in Canada that are doing some very interesting work looking for diamonds in Canada.

They are following the trail of indicator minerals back up-ice, trying to find the source. Now, these prospectors have a good laboratory in which to identify the indicator minerals, and they have found the one which we know is absolutely critical to finding an economic diamond-bearing Kimberlite. They have identified this particular garnet mineral. It has a particular chemical composition, and they called it a “G10” garnet. It is only associated with diamond-bearing kimberlites and its significance was recognized first in South Africa by John Gurney and DeBeers, who know more about exploring for diamonds than anyone.”

continue Interview 5: January, 26, 2004
[Begin disc 9]

09:00:00:02

Swent: Okay, I am sorry to interrupt you in mid-sentence, but you were talking about G10 garnets and exploration for diamonds in Canada.

09:00:00:22

Woodall: Well, my response to my discussion with Hugo was to advise Dr. Jim Ross, who was in charge of our diamonds exploration program. He obtained his doctorate from this university. Jim met with Hugo later in 1985 to review the data and then obtained more information from the prospectors. By the end of the year he believed that it represented the world's best available diamond exploration opportunity. In January 1986 Jim went off to meet the prospectors who were running the Canadian program and the discussions with them extended until September 1986. They wanted either to retain a 25-30 percent equity in their project and receive a 7.5 percent on net operating revenue. Our head office personnel were not used to dealing with prospectors who wanted to retain such a high equity and royalty. The company thought that since we would have to finance exploration and all of the development if we made a discovery, something like 10 percent equity, or a 5 percent royalty, capped at 15 percent of cash flow was more reasonable. So in terms of what the prospectors wanted and what Melbourne office hierarchy would approve, we were miles apart. The other thing is that this is all happening in 1985-86, when our exploration budget was almost halved because of the declining profits from the nickel business. So we were running a very tight ship. And it appeared to me that the only way we could afford to take over financial responsibility for a Canadian exploration program would be to close down Australian diamonds exploration. In retrospect, that's what I should have done in the interest of Western Mining shareholders, but it would have meant retrenching perhaps a half a dozen or more very loyal geologists and technicians skilled in minerals identification and employed in our own laboratory. We had now been in the diamonds exploration business since 1979, but the hope was that soon we would make our own big diamonds discovery in the difficult-to-explore Achaean of Western Australia.

Well, we could not reach agreement with the Canadian explorers. I think that if this opportunity had come when Sir Lindesay Clark or Mr. Bill Morgan had been managing director, as in the early Western Mining's days, I would have felt very comfortable to talk to them, explain the science and the importance of finding G10 garnets. Then, like in the 1960s and 1970s, I think the answer would have been, "Roy, if that is what's critical, we can't let the opportunity pass us by, no matter what it costs." But from 1986 onwards, the management of the company was not in the hands of such technical people. WMC's management was now in the hands of people who were very comfortable assessing financial or legal risk, but less able to assess technical/scientific risk. To get them to understand the importance of a G10 garnet was rather difficult, especially as our diamonds exploration team had no history of success despite seven years of exploration. Now Jim Ross would have said, and probably did say, "We will never find an economic diamond mine unless we can be led to it by G10 garnets." But skeptical non-technical people are more apt to think, perhaps aloud: "Jim, you know, he's a great scientist, but probably next year he'll change his mind. He'll think he wants a G11 garnet or whatever." You see, assessing technical risk is a different world: it

requires teachers and learning and confidence. If the decision had been Sir Lindesay Clark's or Mr. Bill Morgan's or Sir Laurence Brodie-Hall's, the discussion may have been more like "Explain the science to me so that I can give the board an informed opinion as to why this time we should accept the terms: i.e., why this opportunity is so important. You say the Australian environment is so difficult, well let's cut-back in Australia, but not abandon our effort in Australia and let's give the Exploration Division enough extra money so that they don't have to retrench skilled, loyal staff."

Well, we never reached agreement with those entrepreneurs. The Canadian explorers continued their search and another five years elapsed before the discovery of the Ekati diamond field. In 1992, Hugo took the project to BHP who accepted a 50 percent equity and went on to find the very rich Lac de Gras diamond field. Interestingly, those discoveries occurred within the area that had been agreed as the area of influence for the proposed deal between the prospectors and WMC. And I read in the technical paper just this last week or so that Canada now, with this diamond field and other diamond fields subsequently discovered, is starting to surpass South Africa in diamonds production. The sad recollection is that WMC could have been at the cutting edge of that exciting exploration success. So that's one of the tragedies of the 1980s. We had the science, we knew what we needed to find, but didn't have the financial flexibility or influence to pull it off. We were also compassionate towards our staff, whom we trusted and believed would succeed in time. As it happened, even after another next ten years, they still didn't find a diamond mine in Australia, not because they were not doing good science or good technical exploration, just because the task was so, so difficult. Without streams to concentrate "indicator" minerals, or a simple soil profile, i.e., a simple regolith, the task was beyond their capabilities. Even today, diamond exploration anywhere in the world has only been successful where there are active rivers or recent active glaciers to leave an "indicator mineral" trail which can be traced back to a source, or simple soils without a deep, completely weathered soil profile. Our failed Australian diamonds exploration project was a second disappointment of the 1980s.

09:00:08:17

Swent: What might have been.

09:00:08:17

Woodall: What might have been. There were also mistakes made in 1987 when the company tried to expand its gold production by acquisitions in the U.S. and Canada. WMC sold its interest in the Kalgoorlie goldfield which subsequently became a large low-cost open pit mine: to me, a mistake. Worst still, that money and more, over \$400 million, I believe, was used to buy four gold mining properties in North America: one gold mine in Nevada called Hog Ranch, a gold mine in California called Carson Hill, copper-gold mines in Canada at Chibougamau, and gold mines in Nova Scotia. Now those decisions were made without any reference to the Exploration Division, which was a mistake. It was also a decision consistent with the company's long standing financial policy concerning acquisitions—buy on the basis of reserves: give no value to exploration potential. What was ignored, was the knowledge and competence of Exploration Division's geological staff in North America and the competence of several in the Division who were expert in estimating and auditing ore reserves.

09:00:10:33

Swent: Must have been a surprise.

09:00:10:38

Woodall: By 1986, WMC's Exploration Division had established a small exploration group in the United States, staffed by really top geologists. During this time they learned a lot about gold in western USA. So we had a considerable amount of local knowledge and competence to assist in acquisitions, but we were never consulted when those purchases were made. As it turned out, they were financial disasters, and millions of dollars were lost. I don't think Exploration Division's North American geologists would have recommended any of the properties. Establishing the grade of ore reserves in gold mines is not easy: it is easy to get it wrong! In the Exploration Division there were several people who could have advised wisely on the integrity of the gold grades, but they were not consulted. So those North American purchases proved to be the third tragedy of the 1980s.

There was a glimmer of "sunshine" in 1987 when we found our first gold mine in Brazil, and I have to tell you about its discovery. It's astonishing. We went to Brazil in the belief that it was a relatively unexplored country. Critics said: "Now, how can that be, Roy? It's been settled and explored since the seventeenth century. Where are you exploring?" "Well, we are exploring in central Brazil." "Central Brazil? What? Near Brasilia?" "Well, not far away, in fact, not far from the famous old capital of Ouro Preto, which means black gold in Portuguese. We are doing simple geochemical exploration in farm country."

Where we were exploring, the regolith or weathering zone was simple and not difficult to deal with, and there were active rivers and relatively young soil profiles. It was in farm land that we found traces of gold in the soil and followed the gold up to the source in a remnant of rainforest in one of the farmer's fields. In amongst the trees we found outcropping quartz showing visible gold in farmland! The area had probably been farmed for 200 years or more but never explored for gold. You can imagine how excited we were about that! It turned out to be quite a small deposit, perhaps 300,000 ounces, but we made quite a lot of money from a very simple operation. We paid back the US\$10 million capital cost of developing the deposit and building the treatment plant in seven months, and made a cash surplus of about \$20 million. A glimmer of sunshine in the gloom!

09:00:15:31

Swent: Did you give it a name?

09:00:15:34

Woodall: Yes, it was called Jenipapao. Now what the discovery confirmed was, firstly, that the country had not even been explored systematically for outcropping gold, and that if we persisted, we could use the profits from even these small discoveries to finance the discovery of larger gold deposits, which I was quite confident we would eventually find. It also demonstrated that we had exploration competence in Brazil, and it could have given us the means of self-funding exploration there, thus taking the stress off the Melbourne office and our financial people. The trouble was that the Exploration Division was never encouraged to operate as an independent business. We were never allowed to benefit financially, as a Division from discoveries.

09:00:17:03

Swent: That influences your decisions then, doesn't it?

09:00:17:06

Woodall: I think if we had been allowed to be an independent business unit with a certain level of annual financial support from the company, and a long term focus, we could have been more effective, especially with our international exploration. For example, we might have been able to sell the small gold mine we found in Brazil to buy our way into the diamond-exploration venture in Canada without having to go to the head office and beg for special permission to do special deals. The company's philosophy of selling our small discoveries in Australia was also questionable. For example, after we found a small gold deposit in Queensland called Yandan, WMC sold it for a small sum. The new owners made millions of dollars from mining the deposit and Exploration Division achieved no financial benefit from the sale. What might have been?

09:00:17:43

Swent: Yes, indeed.

09:00:17:48

Woodall: In 1986 I felt we had the resources, skills, finance and personnel, to tackle the search for gold in western USA. We knew we were starting behind the pack, but, gold discoveries were still being made: Gold Quarry, Jerritt Canyon, Chimney Creek, Rabbit were all discovered in the 1970s and early 1980s. We were behind the competitors: a serious disadvantage in exploration, but I thought we still might succeed because Nevada was being shown to have such a rich gold endowment. Bruce Kay, who had studied at the Colorado School of Mines, was put in charge of exploration in the United States, and Larry Smith, an American recruit, supported him. They quickly realized that because we were late, it was now difficult and expensive to get access to the more prospective ground. You just couldn't expect to offer the ranchers or the small companies that held the claim peanuts for the right to explore their tenements, just because we regarded ourselves as good explorers. They wanted real dollars, and dollars up-front! Several recommendations were made to the Melbourne office to buy into some of the better discoveries, but to no avail.

Exploration Division's mandate in North America was made quite clear from the outset. WMC had no money for exploration or the purchase of exploration opportunities and we should strictly look for "Vatakoula type opportunities" that could provide cash flow to finance near-mine exploration. Large up-front cash payments were not allowed and we therefore looked at numerous historic, near-mine situations that had production opportunities where value might be created by consolidating leases, etc., for example, at Tintic, Comstock, Goldfield, Cripple Creek, Oriental Mine in the Motherlode of California, etc. Had the mandate been different—and with the benefit of hindsight, there were probably many corporate opportunities for acquisitions, mergers, or takeovers that could have provided a cash flow producing US subsidiary for WMC—that could have been the basis for further growth and exploration. WMC's aversion to corporate dealing with junior companies was also a major impediment to this approach.

I recommended that we purchase equity in the Round Mountain discovery, but it wasn't pursued. The deposit turned out to be a great gold deposit. History has also shown that even 1986 was not too late to get into other highly prospective areas, like the Carlin Trend. In 1986 Barrick bought the famous Post deposit, a purchase which turned Barrick into a company with the biggest gold reserves of any company, even more than Newmont. I believe that when the Post claims were for sale, Barrick was the only

bidder. WMC might have been able to buy this jewel for \$60 million if they still had that \$400 million to invest. What might have been the result of the company's acquisition spree in North America if Exploration Division had been involved or at least consulted as to how to invest \$400 million? Maybe WMC would have become the new Barrick. Other opportunities which were still available late in the 1980s were ground north of Gold Acres and, as late as 1991, ground near Cortez that contained the Pipeline deposit.

09:00:21:16

Swent: What might have been!

09:00:21:21

Woodall: Another unfortunate decision of the 1980s was my decision to commence exploration for gold in Liberia. Now, Liberia was then the most stable country in Africa. Why? Because it was important to the United States. They had their principle Voice of America radio communications base there to transmit information throughout much of Africa. It was a country originally established by U.S. citizens as a home for returning slaves, and received a considerable amount of financial assistance from the U.S. Many of their professionals were U.S.-educated.

09:00:22:39

Swent: African freed slaves, wasn't it?

09:00:22:43

Woodall: Yes, it was established by U.S. citizens who felt the right thing to do when slaves in the U.S. were freed was to offer the slaves the opportunity to go back to Africa. Anyway, it was a stable country. I made a visit and it was obvious that it had potential for both gold and diamonds. The government Geological Survey had many very well-trained geologists, educated, I think in the United States. So, here was a small country, stable, being looked after by the United States both financially and security-wise. It already had a group of well-trained geologists that the government could pay only a subsistence salary, and the government was prepared to give us a very big exploration concession. To go there, under these circumstances, was the right decision. So we started a very exciting gold and diamonds exploration program in Liberia, taking well-trained geologists from the geological survey and paying them a real salary. They became very loyal, committed employees, and we had the most wonderful relationship with them. But tragedy! Within two years there was a minor civil unrest. It could have been put down by one hundred U.S. Marines, but the U.S. didn't act. It then developed into the most terrible civil war, which I think, is still going on. We left a potentially wonderful exploration project that failed for political reasons.

09:00:25:01

Swent: Yes, that's a tragedy.

09:00:25:02

Woodall: Absolute tragedy.

09:00:25:13

Swent: Now, when did you become interested in the Western Pacific?

09:00:25:18

Woodall: This was also in the 1980s. You see, we had gone to Fiji, bought equity in and gained management of the Emperor Mine and found the million-ounce Prince William gold lode in just two years. It was obvious that the Western Pacific, in other words, Papua New Guinea, that part of New Guinea that was controlled by Indonesia where a famous Grasberg copper-gold deposit was found, Indonesia itself and the Philippines was prospective territory. We set up a small group of people to look at the various opportunities in the Western Pacific.

09:00:26:14

Swent: Even New Zealand.

09:00:26:16

Woodall: Even New Zealand, but not exclusively. We were convinced that there was opportunity in the Western Pacific for significant copper discoveries, as well as gold, a view I had held way back in the Berkeley days of the 1950s. Our Western Pacific exploration extended into the 1990s. We found a very large copper-gold deposit in the Philippines called Tampakan. It was not high grade, but huge. We thought, being both a copper and gold deposit, it would be an excellent discovery. The trouble was that it was in land originally owned, and still occupied by, the original indigenous native people, and in a part of the Philippines where it turned out we were not welcome.

09:00:27:52

Swent: Which island was this?

09:00:27:54

Woodall: On the island of Mindanao.

09:00:27:54

Swent: Mindanao.

09:00:28:02

Woodall: Now we were well aware that when dealing with the indigenous people it was very important to take care, but we had had a lot experience in Australia dealing with the same situation with our own aboriginal people. The people living on the discovery site, which was in the hill-country, were living a subsistence existence based on slash-and-burn farming. Slash the rainforest, burn it, grow corn and perhaps rice for the next two or three years, then move on when the land becomes infertile. On the low lying country were the traditional Filipino farmers, reasonably well educated, and quite prosperous people. They were called the Christianos, which I understand is Spanish for Christians. In my opinion, their behavior was anything but Christian, because they were very jealous of the land that the indigenous people still occupied, and were always continually encroaching on their lands. We went to a lot of trouble to get to know the indigenous people, to understand what they considered to be their tribal boundaries, which were based on family ties. We surveyed their territorial boundaries and identified them on the ground so we knew which group we needed to talk to if we wanted to do exploration there. But this, to the Filipino farmers down on the lower lying ground, was bad news. Somebody was saying there's a boundary and this was the indigenous people's own land.

This was the indigenous people's tribal land we had defined, and confirmed the genealogy that established their ownership! So we became the enemy of the farmers. But worse still, some missionaries in the area felt threatened by our presence. Who were these Australians, coming in and winning over the confidence of their flock, reducing their influence? One church group even resorted to giving us bad publicity in Australia. Meanwhile we were building health clinics, re-establishing all of the traditional crafts for the women and educating them as to how there was a better way to farm this difficult rugged hill-country, a way that was better than slash-and-burn agriculture. We also promised, that if we could get a mine going, there would be even better opportunities for education and employment.

Those against us portrayed us a mining company that would destroy the environment. We were going to inflict capitalism on these poor indigenous people that were living such a tranquil idyllic life, even though they were desperately poor. In fact, they had next to nothing, and we were trying to create for them a better lifestyle, with hope for the future. Well, company directors don't like seeing their company receiving bad publicity in the press, and so our discovery in the Philippines started to lose appeal. It should have been getting good press, but, instead, we were getting bad press, and to make matters worse, Philippines politics was still very unstable.

09:00:32:55

Swent: I was going to ask, were there Muslim uprisings at that time?

09:00:33:02

Woodall: Which?

09:00:33:00

Swent: Were the Muslims involved?

09:00:33:02

Woodall: That's another issue. We were in Southern Mindanao, where there is the conflict between the early Muslim settlers and the Christians who came down from the northern islands and populated Mindanao after the Second World War. But we never had any trouble! However, if you sit in Melbourne office and read the press you think, "This is a fairly dangerous place in which to be thinking about investing a billion dollars to create a huge open pit copper-gold mine." And the politics didn't help. There were rumblings of a revolution up in Manila and there was the question of what might the Muslims do if we became a major investor in Southern Mindanao? The fact that the discovery wasn't a super-rich ore body didn't help. There seemed no way to start small, until we were more confident of the politics and security. You either started in a big way or you left the deposit for someone else to develop. So we left it alone! We walked away from it: yet another set-back of the 1980s. Others may yet bring the discovery into production for the benefit of all Filipinos. Tampakan was and is a major discovery.

09:00:34:44

Swent: You haven't mentioned this limestone possibility in Texas.

09:00:34:51

Woodall: Well, it's called Anachacao.

Yes, some people came into our office in Denver and said, “Look, we have found a very unusual gold deposit. There is a carbonaceous limestone outcropping for many miles in Texas and it contains gold. Here are some assays from that deposit.” Now they were very significant assays! So we went down to have a look at this place, and we collected our own samples, but could find only negligible amounts of gold from our assays. Now, it’s true that when there are organic carbon compounds in samples you have to be very careful when you assay for gold. Carbon has a great affinity for gold, and also, if you assay it by traditional fire assaying, the gold may volatilize. Who knows what metals the volatile organic compounds might not take away from the sample and result in incorrect assays. So we spent a year or more trying to find out why the people who had this property were getting high gold assays when we couldn’t! They said they had developed very special analytical techniques!

09:00:38:08

Swent: Secret ingredients?

09:00:38:16

Woodall: Well, we were allowed to visit their laboratory and took their samples back to Australia to be assayed by neutron activation, whereby you radiate the sample with neutrons, and if there is gold present, you get a specific gold response. We believed this method of gold analysis was infallible. If there was gold in any sample we would see it: but again we found none! We enlisted the help of a top chemist, a specialist in this type of analytical work and other alternative analytical techniques, and we convinced ourselves that there was no gold in this material. To say it was gold that you couldn’t detect by normal gold assays techniques was just not true. So we went back to the promoters’ laboratories with a smart chemist and mineralogist. They showed that there was nothing fraudulent about what the owners were saying, it was just that the cleanliness in their laboratory was suspect. They were detecting gold, but gold contaminated from other samples. Now, that was just one of three experiences I have had in my career when people have come to me with samples said to contain gold which was either very difficult or impossible to analyze for by established normal assay methods. In all cases the “difficult to measure” gold didn’t exist. That’s the Anachacao story.

I have omitted to mention another potentially exciting gold opportunity in 1987 which failed to materialize. It preceded the acquisition of those four gold properties in North America which caused us so much pain. Homestake advised us that a very rich gold mine in Chile, called El Indio, in the high Andes, was available for purchase. I think it was to be sold by Fluor, one of the big San Francisco based mining and contracting companies. We decided to jointly bid for the deposit.

09:00:41:34

Swent: In California?

09:00:41:38

Woodall: Yes. Now, this really was important. This was an opportunity to obtain a foothold in Chile, which we recognized as a politically stable country with a rich mineral endowment and a country with good mining laws. Other people had been extremely successful there finding and mining copper, and now it was being shown to be “gold country.” So, here was an opportunity to buy something already discovered, known to be high-grade and we were going to do this in partnership with Homestake, a very

reputable company, with whom we had had good relations in the past. So the whole Board went to Chile to satisfy itself that the political environment was satisfactory for a major investment. We were there for a week or more and we all had different responsibilities. One of my responsibilities, with another director, was to interview the head of the human rights group in Santiago. Now, remember this is after Pinochet led a military coup that ousted the left-leaning Allende government—

09:00:43:13

Swent: Allende.

09:00:43:11

Woodall: Yes, Salvador Allende. So we were interested in what the head of the human rights group in Santiago thought of the political situation. There had been a lot of repression of the communists and anyone suspected of having sympathies with communist ideologies. We also interviewed one of the military commanders, the general in charge of the airforce, one of the group of three who were now ruling Chile after the coup. We found the general to be a very reasonable person. More surprising though was the head of this human rights group in Santiago. He told us that conditions under the communist regime were deteriorating so fast that something dramatic had to be done. So, he and the human rights movement didn't resent the change in power, nor the new economic system that was being imposed on the country. They did, however, resent the manner in which the new military junta imposed the government, even though they knew it was good for Chile.

So we were fairly sure that Chile was in for a very stable period. For example, one of the things the new regime did, they gave the workers equity in the businesses they worked for. They established excellent pension schemes for the workers and there was lots of good news about a rebounding economy. So we agreed with Homestake to bid for El Indio. We were diligent in our enquiries to satisfy ourselves that it was a good opportunity to invest a large amount of shareholder money. But just when we felt our chances of buying the El Indio mine were very good, along came a very smart Australian entrepreneur, Alan Bond. I believe he went to Fluor, put a pile of money on the table and said, "I will buy El Indio for that and you have twenty-four hours to accept it." Fluor went back on their promise to make this a free and open auction process. They took Mr. Bond's money and the mine was no longer available. Another lost opportunity of the 1980s. If we had succeeded in acquiring El Indio I doubt if we would have subsequently been tempted to buy those four North American gold properties.

There was also an opportunity for us to become involved with the Santa Fe Southern Pacific Company that had large land grants throughout the gold-endowed areas of Nevada. They had an exploration group that had not been very successful, and we recommended WMC open discussions with Santa Fe and say: "We are good at exploration, you have these large land grants where you own the mineral rights, let's join forces. You have been unsuccessful. We think together, we can be successful." I don't know whatever happened to that idea, but it was never pursued to any degree of finality. About that time a Canadian company made a takeover bid for Santa Fe and that complicated the situation. Maybe Santa Fe asked their own explorers for an opinion: "What do you think of this idea?" If they did, the likely response would naturally have been: "Oh, no. We are as good as anybody else at exploration. Have confidence in us for

a little longer!” Maybe our negotiations were not vigorous enough! Had the negotiations succeeded we would have gained access to the Pipeline discoveries.

09:00:49:42

Swent: Well, that makes a great story!

09:00:50:00

Woodall: I don't know whether you can take any more bad news, but we might as well finish discussions of this period.

09:00:50:17

Swent: There's the Seabright operation.

09:00:50:24

Woodall: That was one of the four operations that we bought, and where the published grade was wrong.

09:00:50:27

Swent: I see, okay. Let's change focus. What's this about a venture into ceramics?

09:00:50:44

Woodall: Oh, I didn't want to make this interview too long! The ceramics project came about because of Australian research in ceramics and the idea that if a company is in the business of metals, perhaps they ought to at least be informed on what's happening with other materials that could be used as alternatives to metals. Instead of say using hardened steel containing nickel, which we produced, why not use much lighter ceramics? And again, I refer to this Federal Government's research group, CSIRO. They developed a patented method of making a very, very hard silicon carbide ceramic, and they wanted somebody to join with them to commercialize the discovery. They needed a pilot plant to develop manufacturing technology on a semi-commercial scale and then to market the products. We interested a German company in producing samples of this material at more than laboratory scale, i.e., in a small pilot plant, so we would have samples to take to people who might be persuaded to use this material, like the U.S. military. This material was much, much better for armor protection than many of the steel alloys being used in personnel carriers and was a fraction of the weight of steel. But do you think we could get a market? We never could! The Australian Army were talking about upgrading their armored personnel carriers, and we said, "Look, we can make silicon carbide tiles that are a fraction of the weight of steel armor plate but just as effective." We had actually tested the tiles in military firing ranges. We could show how good our material was. But we never could get a market. The person who worked for me to develop the project, Norman Trueman, left WMC and the company transferred all rights to him. For eight years he tried, as an independent, to get the product into the marketplace, but eventually decided that it was just too difficult. So you can have good ideas, you can have good material, but if you don't have the political influence when your market is military, it's too difficult. There are all sorts of obstacles.

09:00:54:46

Swent: We are hearing a lot about that these days.

- 09:00:54:47
Woodall: That's the ceramic project. We produced a good product but we couldn't get a market. But the idea I think was smart.
- 09:00:55:02
Swent: You would mine the silica?
- 09:00:55:05
Woodall: Obtaining the material used to make silicon carbide was not a problem. There's lots of ways—
- 09:00:55:14
Swent: You can find it.
- 09:00:55:18
Woodall: One novel source of super pure silicon is to use the husks of rice from Australia's rice fields because they are rich in silica and of course also carbon. And you can take that material and make from it silicon carbide ceramics.
- 09:00:55:40
Swent: Really!
- 09:00:55:40
Woodall: There are lots of ways you can get your carbon and your silica source, but the silicon must be super pure.
- 09:00:55:55
Swent: In your notes you also have mentioned the Bronze Wing and Jundee gold discoveries in the Yandal Belt.
- 09:00:56:07
Woodall: Well, remember I was telling you about the Goanna Patch gold discoveries, in the late sixties. They were in a flat, highly weathered area where the geologist who looked at it said, "The deposit is small, there is too much concealment and not much to see. It's not of interest!" Well, when the gold boom started in the 1980s you could get any amount of money you wanted to drill holes through this deep weathering. And remember, I told you I wrote that report to CSIRO recommending that they study the regolith. Although, initially, they turned their back on the idea, they eventually allocated some of their top geological scientists to study the weathering profiles and they made some very major advances in understanding the nature of the regolith. This information became public, and available to people exploring north of the Goanna Patch, in what is called the Yandal Belt. They knew that they had to drill through the whole weathered zone to effectively explore, and hopefully find that gold-enriched supergene blanket. This blanket enlarges the target and gives you a vital clue as to whether you are in gold country. And the supergene zone can be the basis for a very profitable mine! So, the company that took up exploration tenements just pattern-drilled the concealed ground. Subsequent discoveries in that belt contained 12 million ounces of gold, all concealed. If, in the seventies, we had made a major commitment to map the regolith over perhaps 200 or 300 hundred square miles, and understood the weathering process, we might have been the people who discovered the potential of the Yandal Belt by following up those Goanna Patch gold discoveries. In the 1960s, I said, "We have to map the rocks if we are going to be knowledgeable and have a competitive advantage in exploration."

That was true and the Kambalda discoveries followed! What we should have also said in the late sixties and seventies: “If we want to maintain that competitive advantage, as ninety percent of the ground is concealed, we now must map, drill, and understand the concealed ground.” We would then have found out where the regolith was simple and suitable for geochemical soil sampling, and where it was more complicated and needed to be drilled. We would have learned to recognize the different weathering profiles, from the Permian to the Recent. We would have learned about supergene gold ten or fifteen years before anyone else. We eventually did, of course when we drilled the Victory gold mine south of Kambalda, which led to our discovery of the rich St. Ives goldfield.

So if there is a message for young explorers it is this: if you are in country that is not well mapped, it is a very cheap exercise with tremendous potential to map both outcropping and concealed country carefully and be the company or the person with the best knowledge of the near-surface environment, both the bedrock and weathered zones. From a scientific point of view, understand the rocks, the alteration of those rocks, and in areas like Australia, which are deeply weathered, understand the nature of the regolith.

09:01:00:50

Swent: You have not mentioned Camp Bird. We talked about it off tape, but we didn't get it on tape.

09:01:00:57

Woodall: I thought I had told you enough bad news stories.

09:01:00:59

Swent: Well, we need that one on the record also.

09:01:01:01

Woodall: By 1986, we had very good geologists working for us in the United States, and their mandate was to find us a gold mine. That was also the time of the emergence of the strong, anti-mining, politically influential groups. We had, for example, the problems of bringing the Olympic Dam deposit into production. Okay, the Olympic Dam deposit was a bit more complicated than most mines because it contained uranium, but you have to get environmental approvals for any development and there is so much political debate. You find a deposit and, perhaps, twelve years later, you're in production. So Mr. Hugh Morgan said, “Look, is there a shorter way to finding a gold mine in North America? If the problem of environmental activism is strong in Australia, how much more is it an issue in the United States? So Roy, you can't just go and find orebodies and expect that you are going to be allowed to bring them into production in a year or two. Wouldn't it be better to see if you can find an opportunity in an established gold mining district where mining is already permitted?” (I.e., where mining is already an accepted activity.) Of course Nevada was acceptable, but we were late.

Our man in Denver found out that a once famous Colorado gold mine called the Camp Bird, high in the San Juan Mountains, was available. It had had a very illustrious history. It was found by a prospector called Walsh. I think he had extracted about four million dollars of profit from the mine by about 1902, which was a lot of money in those days. He then sold the mine for \$7 million to British financiers who formed the

Camp Bird Mining Company. Now, you add \$7 million plus \$4 million in the first decade of the 1900s, and you are talking about huge wealth. Well, Walsh wanted his children to be well educated, opportunities he didn't have, so he took the family to Washington. There his daughter, Evelyn, married the heir to the *Washington Post*. So you have wealth plus wealth, and that story is written up in a book called *Father Struck it Rich*. I think it's required reading if you are interested in life in the mining world in the late 1800s and early 1900s. It's a tragic story, in a way, because the wealth never did the family much good at all. But in her latter years, Evelyn became very motivated towards charitable causes, especially during the Second World War. But that's the background to my story of the Camp Bird. It had been mined, probably up until the Second World War.

09:01:06:03

Swent: Closed, I think, during the Second World War, and never reopened.

09:01:06:06

Woodall: Yes! So we had a look at the opportunity of reopening this mine, which is in one of the great mineral districts of Colorado. Many of the lodes were not economic where they outcropped because the enriched gold and silver had been deposited deeper in the system. So here was an opportunity to really get involved with high-grade gold or high-grade gold and silver in an established mining district. And the good thing about this mine was that there was very little sulfide in the ore to contaminate the environment. The waters draining from the mine were rich in carbonate and crystal clear. You could bottle the water and sell it, it was so pure, and that is what has subsequently happened. The mine waters from the Camp Bird actually improved the environment, whereas other mines, rich in sulfides, created real environmental problems. For example, mining leases at a place called Red Mountain, which gets its name from the fact that it was an area of rocks so full of oxidizing iron sulfide that every outcrop was red, putting all sorts of nasties into the streams. But, Camp Bird was a pure mine in terms of the environment. And here was a mine with a history of high-grade and a mine with an opportunity to find other lodes which might have never reached the surface. It looked perfect.

We had no trouble recruiting miners because there were still men around that had worked on the Camp Bird and liked the idea of going back there. We found an excellent mine manager and the mine already had some geological staff. So we financed the refurbishment of the mill and reopened the mine. There was unmined gold ore known, and with the price of gold the way it was in 1986, which was nearly \$400 an ounce, it was economic. This was mineralization which had been left behind before because it was low grade, but now it was economic. So, we started the mill and we started producing gold and we started exploring.

So here we were having made the type of discovery we were looking for; a new lode, and high-grade. We cross-cut to the lode, then we started to drift along it to really sample it. But we couldn't find any significant gold. So we went back to the drill core and did new assays and there was no gold in the drill core. So here is another tragedy of the eighties. We put together a fine group of people, both miners and professional leaders. The resident manager was a mining engineer. The geologists were well trained, but somehow there was gold in the samples from the drill core that were sent for assay that was not in the lode. The samples which went for assay were "salted," i.e.,

deliberately contaminated with gold from another source. The circumstances discredited our management skills, and people in our head office in Melbourne felt that if there was any possibility we were involved with dishonest people, we should get out quickly. Now the sensible thing to do was to drill into the walls on either side of the known lodes, to see if there were parallel lodes; and lo and behold, we found parallel lodes, and one was not very far away from mine development. So we started to drift out to it: we crosscut to this new lode in which we had six or eight quite high-grade diamond drill intersections. Now, we had a junior company as our partner in this venture because we thought it was good to have a local Colorado company with us to keep us politically smart. Although these new drill intersections into a new lode were significant, they weren't so significant to Western Mining as they were to the little Colorado company. To them these were very significant intersections, and when they were announced, the price of their shares started to rise.

09:01:12:13

Swent: You haven't named the other company. Do you want to?

09:01:12:19

Woodall: The other company was Royal Gold. Now, I am quite sure that the directors of Royal Gold were as disappointed as we were. But they had a problem also because they had announced false assay data to their shareholders. So we not only wasted good money following up false assay results, but we had to pay compensation to Royal Gold for alleged bad management. I guess from their shareholder's point of view that was fair enough, but a pretty hard pill for us to swallow in the circumstances.

09:01:13:52

Swent: Keep going then. A little bit more on Camp Bird.

09:01:13:51

Woodall: No, I think the story should end there.

09:01:13:53

Swent: You think that's all.

09:01:13:56

Woodall: That's all and that's enough: let's leave the 1980s. So-many "set backs", so many lost opportunities, some perhaps best described as disasters.

09:01:14:01

Swent: Okay: onto the 1990s.

09:01:14:08

Woodall: There is another sad story! In the latter part of the 1980s I sent one of our top geologists, Dan Evans, who was part of the Olympic Dam discovery team, to Canada to head up regional exploration. No buying bad mines, let's go find a decent deposit ourselves. And he did almost the right thing. He said, "Let's look for nickel. We are in the nickel business. If we can find just a fraction of a Norilsk orebody, or a Sudbury for example, we'd have a winner." He had a reasonable team working with him, and quite correctly, the first thing he did was study what was in the records of the Canadian Geological Survey.

continue Interview 5: January, 26, 2004
[Begin disc 10]

10:00:00:35

Woodall: Okay, so in 1990 I sent one of our top geologists, Dan Evans, who was part of the Olympic Dam discovery team, a top class exploration scientist, to Canada. “Let’s find ourselves substantial gold or nickel there. Let’s not try to buy mines.” He focused on nickel exploration and, quite correctly, the first thing his team did was research all the old records, especially those available from the Canadian Geological Survey: where nickel had been found and where rocks in which nickel deposits might occur. The team studied a vast area in Northern Manitoba, Northern Ontario, and Labrador, and selected an area in far north Ontario. For the next two or three years exploration was concentrated in that area. What they did not find when they did their literature research was that there was evidence of nickel having been found by the Canadian Geological Survey in Labrador. If they had known that and had visited the site, they would have discovered the fabulously rich Voisey Bay nickel deposit. I understand you can see the mineralization from a helicopter because of all the iron staining, and that there is sufficient outcrop to tell you that it is a favorable environment in which to explore for nickel. So the strategy of literature research, followed by field reconnaissance, was right, but the early intelligence gathering, i.e., the literature research, was deficient. That was another disappointment, another missed opportunity.

Now, I want to go back briefly to the diamonds exploration program that was going on in Australia all this time. We had made the decision, I had made the decision, that we were not going to disband the Australian exploration group despite the fact that they had been exploring for over ten years unsuccessfully. But they were doing some very intelligent exploration, and one of the things they were doing—as a way of tackling this very difficult weathering environment that covered extensive area of riverless flat desert and semi-arid terrain—was to collect samples of iron-rich pebbles, remnants left behind on the surface after the wind had blown away the finer soil, leaving behind these heavier iron enrichments. They would collect this material with a little hand brush and shovel, several samples of this material over several square miles, and combine them for study. In the diamonds assessment laboratory the samples would be examined for those indicator minerals that might lead them to a diamond deposit. To do this, they had to separate out the heavy iron-rich pebbles. They would roast the sample to make the iron material magnetic, strip that off with a magnet, leaving behind the non-magnetic heavy minerals that might be a clue to concealed diamond-bearing rocks. And they also did a very clever thing. They assayed that iron-rich fraction. Now one sample might be representative of several square miles. They collected hundreds of such samples and so built up a pattern of the distribution of, for example, gold, and elements that had an association with gold deposits like arsenic. And they said, “Look, in some areas we find no metals that are associated with gold deposits, but in other areas look, we get ten times the usual amount.” But the people to whom I had delegated responsibility for exploration at that time turned their back on this evidence, even evidence of very elevated gold in some samples. Why? It is hard to say. I believe one of the problems was: “Look, we are scientific explorers, we use good conceptual thinking to tell us where we ought to be exploring.” Remember, they knew that Yeelirrie was found as a result of good conceptual thinking, and Olympic Dam was found from good conceptual

thinking. “This company employs us to be good scientific explorers, to consider why gold ore bodies are where they are. This is how we decide where to explore!”

Now, there is nothing wrong with that strategy, but to ignore obvious empirical evidence, effective prospecting techniques, thrown up by the diamonds group, was pure arrogance! In hindsight, when we look at what the diamond explorers were saying about the distribution of gold and elements that could help you focus gold exploration on the most prospective areas, we find it highlighted in the Yandal Belt that I have previously mentioned, that proved to be a 12-million-ounce province, which we also could have found much earlier if we had followed up the Goanna Patch discovery. The diamonds explorers’ samples could also have led us to be aware of the potential of the area where the 7-million-ounce Plutonic deposit was discovered, a very rich discovery, and the Kanowna Belle. All these areas were highlighted by the diamonds exploration group, but the people making the decisions as to where to explore or where to pursue deals to acquire prospective ground were just too keen to be conceptual: smart, conceptual scientific explorers. They forgot that a lot of good discoveries can be made just by applying simple prospecting techniques.

10:00:09:58

Swent: You need both.

10:00:10:01

Woodall: You need both. So we missed out on the Voisey Bay discovery in Canada, and gold discoveries in Western Australia.

It was not all bad news! We were continuing to find new deposits around our mines, nickel sulfide deposits in the Kambalda district, and major gold deposits in the St. Ives district in 1991 and 1993, which all added up to make the district at least a 10-million-ounce field. We also continued to find significant gold deposits for our Norseman gold operation. This helped keep up my morale as I had not relinquished responsibility for mine-site exploration. Then the regional explorers finally made a discovery: a copper discovery.

The new copper discovery was called the “Ernest Henry.” It was found in Queensland. It was discovered by a combination of good geological thinking and good geophysical exploration. The area was just flat grass plain. Beneath the grass was thick, black soil, typical of the tropical grasslands of Queensland. There were no physical features. It was known that there was a small mining claim somewhere in the area they were exploring and near where they had obtained a strong geophysical response. The claim was held by another party but could not be precisely located, despite searching for claim pegs in the grass, which in the tropics can be quite high. Chris Middleton, who was in charge, went to the owners and optioned the claim, i.e., agreed to buy it at an agreed price. Having got a good geophysical response they brought in a drill, and were very excited when the first drill hole found copper mineralization under this black soil plain and grassland. The discovery was announced, and we went to the owners of the small claim whom we believed had a legal obligation to hand over title in exchange for the agreed purchase price and the royalty we had agreed to.

Unfortunately, our legal people in head office had been tied up with corporate work deemed more important by the managing director, so despite a quick exchange of letters

agreeing on the terms of the option, the formal legal documentation took nearly a year to be completed. Within days of the formal legal agreement being signed, the first drill test of the strong geophysical anomaly commenced. This anomaly had been better defined by more field readings after the exchange of letters agreeing on commercial terms but before signing of the formal legal agreement. The first drill hole found significant copper mineralization under the black soil and grassland and we were very excited.

The discovery was announced after consultation with our joint venture partners, Hunter Resources, who insisted that the drill intersection was market sensitive to them. We then went to the owners of the small claim, whom we felt had a legal obligation to hand over title in exchange for the terms we had agreed to. They refused! They said, “You have trespassed on our claim.” We said, “Well, we couldn’t find your claim.” “You trespassed, and what’s more, you didn’t advise us of your exploration results and you are trying to defraud us.”

Well, I was never consulted on the conflict until the disagreement was out of control. The person who was heading up the company that had this old claim had lengthy discussions with Mr. Hugh Morgan, our managing director, and regrettably they could not reach agreement. So, the dispute went to trial and the short answer is we lost! The judge decided that we, a big company, were trying to defraud a small company by trespassing and by withholding information, which the small company had a right to. I can assure you that our people worked always with complete honesty, and if our legal people had said, “Look, it would be wise, legally, for you to advise these people of what you are doing while we tidy up the agreement,” we would have done so. We did not receive such advice. Then to be deemed to be frauds by a judge, not publicly of course! But because the judge threatened to use such words we were forced to give the discovery away and pay compensation to Hunter Resources with whom we had become associated in this early exploration program. So we lost a major discovery! We got dreadful publicity. I was personally, financially penalized and publicly disgraced in public announcements. That’s the Ernest Henry affair. Just another tragedy.

10:00:22:15

Swent: Have we come to a good stopping place, do you think?

10:00:22:23

Woodall: I think so. And perhaps we can finish the mineral story tomorrow?

10:00:22:28

Swent: Okay.

10:00:22:29

Woodall: And then—

10:00:22:31

Swent: Petroleum, we haven’t even mentioned—

10:00:22:30

Woodall: And then talk about petroleum. Which we can perhaps slip over rather more quickly.

10:00:22:41

Swent: As you wish.

10:00:22:45

Woodall: Before we finish today's discussions, let me for a moment review the 1980s. There was good news from our petroleum exploration, and we will discuss that later. There was also continuing success with our exploration at our mines in Western Australia, and I maintained an oversight of that exploration. We also launched into mineral exploration in countries other than Australia: our minerals exploration went international. We found a major gold-copper deposit in the Philippines but abandoned it for "political" reasons, and a major new gold lode at Vatukoula (Emperor Mine) in Fiji.

But during the 1980s, Australasian regional exploration was a failure, despite those to whom strategy and management was delegated having double the financial backing I had in the 1960s and 1970s. Even our regional exploration in Canada for nickel and in the Western U.S. for gold was a failure. In Brazil, we had some success, and, I believe if we had persisted, we would ultimately have been more successful. Just before I retired, our Brazilian team found another small, but extremely high-grade deposit. Soon after I retired, the discovery was sold, and the lucky purchasers have made millions of dollars (which a smarter WMC could have had and used to continue exploration in that country). But, from the late 1980s I no longer had real authority in the Americas. Finally, our strategic move into Liberia was thwarted by political unrest.

My one major personal mistake was not to sacrifice our Australian diamonds exploration for diamonds exploration in Canada. We were offered what turned out to be an opportunity to be the earliest or one of the earliest involved in diamonds exploration in northern Canada and I failed to fight for that opportunity. My efforts to build a petroleum division at the cost of less attention to regional minerals exploration.

Interview 6: January, 27, 2004
[Begin disc 11]

11:00:00:00

Swent: This is January 27th, 2004. We are continuing the interview with Roy Woodall in the Hearst Mining Building at the University of California, Berkeley.

11:00:00:29

Woodall: We are now coming to the last five years of my long career with Western Mining Corporation. I'd like to make a few comments on things I tried to do as the 1980s came to an end, that decade when there were so many disappointments, although a decade when we were able to look for, and find gold again.

In 1988 I wrote to the managing director, Mr. Hugh Morgan, and recommended that we ought to establish in-house expertise in microbiology. I had for many years been following the development of the use of bacteria to strip heavy metals from water draining mining areas, waters that were contaminated by heavy metal. This work was being pioneered at Guelph University in Canada. They demonstrated that you could strip out, for example, nickel and cobalt from waters draining waste dumps at Sudbury in Canada. It was also becoming apparent that bacteria could also be used to break down refractory minerals in refractory ores and release valuable minerals for subsequent extraction. However, that recommendation didn't get anywhere, partly perhaps because there was not enough interest in innovation in our metallurgical department. In 1989, the chief metallurgist asked me how I was able to maintain such a high level of innovation and scientific and technological skills in the exploration division, a culture that seemed absent in the metallurgical department. I wrote him quite a long letter and pointed out that if he wanted to change things, the first thing to do was to have much more control over recruitment, and that operational metallurgists would have to be encouraged to read the scientific and technical literature. They would also need opportunities for in-service training, perhaps a break from operating a process plant, and a few months at a university or metallurgical research establishment. And they should also be forced to write regular technical reports on what they were doing, even monthly reports, as I insisted all geoscientists should do. The reason for that is to make sure that whatever advances you make in understanding or whatever mistakes you make, they are recorded. You then have a good corporate memory. Mistakes are not repeated or are unlikely to be repeated, and whatever advances you make in the understanding of technical problems are known throughout the company. You can build on the progress made by people who were before you, but only if there is a good technical reporting and records system.

I also had to take issue with the operating management at the Perseverance and Mt. Keith nickel mines. Both of these deposits had been found by others, but Western Mining had acquired them. Now they were clearly complex ore deposits. I suggested that at the Perseverance mine, not only should we be documenting the various types of ores, their mineralogy, as this would assist in planning their treatment, but also start doing research into how they might treat the large amounts of low-grade nickel sulfide ores that were present and were not being mined at the time. There was also a large quantity of soluble nickel in the oxidized and semi-oxidized ores, and it seemed to me that if ever we started an open pit, there would be soluble nickel in the waters draining the mining areas. Perhaps bacteria, for example, might be used to recover this metal. I

also pointed out again and again that it was a mistake to distance the operational metallurgists from sources of scientific and technological innovation and stimulation.

11:00:06:39

Swent: How were you making these recommendations?

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Woodall: Well, I would go on site and talk directly to the resident managers. At times I would write a subsequent letter, just putting in writing what I thought we had talked about, but it was mainly just by personal communication. I would always draw a parallel between the success of the exploration division where the scientists were encouraged to keep up to date, and the metallurgists who at times seemed to be, once they were recruited from the university, shut off from technological change and scientific developments. We have already talked about some of the unfortunate mistakes the company made as a result of not having—at an early date—realized the importance of carbon-in-pulp and carbon-in-leach technologies, and using highly saline water in mineral processing plants.

11:00:07:36

Swent: Was there anything comparable to our professional societies that have monthly meetings?

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Woodall: Oh yes. One is called the Australian Institute of Mining and Metallurgy but they meet mainly in the capital cities. And we are talking about metallurgists, young metallurgists, and young geologists remote from the capital cities, often living on site at the mines.

11:00:08:05

Swent: And they didn't have any sort of meeting schedule on-site?

11:00:08:05

Woodall: Sometimes there would be enough enthusiasm to arrange a meeting, but that could only happen if there was somebody visiting that could perhaps present a talk of interest. And that didn't happen very often, because often visitors aren't prepared to contribute or are never asked to contribute. Many come to see and gain for themselves, but don't offer very much in exchange. It was a little different in Kalgoorlie because there was a much bigger mining community there and they did have technical meetings.

Mt. Keith was a very low-grade nickel deposit, assaying about 0.6 percent nickel, and it seemed extremely uniform. When the first management plan was prepared to bring this large ore deposit into production via a big open pit, I noticed that there were no plans for a geology department. And I said, "How come? We have always demonstrated that having a good geology department on a mine paid for itself handsomely." And they said, "Well, look, Roy. This is such a big deposit, we don't need to do any exploration, and secondly, it is so uniform we don't need geological mapping of the deposit. This is an earth-moving operation." So for twelve months, they opened up the mine as if it were just an earth moving and milling operation, and lo and behold, they couldn't get their recoveries. They found there was talc in the ore they didn't know was there. They found that the nickel minerals were not always the same, even though they were sulfides, and so there was all sorts of trouble in the float circuits. So, we went back to establishing a mineralogical research facility on site, which is still there, and this mine now produces some of the company's cheapest nickel, despite the fact that the ore is only 0.6 percent

nickel. And that's very much because the operators woke up and employed first-class mineralogists, whom I was able to supply via the geological guild that I have talked about.

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Swent: We need to talk about that, I think.

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Woodall: As a little side issue, the top mineralogist on site wrote to me after I retired and said, "Roy, we found a new mineral. We have submitted it to all of the tests that you have to submit a new mineral to for it to be recognized by the world authorities as a new mineral, and we would like to name it after you." Which was a very nice surprise!

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Swent: That's a huge honor.

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Woodall: And they called it "Woodallite." And why I was so pleased was, not so much that there was a mineral called "Woodallite," but that even after I had left the executive ranks of the company, there were people that I had recruited and helped get established that showed their appreciation in such a genuine sort of way.

I think I have already hinted at the fact that towards the end of the eighties, the company was having negative feelings towards exploration. And this was in part due to the fact that the managing director was under increasing pressure to produce favorable short-term results by the investment-fund managers. Now investing in exploration doesn't guarantee short-term results. You may invest in exploration for ten years or fifteen years before you find a world-class ore deposit.

11:00:12:43

Swent: Where was this pressure coming from, do you know?

11:00:12:50

Woodall: It was coming from the people that now were the major shareholders in companies: the big superannuation funds, or what you would call the pension funds; also, what I think are called managed funds. People who are not confident to invest in the stock market give their money to a fund manager who invests it for them. But these fund managers and the people that manage the superannuation funds are under intense pressure to perform, short-term. In other words, they have so many millions or billions of dollars in their funds, and they have to report every three months on what financial return they are achieving, and whether the fund is increasing or decreasing in value. They certainly have to report every year to the people whose money they are investing. And the fund managers make their money out of commissions! Now, if a fund manager is investing in a company that is thinking long-term, but in the short-term has poor results, his performance starts to look bad by comparison with other fund managers who are investing for short-term financial gain. So what happens? People take the money from his fund and put it in the other fund. So managed funds with "long-term" investment strategies decline, so these fund managers put intense pressure on managing directors to improve short-term gains. And so they would say to Mr. Morgan, "Your exploration division hasn't found anything for five years, or anything like the Olympic Dam deposit, for 20 years! You are wasting money. You are wasting shareholders' money."

And what could Mr. Morgan say? He might say, “Well, we did find the St. Ives gold district in 1980.” To which they might reply: “Yes, but that’s years ago.” Well, how do you win an argument with these people? They are holding shares in a company for short-term gain, for very different reasons from those on which WMC were founded. All very unfortunate!

I did the best to defend what we were doing and this got quite serious by about 1992 when Mr. Morgan wrote to me and said, “There is a ‘generalized view’ that during the last four years or so WMC has been nothing but ‘ordinary’ in our exploration endeavors.” Well, you cannot judge exploration performance on the basis of four or so years. He went on to point out that “the owners of our company are more and more the investment and superannuation funds who are embarked also in the lifelong struggle against each other in a very competitive world. Clearly, performance figures matter to them. Even we are influenced by them. WMC has over \$120 million of superannuation funds managed by four competitive fund managers and they are reviewed every six months to compare their competitive performance one against the another. Changes in the batting order do occur. Consequently, Western Mining had to seek a balance between its capacity to handle long-term projects, which do not meet the fashion and demands of our owners, and the requirement to produce healthy financial returns, short-term, in a very competitive financial market.” And that sums it up very well.

11:00:17:54

Swent: That’s a direct quote. This was a report that he sent?

11:00:18:02

Woodall: A letter to me which indicated that we were drifting apart. There is no question about it.

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Swent: And what was the date of that letter?

11:00:18:12

Woodall: That was a letter to me on the 18th of February 1991. Somewhat in defense, I wrote to Mr. Morgan in April 15, 1991, and pointed out that a mining company is very much like a company producing new drugs. New drugs have a short shelf-life. Everybody wants to buy this new antibiotic or new arthritis drug, but in three or four or five years, there is a better one. So unless pharmaceutical companies are continually researching, they run out of new products that have appeal in the marketplace. And I pointed out that mining companies are very much the same. They have ore bodies, and the ore bodies are destroyed, depleted as the company progressively mines the deposit. And unless they have a vigorous exploration program, replacing those ore bodies, then the company ends up with nothing to sell.

I pointed out that in the United States in 1988, drug companies invested ten percent of their revenue, or forty nine percent of their profit, on research. Office equipment is also rapidly changing, copying machines, laptops, you name it! The companies that make them invest over seven percent of their revenue in research, and sixty-seven percent of their profit to get new products into the marketplace. Electronics companies invest five percent of their revenue and seventy percent of their profit on research. Our exploration expenditure was only forty percent of profit, and I was trying to get him to understand that we are like those companies. I pointed out if the company was to grow, it had to

invest generously in exploration and on the long-term. And when these people attack, these are the statistics you can use as ammunition to fire back at the critics, and say, “This big Australian company that has existed since 1933, is now nearly sixty years old and has created great shareholder wealth, do you want it to disappear?” Shame them while acquiring the high ground.

The other thing that was happening in the 1990s was that I was now having less and less influence over the exploration that was going on at the operations. In WMC’s early, successful days, the managing director would take along his chief geologist (exploration manager or equivalent) when he visited operations. Mr. Morgan in his wisdom was now dealing much more directly on these matters with the resident managers and the general managers, and I was being bypassed. I had a lengthy discussion with Mr. Morgan in May of 1992, and he said, “Well, I understand the problem, and perhaps we need to discuss this matter further.” And that’s the sort of rather evasive responses I was getting!

In trying to be as generous as possible, I guess we need to recognize that here was a man who was under intense attack because of his bad investments in Canada and America, and the loss of the Ernest Henry deposit because of poor legal advice. So he unquestionably was quite fragile to any sort of criticism. I had another long heart-to-heart discussion with him in July of 1992 when he really opened up his soul which reflects the fact that he was in a difficult situation with few friends to talk to. Well, he chose to talk to me! Some of his words were: “You know, I am suffering from a North American hangover.” “I am accused of being an autocratic manager.” Well, there is some truth in that. “My top management that I have now appointed in charge of the mines and operations are considered by people outside the company to be unreliable and untrustworthy.” I stress the word untrustworthy.

Remember how several times during this interview I have said how absolutely critical for a company to be successful is to have the line of unbroken confidence from the board, the managing director to the top management to the workers, and unbroken trust and respect from the workers to the managers to the managing director. If that gets broken the company is in real trouble. Now here was Hugh admitting that outsiders were saying there is an air of untrustworthiness in WMC that didn’t used to be there. Hugh continued “Well, I am being accused of poor corporate planning, not enough attention to operational detail. I am told that my company is now rudderless and that if they got rid of me the shares would go up” and that they are “tired of the Morley-Morgan tap-dances.” Mr. Morley being the director of finance and administration. His mentioning these things to me indicates how low his own morale was getting because the company wasn’t making the short-term profits these aggressive fund managers wanted.

11:00:25:33

Swent: Was it about this time also that you began getting attacks in the press from the organizations like Friends of the Earth and the aboriginal activists?

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Woodall: Oh, that was always on. Initially, Mr. Morgan took them head on, and then realized that he had to be more careful in dealing with these critics.

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Swent: There seem to be two focuses for attack: one was the environment, and the other one was the rights of the aborigines.

11:00:26:25

Woodall: Initially Mr. Morgan took what you might call a right-wing attitude towards the aboriginal cause, and said that although the aboriginals had rights, their rights were being exaggerated, and that just granting land rights was not the answer to their poverty; there was a need for cooperation. Subsequent events have proved his judgment to be correct.

On environmental issues, no one responded more responsibly than Mr. Hugh Morgan. For most of the 1990s, the company was given high praise for the way the company handled its environmental issues and for the information it made public on its environmental problems, and what it was doing about environmental problems and its openness. And from then on the company received less criticism of its environmental practices. In fact, it received several examples of praise. The only place that that didn't happen was in the Philippines with the Tampakan deposit, where the critics were being dishonest. And I don't know how a company can win an argument in public against dishonest critics, because if you try to defend yourself, they say, "Oh, we can't trust the company spokesperson because you have a financial interest in this, but these other people have no financial interest." It is a very difficult situation!

11:00:28:23

Swent: That's hard to fight.

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Woodall: So we are into the 1990s, and late in 1993 I got to the stage where I was no longer really director of exploration, as I had been for so many years. I no longer had authorization over exploration expenditure at operations. I had delegated Australasian regional exploration to others and had been removed from being responsible for exploration in the Americas. Moreover, I no longer had the opportunity to speak at any length at board meetings. And this was a very unfortunate, and for me and the company, an unsatisfactory change. For many years I had always, especially under Sir Lindesay Clarke and Sir Arvi Parbo's chairmanships and managing directorships, been given ten or fifteen minutes at each board meeting to talk about what we were doing in exploration. And I used this to educate the directors, most of whom were non-technical people. For example, I would say, "You know we have been exploring in this area. You know that over the last two or three months we have had the drills in there to follow up geophysical anomalies, and the news is that we have not found an economic ore deposit." Now that's bad news, but at least I could tell them what we have learned from the experience. But if there is no opportunity to talk about these things, the Board members have no idea about what is happening in exploration, and we can't develop any empathy for the exploration investment. All they knew was that sometimes, and very infrequently, there was a success; and that it costs a lot of money. But if you are not given the opportunity to have ten, fifteen or perhaps twenty minutes at Board meetings to explain what's going on and the ideas you are trying to develop and the potential prize, you can't blame the non-technical, non-executive directors for losing interest in exploration. The Board members, if poorly informed, start to get very uncertain about the merits of an investment of sometimes up to a hundred million dollars a year in

minerals and petroleum exploration. For years I had the opportunity to talk about it, explain it, justify it, but in the 1990s, that opportunity disappeared. It was felt that the board should concern itself mainly with “important” things like money and discussions on financial or legal matters. A changed company!

11:00:31:44

Swent: We haven't mentioned David Lowell? Is this the time for that?

11:00:31:49

Woodall: Well, we could. In June 1993, Mr. Jeff Gresham, who was now in charge of exploration in the Americas and reporting to Jim Lalor in Toronto, advised me that he had had contact from David Lowell, who, as you know, had been very successful in exploration in Chile. He had now moved his area of operations to Peru and he was sympathetic to Western Mining financing some of his exploration in return for equity in any of his discoveries. I encouraged that association but it never came about. It was another case of missing an opportunity, even though it was well known how successful David had been in Chile and Peru. There had been a big gold discovery in Peru.

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Swent: Pierina.

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Woodall: That's it. Whether David found it, or helped to find it, I don't know. I will have to look into that!

Probably one of the most useful things I did in the last five years of my time with Western Mining was to put some integrity into our international planning. Now remember, we went to Brazil, not because we decided that Brazil was the best place in the world to explore, but because Alcoa said, “If you go to Brazil, we have the money to fund the exploration.” Now there was nothing wrong with that decision, because Brazil is a very mineral-rich country. We went exploring in the Western Pacific because it was close to Australia and it was known to be mineral rich, but it had political problems, which I don't think we really understood. We went there for good geological reasons. We went to Fiji because we were offered management of a mine, and we put our exploration expertise to work there. Within two years we had found a million-ounce ore body. But it seemed to me that we needed more integrity in our international area selection process. I talked this over with Mr. Morgan and he thought it was a good idea. So we put together a very highly skilled team. It had a first-class geologist heading it up, Dan Evans, of the Olympic Dam discovery team. It had a top-class lawyer and two excellent financial people worked with us: one a Mr. Bill Blandy, very experienced in the economics of the mining world, and a Mr. Richard Schodde, a brilliant young financial analyst. We brought in, when needed, guidance from some of our top geologists and geophysicists, and supported literature studies with country visits. And we studied 123 countries.

11:00:36:29

Swent: Is this the IMES?

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Woodall: Yes, the International Mineral Exploration Strategy Study, which we started in the early 1990s. By the end of 1993 we had assessed 123 countries and selected thirteen for more

detailed studies of opportunities. Now, the selection was not just on the basis of mineral endowment and you might well ask how could we assess the mineral endowment anyway? Well, we went to the literature, and then if we were trying to assess the mineral endowment of say Ghana, we would send a team, usually two or three, over there. Why? Because we had to assess whether the literature was giving us a true picture of the endowment. A country may read as if it is poorly endowed because of lack of discoveries, but when you go there you may find that there has been no significant exploration or the mineralized areas are concealed and poorly explored, or covered with dense forests and what all. So literature research and conceptual thinking was carried out, supported by on-the-spot visits, which included discussions with the government people about what was known about their country's mineral endowment, the legal regulations, tax etc.

We made a short list of the types of ore deposits that were of main interest to us. World class gold deposits, world class copper deposits, be they in sedimentary rocks or the porphyry style, world class nickel deposits. They were the principal targets. So when geologists were assessing endowment, we wanted them to focus on those commodities and deposit types; ore bodies that we knew could be large and have a big impact on the company, if found. And out of this study came what we called GEORANK ("geological ranking"), the geological ranking of a country in terms of mineral endowment and opportunity. Then we put our financial experts to work, and we would say, "Look, we think there is an excellent opportunity to find a porphyry copper deposit in, shall we say, Peru. There is also an excellent opportunity to find a porphyry copper in Papua, New Guinea. This is the probable size. It will be so many millions of tons. It probably will have a grade of such and such. In Peru it will have a supergene blanket, probably of higher grade." We would try and describe what we were looking for in these different countries in terms that the financial people could understand. And they go away and report back: "If you found what you are looking for, this would be your financial return." So they could then turn around and rank opportunities on what we called GEMRANK ("economic ranking"), which considered the general economic parameters.

11:00:41:11

Swent: Were other companies doing anything like this that you know of?

11:00:41:14

Woodall: I wouldn't know, but I doubt if they were doing it so thoroughly and with such an exciting multidisciplinary team as we had. We would also say to the lawyer, "Now listen, what's coming out of this study is that there are these thirteen countries that rank high on the basis of their mineral endowment and the economic environment, the cost structure there and the tax structures. In other words, if we can make money there, this is what would be the tax situation. It is all looks very favorable, but what about the politics and the legal side?" And so they would access, often from various sources, information on the legal systems of these countries, the political risk factors, and we would plug that into the decision making process.

11:00:42:17

Swent: Takes a lot more than just looking at the rocks, doesn't it?

11:00:42:21

Woodall: It's more than just the rocks, and that's why I say that the output had extremely high integrity, and we set this down then as the benchmark for ongoing, corporate decision making. It not only ranked opportunities in foreign countries, but also similar opportunities in Australia. And I think, as far as I know, it still stands in good stead, although it has probably been revised from time to time as political systems and economic conditions change and as more information becomes available. Still, if you said to me, "Were you still having trouble being effective in the 1990s, before you retired in 1995," I would have to say "Absolutely!" And it principally was because of the breakdown in the chain of confidence and respect, not just in the exploration division, but certainly in our division. We weren't as highly regarded as we used to be!

11:00:43:52

Swent: Your effectiveness in the 1990s.

11:00:43:55

Woodall: Well, I wasn't being consulted, for whatever reason, by senior management to the same extent that I was previously. I would find out about things often in a secondary way. And when I was consulted, I didn't have the same authority to act as I had before.

11:00:44:16

Swent: Who was hiring the on-site geologists?

11:00:44:20

Woodall: Well, even that came under threat because Mr. Morgan decided, on external advice, I believe, that the whole business of recruitment, career path training and personal management in the company was poor, and a powerful human resource department was required. To some extent he was right, but not with respect to the exploration division. In the exploration division, the top person, and that was me, regarded recruitment as one of my most important responsibilities.

11:00:44:55

Swent: And so, you would recruit, for example, a geologist and then assign him to a site. And the manager—did the manager come into that? How did he come into that picture?

11:00:45:08

Woodall: Initially, up until the end of the eighties, there was never any question about assignments. As I mentioned earlier in this interview, at least once a year and often twice a year I would sit down with the chief geologists of all the operations and with all the top exploration people and say "What's the need for geologists, say, at the Kambalda nickel mines?" And they would say, "Well, we have got two mines to open up. We need two more mine geologists." And we would say, "Right, we have got to find them." And we would find them! We would either find them by transferring people in from regional exploration, or I would go out and, perhaps with the help of some of my senior people, find and recruit good people. And we were so successful at this that the mine managers never questioned our judgment.

11:00:46:01

Swent: Were they in the loop at all?

11:00:46:02

Woodall: No.

11:00:46:03

Swent: The mine managers?

11:00:46:03

Woodall: No, their job was to manage the mine. My job was to provide the geological skills they needed to find the ore and to help them mine it properly, and for twenty or thirty years they accepted that because I'd been supplying them with top people. Many who visited our mines would say, "Gosh, you have got a smart bunch of geologists here." And so, the system was never challenged because it was so effective. It provides top-class geologists on mines, and if they were ever a bit uncertain about their role as mine geologists, feeling a bit lowly, I could transfer them back into exploration or put them into research for two years and bring them back again refreshed. And so, we rarely lost a good geologist. They stayed with us. But this was not so with respect of other professionals in the rest of the company. Yet, this powerful human resource department, despite our effectiveness, took away the exploration division's authority for geoscience recruitment, training and transfers.

A human resource department could have been useful, but in my opinion, some of the people that were recruited into the HR department were so keen to demonstrate their influence, their power, that they developed systems that excluded management from decision making on personnel matters. And, there was a feeling, supported by HR behavior, that if you had been with the company for a long time, you were singled out as a likely problem. So what does a top-class professional do, who has worked with the company for fifteen years, is really good, has the interests of the company at heart? He hears that it is being said that "If you have been with this company for a long time, you are probably a problem." You say, "I'm out then! I am not working under these circumstances." And a lot of good people, engineers especially, left to work with other companies, and good geologists left to become independent explorers. I didn't lose too many geologists because right up to the day I retired, the geological guild was strong and effective, doing good things for the company. Although geologists were criticized, their morale was never destroyed. But it was destroyed as soon as I retired, because then they had no one high enough "up the ladder." so to speak, to defend them and the guild system.

11:00:49:33

Swent: Well, we had talked briefly about the guild system, but I thought you might expand a little.

11:00:49:39

Woodall: Well, let me try to describe it again. It was based on the philosophy that all the geologists worked under the director of exploration. The director of exploration was responsible for providing the geological skills required anywhere in the company, whether they be for a mine or at an exploration base. A geologist on a mine was as much part of the geological guild as somebody working in regional exploration or somebody working in a geological research laboratory. The geologist from the mines and the exploration groups and geological research groups always got together every twelve months as a family for a technical meeting to speak about their work and build friendships. They would speak about the work they were doing on a certain mine, or the work they were doing, say, in a certain laboratory, or work they were doing say in Brazil. So we came together every twelve months. This was a family. Also, we all wrote

monthly reports, which were available to everybody. So you could always find out, if you really wanted to know, what was going on geologically anywhere in the organization. Because we met at least every twelve months to consider every geoscientist's career path, all careers were very well planned. It wasn't just my opinion as to whether "Lee Swent" should become an exploration geologist, it was a joint decision. Someone involved in the decision would know "Lee" the person, would know what she really wanted to do and would know the family situation. Or, look, this young man has now got high school children, and for him to be based in a place where there is no high school is not going to be in the interest of the company. So let's move him for the next five years to a capital city where there are first-class high school facilities until he gets his children through high school. You see, we took into account not only a person's skills, skill base, their experience, but also what they wanted to do and their family situation. Now, that's how we ran the geological guild.

11:00:52:22

Swent: Was there anything comparable among, say, the processing people?

11:00:52:31

Woodall: Nothing! And that's why I can only presume it was because of that Mr. Morgan knew something had to be done about human resource management. The sad thing is that the geological guild stuck out, you might say, like a sore thumb. So different.

11:00:52:50

Swent: I am thinking that you were a target.

11:00:52:54

Woodall: Yes, we were a threat to the HR power base.

11:00:53:00

Swent: You were a fiefdom.

11:00:53:01

Woodall: I believe we were doing things better than the HR people could ever hope to do. The system had been operating well ever since I took over in 1967. It had nearly thirty years of successful experience. It had a great tradition. To be a Western Mining geologist was really something special. Why? Because you were looked after. You were helped to become the best geologist you possibly could be, either by giving you an opportunity to come to, say, the University of California to do a doctorate, which some of them did, or providing opportunities for staff to go to conferences, visit mines, all sorts of things to increase competence and job satisfaction. I had complete authority to manage geoscientists. I also devoted quite a significant sum of money each year to sponsor research projects at universities and maintained close relationships with the professors of geology at universities. Perhaps one of his top students needed financial assistance. We would provide a grant of, say, \$5,000 for that student to do their research on one of our mines or deposits. This was also good for the geologists on site because they had an interface with the academic world. How could the HR department possibly emulate this when they wanted to do the recruitment themselves and tell us how to manage geoscientists? They wanted to set the standards for recruitment and they wanted to control career planning. Some of these people didn't even know what geology was about, let alone metallurgy.

- 11:00:55:07
Swent: Well, this was sort of a fad at the time.
- 11:00:55:06
Woodall: HR was a fad, and in my opinion, its impact on WMC was disastrous. And it got to a stage when some of the things the HR people were saying about the exploration division were just not true. They needed to somehow undermine the anomaly, the geological guild, which was operating so effectively without any input from an HR department. They really resented that, and when I retired the guild was destroyed.
- 11:00:55:50
Swent: There was this theory that management was a skill only known to the HR people and it didn't matter what you managed.
- 11:00:56:00
Woodall: A manager's most valuable asset are the people, and you cannot argue about that. Therefore, a manager must devote a large amount of his time to his people. He must be involved in their recruitment, their training, their career path, their family matters, everything. So on November the third, 1995, I retired as an executive, somewhat relieved, because the last five years in particular had been very difficult.
- 11:00:56:36
Swent: Sounds very stressful. Had the company grown in size significantly during this period? Was that part of the challenge?
- 11:00:56:49
Woodall: You have got to describe what you mean by size, you know. Was it in revenue?
- 11:00:56:55
Swent: No, I am thinking numbers of people that you tended to lose touch with because it was a lot bigger.
- 11:00:57:01
Woodall: Somewhat, it had become somewhat bigger because I had taken the company into petroleum, which we will talk about next. We bought the Perseverance and Mt. Keith nickel mines so they had to be staffed, and nickel production increased. We expanded the smelter and the refinery to produce more nickel.
- 11:00:57:23
Swent: So you were dealing with a lot more people.
- 11:00:57:23
Woodall: Yes! In 1980 I had responsibility for about seventy-five geoscientists working in mines and minerals exploration. In 1990, the number was two hundred. We were also expanding the Olympic Dam operation, but obviously, we were not growing that operation fast enough, because the analysts and fund managers were not satisfied.
- 11:00:57:58
Swent: One question. Is there mandatory retirement in Australia?
- 11:00:58:02
Woodall: It's illegal now to have mandatory retirement, but it is customary to retire at sixty-five.

11:00:58:10

Swent: So this was fine.

11:00:58:14

Woodall: In retrospect, I think I might have done better to have retired earlier.

11:00:58:18

Swent: But sixty-five was the customary—

11:00:58:18

Woodall: Yes, and as that was customary, I felt that, like a good soldier, I should retire. When I announced my plan to retire I was approached then by both the managing director, Mr. Hugh Morgan, and the chairman, Sir Arvi Parbo to consult for the company on retirement. This was a very pleasant gesture, or should we say, accreditation. Perhaps it was because I had been with the company so long; a long history of knowing what was going on and why. I knew all about the geology of all the mines like the back of my hand and whoever came into replace me would have their hands full just getting on top of regional exploration, and getting to know the people. So I saw a useful role as a consultant, especially at the mines.

11:00:59:38

Swent: Had you groomed anybody to be your successor?

11:00:59:40

Woodall: No, they went outside the company, with negligible input from me. There were people in the company that I think could have taken over, but they went outside and they selected a very experienced and intelligent man who had worked with Newmont, Mr. Jack Perry. Now it was obvious to me, no matter how good my replacement might be and how experienced, there was a lot to get on top of exploration throughout Australia, and on six or seven mines; exploration in the United States, Chile, Brazil, the Philippines, plus the challenge of assessing a select group of countries that had come out of the International Mineral Exploration strategy document. I felt Jack could be helped by me being available. He might hear that there's problems on one of the mines. Perhaps the grade's down. Then he could say to me, "Well Roy, go there for a couple of weeks and tell me what the problem is." This is what I wanted to do. This is what I thought I was being asked to do.

Well, for the first six months I was asked to do nothing! I said, "Who's going to the mines and talking to the geologists about what they were doing?" The answer is, "It's not your job." I said, "But I am still a director." "No, you are now a non-executive director, and when a non-executive director, Roy, visits a mine, your job is to ask questions. It is not to give advice." These are the actual words said to me. But, I replied: "I am employed as a consultant; I am being paid a lot of money! Jack Perry, despite all of his energy and skills, can't get everywhere, and if I want to visit, say, Central Norseman, where we are still mining gold and having success in gold exploration, why am I not allowed to give any advice?" On one occasion, quite casually in an airport lounge, I met the manager of the nickel business, and I said, "I have got an idea, you know. What I would do at Kambalda is this." I thought I was being helpful. I was subsequently paraded before the managing director and severely reprimanded. "If you want to give advice to any of my managers, you give it to me and then I will pass it on to the managers." I have probably said enough about my five years as a non-executive

director. It was an unhappy time. Well, it didn't work out like that. They paid me \$200,000 a year for 100 days of consulting, which in Australia is a lot of money. I had to sign an agreement saying I wouldn't consult for anyone else, but I never had any intention of helping any other company. I had worked for Western Mining for so long that if anyone doubted that my heart was in the company, then there is something wrong with their mental capacity. However, they made me sign and swear on a legal document that I would not consult for anybody else for five years. I was interested in helping the company; the fact that they were going to pay me this was beside the point; to my mind it demonstrated that they were serious in wanting to make use of whatever skills I still had, that might help the "new guy" coming in.

01:04:57

Swent: It must have been very difficult. And Mr. Perry?

01:04:59

Woodall: Mr. Perry didn't stay very long. During this time the company didn't find anything economic in those five years. That's not to criticize Jack. Sometimes you do have five years without finding anything. They did get onto some new nickel mineralization in Central Australia, which may yet prove to be significant, but it was an area we had identified before he joined. It came out of that International Mineral Exploration Study. During my last few years with the company, they sold the gold division, which was producing up to one million ounces of gold a year!

01:05:59

Swent: And that's what the company was founded on, wasn't it?

01:06:04

Woodall: Yes. And when they sold the St. Ives field, which I had always said was the most valuable goldfield in Western Australia outside of Kalgoorlie, they told the shareholders that the price paid was \$180 million in cash and shares, plus a royalty. The fact that they were taking shares in part payment and a royalty was highlighted in the annual report, as enabling WMC "to continue to participate in the potential of the gold field". Now that was for me, encouraging stuff. It showed they still believed that what they were selling had got a future. The sale of the Gold Division actually generated a profit of \$140 million plus the value of the royalty. But the shares and the royalty were sold almost immediately after the acquisition.

01:07:51

Swent: You were quoting there from the annual report of which year?

01:07:57

Woodall: Yes, year 2001.

01:08:01

Swent: 2001. Who bought it?

01:08:03

Woodall: Anglo Gold.

01:08:04

Swent: Anglo Gold.

01:08:07

Woodall: Well, they bought St. Ives and the Agnew Gold Mine, and a company called Croesus Mining Limited bought the Norseman mines.

01:08:33

Swent: The end of a great chapter.

01:08:39

Woodall: That's the finish of my involvement in minerals exploration for Western Mining. Not the happiest ending, and perhaps after a short break we can talk briefly about the other adventure I had with Western Mining which was taking them into petroleum exploration.

01:09:08

Swent: Yes, well okay, let's take a little break then.

Interview 6: January, 27, 2004
 [Begin disc 12]

12:00:00:04

Swent: Okay, you had said that you had this contract for consulting, and for the first six months you had nothing to do, and then presumably there was a change. What happened after six months?

12:00:00:33

Woodall: Well, I was rather embarrassed to be paid a substantial amount of money to consult and not being asked to provide any technical advice as a consultant might expect to do.

12:00:00:54

Swent: Disappointing as well as embarrassing, isn't it?

12:00:00:54

Woodall: I was particularly very disappointed that I was not encouraged to keep in touch and advise on the geological work on the mines, because this was one area where Jack Parry had very limited time to come to grips with what the geologists were doing and what the exploration challenges were. His prime job was to focus on regional exploration, especially the international exploration, and try to focus exploration as quickly as possible on to targets that would generate world-class discoveries. However, when I asked if I could visit the mines, you have heard the reply. "You can visit them. You can ask questions, but, being a non-executive director, don't give advice." "But I am a consultant." "Never mind!"

So I thought that one of the things I had done that had been very useful to the company when I was an executive, was to keep in touch with universities. This allowed me to participate very effectively in recruitment because I would visit universities for a week, perhaps give one or two lectures, meet with all the bright research students, those likely to graduate, and select one or two that I thought we should try and recruit. It also allowed me to keep in touch with the cutting edge of research. So I said, "Well, perhaps for my consulting I should visit universities in Australia and overseas and keep in touch with research, and advise also if I come across any really bright students that you should recruit." And a big loud shout went up, "Hooray, that's what you should do." I think I just saved them from the embarrassment of what they had got themselves involved in: offering me a "non-consulting" assignment, perhaps just to prevent me from helping any other company. So I put together a list of what I considered to be the top universities in the world, and I put forward a program of visiting them all over an eighteen month period. It actually took a little longer than eighteen months, so that is what I did as a consultant.

12:00:03:42

Swent: What were the universities on the list?

12:00:03:49

Woodall: Well, it was all the top universities in geoscience in Australia, the University of Western Australia, Australian National University in Canberra, the University of Tasmania in Hobart. Overseas, I visited the University of California, Stanford, Alabama: in Canada, Toronto, University of British Columbia, Memorial University, Newfoundland in St.

John's; in England, the Imperial College of Science in London and the University of Southampton. That's a sort of snapshot.

Three years after I had retired, and had finished the university consultancy, I was asked by David Roberts who was the Western Mining geologist in North and South America if I would attend a technical review session. I had to reply and point out that as a non-executive director, I had very limited scope to contribute to discussions with management. Sir Arvi had written to me with guiding principles, a copy which I sent to Dave with this comment: "Under these principles, I would not be able to contribute to a technical review in a way you probably have in mind." End of story!

12:00:06:18

Swent: You are quoting from a letter of what's the date?

12:00:06:23

Woodall: It's a letter to Mr. Dave Roberts of August 7, 1998.

12:00:06:27

Swent: Now what's the letterhead there? I am interested.

12:00:06:33

Woodall: Well, because I was asked to consult, I had to form a consulting company. And I formed Earthsearch Consulting Proprietary Limited.

12:00:06:45

Swent: Consulting, okay. You were allowed to do that?

12:00:07:08

Woodall: I had to! It was mandatory that I form my own consulting company, because WMC wanted me to consult for this two-year period.

12:00:07:07

Swent: But you couldn't consult with anybody else.

12:00:07:12

Woodall: Oh no. Not for five years!

12:00:07:30

Swent: Your hands were tied. Muzzled?

12:00:07:29

Woodall: Yes, muzzled and made irrelevant! I will quote from this letter which I received from Sir Arvi on the 28th of October 1997. "If when a director visits an operation, the director agrees with what is being done or what is proposed to be done, because you are allowed to ask questions, there is no problem in saying so. If the director disagrees, it would be acceptable to ask searching questions about the aspects, which are of concern. It would, however, be out of order to tell the staff that the director disagrees with what is being done. The correct procedure would be to take the matter up with the Managing Director who would then consider it and cause appropriate action to be taken. If pressed by staff to express a view the answer should be just that, that it would be inappropriate to do so because it would amount to interference with management. The guiding principle is that

non-executive directors must never interfere with management.” Yet non-executive directors carry a very heavy responsibility! Amen!

12:00:09:25

Swent: Amen.

12:00:09:30

Woodall: Now, let’s talk about petroleum. Because it is not the focus of this interview, we will skip over it fairly quickly.

12:00:09:42

Swent: It certainly had ramifications.

12:00:09:49

Woodall: It was for me the happier part of my last few years with the company.

12:00:09:59

Swent: And was this done on your initiative? Where did the initiative come from?

12:00:10:08

Woodall: It began on January 26, 1971. Now, that (incidentally, January 26 was yesterday,) is Australia Day; the founding day for the Australian colonies. Let me tell you a little story. When I came to Berkeley in 1955, our first child was born here in November that year, and this story is to illustrate that when you are well received in a new community like we were in the U.S., it is easy to forget your nationality. You feel so much at home. And this is a story about feeling so much at home in the United States, even though I was what your Immigration Department call an “alien.” Now, we had to register, Jennifer, our first child, with the Australian Consulate if she was to be entitled to Australian citizenship. She was automatically entitled to United States citizenship because she was born here. So we thought sometime in the next six months we had better go and register Jennifer, which meant we had to take the child to the Australian Consulate, plus photographs and whatever, and fill in forms. So we went over to San Francisco; caught buses and trains to register our first child so she could have Australian citizenship. We found the building where the office was and it was quite high up in that building. We caught the elevator, and went up to the office of the Australian Consulate of San Francisco, and when we got to the door there was a notice on the door: “Closed, Australia Day.”

12:00:12:25

Swent: And you had forgotten.

12:00:12:29

Woodall: So, there you go. Anyway, on Australia Day, 1971, Arvi Parbo, who was the chairman and managing director, asked if I thought we should get involved in petroleum exploration with a small company called Beaver Exploration. At that time, the opportunity did not appeal.

12:00:13:09

Swent: Now, I am trying to think. You were mining uranium? No, you were not yet into uranium. That came just a couple of years later.

12:00:13:25

Woodall: Yes, going into petroleum had nothing to do with the energy business as a general statement. Then, in 1972, we had the opportunity to buy the petroleum interests of a company called Flinders Petroleum, who had exploration tenements in what's called the Cooper Basin in northern South Australia and Queensland. They had drilling commitments, and for whatever reason, they were selling out. We took over their interest and drilled our first well, Durham Downs No. 1, in 1973, and it flowed gas at nearly three million cubic foot a day. It was a commercial gas discovery. We had other commitments, which were not significant. On January 14, 1976, Arvi, the chairman and managing director, decided it was time to get more involved in petroleum. He wrote to all the directors and gave his reasons. He said, "There is a substantial and growing market for oil in Australia, so the market is there. The new Federal government is expected to take action to encourage oil and gas exploration. So politically we are going to get support. It is a good diversification. Instead of trying to sell products internationally, we have got a local market for oil and gas, and this would bring a very welcome diversification of the company's income. Ownership of oil and gas assets would also provide a hedge against increases in energy costs." If the cost of using energy in our mines rose, it meant that the cost of petroleum products would also rise but we would benefit from that anyway because we would be producing. So the Board approved us getting involved in petroleum exploration in a serious way.

By 1977, we were spending three million dollars a year on petroleum exploration, and we started to drill some of the tenements we had acquired from Flinders Petroleum in the Cooper Basin, and in 1980-81, we drilled three successful gas wells. In 1982, we had the opportunity to get involved in offshore oil exploration in Western Australia in a geological province called the Carnarvon Basin. There, with partners, we also made three successive oil discoveries in which our equity was twenty percent. Then we bought out a United States company called Mesa Petroleum, and acquired another twenty percent in those discoveries. We had more success and found oil in the Cooper Basin, in 1983 and 1984: five oil discoveries and four gas discoveries. In 1985 we made another gas discovery in the Cooper Basin and in 1986 we made two more oil discoveries, one in the Cooper Basin, and one in the Surat Basin in Queensland. But what Arvi and we had not considered was that the market was controlled by two other companies.

Access to the market for gas was controlled by others, and so we were making a lot of discoveries in the Cooper Basin but we couldn't benefit financially. So we sold the Cooper Basin and Surat Basin tenements. I don't know exactly what we received for them, but at least we showed that we knew something about how to find petroleum. On the other hand, the offshore oil discoveries that we made in the Carnarvon Basin were brought into production and the Petroleum Division started to generate profits, I think it was fifteen million dollars in 1989, thirty million dollars in 1990 and 1991. It rose to fifty-six million in 1992. In 1993, we probably made our biggest and most important discovery. We drilled a prospect offshore Western Australia called East Spar. It was a major gas discovery, and not only gas, but gas plus valuable condensate i.e. liquid hydrocarbons. The discovery was developed, and it was sufficiently large to justify a gas pipeline to an adjacent facility on Varanus Island then all the way down 600 miles to the south into the mining districts of Western Australia, to provide them with a much more reliable, cheaper power source. Up until then, all their electric power was generated from diesel power plants, and here we had now made it possible to reticulate

natural gas for power generation, at a lower cost, using much more fuel efficient generators.

12:00:21:46

Swent: What happened to this rosy letter about the assured market?

12:00:21:54

Woodall: For our gas in the Cooper Basin, the government didn't interfere. Well, go back a bit. The government was talking about a national grid of pipelines, so that wherever gas was found, there would be a common carrier and access to market. But the national grid never eventuated. In South Australia, the pipeline and market for gas in Adelaide was a market controlled by just two companies, and they were allowed to maintain that monopoly because that's what the South Australian government had committed to, in order to encourage exploration many years earlier. So it was a hang-over from the past. Offshore, we had no trouble getting the oil and gas to market.

12:00:23:03

Swent: So there were no State agreements.

12:00:23:03

Woodall: There were none. So we were able to develop the offshore oil discoveries and they became very profitable, and when we found that major gas field, it was quickly developed. And, quite apart from the value of the discovery, it made a big difference to the economics of mining in Western Australia because it gave companies a much more reliable source of energy for their power generation at lower cost.

12:00:23:40

Swent: How far offshore was it?

12:00:23:42

Woodall: Oh, the oil discoveries, 10 to 30 miles and the East Spar gas discovery about 60 miles.

12:00:23:45

Swent: Was it still in domestic waters so there was no problem with that?

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Woodall: Oh, it was still in Australian waters.

12:00:23:54

Swent: But Australia had jurisdiction without any problem?

12:00:23:59

Woodall: There wasn't a problem of sovereignty or ownership.

12:00:24:06

Swent: Well, that must have been a happy occurrence.

12:00:24:10

Woodall: One of the reasons why I found this petroleum work very interesting was that it became apparent quite early that petroleum exploration was dominated by geophysics. Now, that's not unreasonable, because you are looking for something that's not outcropping. It is down deep, and seismic technology was very effective. You use seismic to map the

rock structures at depth and when you drill a well, you put down geophysical logging equipment to measure the characteristics of the rocks, although you do have some idea of what the rocks are like, because you have chips coming up during the drilling of the well.

12:00:25:01

Swent: Did you do your own drilling or did you contract it?

12:00:25:00

Woodall: All petroleum drilling is always contracted out, and the seismic work is also always contracted out in the petroleum business. What was apparent to us was that many companies were not making full use of the geological information provided by the drill cuttings. They were relying entirely on the seismic response to locate and define the trap, on which the exploration well would be drilled. Now when you succeed in petroleum, you make a lot of money very quickly, and that, from my point of view, was another reason for being in petroleum exploration. When you discover a major mineral deposit, it costs a lot of money to bring it into production, but your real profit is usually sometimes five, ten or more years after the discovery. That's when you reach maximum production. It can be somewhat different when you find a rich near-surface gold deposit that you can mine in an open pit, but you still have to spend time and money removing all the overburden in the first two or three or four years before you get any revenue. With petroleum, once you discover it, you just drill development wells, turn on the tap and your largest production is often in the first year, not in your tenth year! And that's one reason why petroleum companies, I think, have become very wealthy, because they get their money back quickly after exploration success, real quick.

12:00:26:51

Swent: Tell us the reason why so few petroleum companies and mining companies have been able to do well in each other's territory.

12:00:26:52

Woodall: Well, petroleum companies, as you know, tried to get involved in mining, and it was quite disastrous. They didn't understand that when you found an orebody it might take you ten years to reach peak production. They were used to making a discovery and having peak production in year one. Also, in mining, the geophysics is different, and geology is much more important.

12:00:27:28

Swent: Many mining companies have not been successful going into petroleum either. You were special in that.

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Woodall: Well, I think that was in the back of people's mind in WMC's head office once Sir Arvi retired. Which subsequently became dogma that we shouldn't be in the petroleum business.

12:00:27:52

Swent: Although you were doing well.

12:00:27:54

Woodall: We were doing well, but petroleum exploration is no different than minerals exploration. You cannot expect to be always succeeding. You may go through quite a long period of no discoveries and then you succeed. In that quiet period, when you are not being successful, if you are a traditional petroleum company, nobody criticizes you. If you are a mining company people say: "mining companies don't know anything about petroleum exploration and shouldn't be in the business." You get intense criticism!

12:00:28:43

Swent: You needed to build up a staff of petroleum geologists.

12:00:28:55

Woodall: That's right, and they were a very good staff, too. From my point of view, the most exciting and most successful adventure into petroleum was when we were introduced to a group of petroleum consultants in the United States which led to us establishing a petroleum exploration and production company in the U.S., called Greenhill Petroleum. These consultants were, Bob Sneider, John Sangree and Jim Hartman; all very experienced ex-Shell and Exxon petroleum geologists, who had retired and formed their own consulting companies. And they were full of bright ideas, and they introduced us to other very smart people working independently in petroleum exploration: Larry Cochran and Bob Beardsley.

Now, our first opportunity in the United States came in 1988 from Larry Cochran and Bob Beardsley. They were very knowledgeable about the oil producing carbonates in the Permian Basin of West Texas and New Mexico. These carbonate rocks had been prolific producers of oil, but the initial flows of oil had declined as reservoir pressure declined, and many of these oil fields, hundreds of them in fact, were under what is called water-flood.

12:00:32:41

Swent: Water-flood?

12:00:32:40

Woodall: So we paid Larry and Bob to scan hundreds of oil fields in West Texas and New Mexico, to identify the ones that were not performing under water-flood, and then to look at the poor performers, to find out what they could about those fields and find out why they were not performing: hadn't people done the geology right; was the well spacing too great or was there just something fundamentally detrimental about the environment which even we could not overcome? Yes, water-flood.

In other words, when these oil reservoirs were found, there was enough natural pressure for the oil to come to surface, and made many of the Texans millionaires. But when the pressure dropped you have only recovered perhaps ten or fifteen percent of the in-situ oil even after installing pumps to lift the oil to surface. So what can you do? You drill other wells, and you inject water, and you repressure the reservoir to flush out more oil. Well, imagine, if you can, a thick thousand foot sequence of carbonate rocks, old fossil reefs, in which there might be ten porous, permeable horizons still containing oil. You decide to start injecting water into one well in the expectation that oil will flow again from a neighboring well. But what if the geology is not simple? You may have a well here with ten porous horizons, you may have another well some distance away, also

with ten porous horizons, but they may not all be the same horizons. So if you pump the water in one well and the water disappears you may not know exactly where it's gone. If it didn't produce any more oil you know you have a problem. The answer is to remap the sub-surface geology. You must drill other wells to find out the pattern of permeable horizons: which oil-bearing horizons are present in which wells? So, solving the sub-surface geology in great detail is most important, and Larry Cochran and Bob Beardsley were experts at that. And they said, "Look, many of these fields are being poorly managed because the owners do not understand the geology." Now, my interest was to put geology back into petroleum exploration and this was exactly what I wanted to do. This is where there must be money to be made by being geologically smart, not just geophysically smart. Here were two experts in the field saying exactly the same: here there is money to be made by first being the best geologists.

Cochran and Beardsley did that, and when they identified fields that they felt should be much more productive than was currently apparent, we bought them. Mr. Hugh Morgan gave us fifty million U.S. dollars to invest in this venture. But this investment, was unlike typical petroleum exploration because you don't just drill another well and get early peak production. It's a bit like mining. You have to drill a lot of wells to solve the geology. That might take you two or three years. You then have to do a pilot-test, a bit like a pilot plant test in mining to see how best to treat the ore. A petroleum pilot-test may involve, say, drilling six wells, injecting water down three of them. If you do have the geology right, oil production increases in the other three and then you can say, "Well, we do understand the geology and we are going to drill a lot more wells and really boost production." But it takes time.

Now, Bob and Larry did their best to estimate how much time it would take to get to peak production and hence the return WMC could expect from the investment. Their analysis suggested that if we invested, say, US\$10 million buying a field, and then in this piloting and initial investigatory geology work, we would probably get our money back in four years, and from then on it's all profit. But it proved more difficult, and that's not unusual in the geological world. When Sir Arvi Parbo visited these fields, he found out that it would take over six years to get our money back, and this is in the world where people want fast returns; where pension fund managers are banging on the door saying, "You have invested fifty million in the United States. Where is your return? You have been there two years!"

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Swent: Same story again.

12:00:38:34

Woodall: Yes, I am on the board but not encouraged to comment. Gone were the opportunities to continue to teach the non-technical directors what the U.S. petroleum investments were all about—technically and strategically I mean; to convince them that we were succeeding even though it is more difficult than we thought; but were succeeding and the long-term production and profits would be substantial.

Then, in 1989, Bob Sneider introduced us to his friends Jim Hartman and John Sangree, both highly successful, but retired experts in petroleum exploration. Jim was particularly knowledgeable about oil fields around New Orleans. Bob and Jim were convinced that some of these oil fields, which had been prolific producers, had been

poorly managed. Not only was the geology poorly understood, but the fields hadn't been exposed to the new seismic technologies so they were using out-of-date interpretations. When the fields were first drilled, ten or twenty oil producing sands may have been intersected, three or four of them being fantastic producers. So they only perforate the casing to produce oil from those four or so major reservoirs. The oil comes up under natural pressure in huge quantities from such reservoirs and they make a lot of money but gradually production from those reservoirs declines, and often the less productive horizons are forgotten, and never developed. Bob's idea was, let's re-do the geology, let's re-do the seismic, but first buy the field. Go back to the old drill logs of all wells, and pick out the horizons which are oil bearing, but have not yet been brought into production. He forecast that this could be extremely profitable. We went back to Mr. Morgan and said, "Well, we need a little bit more money. We need to buy some of these New Orleans fields." Fortunately some of the Western Mining directors had met Bob Sneider and his friends and were exposed to the ideas and the geology and the geophysical work we believed would be cutting edge! Bob Sneider was a great teacher! As a result, directors understood what we wanted to do, and they were therefore supportive. As a result we were granted the extra money to invest. So we bought several declining, low productivity oil fields, the first one being Delta Farms. We re-interpreted the geology, we re-interpreted the seismic, we re-assessed the petroleum engineering, drilled new wells, reconditioned others, and dramatically increased production!

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Swent: And this was now in what year are we talking about?

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Woodall: The years 1988 to 1989.

12:00:44:00

Woodall: The first Louisiana oil field we bought was Delta Farms, the next one was Bully Camp. We found that Bully Camp didn't have a lot of potential and was soon sold, but the Delta Farms purchase was very successful. And then, in 1990, we bought our two real gems: one was the Grand Bay field and the other was Timbalier Bay.

If I go back to these Permian basin fields: we bought seven properties in New Mexico, they were all producing from the carbonate reservoirs and were thought to have remaining reserves of only two million barrels of oil. That's all the seven fields were thought to have left. But our studies suggested the potential was much greater. When we commenced our own drilling we were finding oil at eighty cents a barrel. The problem was, from the financiers' point of view, that these carbonate reservoirs don't give up their remaining oil easily: you don't get the oil straightaway as you do when you discover a new field. You find oil cheaply, but only after intensive geological or geophysical studies to solve the geology. When we bought those Permian Basin fields the seven fields were producing oil at a thousand barrels a day and we predicted that in six years we would increase that seven fold to 7,000 barrels a day. Now, as I mentioned, when Sir Arvi Parbo visited those fields and found out that this peak production was out to six years, and payback was more than six years, he was not at all that impressed. Remember though, the price of oil in 1988 was only US\$15 per barrel, and only \$19 per barrel in 1989.

12:00:47:36

Swent: Takes a lot of patience and optimism to pursue such strategies, doesn't it?

12:00:47:46

Woodall: I received a letter from Sir Arvi on the twelfth of February, 1991 after he had visited both the West Texas Permian Basin oil fields and the New Orleans fields. The West Texas fields, as I have explained, required very careful geological work, very careful pilot-testing. He wrote to me and said, "Regarding the Permian Basin, information given to me was that the payback period is 6.3 years. I would not consider this a satisfactory return on investment, and it is not clear to me why it takes five years in the Permian Basin to get your money back when we are already achieving good results in Louisiana." Now these comments disappointed me greatly because this intelligent man, had, despite his visit to the fields, hadn't understood how different was the Permian Basin strategy from the Louisiana strategy. They were two very different types of oil occurrences requiring very different remedial exploration and development strategies. In the Permian Basin, the complex reservoirs were under water-flood to re-pressure the reservoirs. You can't do that until you solve the geology and that takes time. In Louisiana there were reservoirs left behind by the previous operators, oil reservoirs already pressurized but never put on production. It's just a matter there of drilling, re-completing the well then opening it up for production under its own natural pressure, hence fast new production. The West Texas wells took longer to bring into production but with every expectation that they would be producing oil for a very long time.

12:00:49:19

Swent: What was the date of that letter?

12:00:49:26

Woodall: February 12, 1991.

12:00:49:26

Swent: '91.

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Woodall: So even though some of the directors were visiting the fields and getting the story direct from the experts, there was still a problem: a lack of understanding at the level of chairman and managing director and concern solely for quick financial returns. Now this illustrates so well, how different the company was to the one I joined in 1953 and had worked for all my professional life, a company founded by W.S. Robinson and Gordon Lindsay Clark. This financial pressure to "perform short-term" started in the late 1980s. Naturally, it was important for the Director of Finance, Mr. Don Morley, to get involved in the debate as to whether WMC geologists were wasting the company's money getting involved in oil exploration in the United States. On the second of September 1991, no doubt under instruction from the chairman, Don visited the fields himself and talked to the people running the whole business.

12:00:51:12

Swent: This was Morley?

12:00:51:15

Woodall: Yes, Don Morley. And he produced a series of graphs, to illustrate the short term potential of Greenhill petroleum properties and the total return which could be expected

over the life of the projects, which in some cases was more than twenty years; twenty years of production. The graphical presentations illustrated that eventually the cash flows from these projects would be very substantial and this, from a conservative financial manager's perspective—in the case of the Permian Basin could be of the order of U.S.\$300 million.

The problem was that nowadays, everyone tends to judge a project on the basis of its rate-of-return. Now, I won't go into the definition of rate-of-return, but briefly it's if you invest some money now, in a high-risk project, you expect a high rate of return—which means a fast payback. The lower the risk, the lower the acceptable rate of return. Now admittedly, any investment in mining or petroleum has a risk factor. If you go out drilling wildcat wells in the Gulf of Mexico, this is very high-risk exploration, or if you go to a strange country where you don't know the geology very well and the politics are risky and start drilling wells, it's very high risk. Such projects don't make sense, financially, unless there is expectation of a high rate of return from success. We were not in that business. We were spending our money where oil had already been discovered. It was only a matter of improving the management of extracting it. But what was I told? "Roy, if you want us to keep funding this petroleum exploration in the United States in the Permian Basin carbonates and in the sandstone reservoirs of New Orleans, you have to demonstrate a twenty percent rate of return." That's like as if we were drilling high risk wild-cat wells. Gone was the interest in establishing a petroleum production arm of the company over the long term. Now, no interest!

In 1991, the bright geologist that I sent over there to help set up our U.S. venture, Simon Ashton, wrote to me and said: "Don Morley's graphs don't give the whole picture and are misleading if looked at in isolation. The focus should be on the future. There is no question that the actual costs have exceeded the expected-case costs, but for good reasons. For example, on our Louisiana fields, recently completed 3-D seismic programs have been shown the justification for several additional wells to test deeper and adjacent opportunities that were not recognized when we recommend we buy these properties. We didn't know that we had this opportunity to spend some more money on good additional prospects within the oil fields.

"Changing development programs and costs have been occurring constantly since we put the original business plans together. Our biggest knowledge increase has occurred in Louisiana where major additional potential has been recognized. We can now see that there is more opportunity to dramatically change the forecast economics. In short, we are now not developing the fields according to the scenario we first put up to the board. So to compare current performance with out-of-date references is misleading. The critical factor is how certain we are of our future after-tax-rate of return. Now we have so much more information and we are much more certain. This project is not nearly as high risk as in the beginning. We now own the fields, we have re-interpreted the geology; we know what we are talking about. What needs to be established now is whether WMC is happy with the now forecasted overall seventeen percent after tax rate-of-return on projects which now have a much lower risk."

Now, seventeen percent is a pretty good rate of return when risk is low. Delta Farms was expected to be a fifteen-percent rate-of-return project, Grand Bay sixteen percent, Timbalier Bay twenty one percent, and Permian Basin projects nineteen percent. Consistently good returns, but not twenty percent and certainly not thirty or forty

percent that you might expect if engaged in high-risk exploration drilling where no one else has found oil. But we are not in that high-risk business!

12:00:59:34

Swent: Now is this New Mexico property in the Permian Basin?

12:00:59:38

Woodall: That's Permian Basin.

I just want to conclude by telling you what happened to the petroleum division.

This is the finale. In the financial year 1995-1996, the revenue from our oil production was \$130 million.

12:01:02:59

Swent: Australian dollars?

12:01:03:02

Woodall: Yes, But not insignificant! And that's when the oil price was only nineteen dollars a barrel; now it is thirty (and in 2005, US\$60). The profit was only \$14 million on assets of some hundreds of millions. And so the directors were jaundiced about the return, even though we could show in the case of the American investment, there was a very high level of confidence that the long-term return would be at least seventeen percent even at low oil prices. Anyway, in January of 1997, the Western Mining petroleum assets were sold for \$603 million, an amount which surprised the skeptics in the company, and the profit was \$224 million.

12:01:04:13

Swent: So WMC got out of the business!

12:01:04:17

Woodall: They got out of the business at the wrong time. Those fields in the United States are still producing at 15,000 barrels of oil equivalent a day, and they will probably do so for the next twenty years. Now, 15,000 barrels of oil a day at thirty dollars a barrel is significant revenue

12:01:04:55

Swent: US\$ 450,000/day.

12:01:05:03

Woodall: Suppose you produce for 300 days of the year, you then have produced 4.5 million barrels of oil a year, worth US\$120 million, with low operating costs once development is complete.

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Swent: You just have to sit there and let the money pour in.

12:01:05:46

Woodall: That's it. The operating costs on those fields was something like six dollars a barrel. With oil thirty dollars a barrel, there are big profits being made out of those fields, which we bought, reinterpreted the geology, updated the geophysics and production engineering ie how to complete the wells and bring them into production, either by

water flood or by natural pressure. So, Lee, my whole career has been motivated by creating wealth. I am not embarrassed because we invested heavily in the United States petroleum business to revigorate declining oil fields to create wealth. That Western Mining wasn't interested in owning that future wealth was, in my opinion, a tragedy, a tragedy caused by concern only about short-term financial returns.

12:01:07:13

Swent: They walked away too soon.

12:01:07:15

Woodall: They walked away because a seventeen percent rate of return was not enough even when the oil price was low. It was the wrong decision! And then of course when they sold the fields, other people realized their real worth and paid \$600 million for the assets. We built up assets of more than half a billion dollars. So, that's the petroleum story, which was a delight in many ways because I was working with wonderful U.S. geologists and geophysicists, and some very experienced ex-Shell and Exxon people. Their motivation was no different than mine. Let's take something that other people think is finished, and let's give it a new life and create new wealth.

12:01:08:06

Swent: And you must have felt very much vindicated by the results.

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Woodall: Personally?

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Swent: Yes.

12:01:08:11

Woodall: No one ever told me so, but I am quite happy that we invested the money wisely, and over the long-term more wealth has been created in this case, for Americans, not Australians. I am not embarrassed about that either.

12:01:08:30

Swent: Well, that's a good note to end on.

12:01:08:46

Swent: Okay. Let's talk about some of the fun you've had.

12:01:09:01

Woodall: Well, it was always, as I have mentioned, a joy to have worked with these top American geologists and geophysicists in planning the acquisition of the fields and their redevelopment, but what was equally enjoyable was the wonderful way we, the owners of the properties, were treated by them, the operators. The personnel, out on the production platforms, even the chef and the roustabouts that were just doing the more menial tasks, they all showed us such affection. It is not too strong a word to say that they loved us. When it came to my retirement, and I made my last visit out to the production facilities, they turned on one of the most fantastic farewell parties. There were banners all around the mess hall, "Welcome Roy and Welcome Barbara Woodall", and "Sorry to see you're going." And they produced big cakes with all sorts of lovely messages on them. Quite apart from the farewell parties, Bob Sneider was champion at organizing parties in his own home in Houston where we would all get together and also

have a lot of fun. On one such visit they presented me with a Texan hat and Texan belt buckles, with more presents to come if I could learn to speak like a Texan.

12:01:10:42

Swent: Oh, the belt you are wearing. The Lone Star.

12:01:10:45

Woodall: Yes. And in New Orleans we had some great parties too—what do they call them? Not shrimps.

12:01:11:01

Swent: Crawfish?

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Woodall: Crawfish, Crawfish parties! They would have this great big pot of boiling spiced water and cook the crawfish and then they would spread them out on what I would call butcher's paper, you know, sort of porous, white paper, on a long trestle. There would be all these hot crawfish, beer and other delicacies and we would just have a lot of fun and a feast. But, when I visited the production platforms and drilling rigs with my wife Barbara, you know, the workers, especially around New Orleans, would be so courteous. It was always, "Ah, Mr. Roy, it is so good that you have come to see us." "Ah, Ms. Barbara, you have come also. Good that you have come to see us as well." The fact that we had come to see them working meant so much to them—I don't think they had ever seen this sort of management before. Fancy, the director coming to see me on this pump trying to get the oil flowing better, or me trying to make better records of today's production, or just a junior technician reading the gauges. "Ah, Mr. Roy, it's great of you to come." And so when we left we had this wonderful farewell party which was pretty sad in many ways, but—

12:01:12:46

Swent: But very gratifying.

12:01:12:46

Woodall: Oh, yes. The fact that you are working to create wealth and everybody from the most senior person to the most lowly worker is happy. That's just wonderful: you cannot have a better working environment. You cannot have a better environment in which to generate wealth. There was no bitterness; no jealousy. Sure, the people were well paid, but they are not working just for money. They were working because they enjoyed their work and the work environment. They were encouraged to become the best technicians they could possibly be, the best geologists, or the best geophysicists. They were given the opportunity to drill wells to solve the geological problems. Happy, happy times, and, the only tragedy was that WMC couldn't see the future because they were only looking for short-term gains. If I had been the chairman or managing director I would have never sold Greenhill Petroleum and I am certain, with the talent that came to work for us, we would have grown Greenhill into a major production arm of the company and profit generator.

12:01:14:12

Swent: You would have hung in.

12:01:14:18

Woodall: Yes because we were wealth generators. The more geology we did and the more geophysics we did, the more opportunity we found existed to produce more oil and generate more wealth. Only at a seventeen-percent rate-of-return mind you. But if you can generate a seventeen percent interest on the money you have invested when the price of oil is low, you are doing pretty well.

12:01:14:38

Swent: Very well indeed.

12:01:14:39

Woodall: And that's after tax, not before tax. That's after you've paid all the taxes and royalties and all costs. You end up with a seventeen-percent rate-of-return. You double your money about every three years, I think, if you work out the economics. But to the powers in Melbourne, that was not good enough. So they sold it off and walked away with \$200 million but gave away opportunities we developed for the shareholders which, at today's oil prices, are great wealth generators.

Interview 7: January 28, 2004]
 [Begin disc 13]

13:00:00:27

Swent: I think this will be our final session.

I think we have covered a great deal of your career. We are coming up now to the nineties. You gave a lecture; a lecture that was published looking forward into the nineties predicting what was going to happen; how accurate was your prediction?

13:00:01:14

Woodall: Lee, I will have to refer back to the text. As regards to the future, there is no doubt that the world is going to need metals and minerals and especially energy-producing minerals, especially petroleum products. So there is no doubt in my mind there is ample scope in the world for young people to select exploration geology, either in the world of minerals or metals or petroleum if they wish to have a very worthwhile career.

13:00:02:08

Swent: I would like to quote—I guess I threw you a little bit of a curve. I didn't warn you that I was going to do this. This is from *Mining Engineering* in 1992, July, the issue of *Mining Engineering*, the journal of the Society of Mining Engineers. And I liked this. You said, "Mineral discoveries are the result of creative activities, the result of innovative thinking and smart scientific research," which you certainly have exemplified. "Mineral discoveries resulting as they do from the application of science and technology are inventions in the true sense of the word." And you certainly have proved that in your career.

13:00:02:53

Woodall: Well, that's the exciting thing for young people to realize. They can go out there and be inventors in the world of ore deposits and petroleum discoveries, the same as people can be inventors in the world of electronics or pharmaceutical drugs, just as exciting and just as important for any country as any new discoveries. However, there is no question that in a country as advanced as the United States, the mining industry is just not as important relative to the rest of the economy as it used to be. That doesn't mean to say it is not important. It is more important in developing countries. And if young people want to make a difference to this world where there is such a gap between the rich and the poor countries, to devote themselves to the discovery of mineral wealth in the developing countries is to make an enormous difference to those countries being able to provide employment, educate their children, and provide tax revenue for the government. There is just as much scope for young people to make a difference for good now in many countries in the world as there was when I started trying to make a difference in my own country, Australia, in 1953. And I hope many young people will take up the challenge.

What do they have to do? Well, they have to find a good school to get themselves educated and, I hope, work under professors of the caliber of Professor Wisser or Professor Meyer; teachers who set you on fire. My old professor back at the University of Western Australia, Professor Rex Prider, was also just such a man. Then, they must

find employment with a company where there is as much interest in mineral exploration at the level of the chairman and the board as there is in the person's own heart and soul.

I can't over-emphasize how important is the critical line of confidence between the people in a company; between those who are providing the money for exploration through to the people like the geologists and geophysicists and geochemists who are using that money, through to the technicians who are directing the use of that money doing the technical work in the field. How critical that line of confidence is to success! And just as critical is the line of respect. The technicians must be working for geologists and geophysicists and geochemists whom they respect, people they are going to want to work for. All must have respect for their bosses, and respect for the people who are providing the money. You are much more motivated if you are working for people whom you know are not just interested in personal financial gain. I worked for people for whom that was not their sole motivation at all, and as I have already said, I would never recruit anybody whom I suspected was motivated entirely by ambitions of personal financial gain. I always wanted people who worked for me to principally work to make a difference to society for good, and you can do that through making discoveries.

The other thing that I must stress, and it became apparent to me to be so important when I was here at Cal. It is so important to use every opportunity to carefully describe, to carefully document every orebody that you have contact with, and every ore environment that you have contact with. We must make sure that every orebody, that a company is mining and therefore removing from the face of the earth, is scientifically documented. We must ensure we are leaving behind a true record, even if we can't yet properly interpret the significance of what we are seeing. Other young geologists will come along, perhaps in the next generation and be able to interpret what we have seen, what we have described, but not fully understood.

I must emphasize this, because it became important to me very early in my career. I wrote to my old University of Western Australia professor on the second of February 1957 because I was fired up by what I had learned from Professor Wisser and Professor Meyer here at Cal. I was writing to Professor Prider because he was offered an academic position on the faculty of the University of Western Australia. And I said to him, "It is a serious matter, Prof, when the ore deposits of the world are being rapidly removed from the face of the Earth before a fraction of their secrets have been uncovered. Admittedly, as yet we cannot reasonably explain much of the data that can be collected, but as I see it, mining companies have a responsibility, which they are trying to forget. That is the obligation to record the finest details of the orebodies they are mining." So it was very early in my career that I not only committed myself to try and to make a difference for good in terms of making discoveries and helping my country Australia. It was also early in my career that I realized that there was also another important role to play: the role of the scientific documentation of ore deposits.

The history of Australia is full of stories of the early colonies almost going bankrupt until they found mineral wealth, and mining is still a very, very valuable part of the Australian economy, even though Australia is a relatively highly advanced nation. If Australia still relies on mineral exports, and products derived from mining, for about forty percent of its exports, how much more critical is it for less developed countries?

Never doubt, young people, that there's a wonderful career out there that will make a difference.

When I joined Western Mining, its value on the stock exchange as a company; in other words, the value of the company to the shareholders was \$3.5 million. When I retired in 1995, it was worth ten billion. An increase of three thousand times. When I joined the company in 1953, it was producing ninety thousand ounces of gold a year which produced a revenue of only \$3 million, which, at even today's high gold price, was a revenue of only \$40 million. I suspect that the value of the annual production of the company when I retired in 1995 was very close to a billion dollars a year. Now, this is new wealth. This is not taking wealth from someone else. This is wealth the nation didn't know they had, and wouldn't have known they had, unless we had discovered the bauxite, the nickel, the gold, and the copper uranium and gold at Olympic Dam. This is exciting stuff. This is discovery!

13:00:12:58

Swent: And creativity.

13:00:13:55

Woodall: A very talented financial analyst with WMC, Richard Schodde, wrote to me recently. Now, I didn't ask for the letter, but Richard heard that I was coming here to record an oral history, and he wrote to me and he said, "Hi Roy. You may be interested in what I have put together on WMC's exploration expenditure and discovery performance from 1955 to 2000," which was almost, except for the first two years, the time I was responsible for the Company's exploration programs. "The bottom line is, during the period 1955-1996, which covers the time you were running the Exploration Division, a total of 122 discoveries were made. This includes forty-six found by the operations geologists," in other words, around the mine sites, where I was just as keen to have top class scientific explorations as out on the regional programs. "This includes two super-giant discoveries, the Darling Range bauxite deposits, and the Olympic Dam copper-uranium-gold deposit, plus five giants, the Kambalda Camp, Yeelirrie, St. Ives Camp, Tampakan, and Meliadine." Now, we haven't talked about Meliadine.

13:00:15:50

Swent: No we haven't.

13:00:15:46

Woodall: It was towards the end of my time with the company. We got involved in the discovery of gold in Northern Quebec, and the astonishing thing was it was only about twenty miles from a town called Rankin Islet, where there was once a nickel mine.

13:00:17:32

Swent: One hundred and twenty-two discoveries, is really an amazing number.

13:00:17:37

Woodall: Well, let me read the final sentences. "Over the same period, a total of \$871 million in today's money terms ie in constant 2003 dollars, was spent on grassroots exploration. In light of the discoveries made, this money was money well spent."

13:00:18:20

Swent: Understatement of the year.

13:00:18:22

Woodall: So there it is from one of my old company's top financial men. I didn't ask for it, but there it is; he wrote it.

13:00:18:29

Swent: That's wonderful. A wonderful testimonial.

13:00:18:40

Woodall: I would like to make a few summary statements about the ingredients of success, and just recap a little more about the critical importance of recruitment. If you get recruitment wrong, everything is wrong. If you recruit someone whose interests are selfish, someone not really interested in keeping up to date with science and not prepared to sacrifice some family time to go out and do the hard work in the field, you will never succeed. Of equal importance is the culture of the company, and we have talked about this. I have demonstrated how it was identified by the famous management company, McKinsey and Company when they examined fourteen Australian exploration companies and came to the conclusion that success had nothing to do with the amount of money available, it was all to do with the culture within the company.

Probably the most important series of lectures I ever gave were the Joubin-James lectures. I was invited to spend three months at the University of Toronto in Canada, and during early 1983 I delivered three lectures, the titles of the series was "Success in Minerals Exploration." The first lecture, "Success in Mineral Exploration: A Matter of Confidence," was about what I have already mentioned, the importance of the unbroken link of confidence from the people with the money to the lowest-paid field assistant, and the importance of trust between the persons with the money right through to the field hands. I think we have demonstrated with some of the scary, early barren holes that we drilled at Kambalda and Olympic Dam how, unless we were trusted, we would never have been allowed to persist and make those discoveries. Trust is absolutely critical to having financial support committed over a long period of time, for it sometimes takes a long period of time to make great "inventions." And equally important in the culture is the respect that must be an unbroken line from the most lowly field assistant through to the board of directors. All this I believe we taught the authors of the book on management entitled *In Search of Excellence*.

The second lecture was on the importance of the people involved having confidence that exploration will contribute to prosperity: the financiers, the board of directors, the managing director, the geoscientists and the field assistants. It is also critical for the directors of a company to be interested in the science the geologists and geophysicists are applying. If they are not interested, how can they have confidence in the work of these people when good work, hard work fails, which is what often happens. But if they have confidence in these people and understand something of the science, they can recognize good scientists who are learning from failure, improving their techniques all the time. Then you get the commitment to persist and the opportunity to improve skills until you do succeed. It's not just the geologists and the geophysicists who have to be confident that the best strategy is to use good science. The people who are providing the money have got to believe it, too. This was the theme of the third lecture in the Joubin-James Lecture series was "Confidence in Science." Perhaps I have indirectly said enough about the importance of applying the best science. It starts with recruitment, it

involves study leave, it involves disciplined, technical reporting, it involves the gentle education of the directors of a company and all non-technical senior executives.

I have also mentioned that if I was advising a young person to enter the mineral exploration business, I would encourage them to acquire a good understanding of mathematics, physics, and chemistry, as well as geology, and also metallurgy. If there was a deficiency in my education, it was a deficiency in exposure to the cutting edge of metallurgy. If I had been up-to-date in ore processing, when my company was building a wash plant to treat clay rich ores, I would have thrown up my hands in disgust and said, “For goodness sake, get yourself an air ticket to see what the U.S. Bureau of Mines are doing, or go and see what Homestake are doing”—that’s if I had known what Homestake were doing. We could have probably found out about Homestake’s research because we were really very close.

13:00:26:30

For nearly fifty years I expounded, and tried to apply, all my ideas that we have talked about. I knew that this was the way to be successful in exploration. I have been told that the culture of WMC’s Exploration Division influenced the writing of *In Search of Excellence* (Peters and Waterman). In 1994 another book of interest was written by Collins and Porras. It was published by Century Random House, and it was called *Built to Last: Successful Habits of Visionary Companies*. Let me tell you what they said. “Visionary companies are premiere institutions, the crown jewels in the industries, widely admired by their peers and having a long track record of making a significant impact on the world around them.” I would like to think that the Exploration Division of Western Mining fits exactly that definition. We certainly created an enormous difference to the Australian economy.

Collins and Porras also wrote: “Visionary companies are bold companies.” Well, we were bold enough to go out into the middle of the desert and drill holes where there was no sign of copper for a hundred miles and find a giant copper deposit of a type not known before. We were pathfinders, believing in a philosophy that says: “Far better to dare mighty things to win glorious triumphs, even though checkered by failure, than to take rank with those poor spirits who neither enjoy much nor suffer much because they live in the gray twilight that knows no victory nor defeat.” And do you know who said that? Your president Theodore Roosevelt in 1899. And he was the visionary behind the successful completion of the Panama Canal.

Also, listen to this: “Taking care of his or her people is the most important part of every management job.” I have stressed this. The manager must be the person caring directly for the people working, not remotely via a HR department. “In no case is the personnel department expected to handle a manager’s personnel problems. He or she must accept and handle the personal responsibility to be a good manager.” I felt quite proud when I read that because for some years I devoted a third of my time to recruitment and keeping in touch with the people who work for me.

And one last quote: “Work is love made visible.” You have got to enjoy your work; you have got to respect your boss. “If you cannot work with love, but only with distaste, it is better that you should leave your work and sit at the gate of the temple and take alms from those who work with joy. For if you bake bread with indifference, you bake a

bitter bread that feeds but half of man's hunger. And if you grudge the crushing of the grapes, your grudge distills a poison in the wine."

13:00:31:15

Swent: Biblical?

13:00:31:16

Woodall: If you said to me, convince me that the strategy and philosophy you applied for fifty years has credibility, I could say, don't just believe me, here's a book, Built to Last, that talks about all the U.S. companies that have been really successful, the Wal-Marts and so on. Miraculously, I don't know quite how, I knew about it anyway. What else can I sum up and say.

13:00:31:58

Swent: Well, I think you have really answered this question already, but what has given you the most satisfaction in your career?

13:00:32:11

Woodall: Two things stand out! Firstly, to see real wealth generated. When you find an ore deposit, and in due time you see the company producing a billion dollars worth of new products every year, and you look at how that wealth is distributed, a very large part goes back to government through personal income tax, through company tax, through sales taxes, through the taxes of the service the people. I bet three quarters of new wealth generated by mineral discoveries ends up back in the hands of government to use for the benefit its citizens.

Secondly, there are now many Australian ore deposits that are beautifully documented. They may now have been mined out, but there is a very, very good record of what they were like, so that forever young, bright geoscientists, better equipped and educated than I ever was, will be able to go back to those records and say, "Oh, is that what they were like? Now we can solve the problem of their genesis and can be confident that we really understand the environment on earth when they were forming." We may never be confident that we know where those valuable metals in ore deposits originated in the cycle of the evolution of the earth, but we can make progress because we have available ore deposit data of great integrity. It's there for others to study. As I have mentioned, one of the best of all of our discoveries, the Olympic Dam copper-uranium-gold deposit, is still being documented in the hands of first-class scientists led by a graduate of this university, Kathy Ehrig. She doesn't write technical papers very much, but that's not critical. The thing is that the record is being put together. And I am quite sure that when she does understand it herself, she will write some absolutely cutting-edge, seminal technical papers.

13:00:34:52

Swent: You have mentioned hope that students in the U.S. could put to work documenting ore deposits as part of their training.

13:00:35:10

Woodall: Yes, the United States has been richly endowed with mineral deposits. That was one of the reasons why the country developed industrially so quickly, financed by the money made out of the gold mines, silver mines, copper mines, iron ore mines and coal mines and oil. Regrettably, little of the detailed descriptions of those mines, especially the

underground mines, is available to the public. This is different than in Australia where mining companies are obliged—in fact, they are forced—to hand over their technical records to the government for archiving, including samples of their drill core and so forth. In the US it's not so. I believe it is partly because companies are concerned about litigation, i.e., being sued. The nation is now suffering because the companies are reluctant to release those records, and I am sure unless those technical records are preserved in some better form, readily available to students and the like, they will be lost forever. If this happens the whole geoscientific community of the future will then not really know very much about some of your most famous ore bodies. That would be a tragedy! There would then be no reliable data base from which to improve on the present day understanding of how those ore bodies formed, why they formed and where they formed.

Now one way to solve this is for the companies to be granted freedom from any litigation if they release their records for proper storage and study. I am principally talking about underground mines. The survey information on the underground drifts and cross-cuts should be digitized, so we would know exactly, in three dimensions, where the mine openings were, and the information stored in 3-D software packages. To that survey information, the geological information can be added: assay data from the regular sampling of these workings, data from geological mapping, the faults, the lodes, and the nature of the host rocks. This is a job for probably a thousand students. I would like to see a thousand students each spend at least one semester on this task, using records from, say, the Butte Mines or the Idarado mines in the San Juan Mountains, or the Comstock Mine in Nevada, or any of your other famous underground mines.

Their job would be to take this data, data available in plan form, digitize it, and put it into safe keeping in a three dimensional data base. Over a period of time an incredibly valuable picture of these famous mines, with all the vital geological information, would be collected, interpreted and preserved. I wish something like that could be started. So Lee, what else?

13:00:40:35

Swent: You haven't spoken about your family. I had one question too. Why did you chose to stay in Adelaide? I think most of the Western Mining people lived in Melbourne.

13:00:40:57

Woodall: I met my lovely wife in Kalgoorlie where she had lived since she was a wee child, and we married there. She came to live with me when I came to Berkeley, and thanks to the generosity of some kind people in San Francisco, especially from the English Speaking Union, I was able to survive on their scholarship and a studentship in the Hearst Mining Department. The ladies connected with the English Speaking Union were incredibly generous. When our first child was born in the Herrick Memorial Hospital here in Berkeley, Mrs. de Brettville arrived in a chauffeur-driven limousine at 236 Hillside Drive, and walked up the driveway to the garage above which was our one-room home and presented Barbara with a huge collection of baby clothes.

13:00:42:23

Swent: A layette.

13:00:42:24

Woodall: A layette, which she bought in the famous San Francisco store of: I Magnins.

13:00:42:45

Woodall: I don't remember all the details, Barbara will remember, but the ladies of the English Speaking Union, especially Mrs. de Brettville and Mrs. Bayliss, continued to look after us and invite us to their functions in San Francisco.

In 1957 we left Berkeley and went back to Kalgoorlie because that's where I was required to work. We lived there until 1976, and there, our other eight children were born, the first two having been born here in the US.

In the 1950s and sixties, the Australian government made it very clear that a country of three million square miles with only eleven million people needed more people. So you were a kind of hero if you were a mother. That's not the only reason we had ten children, nor has it anything to do with religious beliefs. We just loved children, and as I progressed with my career, we realized that we could afford to have more. And Barbara was always most beautiful when she was expecting. She is one of those women for whom pregnancy just seemed to make her blossom. She was always in the best of health and the children were always healthy. We rarely had a sick child. Also, we believed very firmly that whether you have no children, two children, or a big family should be dependent not on some philosophy but on key questions. "Can you afford to feed them? Can you afford to shelter them? Can you afford to clothe them? Can you afford to educate them? Can you afford and are you prepared to provide the time to love them?" And, as long as you can tick all five boxes, I believe you are entitled to have children. And the world's population problems would be solved if those rules all applied universally.

So we had ten children, ticking all boxes and raising a lovely family. Kalgoorlie was a small mining town, which was not very prosperous, although it is now, due to the gold boom.

Before I was even appointed to the board of WMC, I was frequently invited to Melbourne for board meetings to brief the directors on exploration. This reflected the culture of the company. The directors, i.e., the people providing the money, were interested in scientific exploration, they wanted me to come across to tell them what we were doing. When I was made a director I had to go to Melbourne every month. Now, to get to Melbourne, where the board met on Mondays, I had to leave Kalgoorlie on a Friday night, because that was the last flight out for the weekend. I had to fly to Perth and then fly to Melbourne. This was the catalyst for us realizing that, with education problems in Kalgoorlie, where the high school at the time was not very good, it was time to leave Kalgoorlie. We were sending our older children to boarding school in Perth. So we decided that we should move to a capital city: the preferred option being Melbourne, where the company had its Head Office. But I always have had an aversion for exploration being run out of Head Office. Also, I couldn't afford a big house in Melbourne. So we moved to Adelaide, which is just a one-hour flight from Melbourne, and we were able to buy a big old house in the Adelaide hills, which, over fourteen years, with the help of my boys, we restored. It's an old house that was built in the 1860s. It was a summer home for what you would call ranchers and we would call pastoralists. A family called the Kennedys had a million acres in the semi-arid country

of western New South Wales. So the family would not have to suffer the extreme heat of the summer, once the Kennedys became prosperous from their sheep, they bought land in the Adelaide Hills and built the home for the family as a summer home. So, that is how we ended up domiciled in Adelaide.

As for our house in Ouray, in the San Juan Mountains of Colorado, that's a very different story. I became familiar with the town when we were trying to reopen the Camp Bird gold mine, an investment that I have mentioned already and had such a sad ending. Buying a house there came about this way. When I retired, all my geologists from Canada, the United States, Chile and Brazil assembled in Tucson and gave Barbara and me a big party. We made it "official" by having some of the geologists talk about their work and so it was called a technical conference. That made the accountants feel happy about us spending money congregating in Tucson. That was in October 1995. Having come all this way, it seemed a pity not to do something else so, as my birthday was on November the third, and it was now the end of October, Barbara said, "What would you like to do for your birthday?" I said, "I would like to go back to that beautiful town called Ouray." So we went back to Ouray and we stayed at the St. Elmo Hotel. It was the only hotel in town at the time. It still had rooms decorated like they were in the early 1900s, and we just walked around the town and environs enjoying the glorious scenery. It was autumn.

Because we had already restored an old house, we noticed that there were several beautiful old homes of the same vintage in the town: a little younger than ours, perhaps. Most of the town of Ouray was established in about 1880 or 1890. Now there was a big old house for sale, and we thought, "Well, wouldn't it be fun if we had a look at this big old house." So we went to the real estate man and he said, "Oh yes, I can show it to you." He took us up to this house and we looked at it, and it really was in bad condition. I said to John, the real estate man, "John, I have restored one old house, but this is in even worse condition. I am not interested." And he said, "Well, look Roy. If you are interested in owning a beautiful old house, in much better condition than this one, there is one just two blocks away, and it's for sale. And you don't even have to furnish it! And it has been well maintained!" So we walked down two blocks. "Look," he said, "I am not the agent, but I will get the key and help the other real estate man in town." So he got the key and we went to look at 505 Fourth Street, which turns out to be the home built for the first resident doctor in town when the Camp Bird mine was operating in the 1800s: a man called Dr. Ashley. When we went inside, there was a man in there, whom I assumed was the owner. I was introduced to Keith, and I said, "Oh Keith, you have a lovely home." "Oh," he says, "It's not my home. I just come here every week and water all the house plants because the lady who owns the house is away."

Well, to make a long story short, we thought we could afford to buy it provided John, the real estate man, could rent it part of the year. John said, "I can rent it for you in the summer for three or four months, and that will help cover the costs of keeping it heated, which you will need to do." We talked it over, and thought: "If we bought this house, for the next few years we could bring all our grandchildren here and they could experience a white Christmas, something they could never do in Australia." And they could go over to Telluride, which then was hardly known in the ski world. Ski lessons for the children and grand children were quite cheap then. And so, we took some of my pension money and bought the house. For the next six years, we brought one or two of our families to Ouray each year. Their Christmas and birthday presents were the airline tickets. It was

an incredibly valuable family bonding experience. Often the child or grandchild would know by February, that next Christmas they would be going to the US, to grandma and grandpa's house in the mountains. Although we were already a close-knit family, this opportunity to live together for a month in beautiful surroundings was just an invaluable family investment. We still have the house but not too sure for how much longer, but it is wonderful to visit. That's the story about how we ended up owning a house in Ouray.

13:00:54:48

Swent: I think those are all the questions that I had. Did you have more you wanted to say?

13:00:55:02

Woodall: I just wanted to mention one of the last lectures I gave. I was awarded the Ian Wark Medal by the Australian Academy of Science and I had to give a lecture.

13:00:55:38

Swent: The price of success.

13:00:55:40

Woodall: I called the lecture "Mineral Exploration. Industrial Research at the Boundary of Science." And I would just like to read the last words in that lecture, which sum up, better than I can in my own words, the reason why I did what I did in my career, and what I hope are the benefits that will flow from it. And they are words from Longfellow's famous poem "Hiawatha."

13:00:56:19

Swent: One of our beloved American poets.

13:00:56:26

Woodall: "You shall hear how Hiawatha prayed and fasted in the forest." Plenty of remote land in Australia where we tramped around the bush. "Not for greater skill in hunting, not for greater craft in fishing, not for triumphs in the battle and renowned among the warriors, but for profit of the people, for advantage of the nations."

13:00:57:01

Swent: That's very good.

13:00:57:05

Woodall: That's it. I thought that was a good way to end this interview.

13:00:57:18

Swent: Well, I would like to ask you how you feel about the oral history process? You have certainly come to it with an incredibly organized preparation. You have put a lot of work into your preparation.

13:00:57:32

Woodall: Well, Lee, when you asked me to do it, you convinced me very quickly that this was a very well organized program by a first-class university's library, and it was to be done very seriously. You said some very famous people had recorded their oral histories, and you convinced me that by a person recording their career's highlights and the low points, their philosophy, the strategy of their career, what they learned and what they contributed, this could help young people who might be considering entering this same

profession or, if already in that profession, deciding to stick it out. So there was never any doubt that it was a worthwhile thing to do.

When, in January 2003, I found out that my old company had given you \$15,000 to help finance this program, (\$20,000 Australian dollars), I committed myself to either do it properly or not at all. I have read some oral histories produced very unprofessionally, by people who have not devoted enough time by way of preparation and thus relied mainly on memory. It would have been better if those interviews had never been recorded, because they were based mainly on memory, and in some cases a very selective memory. They did not record the truth. I didn't want that to happen! The last thing I wanted to do for my old university was to produce an oral history that suffered from lack of integrity.

So for about six months I was able to access from the Western Mining archives many, old files and many old reports. And I guess if you stacked them one on top of another, you would have a pile about three meters high, ten feet high. Over a period of months I went through those files and documents for two reasons; to refresh my memory so that I would record all the events and all the circumstances and not forget important people or interrelationships. Because I was doing this in some cases six months before I knew I would be interviewed, I copied key documents, key letters and key notes that I had made so I would be able, six months later, to be precise with events, dates and circumstances. I didn't want to be in an awkward position and have to say: "Well, I think this is what happened, and it was sometime in the late 1950s, not too sure when." I wanted my account to be as accurate as it could possibly be, based on the written record wherever possible, and not on memory. Mind you, there is nothing wrong with emotional aspects and feelings being incorporated in such an interview. Well, I condensed that ten foot high pile of documents into something that was perhaps two feet high, and I put aside a small portion of those documents to bring with me, those which I thought were absolutely critical, records I knew I must not forget to mention. When you get into your seventies, your memory is not as sharp as it was when you were a young graduate student. So, I brought that select group of documents with me.

01:02:31

Swent: You had—how many? Two three-ring binders, or were there more? One was blue and one was white.

01:02:36

Woodall: Yes, each day there was a selection of documents for the day's work.

01:02:55

Swent: And your spreadsheet: very impressive!

01:03:05

Woodall: So, what do I think of the program? The program is excellent, it should be encouraged. What do I think of the fact that I have done it? I don't know how valuable it is going to be, Lee. All I can say is that it is the truth, and some of the truth is happy to remember and some is not happy to remember, but I have told it to you as it was. It's there in its happiness as well as its sadness, and at times with a touch of bitterness when I was not supported as I believe I should have been. I can also say that I couldn't have done any better for you. I put my heart and soul into this program, as I did in exploration, and I hope, that with a bit of editing, the result will make it a transcript you are satisfied with.

- 01:04:03
Swent: I don't think it will need much sharpening. I hadn't thought of this before, but this in a way parallels your interest in documenting ore deposits, documenting the person who does that work is perhaps just as important.
- 01:04:20
Woodall: Well, Lee. I hope it is going to be valuable to young people; that it will motivate them, that it will help them stick out the tough times, help them to stand up for what they know is right, to stand up for what is essential if the company wants to be successful. Maybe one or two may quote part of this oral history and say, "Look, if you want to be successful like Western Mining, you have to do this." Maybe the result of this interview will be useful to somebody some day.
- 01:05:02
Swent: Well, I am sure it will be.
- 01:05:06
Woodall: For me, personally, and this is something I have only realized in the last few days, at the end of fourteen or fifteen hours of just talking, a great burden has lifted off my shoulders. One has a memory of things that happened, but I think the preparation and this interview has sharpened my memory, and now I have documented it. I now have a small selection of papers that I didn't have before, which summarize my career, and you have got all these tapes as a record. And I no longer have to say to myself sometimes if I wake up at night, "I wonder whether anybody will be interested in what was happening in the 1980s when we were struggling so hard? Should I ever tell anybody? I wonder what will happen to all those files? The company will probably change hands and they will look at that room full of old files and they will take them out to the refuse depot for landfill, which is what's happening to some Australian mining company records." Are we are doing the right thing by allowing that to happen. Of course not! But I have done my best to record a history from a selection of key documents and letters and you have the result now, all recorded.
- 01:06:49
Swent: We have captured some very very valuable material here.
- 01:06:54
Woodall: Well, I hope it is valuable. I hope it ends up with people finding orebodies that they never thought they could find. That would be the real justification for this effort.
- 01:07:02
Swent: That would be good. Well, I thank you for consenting to do this. It wasn't easy to get your consent. It took a while.
- 01:07:16
Woodall: But Lee, let me thank you for being so patient, persistent and so gentle during these interviews.
- 01:07:28
Swent: Well, I was hunting for a kind of "orebody," also. All right, that's a good place to stop.

[End of Interview]

Eleanor Herz Swent

Born in Lead, South Dakota, where her father became chief metallurgist for the Homestake Mining Company. Her mother was a high school geology teacher before marriage.

Attended schools in Lead, South Dakota, Dana Hall School, and Wellesley College, Massachusetts. Phi Beta Kappa. M.A. in English, University of Denver. Assistant to the President, Elmira College, New York. Married to Langan Waterman Swent, mining engineer.

Since marriage has lived in Tayoltita, Durango, Mexico; Lead, South Dakota; Grants, New Mexico; Piedmont, California.

Teacher of English as a Second Language to adults in the Oakland, California public schools. Author of an independent oral history project, Newcomers to the East Bay, interviews with Asian refugees and immigrants. Oral historian for the Oakland Neighborhood History Project.

Interviewer, Regional Oral History Office since 1985, specializing in mining history. In 1998, awarded an honorary Doctor of Letters degree by South Dakota School of Mines and Technology.