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Western Mining in the Twentieth Century Oral History Series

J. David Lowell

USING APPLIED GEOLOGY TO DISCOVER LARGE COPPER AND GOLD MINES IN ARIZONA, CHILE, AND PERU

With an Introduction by
John M. Guilbert

Interviews conducted by
Eleanor Swent
in 1998

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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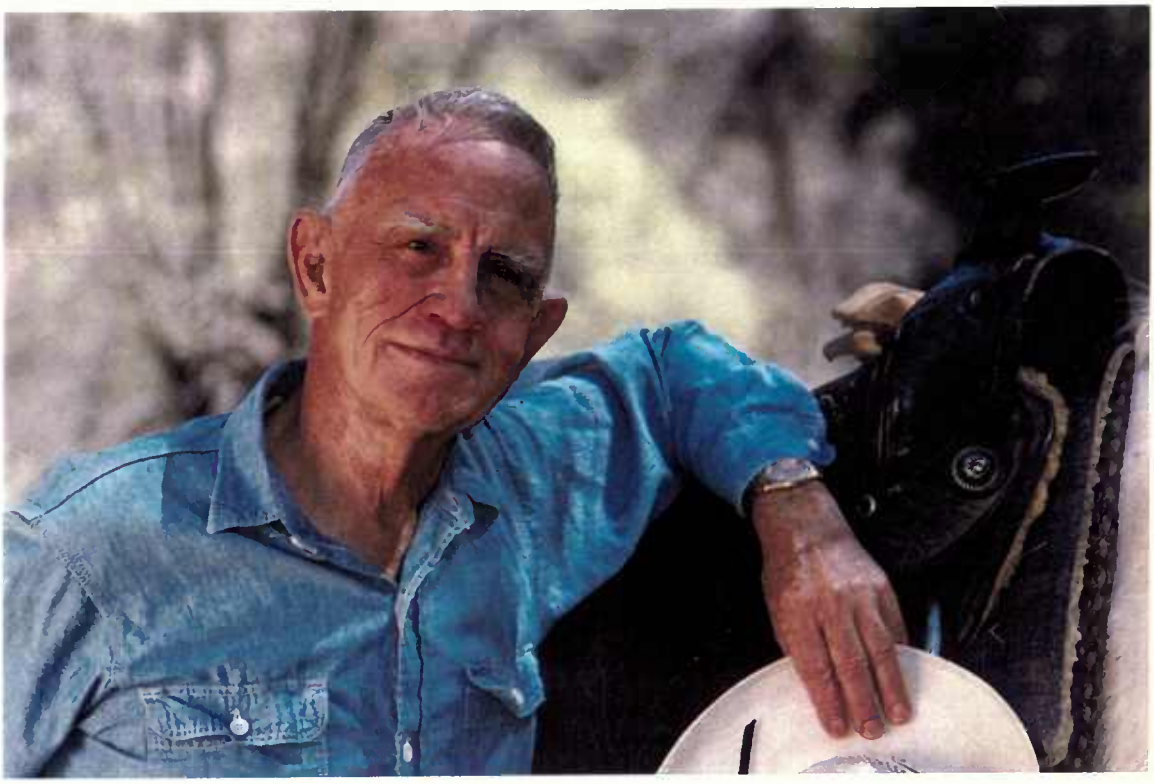

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Lowell, Currier pioneer families in Arizona; working in father's mines during Depression years; Arizona School of Mines, 1945-1949; mine engineer for ASARCO, 1949-1951; geologist, AEC, 1951-1954; a year at Stanford University; exploration geologist, Ranwick, Southwest Ventures, Utah Construction, 1955-1959; independent consultant from 1960, associated with major mine discoveries: Kalamazoo extension, Vekol Hills, Casa Grande West, AZ; Escondida, Zaldivar, San Cristobal, Leonor, Chile; Los Pinos, Los Calatos, Paron, La Pierina, Peru; discusses developing theory of concentric zoning of porphyry copper deposits, alliances with international mining companies, problems in business in Latin America, negotiations with Barrick for sale of La Pierina.

Introduction by John Guilbert, Professor Emeritus of Economic Geology, Department of Geosciences, University of Arizona, Tucson.

Interviewed in 1998 by Eleanor Swent for the Western Mining in the Twentieth Century Oral History Series. The Regional Oral History Office, The Bancroft Library, University of California, Berkeley.

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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 tenth year the series numbers thirty-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 forty-three interviews.

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.

The Regional Oral History Office is under the direction of Willa Baum, division head, and under the administrative direction of The Bancroft Library.

Interviews were conducted by Malca Chall and Eleanor Swent.

Willa K. Baum, Division Head
Regional Oral History Office

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

January 1998
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University of California, Berkeley

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Interviews Completed, November 1999

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

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

Norman Cleaveland, *Dredge Mining for Gold, Malaysian Tin, Diamonds, 1921-1966; Exposing the 1883 Murder of William Raymond Morley*, 1995

James T. Curry, Sr., *Metallurgist for Empire Star Mine and Newmont Exploration, 1932-1955; Plant Manager for Calaveras Cement Company, 1956-1975*, 1990

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

James Mack Gerstley, *Executive, U.S. Borax & Chemical Corporation; Trustee, Pomona College; Civic Leader, San Francisco Asian Art Museum*, 1991

Robert M. Haldeman, *Managing Copper Mines in Chile: Braden, CODELCO, Minerec, Pudahuel; Developing Controlled Bacterial Leaching of Copper from Sulfide Ores; 1941-1993*, 1995

John F. Havard, *Mining Engineer and Executive, 1935-1981*, 1992

Wayne Hazen, *Plutonium Technology Applied to Mineral Processing; Solvent Extraction; Building Hazen Research; 1940-1993*, 1995

George Heikes, *Mining Geologist on Four Continents, 1924-1974*, 1992

Helen R. Henshaw, *Recollections of Life with Paul Henshaw: Latin America, Homestake Mining Company*, 1988

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

James Jensen, *Chemical and Metallurgical Process Engineer: Making Deuterium, Extracting Salines and Base and Heavy Metals, 1938-1990s*, 1993

Arthur I. Johnson, *Mining and Metallurgical Engineer in the Black Hills: Pegmatites and Rare Minerals, 1922 to the 1990s*, 1990

G. Frank Joklik, *Exploration Geologist, Developer of Mt. Newman, President and CEO of Kennecott, 1949-1996; Chairman, Salt Lake 2002 Olympic Winter Games Committee*, 1997

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, 1978-1995, 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, 1978-1995, 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, 1978-1995, 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, 1978-1995, 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, Dolora, "Environmental Engineer, McLaughlin Mine, 1988-1995"

The Knoxville Mining District, The McLaughlin Gold Mine, Northern California, 1978-1997, Volume V, 1998
Kritikos, William, "Operator, Oat Hill Mine"
Landman, John, "Rancher, Morgan Valley"
Lyons, Roberta, "Journalist and Environmentalist"
Madsen, Roger, "Homestake Mechanical Engineer"
Magoon, Beverly, "Merchant and Craft Instructor, Lower Lake"
McGinnis, Edward, "Worker at the Reed Mine"

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

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

Plato Malozemoff, *A Life in Mining: Siberia to Chairman of Newmont Mining Corporation, 1909-1985*, 1990

James and Malcolm McPherson, *Brothers in Mining*, 1992

Frank Woods McQuiston, Jr., *Metallurgist for Newmont Mining Corporation and U.S. Atomic Energy Commission, 1934-1982*, 1989

Gordon B. Oakeshott, *The California Division of Mines and Geology, 1948-1974*, 1988

James H. Orr, *An Entrepreneur in Mining in North and South America, 1930s to 1990s*, 1995

Vincent D. Perry, *A Half Century as Mining and Exploration Geologist with the Anaconda Company*, 1991

Patrick Purtell, *Maintenance and Management at the McLaughlin Mine, 1985 to 1997*, 1999

Carl Randolph, *Research Manager to President, U.S. Borax & Chemical Corporation, 1957-1986*, 1992

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

Eugene David Smith, *Working on the Twenty-Mule Team: Laborer to Vice President, U.S. Borax & Chemical Corporation, 1941-1989*, 1993

Simon Strauss, *Market Analyst for Non-ferrous Metals and Non-metallic Minerals, Journalist, Mining Corporation Executive, 1927-1994*, 1995

Langan W. Swent, *Working for Safety and Health in Underground Mines: San Luis and Homestake Mining Companies, 1946-1988*, 1995

James V. Thompson, *Mining and Metallurgical Engineer: the Philippine Islands; Dorr, Humphreys, Kaiser Engineers Companies; 1940-1990s*, 1992

William Wilder, *Owner of One Shot Mining Company: Manhattan Mercury Mine, 1965-1981*, 1996

Interviews In Process

Frank Aplan, metallurgist
Harry M. Conger, Kaiser, Homestake
Hugh Ingle, Jr., "Independent Small Mines Operator; The Corona Mine"
Raymond Krauss, "Environmental Manager, McLaughlin Mine"
John Livermore, geologist
Robert McKenzie, "Photographer and Local Historian, Napa County"
Harold Moskowite, "County Supervisor, Napa County"
Marion Onstad, "Morgan Valley Rancher, Homestake Secretary"
Ronald Parker, "General Manager, McLaughlin Mine, 1988-1994"
Robert Shoemaker, metallurgist
Richard Stoehr, "Homestake Vice President and Director"
Joseph Strapko, "Homestake Field Geologist"
Jack Thompson, "General Manager, McLaughlin Mine, 1981-1988"
Twyla Thompson, "County Supervisor, Yolo County"
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Mrs. Frank W. McQuiston, Jr., in memory of Frank W. McQuiston, Jr.
George B. Munroe
Gordon B. Oakeshott
Thomas and Margaret O'Neil
Vincent D. Perry
Plato Malozemoff Foundation
Public Resource Foundation
Carl L. Randolph
Joseph Rosenblatt
Berne Schepman
Mr. and Mrs. Richard J. Stoehr
Langan and Eleanor Swent
Milton Ward
Mr. and Mrs. Alexander M. Wilson

Individuals

Claude J. Artero
Rebecca Bender
Bruce A. Bolt
Clemence DeGraw Jandrey Boyd
James Brown Boyd, Harry Bruce Boyd, Douglas Cane Boyd, and Hudson Boyd in memory of James Boyd
Philip and Katherine Bradley
Albert T. Chandler
David J. Christie
William B. Clark
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
Guy H. Harris
Bonnie, Russell, and Steve Harford
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
Lewis L. Huelsdonk
Ruth B. Hume
Howard Janin
Jack M. Jones
Alfred Juhl
Evan Just
Sheila Kelley
James C. Kimble
Kenneth Kinghorn
Noel W. Kirshenbaum
Nancy H. Landwehr
Carl F. Love
Plato Malozemoff
Sylvia C. McLaughlin
Sylvia C. McLaughlin, in memory of Jay Kimpston Swent
Frances B. Messinger
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Patrick O'Neill
K. Osseo-Asare
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Marily and Thomas Johnson
Remington and Jean Low
Sylvia C. McLaughlin
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INTRODUCTION by John Guilbert

It could hardly be more fitting that J. David Lowell be selected for inclusion in this series of oral histories to annotate and celebrate Western Mining in the Twentieth Century. Not only has he personally discovered more copper than any man in history; not only has he discovered multi-billion-dollar gold and copper districts that have changed the economies of countries; not only has he participated in "rewriting the book" on several ore deposit geologic types; but also he has done it "his way", innovatively, purposefully, and essentially single-handedly. He has been the architect of his own life and success, and has appropriately become a major figure in the world of minerals, mining, and economic geology.

My first contact with Dave Lowell came in September, 1965. I had arrived from Butte, Montana, to Tucson in August of that year to assume a coveted position as Assistant Professor of Economic Geology in the Geology Department at the University of Arizona. My graduate schooling and my post with the Anaconda Company at Butte had inflamed my interest in the then-ill-defined deposit type called "porphyry coppers", and I was immediately upon arrival in Tucson asked to speak to the Arizona Geological Society on the controversial concept that the Butte district itself was a "porphyry copper"--indeed the porphyry-identity-crisis controversy also swirled in Arizona, as it should have. In my talk, I described research progress at the Butte Geologic Research Laboratory that not only had devolved new symmetries and processes for the ore deposits of the Butte camp, but also projected important ideas concerning porphyry systems overall. After my talk--to a daunting audience of 300 or so of Arizona's most capable economic geologists--a slight, somewhat diffident man approached the podium. He said, "I enjoyed your talk, and I'm drilling a prospect over on the other side of the Santa Catalina Mountains that might have some similarities to what you described at Butte. Would you care to look at a few thin sections from it?" I was eager to get inserted into the Tucson ore deposits scene, so I gladly accepted his invitation. The next day the sections arrived, and after a cursory glance I reported excitedly by phone that I could say nothing quantitative about his prospect but that the rocks in these sections were qualitatively so similar to those at Butte and to what I knew of other "porphyry coppers" in Chile, British Columbia, and elsewhere that it looked to me as though he had hit one "spot on". The man, of course, was J. David Lowell and the prospect was Kalamazoo, the just-discovered "other half" of San Manuel and Dave's first major geologic discovery triumph.

There began a long and productive friendship. I quickly discovered in Dave an uncommon mix of the scientist and the practitioner--it is

tempting to use the term "corporate explorationist" but he was too independent for the application of that label. He consulted for and with companies in a corporate mode but always as his own man, the engineer of his own train. He believed then, as he does now, that the best vehicle of exploration is the free-lancer, the small outfit whose leader can think freely, act swiftly, back away and move on when necessary, and pursue inklings of success surely and intensely. But he was far more than a prospector because he actively and imaginatively consulted others, asked questions, marshaled facts, and created knowledge as a scientist does when he needed to solve problems. For example, as we chewed things over in his office early in our friendship, we found that Butte and Kalamazoo shared geometries, chemistries, and zonal characteristics that appeared to define a reasonable "porphyry copper deposit model" for which other geologists and companies were groping, so we decided to try to formulate that model by tabulating relevant data from other ore bodies considered to be "porphyries". His experience with scores of deposits and prospects and the analytical thought processes that led him to design the Kalamazoo Project in the early 1960s, and my more academic-process-oriented approach and corporate experience, fulminated an exciting time while we fitted pieces of the "porphyry puzzle" together in the late sixties. No one had heard of Lowell (or Guilbert) when the first Geological Society of America Penrose Conference was being formatted in Tucson in 1968--in fact, we had to cajole our way onto the program. But the tabulation of porphyry characteristics that we distributed there and our description of the "typical" porphyry copper deposit were among the skyrockets of the symposium. We learned much later that in subsequent years, after we published our synthesis in 1970, four famous geologists were spotted at different times in various parts of South America: namely, David Lowell, John Guilbert, Lowell Guilbert, and Guilbert Lowell.

Lowell's "porphyry calling" was as surely toward field endeavor leading to discovery as mine was into my university role of teaching and research. His steps were sure. He could at many junctures have linked up with companies in various capacities (and did so at least once), but it is my perception that the closer he came to that involvement the less happy he was. He had many strict personal, ethical, and tactical policies and requirements of his colleagues, and many of the people with whom he worked from time to time found them chafing. His was the path of the individual, the individualist, the visionary who was always trying to figure things out. That we collaborated many times during the next decades--and still do--is consistent with his continued reaching for new ideas and strategies. He was the practitioner who had no patience with potential office politics, the one who was focused almost totally on trying to read geologic field alteration-rock-mineral detail into usable text for finding ore. It is worth noting here that most field geologists spend their early years in the field, generally away from family; but as the years go by they get "promoted" into offices and greater corporate responsibility and gradually grow away from contact

with field work and outcrops. David Lowell perennially spent many months away from home, but managed either to take his family with him (as to an apartment in Santiago) or to get home frequently enough. Whatever it took, he has been able to live up to his own boot-leather-and-rock-hammer credo that "you only make ore-deposit discoveries in the field" even into his post-normal-retirement years. His modus operandi was to take his ideas on exploration strategies--he was one of the great interpolationists--to companies, to consortia, and to individuals and to assemble an exploration team to pursue them. Throughout his career, he has shown himself to be a remarkable manager of ideas, men, and materiel, a paragon of discipline, self-discipline and perseverance, and a man of great vision. The amazing degree of his success is obvious from his discoveries list and the interview that follows.

As you absorb his success story, you will see unfold an almost Horatio Alger-like story of growth from inauspicious but salutary beginnings through a series of formative periods of professional development, good education well received, applied learning on several job sites in the southwestern U.S. and Mexico, formulation of exploration strategies, and the launching of his own enterprises and exploration vehicles. What you may not see is the enormity of his professional success as the discoverer of at least eight new porphyry deposits, two of which vie for the largest-in-the-world title, one of which (La Escondida) is a mainstay of Chile's (and BHP's) copper profile. And he has controlled at various times at least two score of important copper prospects, some of which (like Santa Cruz and Los Calatos) may yet prove commercial. His breadth is proven by his also having discovered two major gold mines, one of them (Pierina) having produced a stock-market surge that made him and Arequipa Resources the darlings of mining investors and created hundreds of millions of dollars of wealth. Pierina also resulted in one of the lowest-cost major gold mines in the world for its ultimate owner. His scientific drive is manifest in his having doggedly pursued a leached capping texture problem at what would be known as La Escondida; his correct discernment of what would be called hypersaline "super-leaching" textures fueled his conviction to continue the project to its amazing fruition. That drive is also attested by the fact that although he dislikes writing, avoids public appearances, and dreads giving talks, he owns a long and distinguished list of technical-scientific papers, is a sought-after instructor-lecturer, and has spoken to large and enthusiastic audiences at symposia and conferences for thirty years.

You may not see in his interview the enormous respect that his long-time friends have for him, and the fact that his "worldly success" has affected his personal friendships not at all. His friendliness and generosity of spirit are widely recognized. His eye still twinkles merrily, he seldom fails to stay in touch with old chums, and he is in strong demand as a speaker, writer, and short-course instructor. And through all his success, he has remained his own man. I relish the

story that he was asked a few years ago to give an after-dinner talk to a gathering in Tucson celebrating the retirement of the chief geologist of a major multi-national company. Regional chief geologists, district geologists, office managers, and scores of field staff had been assembled. Dave's topic was "The Design of a Successful Exploration Team". I was never told so, but I'm sure that the assembled hierarchy expected their own vast, far-flung, and highly structured group to get a pat on the back...but Dave proceeded to point out that the small lone-wolf free-lance exploration group had been demonstrably the most successful exploration mode in this century!

As Lowell heads into his "retirement years", he is spending more time at his beloved Atascosa Ranch near Tucson with Edith, seeing more of his sons, his daughter, and a growing list of grandkids, and pursuing old hobbies. For most men, gazing at the trophy wall (his Jackling award, his medals, honorary degrees, and plaques) might suffice. For most men, financial comfort might be a reason to relax. For most men, having discovered Kalamazoo, Santa Cruz, La Escondida, and Pierina (among others) would be enough. But Dave's head is slightly turned, his eyes upward...his energies and enthusiasms will not subside...and he still travels to Mexico, Peru, and Chile...still plotting, still contemplating, still eager, still reaching out to find the next orebody...

John M. Guilbert
Professor Emeritus of Economic Geology
Department of Geosciences
University of Arizona, Tucson

Tucson, Arizona
July 1999

INTERVIEW HISTORY--J. David Lowell

David Lowell, one of the premier mine-finders of his time, is an important addition to the oral history series on Western Mining in the Twentieth Century. His name was proposed early on by several advisors, and arrangements for the interviews were facilitated by fellow geologist Dooley P. Wheeler, Jr., a friend of the oral history project, after a visit to our offices in April 1998. The letter of invitation to participate in the project was sent to David Lowell in May 1998 and he promptly accepted.

In June of 1998, the Mining History Association meeting in Bisbee, Arizona, provided the opportunity for me to meet David Lowell at the Tucson airport. We talked for some time there, getting acquainted and planning for the interviews. Because some world-famous geologists are also long-legged [e.b. John Gustafson, Ira Joralemon, John Livermore], I had visualized him as very tall, but Lowell, like legendary mining figures Plato Malozemoff, Donald McLaughlin, and Vincent Perry, is soft-voiced and of average height. He was dressed then and subsequently in traditional Arizona rancher attire: blue plaid short-sleeved shirt, twill trousers, large silver belt buckle.

Within a few days, a packet arrived in the mail containing a complete career outline, a list of publications, and a list of the people who played significant roles in his life and work. Throughout the oral history process, he acted with similar dispatch, corresponding variously by telephone, letter, and email, and aiding every step to a remarkable degree.

In September 1998, David Lowell and his wife Edith welcomed me to their home, the Atascosa Ranch, at Rio Rico, south of Tucson. They arranged for me to stay at the nearby Tubac Golf Club and lent me a utility vehicle to drive back and forth to the ranch. On September 15, 16, and 17 we tape-recorded nearly fifteen hours of recollections of a life which began seventy years before, only a few miles from where we sat, and along the way had taken him to nearly every part of the world.

Despite the "fast-track" schedule, the interviews were relaxed and informal, in the most pleasant of settings. At Atascosa, the Lowells have made a few modern additions to a very old stone house at the head of Peck Canyon, a valley where bright green "seep willows" line the riverbed. The house is shaded by a pomegranate tree and enormous hackberry trees; tire swings, one fashioned like a pony, hang from the branches. In the kitchen, a large dog cushion takes up much of the floor space. In the dining room is a large antique corner cupboard handed down in Edith's family. There is much evidence of family warmth

and solidity here; the only overt sign of wealth and personal indulgence is in the splendid master bath.

Edith Lowell and secretary/office manager Marcia Racine provide support for the many enterprises conducted from these premises in the office building adjacent to the house. Up-to-date equipment connects to far-flung colleagues and telephone conversations are conducted in Spanish as well as English. Well-worn bridles and chaps hang by the bathroom door. Tall windows give beautiful views of the canyon and the tile floors are softened by tribal oriental rugs. In the spacious, high-ceilinged main office room, there are hundreds of books on shelves. Indian baskets, mine lamps, framed citations, a mountain lion pelt, carefully labeled mineral specimens, and a gold Inca replica memento are among the decorations. The desk is at one side of the room; we sat at a large table. Rolled maps which must usually occupy the table are now in boxes on the floor. We hear dogs barking, horses whinnying; once or twice birds twitter so loudly they nearly drown out our voices.

Although he belongs to one of America's most distinguished families, David Lowell was not born to luxury. His career began with hard work as a little boy during the Depression, hand-sorting ore for his father at a mine not far from the ranch. The death of his older brother during World War II was a harsh formative event. He worked hard through all of his school and college years, encouraged by Dean Thomas Chapman at the University of Arizona and by Edith Walmisley, whom he married during his junior year, when he was twenty years old. He has also found time for sports and hobbies, some rather daring, such as piloting his own plane and skin diving.

In his oral history, he recalls some major decisions: not to continue graduate school at Stanford, not to go into teaching, not to continue with the USGS [United States Geological Survey], and finally, not to stay with the security of working for Utah Construction and Mining Company, but to risk going out on his own to hunt for mines. He tells how he developed his formula for contract exploration to locate mines in partnership with major corporations, to the benefit of both. It has been an enormously successful enterprise, and even though we know the outcome, it is exciting to hear him tell how he risked his financial security and often times his life as well, over-flying the Andes in the search for new mines.

Finding the Kalamazoo extension of the San Manuel ore body in Arizona was his first great success, and illustrates his contention that acquiring the land and negotiating with people is just as important as knowing the geology. The Vekol Hills project never came to fruition because of decisions that were made apart from the geology. The Casa Grande West Mine did not fulfill its geologic potential because of other considerations. La Escondida, one of the world's greatest copper mines, in Chile, and the fabulous Pierina gold mine, in Peru, have led him to

fame and riches. In the latter case, the board-room drama caused by a subsequent "hostile takeover" offer seems to have been as exciting as the original discovery in the high Andes.

During the course of completing the oral history, honors have continued to accrue for Lowell: membership in the National Academy of Engineering; first Robert M. Dreyer Award of the SME [Society for Mining, Metallurgy, and Exploration]; Robert E. McConnell Award of the AIME [American Institute of Mining, Metallurgical, and Petroleum Engineers]; International Exchange Lecturer for the Society of Economic Geologists in the year 2000.

The tapes of the interview were transcribed in the Regional Oral History Office, lightly edited, and sent to David Lowell for review in November 1998. He made several minor clarifications of diction and spelling, and a number of additions, which are indicated in the text. He returned the transcript promptly, early in January 1999. He also sent an assortment of good-quality photographs, meticulously dated and labeled, from which we chose those included in the volumes. The manuscript was corrected, amended, and indexed at our office. The tapes are deposited in The Bancroft Library and are available for study.

The Regional Oral History Office was established in 1954 to record the lives of persons who have contributed significantly to the history of California and the West. The office is a division of The Bancroft Library and is under the direction of Willa K. Baum.

Eleanor Swent
Project Director, Research Interviewer/Editor

September 1999
Regional Oral History Office
The Bancroft Library
University of California, Berkeley

Regional Oral History Office
Room 486 The Bancroft Library

University of California
Berkeley, California 94720

BIOGRAPHICAL INFORMATION

(Please write clearly. Use black ink.)

Your full name James David Lowell

Date of birth Feb 28, 1928 Birthplace Nogales, Arizona

Father's full name Arthur Currier Lowell

Occupation Mining Engineer Birthplace Farmington, Maine

Mother's full name Lavina Agnes Cumming Lowell

Occupation teacher realestate broker Birthplace Nogales, Arizona

Your spouse Edith Walmisley Sykes Lowell

Occupation Teacher, ranch mgr. Birthplace Tucson, Arizona

Your children Susan Deborah Lowell Humphreys, William David Lowell, Douglas Glenton Lowell

Where did you grow up? Nogales and Tucson, Arizona

Present community Nogales and Tucson, Arizona

Education Tucson public schools, Univ. of Arizona BS Min. Engr. & E. Geol, Stanford Univ. MS Geol.

Occupation(s) Exploration Geologist & Mining Engr. Manager Exploration company

Areas of expertise porphyry copper and epithermal gold exploration and mining production & economics

Other interests or activities ranching, skindiving, archaeology

Organizations in which you are active Soc. of Econ. Geol., Min & Met Soc. Am., AIME, Nat. Min. Hall of Fame

SIGNATURE David Lowell DATE: April 20, 2000

I CUMMING, CURRIER, LOWELL FAMILIES

[Interview 1: September 15, 1998] ##[1]

Growing Up in Arizona from 1928

Swent: We're beginning Interview 1, and we're sitting in your very beautiful office out on your Atascosa Ranch near Rio Rico, Arizona. We're going to be talking about all the things that brought us to where you are today. Let's begin at the beginning.

Lowell: Well, I was born not far from here on a small ranch north of Nogales, Arizona. My date of birth was February 28, 1928. I was born at home, instead of being born in a hospital in a town. The reason that this happened was that my brother and sister were both very sick at the time, and the doctor, whose name was Dr. Smelker, was not sure of the cause of the illness and he felt it was probably contagious. He was right because it turned out, years later, that my brother and sister had had polio at that time.

Swent: Were they disabled from it?

Lowell: No, not really. My sister had a few kind of vague effects of it and as far as I know there were none in the case of my brother.

Swent: What made them think they had polio?

Lowell: That I don't know. This comes largely from my sister. A first cousin also was sick at the same time, and he did develop some physical disability, but even in his case it was relatively mild. In any case, a nurse was hired, whose name was Mrs. Brown, who took care of my mother. My sister's comments on this was that Mrs. Brown tolerated my brother and sister as pests but didn't worry about it.

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[1]## This symbol indicates that a tape or tape segment has begun or ended. A guide to the tapes follows the transcript.

My brother was five years older than I, and my sister, nine years older. My brother was a second lieutenant in the Marine Corps and was killed in the Battle of Iwo Jima in the Second World War.

Swent: What was his name?

Lowell: His name was Hervey William Lowell. My sister's name was--is--Margaret Lowell Grade. Her married name was Grade. She's now a widow. She was also in the service in the Second World War and was the first WAVE [Women Appointed for Volunteer Emergency Service] Navy officer from Arizona. I grew up in Santa Cruz County for the first seven years of my life. The 1928 birthdate obviously coincided with the Great Depression; one of the fundamental conditions of my childhood was poverty. My family had been in good shape until about 1930, but during the thirties the family income was very uncertain. My mother had a job selling real estate. I had my first job when I was ten years old and had a regular job most of the time after age twelve.

Father, Arthur Currier Lowell

Swent: What did your father do?

Lowell: My father was a mining engineer and had worked for mining companies but during the Depression was unable to get a job as a staff member of a mining company. He operated small mines in southern Arizona during most of the 1930s, and these were really small mines, usually with only two or three employed.

Swent: Copper mines?

Lowell: The mines were silver, lead, zinc, gold, and copper. There were three or four different mines that he worked in. They were usually optioned from someone and in some cases he acquired them by staking the mining claim.

Swent: Had your father studied mining?

Lowell: My father attended Tufts College in Boston. He spent three years in college, at which time his father died. My father grew up in Farmington, Maine. His father was an apple broker. They were reasonably well off, but there no longer was money for Dad's education when his father died, and he left New England and came to Arizona and Mexico.

Swent: When would this have been?

Lowell: That was about 1914, I believe, that he came to Arizona.

Swent: Was it a booming economy here at that time?

Lowell: Well, the population of Arizona at that time, I'm guessing, was only 5 percent of what it is now.

Swent: When was Bisbee the center of things? Around 1900, wasn't it?

Lowell: Yes, I think that's right.

Swent: Around 1900 to 1905; I'm thinking that those are the years.

Lowell: My father worked in the Tiger Mine near what was later the San Manuel Mine.

Swent: Had he studied engineering at Tufts?

Lowell: Yes. He lacked about one year of graduating at Tufts. He had health problems, which was one of the reasons for leaving New England also. He was over-age to be in the army in the First World War, but he had earlier been a lieutenant in the National Guard in Maine. My father was born April 11, 1884, and died October 20, 1954.

Mother, Lavina Cumming Lowell

Lowell: My mother was born in Santa Cruz County, near Nogales, January 30, 1893, and died February 14, 1982. She grew up on a cattle ranch and had five brothers, I believe.

Swent: What was her maiden name?

Lowell: Her name was Lavina Agnes Cumming.

The Lowell and Currier Families

Swent: And your father?

Lowell: Was Arthur Currier Lowell. His mother's family were Curriers. My grandmother's family name was Currier, and presumably they were

part of the Currier, of Currier and Ives, family in New England. Her name was Henrieta Currier. My father was a distant cousin of Percival Lowell and Amy Lowell and James Russell Lowell, and one of his relatives had been a cavalry general in the Civil War who was killed in battle. The family in Farmington was a small family, and he was an only child; there are now no Lowells in Farmington, Maine.

The Cumming Family

Lowell: My mother's family--my mother's father's name was Douglas Wallace Cumming. He was born in Picton, Ontario. His family were Scots who had first immigrated to the United States. They were English sympathizers in the Revolutionary War and had to move to Canada at that time.

Swent: Loyalists?

Lowell: United Commonwealth Loyalists--I don't remember what that group were called, but when I was a child I had thought that that branch of the family were Americans in the Revolutionary War, and I found out later that they were part of the Redcoats at the Battle of Bunker Hill, instead.

Swent: How did you find that out?

Lowell: My sister is interested in family genealogy, and she has done quite a bit to try to learn about the roots of the Cumming family, and she has made a couple of trips to Scotland and has a family tree worked out in Scotland.

Swent: But as a child you were not told much about this?

Lowell: No, I'm not even sure my mother knew about this.

Swent: I wonder how the family came from Canada to Arizona.

Grandfather Douglas Wallace Cumming, a Wild West Adventurer

Lowell: Well, my grandfather was quite an unusual person.

Swent: This is your mother's father.

Lowell: My mother's father, Douglas Wallace Cumming. He ran away from home and got a job as a cabin boy on a boat and sailed around the Horn to California.

Swent: Do you know an approximate year for that?

Lowell: It was about 1855. He was born in 1834 and died in 1911. I have a picture of him taken in California in 1860. After his voyage of exploration, several other members of the family in Canada immigrated to California, and I still have a fairly extensive set of relatives in California. One of them was a lieutenant governor of California, Warren Porter.

Swent: Where did they settle?

Lowell: They settled around Santa Cruz and Watsonville, California. My mother was sent away to school at Santa Cruz when her mother died. She was a young girl, and my grandfather decided that a cattle ranch was not a good place for her to grow up, and she was sent to Santa Cruz with a note pinned to her dress which said, "I am Lavina Cumming." This was used as a title for a fictionalized biography by my daughter Susan Lowell Humphreys.[2]

Swent: The cattle ranch was here?

Lowell: Not here, but it was near.

Swent: In Arizona. And Santa Cruz--

Lowell: The Arizona county for Nogales and Rio Rico and Tubac is Santa Cruz County.

Swent: I'm getting confused with Santa Cruz, California.

Lowell: Well, yes, it's a coincidence of names.

Swent: Where was your mother born?

Lowell: She was born also on a ranch near here, on the other side of the valley.

Swent: But her father had been in California and then came here?

Lowell: Yes, but I skipped a good part of his history, which was pretty colorful. He returned from--he made two trips to California. The first one, he sailed around the Horn as a cabin boy, and the

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[2]Susan Lowell, I Am Lavina Cumming, Milkweed Editions, Minneapolis, MN, 1993.

second trip he went as far as the Isthmus of Panama and rode a mule across Panama and got another ride up the West Coast. Back in about 1870, he established a freight business and freighted in wagons from Dodge City, Kansas, to Arizona and Sonora. But this was back in the cowboys and Indians days. He was involved in several Indian battles. He died before I was born, so I never met him, but at the time he died he had two lead bullets in his body that hadn't been removed. His left arm was partly disabled because an arrow had gone through the biceps of his left arm, and he had a groove on the top of his head where a bullet had just grazed his head.

Swent: So you grew up hearing these kinds of stories, did you, about your grandfather?

Lowell: Yes.

Swent: That's wonderful.

Lowell: I ran into a fellow when I was a boy who told a story about meeting my grandfather in Nogales, Sonora. He said he was walking down the street, and a Mexican flew through a window in a saloon, and he stopped in amazement, and then a second Mexican came through the same window, and then my grandfather came out to make sure they were not coming back in [laughter]. So this was back in Wild West days.

Swent: Yes, indeed.

Lowell: My grandfather was the Indian agent to the Snake Indians for a couple of years at one point.

Swent: Where were they?

Lowell: In Idaho, I believe. On the Snake River.

Swent: That's a long ways from Nogales.

Lowell: Yes. I think that was prior to Nogales time. The Snake Indians were a branch of the Sioux Indians and very warlike Indians. They may have been responsible for some of the lead bullets.

Swent: Could be.

Lowell: He had various adventures. He was present in Tombstone, Arizona, during the OK Corral shootout and hid behind a woodpile to see all the excitement. But he was one of the witnesses in this battle. On another occasion he was freighting from Tombstone to Nogales and sleeping under his wagon when a group of Apache Indians came

by and stole his team of horses, which were hobbled nearby, and left their horses, which were in such bad shape that they were pretty much ruined as horses. But they were in a hurry, and they didn't look for him. He was under the wagon. As children, we heard various stories of this sort.

He was in a battle in Mexico between Mexicans and Yaqui Indians, who were attacking a little village where he was staying. He first came to the Nogales area in 1876 and settled here something like five or ten years later. Here on the ranch we have the site of an Apache massacre. The Peck Canyon name comes from the first rancher on our ranch, whose name was Peck. His family and a cowboy working for him were killed by Indians about two miles up the valley from here. The same group of Apaches who were Geronimo's group, although Geronimo was probably not present in this attack, in the same raid killed people in Ruby, Arizona, which is just west of the northwest corner of our ranch. And my grandfather was on the coroner's jury to establish the cause of death of these people.

Swent: You said your grandfather died before you were born.

Lowell: Yes.

Swent: Who was telling you the stories about him?

Lowell: Well, my mother and uncle, who owned a ranch just across the canyon, just north of the Atascosa Ranch. His name was John Cumming.

Swent: So he was your mother's brother.

Lowell: My mother's mother's name was Frances Bigsby, I believe. She immigrated to Arizona as a young woman, probably in her late teens. She came from Missouri, and her father and two of her uncles were killed fighting on the Confederate side in the Battle of Shiloh in the Civil War. Her father was William Bigsby and her mother was Melissa Gregory. The Bigsby family was largely destroyed by these deaths, and Melissa went to California where her twins were born but both her brother and mother died. She was raised by her aunt and educated in a convent, then came to Nogales where my grandfather met her, and they were married in Nogales. She died at a young age. I think she was in her early thirties when she died. This was my grandfather's second marriage. He had been previously married in California to Mary Huntington and had two children, Douglas Gray and Louise.

Let's see. I don't have a great deal of information about my father's parents, but his mother died when Dad was in his early

teens, and his father married again, and his second wife's name was Florence. His father died when Dad was about twenty years old.

Swent: Do you have any idea what was the cause of her death?

Lowell: She died of cancer.

Swent: So many people died in those days of tuberculosis and other diseases that we don't think of much now.

Lowell: I think I remember hearing that my mother's mother died of diabetes. My grandfather's second wife's name was Florence, and she came to Arizona and lived with us for several years when I was a small child. Very kind, pleasant person. She was a music teacher.

Swent: You said she came to Arizona.

Lowell: Yes.

Swent: Wasn't she here?

Lowell: No. My father's father died when he was a college student. That date would have been about 1900, roughly. And Florence stayed in Maine, evidently, from 1900 to 1930.

Swent: So this goes back to the Maine family.

Lowell: Yes.

Swent: So there was contact, then, with the Maine branch of the family, even though you were a long ways away.

Parents' Marriage and Life in Peru

Lowell: That's correct, although my father never returned to Maine. They were married in Nogales in about 1918.

Swent: When was your father born?

Lowell: My father was born April 11, 1884. He was a number of years older than my mother, who was born January 30, 1893. Immediately after they were married, they made a trip to Peru.
##

Lowell: My father had a job as a mining engineer and mill superintendent in a mine called Santo Domingo, which is on the east slope of the Andes, just above the Amazon jungle. They stayed there for three years, I believe.

Swent: What kind of mine was it?

Lowell: It was a gold mine. My sister was born in Cuzco, Peru. My mother had to ride a mule from the mine to Cuzco. Stayed in a hospital there for several months.

Swent: Months?

Lowell: Months, yes. Prior to the birth and then for a little while after. And my sister was carried back to the mine in a basket, in a down comforter. I have some notes that my sister gave me about their time in Peru, which I'll give you. I'm not sure whether you want to include them.

Swent: I think so.

Lowell: And also a little article that my mother wrote for the newspaper in Santa Cruz, California.

Swent: She looked on it as a romantic adventure, I presume?

Lowell: Yes.

Swent: That's just as well [chuckles].

Lowell: My mother was a fairly adventurous, very determined, hard-headed person. I felt a great deal more sympathy for my father than for my mother as a child. I'm sure this has had an effect on all my life.

II CHILDHOOD IN ARIZONA DURING THE DEPRESSION

Growing up in the Shadow of an Older Brother

Lowell: I grew up always being in trouble [chuckles] as a child. I was the youngest of three children. My older brother always did everything right. Had probably a more attractive personality. And he was good-looking and athletic and larger and heavier than I [chuckles]. I was kind of the Cinderella of the family during the Depression.

Swent: Was your brother born in Peru also?

Lowell: My brother was born in Tucson.

Swent: I see. They came back after a few years in Peru.

Lowell: Yes. Offhand, I don't know why he was born in Tucson, but he was. He was a member of the Tucson High baseball team and football team and the track squad. When he was in college, he was the Border Conference shotput champion, and he played on the University of Arizona football team. I came along as a smaller, less articulate, weaker, third edition and felt like I wasn't really appreciated as a child. I had a job most of my childhood, beginning at age twelve. I think the two factors of our family being very poor and also sort of growing up in the shadow of an older brother who was more highly rated in the family had quite a bit to do with my subsequent life and career.

Swent: Let's talk a little bit about this notion of being poor. Did you feel as a child that you were poor?

Lowell: Yes, definitely did.

Swent: We so often hear people say, "Well, looking back on it, I know we were poor, but at the time I didn't think so." But you really felt, even as a child--

Lowell: Yes, I did.

Swent: What sorts of things made you feel that?

Lowell: Oh, we were never on welfare, but we sometimes had trouble paying the mortgage payment on our house. My mother had a job part of the time, which was kind of unusual in the 1930s, and my father's income was sometimes good but sometimes nonexistent. It was an uncertain, unreliable way to support a family.

Swent: Did you have relatives that you had to ask for help? Were there relatives in the picture?

Lowell: One of my mother's brothers, whose name was Bill Cumming, was president of a bank in Watsonville, California. That family never gave us money, but I grew up wearing cast-off clothing and that sort of thing.

Swent: The bankers didn't always have an easy time in those years, either.

Lowell: But we were kind of in "poor but proud" category. We didn't have very much money, but we didn't accept monetary help, either.

Swent: What sort of jobs did your mother have?

Mother's Teaching at Palo Parado School

Lowell: She worked as a real estate salesman. She had been a schoolteacher.

Swent: Had she gone to college?

Lowell: Yes. She graduated from what was then called Tempe Normal School, which is now called Arizona State University.

Swent: So she did have a good education.

Lowell: Well, moderately good. She had gone through either a two- or three-year course for becoming a schoolteacher. She taught school for a number of years here in Santa Cruz County. There are a number of stories about that, but she had a school that had one less than the minimum number of students to be qualified for state aid, and when she took over from the other teacher, the teacher showed her the list of students, and she said, "There is something you should know about Pablo Gonzales." Mother said, "What is

that?" The other teacher said, "Pablo is a dog that comes to school but isn't strictly kosher." [laughter]

This also was back in pretty much the Wild West days, and Mother wore a six-shooter to school as a schoolteacher because of problems that they had at that time.

Swent: With whom?

Lowell: With over-age students and bandido types around.

Swent: Did she ever use it?

Lowell: No, no, she didn't.

Swent: She just felt better having it. This is a school out in the country?

Lowell: Yes. You might have noticed a place name, driving to the ranch this morning, that is called Palo Parado, and the school was located there. There aren't even any ruins where the school was, now. Her family ranch was called El Bosque. It was a place which was an area of dense mesquite growth, in the river bottom. The central part of the ranch was a homestead. The homestead had been granted a patent by the government and was apparently perfectly legal, and then there was a lawsuit and the heirs to the Spanish land grant, Baca Float [a float is similar to a land grant] land grant sued the government. The case went clear to the U.S. Supreme Court where the homesteaders lost. So the government then took the homestead away from mother's family, and they had to move out. Their affluence dropped substantially at that point.

One of my uncles established a ranch next to our present ranch, and the others--the ones that were still living at the ranch--moved away. Two of them went to California. One of my uncles attended Stanford University in California. I think the uncle who was the bank president had had some university education also.

Swent: A lot of good schooling in the background, along with all those adventures. An emphasis on education, I would say.

Lowell: Yes. We were raised to think that it was very necessary to have a college education. My brother had been in the university for two or three years when he went into the Marine Corps. He went into the V-12 program and received a commission from the Marine Corps in 1944 and was killed in March, 1945.

Swent: How old were you then?

Lowell: I was seventeen.

Swent: Seventeen. Did that affect you much?

Lowell: Yes, yes.

Swent: He was not married?

Lowell: No.

Swent: Your parents were still alive?

Lowell: Yes, they were still alive. It was, of course, a major tragedy in our family.

Swent: You were living at home and still in high school, then.

Lowell: Yes. Yes, I was.

Swent: Where was the family home then?

Lowell: In Tucson. When I was seven years old, the family moved from near here to Tucson.

Helping at Father's Mine from the Age of Seven

Lowell: That was also the point at which my father started operating small mines. For several years, I spent my summers with my father, living in tents at these small mines. When I was seven years old, which would have been 1935, I lived at a mine near Arivaca, Arizona. It was called Silver Hill. It had a shaft, something like eighty or a hundred feet deep, into a vein. The ore was hoisted with a windlass, a hand-cranked winch. It was dumped at the collar of the shaft, and then hand-sorted. The higher grade part of it was hauled in a pickup truck to an ore buyer.

Swent: I can guess who did the hand sorting?

Lowell: Yes. [laughter]

Swent: That was your job?

Lowell: That was my job or partly my job.

Swent: Who operated the windlass?

Lowell: Oh, the Mexican miners and my father on occasion.

Swent: You didn't have to do that?

Lowell: No, I wasn't big enough to do that. But I decided that my job was really, probably, one of the best jobs in the world, and I decided to be a mining engineer when I was seven years old.

Swent: Your father must have approached this as a good thing to do and made it fun for you, did he?

Lowell: I think so. I don't have very clear recollection of that. My father was a quiet, considerate, kind person. He never gave me much advice, but I think his example was one of the strongest influences on my life.

Swent: Were you doing your own cooking?

Lowell: Yes.

Swent: Perpetual camping out?

Lowell: Yes. Well, not exactly camping out. The tent had wooden walls and a door, and we had a stove which burned wood. The coyotes would come around at night and howl, and our dog would bark at them.

Swent: Was your brother doing this, too?

Lowell: No. He was in Tucson at that time. I lived at several of these mines over a period of four or five years. The Silver Hill mine was a very isolated location. Our mine was probably eight or ten miles from the village of Arivaca, population fifty people, and on a rut road. I several years later learned to drive a car on one of these mine roads, when I was maybe twelve years old. We used to hunt rabbits and doves and quail as a source of meat for the pot. I grew up learning to shoot guns and hunt as a young boy.

Let's see. That takes us up into the 1930s. The family at various times raised chickens and sold eggs.

Swent: In Tucson?

Lowell: In Tucson. Some of my jobs were feeding the chickens and taking care of the eggs and selling eggs and so forth. My father operated a service station and garage for a while when I was about ten years old and I worked in the service station and put gas in cars from a hand pump which filled a glass walled reservoir. I wore an oil cloth cap which said Signal Oil. The customers often

This is a story of the Tunquipata mine as David recalls it.

"In 1936 my father acquired a mineral prospect in the Las Guijas Mountains about ten miles west of Arivaca, Arizona. The prospect was named 'Tunquipata' after a Quechua Indian word in Peru which meant 'cock of the walk.' The generating plant at the Santo Domingo mine in Peru (where my mother and father lived for three years) was also located at a place called Tunquipata.

"The Tunquipata mine was one of the few mineral ventures which turned out profitably for my parents. It was a gold-tungsten deposit, and my dad operated it profitably on a small scale for about two years, then sold it. While it was in operation my father and an average of two Mexican-American miners worked in the mine drilling the vein by hand with 'single jack' 4-pound hammers and 'hand steel' which was sharpened every night in a forge. Housing consisted of a tent and an open kitchen with a small wood stove, and transportation and ore truck were combined in a second-hand pickup truck.

"The mine had had an unusual history in that, according to legend, it had been originally worked by the Spaniards or early Mexicans, and later 20 or 30 years before my father acquired it, it had been opened up by Americans and had been the site of a fatal accident in a cave-in. The local Mexican-Americans were firmly convinced that it was haunted, and they had much evidence to support this view. I remember as a seven-year-old boy lying on my cot at night and listening to my father and the Mexican miners telling ghost stories about

the mine. All present had had the experience of hearing a tapping noise in the bottom of the mine as of a long-dead Spanish miner drilling with hand steel somewhere out in the rock. Verdusco, a one-legged miner, swore that he had heard a ghost pass him in the tunnel and climb down the ladder into the mine. Reyes Palomares, my dad's long-term assistant in mining ventures, had many other stories about supernatural events at Tunquipata, but the most difficult happenings to explain were jointly experienced by my father and my brother Bill who worked two summers at the mine. On two occasions radio programs were heard in the camp or on the hill above camp, but there was no radio in camp and no other people living for several miles in any direction. At this time portable radios were rare, and it is very difficult to explain the origin of the sounds of the radio program. My father thought that minerals in the vein might have converted radio waves into sound waves in some way, but this seems very unlikely. The Tunquipata was definitely a spooky place.

"My father owned a small shaggy dog named Rags. Rags lived at all of our mineral prospects and chased (but never caught) innumerable rabbits, and hid from (and was never caught by) innumerable coyotes. Rags always barked when the 'round was spitted' because he knew that soon the dynamite blasts would be detonated at which time his function was to throw a perfect fit of barking until smoke stopped coming out of the shaft. Our pickup broke down en route to Tucson once, and my father had to hail down the Tucson stage and get a ride into town. He knew that dogs were not allowed on the bus, so he had previously placed Rags in a cardboard carton with air holes. The driver placed the box on the rack on the roof, and Rags, in complete silence, rode into Tucson and was reclaimed in the bus station.

"At the Tunquipata mine there were many mockingbirds or 'wee-ta-coches' as they were called by the Mexicans. Over a period of time my father and the miners taught one of these birds several words, and he would also whistle back tunes from a tree near the tent and imitate portions of songs. There were also coyotes that howled in the distance and owls that hooted at night, and sometimes at night small foxes barked on the opposite side of the canyon. During the day white-winged doves called from the mesquite and hackberry trees in the canyon. I visited the site of Tunquipata two years ago, which was thirty-four years after I lived there as a small boy. All of the distances have shrunk from what they were in 1936, and you can now barely see where our tent was located and the kitchen and the forge. I don't know whether the poor Spanish miner is still down tapping in the rock on his hand steel, but there would be worse places for him to work than the Tunquipata."

pumped the handle for me because I was so small. I rode the bus to a downtown bank each week and did the family banking.

I got good grades in school through about junior high school, and I was a very undistinguished high school student. Did very little homework and had kind of a poor attitude, but got B's and C's, probably.

Swent: But you said you were working from the time you were twelve.

Lowell: Yes. Through most of high school I had a job delivering newspapers. I rode my bicycle twenty miles a day every day which took up a good part of my time after I got out of school.

Swent: And energy.

Lowell: I graduated from high school when I was seventeen years old. That was the year my brother was killed, and the war was still on. This was 1945. A friend of mine from high school and I made a trip to Phoenix, which was the Marine Corps recruiting office, and took our physicals to enlist in the Marine Corps. I was unable to enlist because I didn't have--my parents hadn't signed my form. I came back to Tucson and negotiated with them on this point, and by good luck or bad luck, depending on how you look at it, that was the date of the Hiroshima atom bomb, and I was able to guess that perhaps the war would end very quickly. And it did. By that time I had my form signed, but I didn't enlist in the Marine Corps. If I had, it would have subsidized my university education and maybe have matured my personality, which was still pretty immature. But in any case, that was a little, significant crossroads.

[My closest friend as a boy five to fifteen years old was my cousin Kendall Cumming who lived on the Circle Five Ranch just north of our present Atascosa Ranch. Kendall is two years older and has always been a rough and tumble guy who was a boxer and pole vaulter and football player and rodeo bull rider and bronc rider and paratrooper wounded in the Battle of Bastogne. As a junior sidekick I tried with limited success to imitate a number of these activities, but I grew up convinced that Real Men do A, B, C, et cetera. Kendall after the war got an M.S. in range ecology and worked for the BIA and eventually became BIA superintendent for the Gila Indian Reservation and also the Jacarilla Apache Reservation and now works as a consultant for ranchers dealing with the federal government.][1]

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[1]This paragraph was added by Mr. Lowell during the editing process.

III ARIZONA COLLEGE OF MINES, 1945 TO 1949

Playing Football and a Warning from Dean Chapman

Lowell: I entered the University of Arizona in September 1945 and was admitted to the College of Mines because I scored well on the placement test. I was in the top decile. It was a little bit difficult to get into the College of Mines at that time. I got in okay, but I had some trouble staying for the next two years. I also played on the University of Arizona football team in the fall of 1945. I was on the varsity team but not a first-team member.

Swent: You must have played in high school as well?

Lowell: I did one year in high school. I also learned about going out with girls, which I had never done in high school, and worked for the newspaper, and I was taking ROTC. The sergeant who was in charge of the rifle team noticed that I was a good rifle shot and invited me to be a member of the rifle team. I rode Brahma bulls and was in the wild mule riding contest in the university rodeo. All in all, I had lots of fun for one or two semesters, until the chickens came home to roost, and the dean of the College of Mines told me that it didn't look good for me to be able to stay in the College of Mines. He criticized me frequently for having demonstrated the capacity to be an engineer through my placement test and being about to flunk out because of sloth and lack of seriousness.

Swent: Were you living at home?

Lowell: No. My family at about that same time had moved--had bought a cotton farm north of Tucson, near Red Rock, Arizona, and sold their house in Tucson. They were living there, so I lived in the dormitory.

Swent: Were you working then too?

Lowell: Yes. I worked every summer while I was in university and had part-time jobs during the school year. The total money contribution to my education all together by my family was about five hundred dollars, and the rest of it I earned myself.

Swent: And you were on the football team and ROTC and working part-time?

Lowell: Working part-time.

Swent: And discovering girls.

Lowell: Yes [chuckles].

Swent: Dating. It sounds like a busy year.

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Lowell: I didn't get F's, but I got some D's and C's, which Dean Chapman didn't judge to be up to snuff for intelligent minds.

Swent: This was Thomas Chapman, was it? How did you feel about his telling you this?

Lowell: I became a good friend of Dean Chapman, and the reason was the rules. We had a pre-delinquent list and a delinquent list every semester at the University of Arizona. For my first two and a half years in the College of Mines I had a perfect score of showing up on every pre-d-list and every d-list, and the d-list required a heart-to heart conference with the dean of the college, and so after a while we got very well acquainted [chuckles]. Dean Chapman was one of the people in my life that had faith in me, so that was part of my academic career.

I played spring football in 1946. At that time, when you went out for football, it occupied about fourteen hours a week of your time, and most of the other people playing football were studying agriculture or something that was an easy course. The engineering course required a lot more time. After spring football, I had one of my conferences with Dean Chapman, and he said, "Dave, in my ten years as dean of the College of Mines, I've had one student who played football and graduated on time, and I am absolutely certain that you're not going to be the second one." [chuckles] I thought this over, and--I enjoyed football more than almost anything that I had done, but the awful thought of having to go to university another year decided me to give up playing football.

But by my sophomore year, I had pretty much shot myself in the foot with a poor performance the first year, and my work

ethics improved slightly but my grades not too much the sophomore year, but my junior year, I started to do better as a student.

Swent: What about your teachers? Did they play any role in all of this?

Lowell: Not too much. They had been pretty impersonal about things, I think. I had a little incident in my senior year. A normal workload for an engineering student was seventeen or eighteen hours of work per semester, and when I started my senior year, I determined that I was going to have to complete a total of forty-eight hours of work if I graduated on time. So I laid out a program which was twenty-five hours the first semester and twenty-three hours the second semester.

The professor who was my advisor, that I had to discuss this with, was a pretty hard-boiled, short-spoken, unhumorous [chuckles] fellow. You had to present your program and get it approved, and I presented this program, and he looked at it and didn't say anything. I said, "Well, what do you think about that?" And he said, "I think you're a damn fool." [laughter] But I was able to complete all of these hours during the year. But at graduation time, I wasn't sure I was going to graduate.

It was kind of a calculated risk as to whether to pay my fee for my cap and gown because a grade point average of a certain number was required for graduation, and mine was right on the borderline. I had flunked one course in college, which was differential calculus, and I had to take it again my last semester. It was taught by a young lady that I thought was kind of a nice person. When I took my final exam, that was a swing course. I knew what grades I was getting in the others, but if I got a B in calculus, I would graduate, and if I got a C in calculus, I would have to come back for another semester. I don't remember her name, but I thought this was a pretty serious problem, and I went out to a florist and I bought an orchid [laughs], which I presented along with my final exam, and I explained to her what my problem was. She made no comment whatsoever [laughs], but I got the B. [laughter] I may have deserved it. I'm not totally sure of that.

Swent: I'm not clear on why you had to take all these forty-eight hours your senior year.

Lowell: It was to make up this calculus course. I didn't flunk anything else. I don't remember offhand, but I may have had a light semester in which I didn't take one course I was supposed to.

Swent: But you did graduate.

Lowell: I did graduate. I had gotten married the spring of the previous year.

Swent: Of your junior year.

Lowell: Yes.

Swent: You squeezed in a lot of activity!

Lowell: [chuckles]

Wife Edith Walmisley Sykes

Swent: How did you meet your wife?

Lowell: Well, on a skiing trip.

Swent: So you were also skiing.

Lowell: Well, sort of. There was a small ski run on Mt. Lemmon, outside of Tucson, which is a 9000-foot-high mountain. My roommate, whose name is Jack McGee, had gone out with Edith previously, and all three of us were on this trip to Mt. Lemmon. I actually ended up not skiing but running the rope tow. It was sort of a do-it-yourself arrangement, and I knew something about gasoline engines, and so I ended up running the tow.

Swent: What was Edith's maiden name?

Lowell: Sykes. Edith Walmisley Sykes.

Swent: So that's how you met each other. Was she a student also at the university?

Lowell: Yes, she was a student. She graduated a year earlier and worked in the English Department as a secretary my last year in college.

Swent: You were married while you were still a student also.

Lowell: Yes. I was--let's see--I was twenty years old when I was married.

Swent: And it has lasted over fifty years.

Lowell: Yes [chuckles].

Swent: That's wonderful. How did your family react to your marriage?

Lowell: Well, they were worried that this would cause me to drop out of school. I was married in March of my junior year. I was married in 1948. We were both students that year, and then the following year, when I finished up, she was working in the English Department and I was a student.

1946 Summer Job at Idarado, "A Real Roughneck Mine"

Lowell: One of my summer jobs when I was in college: I hitchhiked to Ouray, Colorado, and got a job in Idarado Mine and worked as a miner and a timberman one summer.

Swent: What summer would that have been?

Lowell: That was between my freshman and sophomore year.

Swent: So that was '46.

Lowell: Forty-six.

Swent: And Idarado was--

Lowell: Complex lead, zinc, copper, gold mine. Newmont.

Swent: --one of those that was made possible by the Reconstruction Finance Corporation, I think. A big war effort.

Lowell: Yes.

Swent: Who was there then? Whom did you work with?

Lowell: I don't remember the mine manager's name. His name was Bob something or other. The Idarado Mine was a real roughneck mine. The mine manager claimed, untruthfully, that he never had a man work for him that he couldn't whip, and there were a couple of fistfights to continue this tradition. Most of my shift one Monday morning were in jail in Silverton, Colorado [chuckles]. There were some pretty tough, hard-bitten guys working in the mine. It was an underground mine at about 9,000-foot elevation. No, it was 11,000. The mine was at 11,000, and Ouray, I think, was at 9,000.

My direct supervisor was a fellow named Bob Cockle. He was a young engineer who had just gotten out of the army. He came down with pneumonia at the mine and died the next day.

He could probably have been saved if they had moved him down to Ouray or somewhere. I worked on a contract mine crew, where we were paid on the basis of the number of tons of ore that we produced and we earned a bonus over day's pay rate. There were five of us, I think, on the contract, and one fellow was referred to as Big Joe and another one as Little Joe. Big Joe was a Hispanic fellow, kind of middle-aged and nice guy, who was about my size. And Little Joe was a fellow who was about six-two or six-four and had just gotten out of the paratroops.

We had to carry very heavy equipment up into the stope, and one of our pieces of equipment was the stoper. Another piece of equipment was a leyner, which mounted on a column bar. The leyner had two parts: the column bar and the pneumatic drill, and they each weighed on the order of--one weighed 100 pounds, and the other 120 pounds. They were very hard to transport because we had to go up ladders and across broken rock and whatnot.

Swent: At 11,000 feet.

Lowell: Yes, at 11,000 feet. I was carrying one of these things and Little Joe was carrying the other, and I was stumbling and making slow progress, and he impatiently grabbed my piece and carried both of them up [laughs].

Swent: You've referred to your size. How tall are you?

Lowell: I used to claim to be five-ten and a half, and I'm probably more like five-ten now.

Swent: And at that time how much did you weigh?

Lowell: I weighed 165 pounds because that was my weight when I played football and it's my weight now. I've never--

Swent: You never changed your weight.

Lowell: Never changed my weight.

Swent: That's wonderful.

Lowell: I was considerably stronger and huskier then in terms of muscles, but that was pretty vigorous stuff.

Swent: Yes. You said you were paid on a contract. How much were you making at that time?

Lowell: That I don't remember, but I think it was something like two or three dollars an hour, but of course, with inflation--

Swent: Do you recall what you were paying for board or room?

Lowell: I stayed in the bunkhouse and--

Swent: The company provided the bunkhouse?

Lowell: Yes. And I don't think I paid anything for board and room.

Swent: That might have been part of your pay.

Lowell: But it wasn't like your hotel [laughs].

Swent: No, not the Tubac Golf Club. But they provided food as well?

Lowell: Yes.

Swent: Did you carry your lunch into the mine or come up?

Lowell: Carried lunch into the mine. I sometimes ate four meals. The bunk that I stayed in was only for--it was only a twelve-hour-a-day bunk. Somebody else slept in it on the other shift. I tried to get a job in which I would have worked two shifts, which was permissible. I don't remember why--I guess the job opening on the other shift disappeared.

Swent: How did you go about getting this job?

Lowell: Well, I hitchhiked to Colorado, and I showed up at the mine, and there was a line of people applying for jobs, and when it got to be my time, I talked to the mine foreman, and he hired me.

Swent: Just on the basis of conversation? Did you have to have a physical exam?

Lowell: I don't think so. I might have, but I don't remember. I got a little special consideration at times because I was a mining engineering student. A couple of times they let me hold an end of the tape on a survey crew, but mostly I worked in the production part of the mine.

Swent: It's such a contrast to the way things are now; they took your word for it that you were a student? Or did you have to bring transcripts or something?

Lowell: No. It didn't cut very much ice anyway because I was hired as a miner.

Swent: But they just took your word for it. No background check.

Lowell: Oh, well--here is a little overlap in some of your own experience. The company consulting metallurgist was Frank McQuiston.[1] Frank McQuiston came to the mine, and I don't remember how I met him, but somebody-- maybe Bob Cockle--said to him, "This is a mining engineering student from the University of Arizona." As you remember, he was a very nice guy. He came by the university later. I'm not sure that I even saw him at Arizona, but he talked to Dean Chapman and told the dean that everybody at Idarado thought I was doing a very good job. Chapman told me that in one of these inspirational lectures [chuckles], which ended with, "Why don't you do better?"

Collecting Mineral Specimens in Mexico, 1947

Lowell: The next year I made a trip--I spent the summer in Mexico with another student from the College of Mines, whose name was Dan King.

Swent: This was 1947.

Lowell: Forty-seven. We spent the summer collecting mineral specimens for sale. Dan had a business, part-time business, selling mineral specimens. We traveled around Chihuahua and Durango and Coahuila --most of the time without any--we didn't have a vehicle, but we got rides, rode on freight trucks and trains and ox carts, buses and--

Swent: What did you do with your specimens? They must have been getting pretty heavy after a while.

Lowell: Well, we packed them up and shipped them back. That was kind of interesting and exciting also, kicking around.

Swent: Did all your specimens get here in good shape?

Lowell: Yes, yes. It was a pretty businesslike job. I didn't make a great deal of money from that summer but probably as much as I had from the previous summer working in the mine. I did some of that mineral specimen work through the following winter also.

Swent: What sorts of specimens were you collecting?

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[1]See Frank Woods McQuiston, Jr., "Metallurgist for Newmont Mining Corporation and U.S. Atomic Energy Commission, 1934-1982," Regional Oral History Office, The Bancroft Library, University of California, Berkeley, 1989.

Lowell: Wulfanite--cubicle wulfanite and vanadnite and fish tail twin calcite crystals. Descloizite was another one, I remember. Adamite, which is a very rare green zinc arsenate mineral.

Los Lamentos Mine, Chihuahua

Swent: You were able to just go out and pick them up?

Lowell: Well, these were in old mines in specific, known localities. We hired Mexican miners to help us and established little camps. One of the places we worked was a very interesting spot. It was called Los Lamentos, Chihuahua.

Swent: It sounds a little sad.

Lowell: Well, it had been operated by an American company back around the turn of the century. It was quite a large underground mine, fifty miles of mine workings. It was in heavy ground, kind of difficult rock for mining, in a period when there was less concern about mine safety, and there had been lots of fatal mine accidents in the mine. There was a small group of independent gambesino-type miners working while we were there, and they told us that fifty men had been killed all together. The custom was to put up a two-by-four cross at the site of the death.

##

Lowell: Dan and I lived with a Mexican couple in a house with dirt floors, and we shared the accommodations with a man and his wife, who were middle-aged Mexicans, and two pigs. It offended me having these pigs in the house, and on one occasion I gave one a little boot, and he turned around and tried to bite my foot [chuckles] so I gave up that idea.

Swent: Did you have beds?

Lowell: Yes, the standard bed then and on other trips to Mexico was a homemade canvas cot made out of two-by-four lumber and a piece of canvas across the frame.

Swent: That should be pretty practical in hot weather, wasn't it? And clean.

Lowell: Yes, clean and comfortable. We had standard breakfast, which was oatmeal. We stayed at Los Lamentos for about ten days or two weeks, and I had assumed that it was a mixture of oatmeal and rice

that we were eating, and about the day before we left I happened to fish out one of these rice grains and looked at it carefully, and it had little legs and little eyes [chuckles], and they were weevils [laughs].

And I pointed this out with horror to Dan, and he said, "Oh, I noticed that right at the beginning but I thought it would be in poor taste to mention it." The drifts were driven by small Mexican miners, and the back, the roof of the drift, was lower than my height and so I had to lean over and the first day banged my head a couple of times. We didn't have hardhats, but I found a straw hat that one of the Mexicans had thrown away outside of the mine, and I cut the brim off until it was only three or four inches wide and wore that to protect my head. The Mexicans kidded me about the hat. They thought it looked funny.

The day we left, we were saying goodbye to the Mexicans, some of whom we had gotten pretty well acquainted with. They grabbed my hat and staged an impromptu Mexican hat dance [laughter].

Swent: You probably had a nickname. They always give nicknames to people. Did you ever find out what it was?

Lowell: No, neither there nor at the Buena Tierra Mine, where I was later engineer and mine foreman. But in general I got along well with the Mexican miners.

Swent: Did you know Spanish?

Lowell: Well, when I was a small child, Mother had kind of a housekeeper-maid named Carolina that taught me some Spanish, say, at age two or three or four years old. Edith says that the reason for my comparative fluency and good accent go back to that time. I'm not sure that's true, but there might be an element of truth in that. Then I took Spanish in high school during my poor scholar days and learned some there, so I spoke kind of poor Spanish at that time.

In the Los Lamentos Mine there had been a miner who was decapitated in a mine accident. He was the source of superstitious stories. When we sat around in the evening or while we were working underground with the miners, they told us stories about this headless, ancient miner showing up and frightening them. They were absolutely convinced that there was a ghost in the mine. Dan and I kind of laughed about it when we were talking apart from the Mexicans.

On one occasion--well, we often split up and Dan would go to one area and I would go to another to collect specimens. On this

occasion, we had one helper. We went to my stope first, and the helper and Dan went off somewhere else. We were planning to meet in three hours again, maybe to have lunch. There was a lot of heavy ground in the mine and old timbers that creaked with weight shifting on them. I was working alone and I had a carbide light, like one of these [gestures to display of several dozen old mine lamps], for light. Carbide lights are notoriously temperamental. This one plugged up and went out, and I was in pitch dark, a mile underground.

Swent: It was that deep?

Lowell: Well, it was that far from the surface. There were fifty miles of mine workings, so it was a pretty extensive rabbit warren of workings. You have a little piece of thin wire attached to your carbide light for \this purpose, and I tried to unplug it and get it lighted again and was unable to, so then I was faced with the prospect of sitting in the dark for two or three hours, waiting for my companions to come back. And I started listening to the timbers creaking and little pebbles rolling down the muckpile, and then I got to thinking about the story of the headless miner, and then I noticed that these noises, which had first been farther away, were getting closer and closer [laughs], and finally hallucinations convinced me that, by God, there I was in the stope with that ghost [laughter] and nothing to do but grin and bear it. Finally, I heard footsteps and saw light from my buddies coming back, and we got my light working again.

Swent: It must have been a terrible experience.

Aguas Calientes Mine, Chihuahua, Summer of 1948

Lowell: The third summer vacation in college, which would have been 1948--

Swent: By now you were married.

Lowell: I was married, and I was beginning to show faint signs of promise to Dean Chapman. I was actually getting pretty good grades by then. Somebody went to see Dean Chapman to ask if he could supply a student engineer to work for a summer in Mexico. He called me in and asked me if I was interested, and I said yes. The salary sounded pretty good, and so Edith and I went to a place in Sonora, near the Chihuahua border in the Sierra Madre Mountains, called Chinipas. The mine was called Aguas Calientes.

There wasn't a road into this camp, and the way we got to the mine was in a small plane from Navajoa, Sonora.

Swent: What kind of plane?

Lowell: It was something like a Ryan--let's see. That's maybe not the right name.

Swent: There was a Ryan.

Lowell: Well, that's what it was. It was basically a three-place airplane. The pilot--this was not a regular plane service but just a fellow that did charter flying on a part-time basis--his name, I remember, was Asención [laughs], which Edith thought was funny, for a pilot. We flew over one range of the mountains and landed at Chinipas in a goat pasture, in this little plane. The other alternative way to get there was a two-day mule ride from Alamos, Sonora.

I spent the summer working there. We lived in a one-room thatched hut with a dirt floor and a very large centipede who lived in the thatch and showed up. He was about that long [demonstrating] and about this wide [demonstrating].

Swent: About a foot long.

Lowell: I soon figured out that this was a promotional mine, not really a serious mine.

Swent: What were they supposed to be mining?

Lowell: Gold. And there was a gold vein, but they were really selling stock in Florida.

Swent: What was the company?

Lowell: I think it was called Compania Aguas Calientes, but I'm not certain of that.

Swent: What were you doing?

Lowell: I was kind of the mine engineer and kind of a mine shift boss.

Swent: Was there some production going on?

Lowell: Yes, a little bit [chuckles], but it clearly was not profitable.

Swent: Did they just ship ore? Was there any processing at all?

Lowell: There was a mill, twenty-ton-a-day mill. One of the jobs that I had was as acting mill superintendent when the mill superintendent went out on vacation. I was mill superintendent for two weeks. The mining camp was about eight miles from the town of Chinipas, which was a little village, very pretty little village. We used to ride mules down to Chinipas. The mine foreman, whose name was Ramón, who was a very flamboyant guy who sang and--do you know the name Jorge Negrete?

Swent: Oh, my, yes.

Lowell: Well, Edith had a bunch of Jorge Negrete records, and Ramón was a would-be Jorge Negrete [chuckles].

Swent: He sang ranchero kinds of songs, yes.

Lowell: He also was very enthusiastic about little romances with young girls and whatnot. The fuel for the mine was hauled in maybe fifteen-gallon barrels, on mules; and the empty barrels collected at the mining camp, which was right on the Chinipas River, a fair-sized river. Ramón and I decided that a good thing to do would be to make a raft out of these empty barrels. We got some lumber and tied about maybe ten of the barrels together, and with ropes--I think we had one oar to steer it with and some poles. Edith went with us, and we were going down to a wedding in Chinipas. We had some party clothes that we had in a bundle.

Swent: So the mine was also on this river.

Lowell: Yes. Well, the camp was. The mine was back in the hills a little way. The raft wasn't too bad, but neither of us knew anything about steering a raft, and Ramón couldn't even swim. This river had some rapids in it and we almost immediately got in trouble banging into things. Part of the raft fell apart, and I think I had to jump into the river to save us once. When we got close to Chinipas, I decided that I had to change my pants into the dry pair I had brought along for the party, and I took my pants off on the raft and was kind of teetering and trying to get the new pair on, and we came around a bend, and there was a delegation largely of ladies waiting to see Ramón [laughs], which was very embarrassing. But not to the Mexicans [laughter].

We spent the night. Ramón and I bought a bottle of liquor which was called habanero. Do you know that? It's a kind of a brandy-sort of drink. Not very good [chuckles].

Swent: I was wondering if it was Cuban rum. From Havana?

Lowell: That's possible.

Swent: I'm just guessing it might.

Lowell: With that name--I hadn't ever thought about it, but that name sounds like--we had several drinks and there was some pre-nuptial parties with a brass band type of orchestra. We attended the wedding. We were staying in a hotel that was sort of partly a house. The room that we were given--there weren't walls all the way to the ceiling, and we could kind of hear what was going on in the next room. But our room had somebody's knitting on one chair and a cat sleeping in another chair [chuckles], and it had a kind of barred window.

The wedding was very gay and interesting, and we met all kinds of local people. It was a poor community. It was strictly a mountain village. Then we went back and went to bed, and those were also cots, these canvas cots. After we had gone to sleep, there was a great clatter, and it was Ramón returning to serenade Edith with this orchestra, which he had acquired somewhere in the middle of the evening. Edith was very excited; it was the first time she had been serenaded. But there was a reason for the serenade, and after it was over, Ramón said, "¿Donde está el habanero?" [laughs] So I passed it out through the bars [of the window] and they went off.

The next morning, we had to return without Ramón because he had gotten into a romantic adventure with some lady, and the lady's brother had threatened to kill him with a pistol, and Ramón had had to flee [laughs].

The other thing that happened that summer was our bookkeeper, who paid the payroll, went out to collect the money for the payroll, on a mule, and was ambushed and killed when he stopped to open a gate. There had been quite a bit of talk of *bandidos* and so on before, and we knew this wasn't an entirely safe part of the world. Then we went down to Chinipas to the funeral. A day or two later, the *rurales* showed up.

Swent: These are the local police?

Lowell: Well, they were the federal rural police. They were on horseback and had bandoliers across their chests and carried rifles and had pistols and were very tough, mean-looking group. The first thing they did was demand payment from the mine manager, which he wasn't in a position to refuse [chuckles]. They poked around and talked to people and frightened everybody. They eventually determined that the murderer was the Chinipas police chief's son. For that reason, I think he wasn't prosecuted, but my memory is a little hazy about what happened. But I had taken a revolver with me on

this trip, and after that incident carried it whenever we went out on muleback.

Eventually the summer came to an end, and we elected to ride out instead of getting the airplane to pick us up. It was a pretty rough ride. In order to make the connection with the bus, we had to move right along. We trotted in the flat spaces, of which there weren't too many. It was a good, hard mule ride. In the afternoon of the first day, we were with an *arriero* [muleteer] named Don Cuco, who was also the manufacturer of the local bootleg tequila which is called *bacanora*.

Edith got a strong pain in her side and had to stop beside the trail, and she said to me, "I hate to tell you this, but I'm getting appendicitis, and I'm almost certain to die here and it will be very sad for my parents and for you."

I said, "Oh, forget it! You're suffering from mule riding." [chuckles] So that cheered her up to some extent. We rode over a range of hills--mountains; they were fairly high. Pine trees.

We spent the night in a place called Lower Aripinapichic. There was Upper Aripinapichic and Lower Aripinapichic. We stayed in a house, slept on the ground in a house with fleas and mosquitoes. I've never been very attractive to mosquitoes, but Edith is and Don Cuco was. I managed to keep my head covered up and was able to sleep more or less. At about four o'clock in the morning, Don Cuco got us up, Edith thought, because he couldn't stand the mosquitoes any more.

We started off on the trail, and it was pretty steep country. One of our mules fell off the trail and rolled down the mountainside.

Swent: With someone on it?

Lowell: No. But our suitcases were on it. And he ended up upside down on top of our suitcases, with all four legs sticking up. I had a flashlight, and we picked our way down the mountain. I thought he was dead, and Don Cuco said, "No, he's all right." He went off and he found a pole and got under the uphill side and levered him, and he rolled over a couple of more times and landed on his feet and brayed, and Don Cuco led him back up the trail [chuckles]. Our suitcases were pretty mashed, but they weren't terribly high quality to begin with.

So we started riding again. We had to stop periodically to let Edith recover from her pains [chuckles].

##

Swent: You were on a mule ride from the mine down to Navajoa, I guess.

Lowell: I'm not sure whether it was Navajoa or San Bernardo.

Swent: You had just gotten the mule back on the trail [chuckles], and now you're starting off again.

Lowell: Edith's mule was named Limonsilla. She bitterly said that she had figured out where the name came from because of the rough ride and difficulty in reining and so forth. I believe that the place where we arrived was called San Bernardo.

Swent: This was two days of hard mule riding.

Lowell: Yes. We arrived in time to catch the little bus, which was really more like a station wagon, that went into Navajoa. It was sort of an open-air, small cafe--small town--and the table that we picked had an oilcloth tablecloth hanging down. We sat down at the table, and there was a whole litter of pigs under the table, and they scattered in all directions [chuckles] between our legs. Those are probably the highlights of that summer vacation, not summer job.

Swent: Just a little bit about that mine. There was plenty of water, then, for the mine?

Lowell: Yes, yes, there was.

Swent: And what sort of mill was it?

Lowell: It had a grinding--it had a small crusher and a ball mill and flotation and Wilfley table.

Swent: It had a lot of things, then.

Lowell: Oh, very small.

Swent: Was this the first time that you had been a mill superintendent?

Lowell: Yes [chuckles], and my qualification was that I had had completed two or three metallurgy courses and so I knew what the function of the machines were.

Swent: I take it in the little mines that your father had had in those summers he was not processing the ore?

Lowell: No, no. It was always hand sorted.

Swent: And then just selling it?

Lowell: The hand-sorted, high-grade--

Swent: Where had he sold what he produced?

Lowell: Well, there was an ore buyer in Nogales who was also the assayer. His name was Hugo Miller. I think some of the ore may have been--he may have shipped ore directly to a smelter or to a custom mill part of the time, but I'm not certain of that. Most of our mine supplies were bought in Tucson. In the very center of downtown Tucson there was a department store called Steinfield's. They sold clothing, and it was also a grocery store and hardware store. I remember we would go to Steinfield's and buy a box of dynamite and a box or two of caps, detonators, and dynamite fuse. Now you almost have to have an act of Congress to be able to buy dynamite. You have to have permits and certifications, and it can't possibly be sold in cities. But those were the good old days.

Swent: Certainly not along with clothing and groceries! [laughter] So in your father's mines what sort of mining procedure were they doing? Just drilling and blasting?

Lowell: The drilling was usually done with hand steel and single jack hammers; this is a four-pound hammer with a short handle and you hit the steel and then you rotate it ninety degrees and hit it, and rotate it again and--a very slow, labor-intensive way to get a hole drilled. I think once or twice we had air compressors and hoses and jack hammers, but the more common thing was just drilling with hand steel.

Swent: At Los Lamentos, was that the same sort of thing you were doing?

Lowell: We were not drilling and blasting there. We were collecting mineral specimens and rock that was already broken. Sometimes we hired miners to drill a hole or two to break a slab for us, but not usually.

Swent: And at Chinipas [Aguas Calientes Mine]?

Lowell: At Chinipas there was an air compressor and air lines and hoses and so forth.

Swent: I see, so this was more advanced.

Lowell: Yes [chuckles].

Swent: And, of course, at Idarado you were using very up-to-date--

Lowell: For the time.

Swent: The leyners and so on. So you were getting a variety of experience here.

Lowell: Well, I knew quite a bit about mining by the time I graduated from university, but some of my classmates also did.

Swent: I think we've come to a good place to stop here for lunch. You're pretty well through college now.

Lowell: Yes.

[tape interruption]

Life as a Married Student

Swent: We're in business again after taking a little lunch break. Was there anything else you wanted to fill in now?

Lowell: I might talk a little bit about our family life the last year in college.

Swent: All right. That's good. You presumably moved out of the bachelor digs.

Lowell: Right. After we were married, we rented an apartment that was a converted garage the few months from March to June of 1948. When we came back from Mexico at the end of the summer, a friend of mine who had been a close friend of my brother's, Chuck Bagby, and his wife had been living in a small apartment on the south side of Tucson, which was pretty modest but much better than our garage apartment, and we were able to take over the Bagbys' apartment. We paid twenty-five dollars a month rent [chuckles]. We bought a car, which was a old Model-A Ford that we named Limonsilla, after the famous mule. It frequently broke down. At the end of the year, when I graduated from college, we were able to buy a surplus red jeep, World War II jeep, that one of the university professors had.

Swent: How much did you pay for it? Do you remember?

Lowell: We paid $215, which seemed like an impossible financing problem [laughs], and we had to get a bank loan to do it. The banker was very dubious about our situation, but I guess because I had my university degree, he thought he could risk it.

Swent: You said Edith was working at the university?

Lowell: Yes. She had a job as a secretary the last year. That was the largest single source of funding for our enterprise. When I graduated, I looked around for a job and was given a job by Asarco in Mexico, but there was a delay of several months for a work permit to work in Mexico. I had a construction job in Tucson for a month or two, and then my same guardian angel, Dean Chapman, got me a job as sort of a low-grade consultant for a fellow that had a mineral prospect near Prescott, Arizona. This fellow was named Port B. Mellinger. He was a very flamboyant fellow who was in the baby chick business back in the Middle West. He seemed to have quite a bit of money and was the owner of this mineral prospect, which was of dubious value, but it required tidying up to get a clearer idea of what it was worth. So we took our red jeep and drove to near Bagdad, Arizona, which was outside of Prescott. I worked for about six weeks on this prospect, and we lived in an old shack in a kind of a ghost town place with no electricity or water or gas or any of those things [chuckles], and had a very happy time there. There were no other people within several miles.

Then word came through from Asarco that they had the papers arranged, and we drove our jeep down to El Paso and then down to Chihuahua City. The mining camp then was called Santa Eulalia unit of Asarco. I've never been able to pronounce that name.

IV MINE ENGINEER FOR ASARCO IN MEXICO, 1949 TO 1951

Santa Eulalia, Chihuahua

Swent: Who were you talking to at Asarco? Who hired you?

Lowell: I guess the fellow that hired me was A. A. Brown, who was I believe vice president in charge of the Mexico division.

Swent: Where was he?

Lowell: He was in El Paso.

Swent: You had to go there?

Lowell: Yes, I went there shortly after I graduated. It was my second ride in a commercial airliner. The mine manager's name was Syner. And the mine superintendent's name was Fritz Hertzel. We stayed two years at that camp. Susie was born in Chihuahua City, and we had our first Springer spaniel, whose name was also Spook. One of the principal recreations that we found was going duck hunting on Sunday on the Concha River. I worked six days a week and worked an average of nine or ten hours a day.

Swent: What was your job?

Lowell: Well, my job originally was as a mine engineer. I did surveying and monthly production reports and that sort of thing. And at the end of the first year, I was given a promotion and I first became a sort of a shift boss in the Buena Tierra Mine and when I was a shift boss, a mine foreman was on the shift with me. Then I was promoted to be night foreman, and I was in charge of the second and third shifts in the mine.

Shift Boss, Mine Foreman, the Buena Tierra Mine

Swent: Tell us more about the mine.

Lowell: Well, the Buena Tierra Mine was a manto type deposit: lead, zinc, copper, silver were the principal products. It was massive sulfide ore bodies. The stoping method was open stopes, and some of the open spaces were very large for a mine. We had a stope that was 600 feet long and maybe 400 feet wide and over 200 feet high. That was all open space after the ore body was mined. That kind of mining is somewhat dangerous because you don't know when rock turns loose on the top, and so it's dangerous to walk across the floor of the stope, and so most of the mining was done in the walls.

Swent: What safety record did they have? A lot of accidents?

Lowell: No, not an unreasonable number. There was a fellow killed while I was there, in a mud rush. He was loading ore cars from the chute, and water had gotten into the chute and had sort of fluidized the rock, and it rushed out through the ore chute and smothered him. The mine was quite deep. It was 2,500 feet below the surface. And very hot, very uncomfortable. There was kind of a continuing problem of bad air because of inadequate mine ventilation.

A Close Call with Bad Air

Lowell: I came very close to being killed because of bad air. On one occasion, I climbed up a raise to a sub-level, and I was by myself, and I was supposed to look at something on the sub-level, and I climbed something like eighty feet of ladders and started off on the sub-level, and I noticed that the flame in my carbide light had suddenly moved way out from the reflector. It was still burning, but it was a long ways out. I tumbled--it took me a second to understand that, and then I tumbled to the fact that there was a shortage of oxygen. And so I turned around and went right back to the ladder and started down. I had gotten down a couple of steps, a couple of rungs, and felt myself passing out. I stuck my arms through the ladder so that there was rock wall on one side and ladder on the other side, and I passed out and was unconscious there for an unknown period of time. But eventually recovered consciousness. But I was using a carbide light, and it had fallen down the raise, and so I had to pick my way down in the dark, and I was lucky enough to find it in a muckpile at the

bottom of the ladder, and was able to get it started again, and there was no real harm done.

I think if you stand up you can see that old carbide light in my lamp collection is the one that fell down the raise.

[tape interruption]

Swent: We just stopped to see Manuel riding up on his horse.

So that was a very close call then, wasn't it?

Lowell: Yes. And there were some other things like that that happened while I was there.

Swent: What was the level of concern on the part of management about these things?

Lowell: [chuckles] Not very much! It was kind of "salvase quien pueda."

Swent: "Save yourself if you can."

Lowell: I was surveying once and sent an engineer's helper up into a mine working, and I was running a transit, and he keeled over because of bad air, but was in sight of us. We couldn't see any way to get him out without the same thing happening to one of us. I forget what happened. We rigged up the ladder or something and a rope. His name was Juanito. Finally got him out, and the doctor came down in the mine, and he was unconscious for an hour but didn't do any permanent damage.

One of the mine foremen that we knew quite well--his name was Jack Pearson--was almost killed also when we were there. A rock came down out of a plugged drawpoint and hit him on the head so hard that it split his hard hat in two pieces [chuckles].

Swent: Oh, my!

Lowell: One of the fellows that I worked with was an English mining engineer whose name was Hugh Clayton, who is still a good friend of ours that we have visited back and forth over the years. Hugh was never a foreman. He was an engineer. On one occasion, he was picking his way down into one of these big stopes, and the interior ladders that we used were often rope ladders made out of steel cables and steel rungs, and Hugh thought that he was going down a winze from one level to another, and the ladder was swinging kind of freely, and he finally got to a point where he couldn't find another rung with his foot. He was feeling in the dark down to another rung. So he got set and got his light free,

and shined around, and he was dangling down in the middle of one of these very large open stopes, just in space [laughs].

Swent: Oh, my!

Lowell: Well, there are endless stories of that sort around.

Swent: What sort of safety equipment or clothing did you have? You mentioned the hard hat.

Lowell: That was about the end of it. I think we had boots that were made locally, and I think they had a steel cap, steel toe caps, but we didn't really use any other safety equipment.

Swent: No safety glasses?

Lowell: No.

Swent: Respirators or anything like that?

Lowell: None of that stuff [chuckles].

Swent: Were you given instruction in safety?

Lowell: No.

Swent: Just the ideas you had.

Lowell: Yes. Typically, a new fellow of course went around with somebody else for a few days to get started.

Swent: What about your health care?

Lowell: They had a hospital and a couple of Mexican doctors. I thought the medical care was reasonably good.

Social Life

Lowell: The principal recreation in the mining camp was playing cards.

Swent: What did you play?

Lowell: Well, we played mostly poker and canasta [said with Spanish pronunciation, cah-NAH-stah]. The men played poker, and the women played canasta. Bridge had been outlawed, much as poison gas was outlawed by the international authorities as being [chuckles] too

dangerous an activity. They had had, I think, fistfights and whatnot [laughs] at bridge games.

Swent: Was there social life with Mexicans as well as Americans?

Lowell: Yes. It was basically an American-Canadian-British camp, but there were Mexican engineers and professionals also. As it happened, our best friends were a Mexican couple. Romeo [pronounced Row-MAY-oh] was a mining engineer, and Muli, a young bride living in the camp. Muli is a nickname for Emilia. And their last name was Ayub, A-y-u-b. The family was originally Syrian or Pakistani or something--that part of the world. We went by to see Muli about a year ago. Romeo died some time ago. He had left Asarco and was in business for himself. But one of their children is something like president of the Mining Association of Mexico, and they've done very well.

Swent: What about drinking in the mining camp at Santa Eulalia?

Lowell: It was really not a problem.

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Lowell: There was a fair amount of drinking done, drinks served, oh, with entertainment. There was a book club in the camp and once a year there was a "literature party." This was the only traditionally heavy drinking social occasion.

Swent: What did you drink?

Lowell: We drank beer, not very much wine.

Swent: Mexican beer, I suppose?

Lowell: Mexican beer and bourbon. I don't remember very many tequila drinks, but there probably were some.

Swent: Rum?

Lowell: And rum. But it wasn't really a problem or too large a part of life there.

Swent: What sort of social occasions did you have?

Lowell: Well, we had kind of regular weekly card parties and entertainment back and forth between houses. We were at the bottom of the ladder as far as status goes, I being a recent graduate. We had an apartment, as did the Ayubs. We invited people over to dinner and were invited to dinner. Hugh Clayton, who was a bachelor at

that time, was given the added job of being in charge of the hotel, where he lived. He had to go to town to shop for the week for the hotel. There was a cook, I guess.

Edith drove our jeep to town, and I usually, but not always, went along with her. The road was very bad going down the mountain, and it was kind of exciting.

Swent: How far was it?

Lowell: It was about twenty miles. Edith became famous after hitting a large pig with our jeep. It didn't seem to hurt the pig.

Recollections of Pancho Villa in Chihuahua

Swent: This is Chihuahua.

Lowell: Chihuahua City. Part of the time she rode to Chihuahua with a taxi driver whose name was Pepe. Pancho Villa had come through Chihuahua, and Pepe's father had been hung from a power pole in Santa Eulalia by Pancho Villa. The old-timers there told us about hiding in the mine when the revolutionaries came through.

Swent: That wasn't too long ago; twenty years or so?

Lowell: Yes.

Swent: No, more like thirty or forty years ago, I guess.

Lowell: That's right. Pancho Villa was kind of in the 1915, '20, thirty years before we were there.

Swent: But still within living memory.

Lowell: Well, '20 to '49. That's about thirty years. No, not that long. It was hard to find anybody that had anything good to say about Pancho Villa there.

Swent: He wasn't a hero to those people, was he? No. Pershing was one of the people who--wasn't Pershing sent down by the U.S. Army to--

Lowell: I guess that's right.

Swent: --fight Pancho Villa?

Lowell: Yes, I think that's right because Pershing died just about the beginning of the Second World War.

Swent: That makes those things come alive, doesn't it?

Lowell: It does.

Housing

Swent: You say you were in an apartment. What sort of housing did you have?

Lowell: Well, it was built out of--it was sort of austere but adequate.

Swent: Adobe?

Lowell: I kind of think it was stone and concrete. I think that's what it was. It had a small living room and a bedroom and a kitchen and dining room. I think it was basically a three-room apartment.

Swent: Electricity?

Lowell: Electricity.

Swent: Enough for appliances?

Lowell: Yes. It was completely furnished, so it was Asarco appliances.

Swent: I was wondering what sort of stove you had.

Lowell: I think it was a gas stove.

Asarco, a Tight Company

Lowell: Asarco is famous for being a tight company. One of the features in our apartment was a spring-loaded hot water tap so there was no chance that they were going to heat water that was left running. In the engineering office--I still have one somewhere--they furnished pencil extenders so that when the pencil got down to two inches long, you sharpened the other end and screwed it into the extender so that you could use the rest of it. [laughter]

Swent: How much were you paid?

Lowell: I was paid $250 a month, and got a raise to $285 after a year.

Swent: In Mexico?

Lowell: It was U.S. dollars. I don't remember that I paid very much tax. I think I paid U.S. income tax, but percentage-wise it was pretty low.

Swent: And your health care was included?

Lowell: It was included.

Swent: Rent?

Lowell: Rent was included, and utilities. We didn't have a telephone, but there was a phone in the office, but it was pretty much an interior telephone system. We couldn't call home on the phone. We got two weeks a year of vacation. One fellow that we got acquainted with, who was a young engineer--he was probably ten years older than I--his name was Ham Bush, who was running a relatively small mine for Asarco over near Presidio, Texas. He reported to the mine manager at Santa Eulalia. He wasn't given a great deal of appreciation or cooperation or support. This is just a story to illustrate the Asarco mentality.

And he came in and talked to Mr. Syner. They talked about his problems and that he wanted a raise, and they wouldn't give him a raise, and so Ham said, "Well, I've been thinking a lot about this, and I'm afraid I'm just going to have to resign. But I do have three weeks of vacation due, and I assume you'll pay me for the vacation." Ham told me that Mr. Syner laughed and laughed and just slapped his leg [laughs] at the thought that somebody was going to get paid for vacation when he quit.

So it wasn't a paternalistic organization like companies now are.[1]

Swent: No, times have changed. You said the English-speaking group included people other than Americans, though, didn't you?

Lowell: Yes.

Swent: How large a colony was it? How many people were there?

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[1]See Simon David Strauss, "Market Analyst for Non-Ferrous Metals and Non-Metallic Minerals, Journalist, Mining Corporation Executive, 1927-1994," Regional Oral History Office, The Bancroft Library, UC Berkeley, 1995.

Lowell: Well, in terms of staff members, I suppose there were maybe twenty-five or thirty, plus families.

Swent: Was there a school?

Lowell: Yes. There was an English school, sort of a one-room type of school, taught by either one of the wives or an imported schoolteacher. I think they brought in a schoolteacher. At the end of eight years, it was pretty much understood that you had to go away to boarding school.

Swent: Did Edith have help?

Lowell: No. She had somebody named Basilia come in to help with the baby.

Swent: She didn't have a maid.

Lowell: No. The people with more status that had individual houses all had maids. We really didn't have any complaint about that. We were perfectly happy. Edith since that time has had maids and feels they're a mixed blessing. She's not very enthusiastic about having people underfoot.

We got our milk from a fellow that delivered milk in cans on a burro. The first thing you did with your milk when you got it was boil it because you were pretty sure that it wasn't very pure. This milkman, whose name I don't remember, was in a category in Mexico of whom I've met three. His problem was that he killed people. But he did it when he was drinking, and Mexican law protects a drunken man. He had killed, I believe, twelve people, and the last one occurred while we were there. During that period, his little boy had to deliver the milk. He was in jail for a couple of months, and then they let him go. On one occasion, one of the ladies saw this milkman adding water to one of his cans of milk out of a garden hose at one of the houses. But no one was about to criticize him. [laughter]

Some of the people at camp were well educated. The geologist, the resident geologist had a Ph.D. from Columbia.

Swent: What was his name?

Lowell: Bill Hewitt. There was a geologist named Severn Brown working on a dissertation there, who was getting a Ph.D. He's a fellow that we've since gotten well acquainted with long after the Santa Eulalia years.

There was a Howe-Sound Mining Company mine that was contiguous--their mine was in the same ore body as the Asarco one at Buena Tierra Mine. They also had a little camp that was very close by, like a quarter of a mile away. They added to the parties and entertainment. The manager's name was Martin [pronounced Mar-TEEN] Nesbitt. He was born in Mexico. I think his father had been a British mining engineer. A very nice guy.

There wasn't very much effort made to be diplomatic between supervisors and junior engineers and shift bosses and people like I was [chuckles]. Fritz Hertzel was a particularly tough, kind of mean guy. His nickname with the miners was El Camaron. And if you thought about it and looked at him, he was a little hunched over. He looked a little bit like a big shrimp [chuckles]. There was a Mexican foreman whose name was Macias, whose nickname was La Bestia [laughs]. I think those may have been the only two nicknames that I heard.

Finally, I was working very hard. I used to come out of the mine--we usually got a chance to come out for lunch and go back in and worked nine hours underground altogether. The mine was so hot that when I would change my clothes, I would pour half a pint of sweat out of my boots [chuckles] every time I was underground. It was pretty tough work.

Lessons Learned: Supervision, Record Keeping, Mine Surveying

Swent: What did you gain from the experience?

Lowell: Well, it was really my first opportunity to be a boss of anything, and I learned something about supervision. I had sixty-five men working for me a good part of the time I was there. I learned more about underground mining and quite a bit about record-keeping for operating a mine.

Swent: Were the people working under you all Mexicans?

Lowell: Yes. I did some pretty complex surveying jobs. Mine surveying, as you probably know, is rather more difficult than surveying out in the open.

Swent: What makes it different?

Lowell: Well, carrying azimuths underground, you have to hang wires, with a weight and a bucket of oil on the bottom, and line two wires up and determine as precisely as possible what the azimuth between

them is at the surface, when you go down and pick up the same azimuth underground.

Now, in the last ten years, they've developed some electronic ways to do that, that gets around the old plumbing-the-shaft type of surveying. But the basic difference is that you're surveying very much in three dimensions underground, and on the surface it's two dimensions with relatively minor, mild vertical angles. Underground, you might go this way [demonstrating] and so on.

Swent: Lots of different angles. Has that been useful to you?

Lowell: Yes, probably to a limited degree, but I think the human mind profits by being exercised, and you kind of learn how to do things, and if you have learned how to do several different things, you're more likely to be able to do something new.

Swent: Sometimes you learn what you don't like to do also.

Lowell: Yes. And that was basically the case in Mexico. In my last year in the university, I had started to tumble to the fact that I was really more interested in mineral exploration than I was in mining production work. After I had been there for a year and a half in Mexico, I started looking around for ways that I could shift into working as a geologist in mineral exploration.

Swent: How did you go about that?

Lowell: Well, just inquiries. I resigned--having learned from Ham Bush what the effect was of trying to collect your vacation, I resigned just after I had finished my vacation [laughs]. And came back to Arizona and started beating the bushes. Somebody told me that the Atomic Energy Commission was hiring geologists, and I succeeded in getting a job with them.

V GEOLOGIST FOR THE ATOMIC ENERGY COMMISSION, 1951 TO 1954

Manager of Cove School Drilling Camp, Arizona

Swent: How did you get that?

Lowell: How did I get it? I got the name of the fellow who was hiring people, and I wrote him a letter.

Swent: Who was it?

Lowell: I think his name was J. O. Jones in Grand Junction, Colorado? I believe that I went to Grand Junction for an interview. I'm sure I did. I don't remember what it consisted of, but the work that we were doing for the Atomic Energy Commission was looking for red-bed type uranium deposits in the Morrison formation in the Colorado Plateau. The basic game plan wasn't necessarily a very efficient way to find uranium reserves, but the Atomic Energy Commission jumped right into the mineral exploration. They didn't subsidize private companies that might have done it better, but they did it themselves.

Swent: What year?

Lowell: This was 1951. Let's see. Yes, this was sometime like in June of 1951.

The whole group that they had doing this work had been hired at almost the same time. The majority of them were recent graduate geologists from the East. I within a few months gravitated to a job as manager of a drilling camp with several other geologists reporting to me.

Swent: Do you remember some names?

Lowell: Yes. There was a really nice guy whose name was Bob Rock, who was a Colorado School of Mines graduate. There was a fellow named Nog

Yeater, who was from Texas. There was a fellow named Louie Roberts from Columbia University. I had a non-graduate sort of technician whose name was Johnny Epic, who had been a Navajo Indian trader and spoke Navajo. And I had a Navajo Indian whose name was Elwood Sosie, who had been in Merrill's Raiders in the war in the Pacific, as a code-talker. One of the geologists was John Blagburough and we had an engineer named Carl Applin.

Swent: Oh, yes.

Lowell: My memory kind of runs out. There were a couple of others.

A good part of my term with the Atomic Energy Commission was in a camp that was called Cove School. It was a abandoned Navajo day school in the Lukachukai Mountains, near the Four Corners area. Near Red Rock Trading Post in New Mexico. The nearest town to us was Shiprock, New Mexico. We carried out a number of diamond drilling projects. There was a drill contractor that had a crew in the camp with us. Altogether, there were probably twenty house trailers.

Swent: Was your family there with you?

Lowell: At that time, Edith and Susie and Spook, the Springer spaniel. We had bought a house trailer, a used twenty-nine-foot house trailer, which we brought in ourselves. Most of the others were living in smaller government trailers, and I think they had to pay rent on their trailers, so we kind of broke even. But ours was larger and somewhat more luxurious, although that's the wrong word [chuckles].

Swent: Relative term.

Lowell: We had a little interior shower, toilet stall, which was about as big as this table from here [demonstrating] over there.

Swent: About three feet square?

Lowell: But it was much better than having to go down to the Navajo school to use the showers there. I succeeded in tapping into a running water supply that the drill contractor had, with a garden hose. I suspended a fifty-five-gallon drum of water in a juniper tree so we had running water--even hot water from a little electric water heater!

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Swent: You had this hose going up in the can in the juniper tree?

Lowell: Yes, the hose was in a sort of under-the-counter-way hooked into the contractor's water line, and I suspended the barrel in the juniper tree, and could fill it by opening the faucet. That in one fell swoop gave us running water in our trailer, and we were able to have hot showers in our little shower enclosure. But our trailer was a second-hand kind of banged-up trailer. It had some kind of electrical short in it. We occasionally felt a little shock stepping into [chuckles] the trailer, but didn't think very much about it, but it was very worrisome for Spook, the Springer spaniel. He [chuckles] got in the habit of gathering himself together several feet away from the trailer door, making a great leap [laughter] so as not to form a continuous contact from the damp ground.

That was a very pleasant interlude for us and maybe the single most enjoyable period in my life.

Swent: How long were you there?

Lowell: Oh, about one and a half or two years, I guess.

Swent: Over different seasons, then.

Lowell: Yes.

Swent: You were healthy?

Lowell: Everybody was healthy. We sometimes learned of a Navajo squaw dance that was going on. They're three-day affairs. Part of it is out in the woods with a bonfire and drums, and they dance all night. We would drive our jeep up and sit on the ground with the Indians, watching the dance.

Swent: You have some nice Navajo blankets.

Lowell: Yes.

Swent: Did you get some of those then?

Lowell: Yes. I often stopped in trading posts to look at rugs when I was driving across the reservation. They're mostly wearing out now. Edith's grandfather had a collection that she inherited part of that are quite old. Some of those are more than a hundred years old. But we had a lot of entertainment in the camp. Everybody was about the same age and all kind of felt like it was all sort of an adventure living up in the mountains.

Swent: It was an exciting time, I'm sure. How much were you paid?

Lowell: I was paid about twice as much as Asarco had paid me [chuckles]. I don't remember exactly. I think it was something like four or five hundred dollars a month, and I got several promotions and raises later. Back in those days, one expression that was often heard was "ten-thousand-dollar-a-year man." Do you remember hearing that?

Swent: That's right, yes.

Lowell: And so four or five hundred wasn't all that shabby. That was like [chuckles] a five-thousand-dollar-a-year man. When I left the AEC in 1954 I had a GS11 rating, which was a middle-management government rating.

Swent: And your expenses were rather low, I imagine.

Lowell: Yes. Oh, one of the fellows overlapped with us for a while in the camp was Leo Miller, Leo and Julie Miller. Leo has since become a rather famous exploration geologist. He is largely given the credit for the discovery of the Kidd Creek Mine in Canada and one of the phosphate deposits in--I think it's in North Carolina. Leo is a real character, but when Leo and Julie were towing their trailer into Cove School, they stopped in Shiprock and were approached by somebody that was a derelict type and was stuck there without any money and hungry. Leo gave him all the money that he had, which was five dollars, and Julie said, "Leo, that's all the money you have." And he said, "Well, we've got enough groceries for two weeks, and he needed it worse than I did." [chuckles] But that's the sort of atmosphere.

District Manager, Holbrook, Arizona

Lowell: We moved from Cove School to White Canyon, Utah, which was another, similar camp near the Colorado River and were there for six or eight months. Then I was given a job in charge of the whole district covering the Navajo Indian Reservation District. We initially moved to Cameron, Arizona, which was a trading post, and then to Holbrook, Arizona, where we had a duplex house which seemed like the height of luxury compared with a house trailer.

Swent: What did you do with the trailer?

Lowell: We sold it.

Swent: That was a real step up.

Lowell: Yes.

Swent: Holbrook was a big AEC place at that time, wasn't it? Was there an ore buying station there?

Lowell: No. Where was that? I know there was an ore buying station, but I don't remember where. But it was somewhere in that vicinity.

Swent: Tuba City, I guess.

Lowell: Yes, Tuba City. And there was some kind of a concentrator there also.

Swent: There was a lot of activity around that area.

Lowell: But in Holbrook was a group of USGS geologists. It was called the Navajo Groundwater Project. One of them had been a professor of mine in the College of Mines, John Harshbarger, who became very famous in the groundwater business in North and South America, and he worked all over the world, principally finding water supplies in arid districts.

Another fellow that we became very well acquainted with and has since been one of our best friends is Charles Repenning. He's the one that made these plaster casts, fossil casts.

Swent: Let's tell what fossil casts.

Lowell: Oh. In the cabinet behind you are fossil casts of an Australopithecus skull and a Heidelberg Man jaw. Charles Repenning, who is known as Rep Repenning, was probably the number one vertebrate paleontologist in the geological survey and one of the handful of most famous in the world. We have visited with Rep and earlier with his family for many years. He now lives in Denver, Colorado. He is retired from the USGS but working as a paleontological consultant.

Swent: You make awfully good friends in a place like Holbrook, don't you?

Lowell: Yes. Holbrook, in my opinion, is one of the ugliest towns in Arizona, maybe *the* ugliest [chuckles].

Swent: Railroad originally, wasn't it?

Lowell: Yes, yes, and still is, probably. It's a predominantly Mormon town and somehow or other the religion aspect is a particular problem in Holbrook because the Mormons have become kind of clannish and not open to being friendly with outsiders. But

because of our good luck in finding two or three friends there, it was a very happy time for us.

While I was in Holbrook--I had finally decided--I had been thinking about this for a year or two before, which was going back to graduate school. I was working as a geologist but didn't have a geology degree. With the help of one of my professors from University of Arizona, Eddie McKee, I was able to get into the graduate school in the Department of Geosciences at Stanford University.

Study of Mapping Fossil Stream Direction

Swent: How did he help you?

Lowell: Well, by giving me a recommendation. For no particular reason, I had initiated at Cove School a study of mapping of fossil stream direction indicators: cross-bedding and ripple marks and lineation. This was used as an aid in finding uranium deposits.

Swent: You did a paper on that.[1]

Lowell: That's right.

Swent: Is that one of your first papers?

Lowell: I think that was *the* first paper. Eddie McKee was kind enough to act as--he was a sedimentationist, and he was kind enough to act as advisor and critic on the paper.

Swent: I had a question about that, too. You had mentioned--I guess it was Bob Rock that you mentioned here earlier, and John Masters?

Lowell: Yes. Well, John Masters was a fellow that spent some time in Lukachukai camp. He was not in my group. He was independent of my group and in a mapping group.

Swent: He did work with you to some extent on this cross-bedding paper?

Lowell: No.

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[1]David Lowell, "Applications of Cross-Stratification Studies to Problems of Uranium Exploration, Chuska Mountains, Arizona." Economic Geology, March-April 1955, vol. 50, #2, pp. 177-185.

Swent: His name came up in it for something. You had mentioned these two names: Masters and Rock.

Lowell: The AEC was organized into two divisions. The one was something like the drilling division, which was sort of a production, physical exploration division. And the other division was called the mapping division. Their function was to do district and regional geologic mapping to support the exploration. John Masters was working in the mapping division, and I was working in the drilling division. We were in the same camp but independent of each other. Leo Miller was also in this mapping division. I don't remember why Masters was mentioned, but maybe in connection with using the base geologic map that he had made.

Swent: Here we are. [reading from paper] The paper was called "The Applications of Cross-Stratification Studies to Problems of Uranium Exploration in the Chuska Mountains," right?

Lowell: Yes.

Swent: And it was in *Economic Geology*, Volume 50, Number II. You acknowledged the help of E. D. McKee and W. L. Stokes. McKee was your teacher from Arizona.

Lowell: Yes. And Stokes was a college professor at the University of Utah.

Swent: And he had done studies of the Morrison formation, which inspired your paper. And then you said that it was based on field data collected by R. L. Rock and J. A. Masters.

Lowell: Well, the geologic base map was probably made by Masters and some of the stream directions mapped by Bob Rock.

Swent: That was in here, I think in your abstract, perhaps. [Reading]: "Ancient stream directions may be reconstructed through use of cross-stratification," but you had said "field data."

Lowell: Well, my recollection is pretty hazy, but I did some of the cross-stratification mapping and Bob Rock did part. My time was limited because I was also managing the whole program of road construction and drilling with up to six drill rigs.

Bob Rock was working for me, and John Masters was not at that time. He was in this other program.

Swent: What sort of field data would you base a paper like this on?

Lowell: Just systematic mapping of cross-stratification structures in outcrops. I think the actual cross-stratification mapping was done by Bob Rock and myself. The mapping that Masters did was more regional, geologic mapping, not cross-stratification. And there was geologic work being done by many different people.

Swent: It must have taken a lot of discipline to get all this together and to get a paper published in *Economic Geology* at that time, when you were so busy out in the field.

Lowell: Well, it's partly a search for glory [chuckles] to get a first publication to help you in your career and so on.

Edith Lowell's Help in Editing

Swent: Did Edith play any part in encouraging you to do this? Helping you?

Lowell: Yes, she definitely did. She didn't get involved very much with the geology, although she had a geology minor at the university. But she was helpful in editing and that sort of thing. Edith was a Phi Beta Kappa and Phi Kappa Phi scholar in college, in contrast to my trying to reach the minimum grade point average [chuckles] to graduate. She got a degree in anthropology, with, I think, split minors in Spanish and geology. At the time I started off in the consulting business, she went back to school to get a teaching certificate so she could get a job as a schoolteacher. That evolved into a master's degree in Spanish. She has quite a bit of academic background also.

Swent: When did she--she did that after your time at Stanford, I guess.

Lowell: Yes. It was around 1970 or '71.

Swent: I see. We're still back in 1954, getting you to Stanford. So your contact with McKee, then--through the years, you stayed in touch.

Lowell: That's right. Edith had also been a student of McKee at University of Arizona. We knew his family also. But anyway, I got accepted at Stanford.

VI GRADUATE STUDY AT STANFORD, 1954 TO 1955

Shifting from Mining Engineering to Geology a Problem

Swent: Why Stanford?

Lowell: Well, the main reason was that Eddie McKee told me to go to Stanford [laughs]. I was also--there was a professor at the University of Minnesota by the name of John Gruner, who was one of our consultants in the AEC, and I worked with Dr. Gruner. He offered me a fellowship at Minnesota to get a Ph.D. I seriously considered that and talked to people about the climate, which seemed kind of awful [chuckles]. It was also--the subject seemed a little bit more academic than--I have always been interested in applied science but not much in pure science. Anyway, I didn't take Dr. Gruner's offer.

Swent: How did you meet him?

Lowell: Working with him at AEC.

Swent: What do you mean "working with him"?

Lowell: Well, he came in as advisor in some of these geologic techniques, and I spent a number of days in the field with him and made little trips and so forth. He decided that he could use me as an assistant at the University of Minnesota.

Swent: What sort of science did he want you to pursue?

Lowell: Well, his program was geology but more in the area of structural geology. It was partly lack of understanding on my part. I have since decided that one Ph.D. is probably about as good as another, that it's more going through the exercise of studying courses and so forth, rather than actually using the graduate education as a basis for doing jobs afterwards; it's more of an exercise than a cookbook qualification, in my opinion.

Anyway, didn't go to Minnesota. Did go to Stanford. And was too optimistic about my financial capability--I didn't have a fellowship at Stanford. I got a little bit of fellowship money once or twice, but it wasn't significant. I had been over-optimistic in thinking that the money I had saved would carry me through three years for a Ph.D., and I actually stayed as a resident student for only one year there.

I had the other problem of shifting from mining engineering to geology, and I lacked some prerequisite courses, and was also thrown in with real professional students who knew exactly how to get good grades and study and all those things.

Swent: Of course, you had a wife and two children, too.

Lowell: Yes. I really had an unpleasant time at Stanford. I got fairly good grades, but I had to work like a Trojan. I worked fourteen hours a day six days a week and then something like six or eight hours on Sunday [chuckles]. At the end of one year, I had gotten the language requirements for the Ph.D., but still lacked course work.

Swent: What were you taking that year?

Lowell: I was taking an ore deposits course, basically, and I took advanced mineralogy and petrology and paleontology, which I had never had.

Paleontology Professor Simon Wilhelm Muller

Swent: Who were your teachers?

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Lowell: The ore deposits teacher was Charles Park. My advisor was George Thompson, who was a geophysicist and structural geologist. The individual professor that I was most taken with was the paleontology professor, whose name was Simon Wilhelm Muller. Dr. Muller was a Russian who had escaped from Russia during the Russian Revolution. He felt that Stanfordian students were too conventional and obedient and methodical, and they were not discriminating because they were, by definition, expert students but not necessarily thinkers.

This is the first and only time I've heard of somebody teaching a course this way, but he at the beginning said, "I want

you to understand that some of the things in my lectures are going to be true and some are going to be false, and it's up to you to discriminate and evaluate this information." This horrified [chuckles] most of the graduate students, who had never run into this problem before. But it just fit with my approach to life, and so I was maybe the top student in that particular class.

Dr. Muller talked to me afterwards and tried to talk me into taking a job as a professor in one of the Oregon schools--University of Oregon or Oregon State University, one of them. Which is also the first and only time that anyone has had the remotest idea that I could be a university professor [chuckles].

Swent: What was different about your background, I wonder, that would make you outstanding in that class as opposed to other people?

Lowell: Well, I think I owe it to my angel mother, who convinced me at an early age that I was almost always wrong and bad [laughs].

Swent: You had to prove her wrong?

Lowell: I had become accustomed a long time before being criticized and frowned at, so it didn't bother me at all telling Dr. Muller, "I don't believe that A, B, and C are not true."

Swent: And he liked that.

Lowell: He liked that. The whole course was kind of a game.

I had courses from Bob Compton, who was a slightly famous petrologist, and Colin Osborne Hutton, who was a New Zealander who was a genuinely famous mineralogist. I was thrown in over my head in both of those courses because the Stanford catalog wasn't really clear on what the prerequisites were. But I managed to survive both courses.

Dr. Hutton was a New Zealander with a heavy New Zealand accent, and I couldn't understand him. I thought he was from some southern European country [laughs] for the first few days. That's about all of the--

Swent: Where were you living?

Lowell: Well, we lived in Menlo Park in a house. That is, not a duplex. And very comfortable. It was a blue-collar neighborhood. Our next-door neighbor was a truck driver. He had a daughter about the same age as Susie. One of the stories that came back to me was this little girl said to Susie, "My father went to school,

too, when he was a boy." [laughter] They couldn't understand why a grown man would be going to school [chuckles].

Our second child, Bill, was born while I was working for the AEC. He was born in Tucson. Edith's parents were living in Tucson. She came down and stayed for a while in Tucson.

Swent: What was this child's name?

Lowell: William David Lowell.

Swent: And Susie's name is?

Lowell: Susan Deborah Lowell.

Swent: And this boy is called Bill?

Lowell: Bill.

Swent: And he was born in Tucson.

Lowell: Born in Tucson.

Swent: And what was the date?

Lowell: Well, I happen to have that [going through papers].

Swent: All right [laughs]. I'm not sure I got the exact date of Susan's birth, either.

Lowell: Well, Susan's birthdate is October 27, 1950. And Bill's birthdate is April 18, 1952.

Swent: Paul Revere day, just about.

Lowell: And Doug's birthdate is June 6, 1956.

Swent: That was after you were out of Stanford.

Lowell: Yes.

Swent: So by now you had two children, at Stanford.

Lowell: Yes.

Swent: I don't need to ask what Edith was doing with her days.

Lowell: Well, she really couldn't get a job. She didn't have--

Swent: She had a job! [chuckles]

Lowell: As I said, it was kind of a miscalculation of mine. I thought I could get through a couple of years and really ran out of money at the end of the first year. I got a job working for a Canadian mining company whose manager was a fellow that I had met in the Atomic Energy Commission, Tom Mitchum. The company was called Ranwick Incorporated and was based in Denver, Colorado. We moved from--I left Stanford with the understanding that I was going to write a master's thesis after I left, to complete requirements for a master's degree, and I did that over the next two years.

VII EXPLORATION GEOLOGIST FOR RANWICK, SOUTHWEST VENTURES, UTAH CONSTRUCTION, 1955 TO 1959

Manager, Menlove-Dalton Uranium Mine, Colorado

Lowell: Ranwick Incorporated had about six geologists. It was an exploration company. It was looking for uranium deposits and based in Denver. I was chief geologist and was paid $11,000 a year which was a very good salary in 1955.

Swent: Edith and the children moved, then, to Denver?

Lowell: Moved to Denver. The way it worked out: she didn't have a chance to go with me to look for a house, and I did the house hunting myself in Denver. I found a house on University Boulevard, which was a remodeled farmhouse in the middle of a large lot. It was something like an acre of land, all in lawn, and a beautiful house, well fitted out. It had one flaw, which was that the garage opened on an alley behind the house, and it was almost impossible to drive from the alley into our garage [chuckles].

I went back to Palo Alto to get the family, and we drove to Denver, and I was really feeling proud of this house. I thought, "Boy, you've really pulled off a coup here." And Edith took one look at it, and burst into tears [laughs]. I think it was the garage that got her more than anything. She finally got kind of fond of it. We had some friends in Denver. It was a really nice house.

Swent: You were traveling a lot, I suppose.

Lowell: Yes. At that point, I was traveling most of the time. Ranwick acquired a uranium deposit which they developed into a mine. It was called the Menlove-Dalton Mine. It was in southeastern Utah. I more or less by default became mine manager of the uranium mine because I was the only one in the company that knew anything about

mining at that point. Ranwick was a subsidiary of Ventures Limited of Canada.

Swent: Oh, yes.

Lowell: It had a short, sort of chaotic, turbulent life. The budget was cut, and Tom Mitchum took a job with Kennecott, and most of the other geologists were fired.

Swent: What had been the point of setting up a subsidiary?

Lowell: Well, Ventures Limited operated through a large number of subsidiaries.

Swent: That was Thayer Lindsley?

Lowell: Yes.

Swent: He was the head of it all.

Lowell: Yes.

Swent: He just liked to have a lot of companies?

Lowell: Well, it was sort of a mechanism for financing new projects. If it had a new name and a new organization, then it was possible to sell stock and get public money to finance a new venture. Later I worked for Ventures subsidiaries for several years, I think four or five years.

Swent: For different subsidiaries?

Lowell: Yes. At one point, I was back in Toronto, and one of the parent company officials gave me a brochure of the Venture companies, and at that time there were 120 subsidiaries. Most of them pretty dormant, but there were a few, like Falconbridge Nickel, that were making money and McIntyre Mines and Compania La India in Nicaragua. But it was a very unusual company.

Swent: What did you think about this?

Lowell: Well, I didn't have enough background information at that time to know, to have an intelligent opinion, but it made an interesting job. I guess I became general manager of Ranwick a year or two later. We ran out of funds in our bank account, and I called the Ventures treasurer and asked to have some money transferred, and he said, "Well, I'll look around. I think there's some money in one or another of these companies." [chuckles] Then I later read that Thayer Lindsley was severely criticized by shareholders and

the Ontario stock securities commission and other people for moving money from one company to another [chuckles]. He wasn't doing it for any bad reason. It was just to try to keep everything going.

The Menlove-Dalton Mine was out in the flats near Dove Creek, Colorado. It was a mine that almost made it, but never quite made it, because there wasn't enough ore to support a long-term mining operation. At one point in spring, and this might have been the spring of 1956, in the spring thaw--we had two or three jeeps and a road grader and a bulldozer and a big haul truck, and one of these got stuck in the mud, and they sent another one to pull the first one out, and the second one got stuck, and so on, until our whole rolling fleet [chuckles] were all stuck in a line in this bottomless mud pit. There were lots of problems.

We had animal haulage underground, and we had, I think, three mules, including a lady mule who had been trained to tow ore cars that had automobile wheels so they would roll easily, and dump their cars in the ore bin.

Swent: This is in the fifties! I had no idea they were still using mules!

Lowell: Anyway, this jenny mule, whose name I used to remember but have forgotten--

Swent: She won't complain. She won't read this and feel bad that you forgot her name. [laughter]

Lowell: She backed her car and dumped the ton of ore into the ore bin, but she backed a little bit too far, and the ore car pulled her into the ore bin, and there was great excitement. I was a non-resident manager. I wasn't there much of the time. She was rescued and pulled out of the ore bin and dusted off and didn't have anything broken. But mules are very peculiar animals, and she decided, "That's it. No more animal haulage for me." And she wouldn't ever pull her car again after that. [laughs]

Swent: Stubborn as a mule.

Lowell: Eventually, the Menlove-Dalton Mine slowed down to a stop. In the meantime, I had found a copper prospect for the company at Copper Basin, Arizona, near Prescott. The budget had shrunk by this time, and we moved to Prescott, and I did a careful study of the district and eventually wrote an article which--I was joint author with Bill Johnson, who had written a dissertation on the Copper Basin district.

Swent: How was the article different? What did you contribute to the article that was different from his dissertation?

Lowell: I had done more work than Bill and had done drilling, had managed a drilling project and had some additional ideas and so on. He was the senior author.

Swent: That was in *Economic Geology?*

Lowell: Yes.

Swent: Okay. Meanwhile, you're also working on your thesis.

Lowell: Yes, but by that point I had gotten it approved and had my master's degree. I don't think I went back to Stanford--I don't remember whether I went back to the graduation ceremony.

Swent: What was your thesis?

Lowell: Well, the thesis was basically on the geology of the Menlove-Dalton uranium deposit and the mineral district it was in.

Swent: Do you recall the title?

Lowell: No, I don't. It wasn't a great contribution to science, I can tell you that [chuckles].

Swent: What was special about the geology there?

Lowell: Well, nothing particularly, it was a sediment hosted oxidized uranium deposit, but I jumped through all the hoops for a thesis. Some of my other publications I think have been contributions to science, but that one wasn't.

Swent: But they come step by step.

Vice President, Southwest Ventures, Inc.

Lowell: Yes. Ventures had another subsidiary that had been working largely in Mexico that was called Southwest Ventures, Incorporated. They told me they were going to fold up Ranwick and make me vice president of Southwest Ventures, so I just changed the letterhead and went on with pretty much the same job, but we moved from Prescott to Tucson. Edith felt very strongly about her roots in southern Arizona, and she was overjoyed.

We moved to Tucson and rented a house for a year and then built a fairly modest house. Edith's father and mother had homesteaded an area in the Catalina foothills north of Tucson. They still had a good part of this land, some of which they had given to Edith, and we had this house built on an acre lot and moved in. I built a swimming pool myself there and did various--

Swent: A small open-pit mine?

Lowell: [laughter] That's right! I had an old friend who was a friend of my brother's in Tucson, and his name was Brackston Whittaker. Another fellow and I both built our own home swimming pools at the same time. We were both friends of Brack Whittaker, and we would go to him and ask how to do various things [chuckles]. He finally--we were talking to him at a party once, and he finally said, "You know what you fellows should do is to get a night job and save the money and let me build your swimming pools." [laughs] Which would have been very good advice, but we didn't do that. I have always been optimistic about being able to do things and build things.

Working for Southwest Ventures, I did quite a bit of work in Mexico and Arizona and California and New Mexico.

Swent: When you say you "did work," what were you doing?

Lowell: I mainly was examining mineral prospects that were submitted to us and sometimes making option agreements and carrying out exploration drilling projects on the prospects.

Swent: Were there any that you remember of particular significance?

Lowell: Well, nothing really came out of that work. We had a joint venture with Cominco, a large Canadian company, and did work in the Prescott district, looking for massive sulfide deposits of the Jerome variety, and found some smells of mineralization but nothing that came close to a viable deposit. We worked on some precious metal deposits in Sonora.

Swent: Let's see. What was going on? We haven't mentioned the Korean War.

Lowell: Well, skipping back to my days in the University of Arizona, in my senior year I was in a metallurgy course, in which we did lab metallurgical projects, and my lab partner was a fellow whose name was Johnny Ware. He had been in the Second World War in the Marine Corps and was the captain in charge of the Tucson company of the Marine Corps active reserves.

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Swent: You were saying that Johnny Ware was in your class, and he had known your brother.

Lowell: Yes. He had been an officer in the Pacific, in the Marine Corps, and when he came back to finish his mining degree, he had a part-time job as commanding officer of the Tucson Marine Corps Active Reserve company. In the course of chatting in our school work, he said, "Why don't you join the Marine Corps?" He said, "I can get you a rating of sergeant in this Marine company, and you will earn"--I can't remember but I believe it was $15 a week. You had to drill one day a week [chuckles]. Whatever it was, it sounded very good to me.

I discussed this with Edith, and she said, "I don't know. I think that's a bad idea, and I wish you wouldn't do that." And since I wasn't thoroughly convinced, I said, "Well, I don't think I will." Then I graduated. Then we went to Mexico, and we were getting the Tucson newspaper and the Korean War had started. I was exempt because I was married and had a child. But there was an article that said that all members of the Tucson Marine Corps company have been called up and sent to Korea! And fought at the Chosin Reservoir. I read a book later about the Chosin Reservoir campaign in the Marine Corps, and it said that a bunch of the troops were just like this. They were sort of undertrained reservists that were sent over, and it was freezing cold, and they were cut off by the Chinese army. I talked to somebody later that knew about this company, and about a third of them were killed there [chuckles]. It would have been an awful mistake.

Swent: You had been in ROTC in college.

Lowell: Yes.

Swent: But you didn't continue with that.

Lowell: I took two years, which were required, and I didn't take the second two years to get a commission through the ROTC. I became a staff sergeant in the two-year stint.

Swent: That's interesting. I was thinking more of what happened to metal prices and exploration as a result of some of these external events. There was of course the uranium boom, which you were involved in, and then there was a copper boom.

Lowell: When I graduated in 1949, it was a depressed period in metals. I think--I hadn't thought about that, but maybe partly as a result

of the Korean War, it went from bust to boom in two or three years.

Self-Education in Porphyry Copper Geology

Swent: In the early fifties.

Lowell: Yes. There began to be quite a large amount of exploration being done in southern Arizona for copper, beginning probably late in '50. Well, I was kind of involved in that with Southwest Ventures. We were looking at porphyry copper prospects. During that period, I began to educate myself on porphyry copper geology. By 1959, when I left Ventures and went to work for Utah Construction Company, one of my credentials was knowing quite a bit about porphyry copper deposits.

Swent: How did you go about that?

Lowell: Oh, by reading and visiting mines and looking at prospects and talking to people. Later in my career, in the 1960s, I set out on a program, with malice aforethought, to try to visit every porphyry copper deposit in the world. I tallied up at one point that I had been to more than half of them. But when I went to work for Utah Construction Company--

Swent: I think we should talk about that. Let's take just a bit of a break.

[tape interruption]

Senior Geologist, Utah Construction Company, 1959

Swent: We're resuming after a little break here. You have been at Southwest Ventures, you've built your house and built your swimming pool. How did you come to leave Ventures and go to Utah?

Lowell: Well, I was offered a job by Utah Construction Company in San Francisco as a senior geologist, with the understanding that I would be returning to Arizona as a district geologist for them.

Swent: How did this offer come about?

Lowell: You know, I don't remember what the circumstances of the offer were.

Swent: Who gave it to you?

Lowell: It came from the vice president in charge of exploration, Wes Bourret. I really had relatively little contact with him. The person that I reported to during most of my time with Utah was Hollis G. Peacock, who was chief geologist.

Swent: What was the name of the company at that time?

Lowell: Utah Construction Company.

Swent: It was still Utah Construction. Not yet Construction and Mining? It was originally Utah Construction and then at some point they added Utah Construction and Mining.

Lowell: I don't think it was Utah Construction and Mining.

Swent: What did you know about Utah at that time?[1]

Lowell: Not a great deal. I knew that it was an important heavy construction company, and I knew that they were pretty heavily in mining, principally iron mining and coal mining.

Swent: Had they gotten into uranium then?

Lowell: Yes, they were in uranium also. I have a faint recollection that part of the background for my job offer was the fact that I was knowledgeable about copper exploration.

Swent: Had you been getting tired of Ventures?

Lowell: Well, not really, but the funding was beginning to run out for Ventures' program in the southwest. Edith had been feeling insecure working for a small company. She later, by trial and error, discovered that small companies, all things being equal, are more secure places than large companies [laughs]. But neither of us totally understood that at that time.

Hollie Peacock probably taught me more exploration geology than anyone that I teamed up with in my professional career.

Swent: Had you known him before?

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[1]See Alexander Wilson, interview in process 1999, Regional Oral History Office, The Bancroft Library, University of California, Berkeley.

Lowell: No, I hadn't. Most people found Hollie Peacock to be a little bit abrasive. He was a very fast-thinking, kind of ironic, hard-to-joke-with type of a fellow. I was almost the only one in our department in San Francisco that really appreciated Hollie Peacock. I think he was very productive, and was probably almost in the genius range as far as intelligence.

Swent: So did you move out there?

Lowell: Yes. We moved from Tucson to Palo Alto, California. Utah had an office in Palo Alto at the time I went to work, but it was kind of a temporary office arrangement. Our office was shortly afterwards moved to their corporate office on California Street in San Francisco. I had to commute to San Francisco after our office moved.

One of my fellow geologists working for Utah was Paul Riddell. Paul was also a second-generation miner. Have you ever heard of the Riddell mucker?

Swent: No, I haven't.

Lowell: His father was a professor, I think in Michigan Tech, and invented a clamshell mucking device for sinking shafts. Was a well-known mining person. But Paul and I lived close to each other in Palo Alto, and we shared rides and commuted together to the office in San Francisco. Paul had a home brewing operation going, and when he had extended field work at a critical time, when I was in the office I had to tend his batch of beer for him [chuckles].

We were a symbiotic team in the commuting process because I was a morning person, and he was a night person, and I often had to drive the car on the trip to the railroad station in the morning, and he would drive back at night. He had problems like forgetting to put a belt in his pants and leaving the lights on [chuckles] and being late and whatnot.

Swent: You took the train up.

Lowell: We took the train. We drove to the Palo Alto train station and took the train to the San Francisco station and either walked or took a bus to the financial district. I did pretty much the same sort of work for Utah that I had been doing in Arizona, and did a lot of airline traveling to various places, evaluating mineral prospects and an occasional drilling program.

Swent: Where were they?

Lowell: Well, mostly in western U.S. and Mexico. I don't remember whether I got out of North America ever. I don't believe so. After working for something over a year in California, I was invited to go to Arizona to open a branch exploration office for Utah in Tucson, which had been the original understanding with them. I did work on several copper projects. One was the Sacaton area, where Asarco was in the process of discovering the Sacaton ore body. Other work was in Utah, in the Eureka district and Cedar City area in Utah.

Swent: They had an iron mine in Cedar City.

Lowell: Right. And I visited the mine, but I really didn't make any contribution to geology there. After two years, Hollie visited my office in Tucson, and he said--well, I'm skipping one step in this. That is, Edith was very homesick to return to Arizona--

Swent: I was thinking you had just built your new house.

Lowell: We had just built the new house, and instead of selling it, we rented it, hoping to come back.

Swent: Did you have three children by now?

Lowell: Three children. She was overjoyed to come back to Arizona. I knew that she really didn't want to leave again. And Hollie came to my office, and he said, "I have good news for you. You're going to be transferred to Vancouver and you'll have five geologists reporting to you, and it's a big promotion."

I said, "Well, Hollie, I won't go to Vancouver."

He thought a minute, and he said, "Well, in that case, you're fired."

I thought a minute, then, and I said, "Well, in that case, why don't you give me a retainer to be a listening post and agent for Utah in Arizona?"

And he thought a minute, and he said, "Okay." [laughs] And so that's how I got in the consulting business. It all happened within five minutes.

And when I told Edith about it, she was very happy to hear she wasn't leaving Tucson, but very worried about not having any security.

VIII LOCATING THE KALAMAZOO ORE BODY IN ARIZONA

Becoming an Independent Consultant, 1961

Swent: Had you entertained this thought at all before then?

Lowell: I had thought a little bit about it, but it was really very much a spur-of-the-moment decision. So she hustled around, trying to get her teaching certificate. I had some old patented mining claims near Prescott that I had acquired kind of on a fluke. After I left Utah Construction I started a project to try to develop these as cabin sites, and at the same time informed all my friends that I was available to do consulting work.

Swent: So this was 19--

Lowell: In 1961.

Swent: I'm trying to think. You were thirty-three years old.

Lowell: Mmm, that's right.

Swent: Had three children. How old were the children then?

Lowell: Well, they were roughly--

Swent: Let's see.

Lowell: [chuckles]

Swent: Bill. You call him Bill?

Lowell: Yes.

Swent: He was nine, Susie must have been eleven. Doug is your third child. He was--

Lowell: He was born June 6, 1956, so he would have been five years old.

Swent: And he was born in Tucson also?

Lowell: He was born in Prescott.

Swent: Prescott, okay. So you had a lot of responsibilities--

Lowell: [chuckles] That's what Edith said.

Swent: --for a young man. But you were young and healthy and--

Lowell: Optimistic.

Swent: It's amazing, though, to make a decision of that magnitude.

Lowell: Well, that is not really very surprising in the mining business. Anyway, I started hustling around, expecting the worst, and I did have this relatively small retainer from Utah, which was equivalent to a couple of days a month of work. To my surprise, work started coming in. I worked for Kern County Land Company on several projects. One was a choice assignment in Death Valley in July and September [chuckles].

Swent: Oh, my! What sort of thing was that?

Lowell: Oh, it was managing some drilling projects for borate deposits, the sort of thing that U.S. Borax had. It wasn't the borax mineral. It was colemanite and some other mineral, but the same kind of occurrence.[1]

Swent: This was a project they already had.

Lowell: That they already had, but they didn't have anybody to send over. I had a similar job on a potash project for Kern County and Duval Corporation up near Navajo, Arizona. And probably a couple of other jobs.

Swent: How did Kern County know about you?

Lowell: Well, the area chief geologist was Wayne Wallace, who was a friend of mine in Tucson. At about the same time, Bob Fulton, who was vice president in charge of exploration for Newmont, asked me to do some work for Newmont.

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[1]See Carl L. Randolph, "Research Manager to President, U.S. Borax & Chemical Corporation, 1957-1986," 1992; and Eugene David Smith, "Working on the Twenty-Mule Team: Laborer to Vice President, U.S. Borax & Chemical Corporation, 1941-1989," 1993, Regional Oral History Office, The Bancroft Library, University of California, Berkeley.

Consultant on Porphyry Copper for Newmont

Swent: How did you know him?

Lowell: Well, I didn't know him, but he knew of me.

Swent: How did he know of you?

Lowell: Well, I had a little bit of a reputation in porphyry copper work at that time, and Newmont at that time was really more of a holding company than a mining company. They operated a number of large mines, but as partly-owned subsidiaries. The company itself had a very small exploration staff.

Swent: They had Carlin.[2]

Lowell: They had Carlin, and they had geologists working there, and they had O'Okiep and Palabora in Africa and at least one other important mine. But the exploration staff in New York was only Bob Fulton and maybe one other fellow. They had a research center in New England, in Danbury, Connecticut, where there were two or three people who were--the manager was Arthur Brant. It was more of a research effort. They had a couple of people in Vancouver, but they were working mostly in Canada.

Swent: Did you work at all with John Livermore?

Lowell: A little bit, yes, but not a great deal. Bob Fulton was in the habit of using consultants more than most companies do, as kind of staff supplements. I got along very well with Newmont and spent most of my time for a couple of years working with Newmont.

[Bob Fulton was one of the most impressive people I have known. He was a very intelligent, determined, decisive man, but economical of words in both his conversation and his letters. One letter he sent me consisted of only four or five words. He had been a distance runner in college and liked to hike long distances when reviewing exploration projects with me. He was grimly determined to get any job done and not inclined to accept excuses.

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[2]See Plato Malozemoff, "A Life in Mining: Siberia to Chairman of Newmont Mining Corporation, 1909-1985," 1990; Frank Woods McQuiston, Jr., "Metallurgist for Newmont Mining Corporation and U.S. Atomic Energy Commission, 1934-1982," 1989; William A. Humphrey, "Mining Operations and Engineering Executive for Anaconda, Newmont, Homestake, 1950 to 1995," 1996; and John Livermore, interview in process 1999, Regional Oral History Office, The Bancroft Library, University of California, Berkeley.

When I began to do consulting work for him he was vice president of Newmont, and he later became president of MacIntyre Porcupine Mines in Canada, where I again did consulting work for him twice at Madeleine Mine in Quebec. Bob and John Livermore were managers of the team that found the Carlin deposit. John Livermore got most of the credit, but I understood that there had been an acrimonious argument about credit within Newmont, and I have always suspected that Bob Fulton, who was a very stiff-necked and understated guy, probably didn't get as much credit as he should have.][3]

Swent: What sort of arrangement did you have with them?

Lowell: Well, it was just on a daily-fee basis. I don't remember having a retainer contract with Newmont. I may have had some kind of a minimum time guarantee, but it was mostly just job by job. I usually worked directly with Bob Fulton in the field. I worked with a couple of other people from Carlin, Nevada, a little bit; but mostly I worked by myself on the Newmont projects.

Swent: What exactly were you doing?

Lowell: I evaluated mineral prospects and did geologic mapping, and I did a little bit of work at San Manuel, but it was as a guide for giving Newmont geologists from other parts of the world a sort of a short course in porphyry copper geology. And I took two groups to San Manuel--

Swent: They didn't have anybody on their staff who could do that?

Lowell: Well--

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Swent: When you had visitors, I would think you would ask your own resident geologist to show them around. Maybe they didn't have one.

Lowell: Well, they had a number of geologists in San Manuel, and one or two of them went with us when these tours would visit San Manuel, but I took the same group of geologists to other copper deposits in Arizona and gave them a short course in porphyry copper geology. I did that twice. As I remember it, one group--I think at that time John Livermore was in charge of their work in Canada. He came with a group of Canadian geologists. And the other group were kind of multinational. They were from Africa, Australia, different places.

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[3]This paragraph was added by Mr. Lowell during the editing process.

Out of that work came the Kalamazoo discovery, indirectly. I had been kind of skeptical about the description of the geology of San Manuel Mine before this happened.

Geology of the San Manuel Mine, Arizona

Swent: Can you elaborate on that a little bit?

Lowell: Well, San Manuel was originally mapped by a fellow named Schwartz. This was back in the wartime copper development period. I forget: I think I met Schwartz once, but I didn't participate in the San Manuel work. But he logged a large number of churn drill holes, many of which passed through the San Manuel Fault into the San Manuel ore body. He was uncertain about the origin of San Manuel ore body.

Swent: The fault had already been named and was recognized?

Lowell: Yes, it was named during the San Manuel exploration work. Schwartz, I think, did a good job on his study. I think he was working for the USGS [United States Geological Survey] when he did that. Then around 1960 the USGS did another study in the district, and a fellow named Cy Creasey, who probably did not do as capable a job as Schwartz but more academic, mapped the San Manuel Fault and geology of that quadrangle in the San Pedro Valley. Creasey described the San Manuel ore body as a typical canoe-shaped deposit. And that puzzled me because--

Swent: Was this in a USGS paper?

Lowell: Yes. That puzzled me because I didn't know of any other canoe-shaped ore body in the world [chuckles], especially a porphyry copper deposit. The San Manuel deposit is like a--is canoe-shaped. It's kind of a trough-shaped deposit with essentially barren material in what would be the inside of a trough.

Swent: Yes.

Lowell: And Cy Creasey explained that as a barren intrusion into the deposit. He explained the San Manuel Fault, which looks like this [demonstrating]--

Swent: That doesn't show on the tape. So it's dipping like a--

Lowell: Okay. The San Manuel Fault dips to the southwest and cuts off the San Manuel ore body on the top. Cy Creasey in his paper said he

thought the San Manuel Fault was a strike-slip fault; in other words, had displaced the missing part of the ore body laterally rather than vertically. None of this--by this time, I had visited quite an impressive list of porphyry copper occurrences in North America and other places, and it didn't seem to fit with my ideas about concentric zoning of porphyry deposits, and seemed like an illogical conclusion to reach.

So during these two Newmont tours, we had maps and I made a point of collecting rock specimens in a fence pattern across the ore body both times, which is somewhat difficult going through San Manuel because the walls have been grouted with high-pressure concrete and it's only an occasional window where you actually see the rock.

But I was able to piece together specimens and then took them back to my office and brooded over them, and the mineral assemblage and the silicate alteration assemblage. I came up with an alternative thought about the geometry of the deposit, which was that it was half of what had originally been a vertical cylinder and had been tilted, and then had been sliced by a fault this way [demonstrating].

Swent: Vertically.

Lowell: Not vertically, but at a steeper angle. I didn't really think very much more about it at the time, but I talked to Bob Fulton about this and said, "Why don't you let me do some work on the west side of the deposit? There might be a target over there to find the missing piece of the ore body." He turned me down, partly because he didn't want to ruffle the feathers of the geologists working at San Manuel.

Swent: May I interrupt with a couple of questions? Is it generally done that when you're going through a mine like this you can grab samples as you go along? Is that all right?

Lowell: Yes.

Swent: You didn't have to be surreptitious about it?

Lowell: No, no, no.

Swent: Were other people doing it at the same time?

Lowell: Yes, yes. But they were doing it more out of curiosity, to have some rocks to take back to Canada, and I was doing it more to try to understand the geology. Dr. Muller would have approved greatly

of that, rejecting the dogma and trying to come up with a new idea.

Swent: It's not in a class with shoplifting, in other words.

Lowell: No [chuckles].

Swent: Okay. I just wanted to make that clear.

Lowell: No, it was perfectly legitimate, and I would ask the Newmont geologists for locations so I would mark it on my bag.

Swent: I had another question, too: This is as a person who is far from a geologist, but when you do this, how do you know which way it went? I mean, the top part and then you've got two halves cut by a fault, but how do you know which one goes up and which goes down?

Lowell: Well, I'll get to that--

Swent: Okay. Wasn't there also a chance that it could have slipped the other way?

Lowell: Yes, although that would have made it a reverse fault, and this was in extensional terrain, where things are in the course of being pulled apart. When they're pulled apart, normally you get normal faults. If you pull this [demonstrating], then that slides down. So that was a possibility, but a remote possibility.

Swent: You were just saying Fulton didn't especially want to ruffle the feathers of the geologists there by taking your suggestion.

Lowell: Yes, by having me come in and second-guess their idea. But it was proposed to Newmont and rejected. A few months after my second visit to San Manuel, a Texas independent oil company, Quintana Petroleum, were told by their financial advisors that they should diversify away from oil production and get into the mining business. This was a popular idea among oil companies.

Mostly, the oil companies, in kind of a sheep mentality, did the same thing at about the same time, and it turned out disastrous for almost all [chuckles]. But Quintana, I believe, contacted Kenyon Richard or Harold Courtright, with Asarco, to ask who they should hire for a local consultant to manage some copper exploration work for them in the Southwest, and they got my name from Asarco.

Quintana Petroleum Company

Lowell: This group arrived in Tucson, and it was more like a Middle East monarch arriving. It's a family company, and they were super-wealthy people.

Swent: What were their names?

Lowell: Cullen.

Swent: Oh, yes.

Lowell: Arnold. The history of Quintana Petroleum is there was an oil driller whose name was Roy Cullen, who kind of dabbled in oil leases also. In one area that was considered favorable for oil production, no one had been able to drill holes through a formation that was called the Heaving Shale. Roy Cullen decided that he could do this, and he acquired a big block of ground and succeeded in drilling holes, some of them that were enormously productive in oil. I guess almost overnight the family became very wealthy.

One of the things that the Quintana Petroleum Company did was contribute $150 million to the Houston University Medical Center, which at that time was the largest individual gift ever given to a university in the United States. The fellow running the company at the time I was associated with them was Corbin J. Robertson. He was known as Corby Robertson. Corby had married the youngest daughter of Roy Cullen, whose name is Wilhelmina. I visited many times in their house in Houston and got well acquainted. The company was operated as a kind of family atmosphere company.

Anyway, Corby arrived with his money-handling man and his lawyer and his geologist and his drilling manager and I met with them in one of the fancy hotels in Tucson. They agreed to hire me on a retainer basis for a limited period of time. They had already in their files some mineral prospects that they wanted evaluated in southern Arizona that other people had submitted to them.

I looked at a couple of these. One was on the other side of the San Pedro Valley, past San Manuel. I spent a day looking around. It was a geophysical anomaly, and I decided that it didn't look very interesting, by looking at the geology with which the anomaly was associated. Most geophysical anomalies have no real significance, and this was one of those. But coming back, I drove through Mammoth and Oracle. I had a friend named Ted

Johnson who worked for the Department of Mineral Resources who lived in Oracle, and in the course of driving over and back I got to thinking about San Manuel and thought, well, these oil people have money enough to drill some deep holes, and I wonder what the status of the property is next to San Manuel.

Martha Pursell's Unlucky Drilling Program

Lowell: It was owned by a lady whose name was Martha--she is dead, but her name was Martha Pursell. She was married to a dentist in Tucson, and one side or the other of the family had a significant amount of money. Martha Pursell's interest was in having a churn drill company. She wore bib overalls and was a big, beefy, loud, aggressive woman. I never met Mrs. Pursell, but this is a second-hand description. She had acquired this group of mining claims that were adjacent to the Newmont claims at San Manuel. She had held the claims for many years, like fifteen or twenty years, I suppose. She knew something about ore deposits and was advised by geologists.

Anyway, she set out to personally drill deep churn drill holes on the Pursell side of the boundary. She had unbelievably bad luck. Some of these holes--a churn drill technology-wise is kind of like a stone axe. It's just banging a bit on the ground, and you get a penetration of maybe ten feet per twenty-four hours. It's a very hard way to get a hole drilled. But it had been more or less a standard technology for some time.

She drilled six holes--five or six. She drilled five holes, I guess. Some of the holes had been as deep as 3,000 feet, which was sort of drilling for a whole year [chuckles] on one hole. She had personally run the machine, herself. But with a crew.

Swent: Her husband was drilling teeth, and she was out there drilling for copper.

Lowell: She had the bad luck to have located one hole over the Kalamazoo ore body that wasn't deep enough and another one that was deep enough that wasn't over the Kalamazoo ore body. The Kalamazoo ore body, remember, is a mirror image of San Manuel.

Swent: It's a cylinder.

Lowell: It's a cylinder, but it's like an overturned canoe, so it's got a high point on the east end that is relatively easy to get to reach with a drill hole, but this end and these sides [demonstrating

with a tilted soft drink can] are deep. So she drilled a hole deep enough but over here, and a hole in the right place but not deep enough.

Swent: Ohh!

Lowell: All of these drill samples were saved and dutifully logged by the San Manuel geologists, who were interested to be Johnny-at-the-rathole if an ore body was found.

Swent: Why would she give them to them?

Lowell: Well, for getting free geology done and because they were her most obvious purchaser or joint venture partner if she was successful.

Swent: You were saying that you were driving back through Oracle.

Lowell: Yes, and I thought, "Well, gosh, maybe"--this fellow's name was Ted Johnson. I said, "Gosh, as long as I'm coming by, maybe I ought to stop and talk to Ted."

Swent: What connection did he have?

Lowell: Well, he was the Department of Mineral Resources' local representative. He covered, I think, a good part of southern Arizona.

Swent: I see, this is the state.

Lowell: Yes, he worked for the state. I had talked to him before about the San Manuel area, and so I stopped to ask him if he knew anything about the availability of this property. He said, "Well, as a matter of fact, Mrs. Pursell died just a month ago," and the estate, he thought, would be open to selling the claim. And Mrs. Pursell had a kind of a worthless nephew who was a lawyer in, I think, in Bisbee, Arizona. I called him and he said, "Well, go see Frank Salazar, who is our watchman on the mining claims." Frank Salazar had been a miner at San Manuel for many years.

Disputed Ownership of the Kalamazoo Claim

Lowell: So I made another trip and talked to Frank Salazar, and he said, "Well, as a matter of fact, I'm more the owner of the ground than Mrs. Pursell's heirs, who haven't paid the assessment work, and I did the assessment work, more or less, and have been living"--he was actually living on the claim. "I would be willing to make a

joint deal with Mr. So-and-So," the lawyer. But he said, "There's a crooked promoter whose name is Jerry Bell, who has overstaked our valid claims since Mrs. Pursell died." Jerry Bell had been some kind of associate of Mrs. Pursell and jumped her claims when she died.

Anyway, this was all a legal snarl. It was a little bit hard to tell who was the biggest crook [chuckles] among the group at that point.

Swent: And Newmont wasn't getting in the picture at all?

Lowell: No. No, they hadn't done anything about it, which is an astute observation because they should have gone in and acquired the property, just on general principles. And so I talked to the lawyer nephew, and I talked to Frank Salazar, and I negotiated for Quintana a reasonable deal on their claim. And then Jerry Bell showed up, maybe hearing about the activity, and said, "You can't make a deal with these people. These are really my claims and not theirs." I think he then filed a suit against the Pursell estate.

We hired--we being Quintana--hired the most highly-perfumed law firm in Tucson to represent Quintana. They said that they thought that the Pursell family's title was better than Jerry Bell's. But by then the lawsuit was underway. I in the meantime had undertaken a scientific study of the evidence. This consisted of evaluating the published data on San Manuel.

Re-examining the Maps and Re-logging the Drill Samples

Lowell: One thing that I did was plotting the elevation of the pierce points of the original drill holes that were given in the published Schwartz report on San Manuel, and then I made a contour map of the surface of the fault coming down from San Manuel towards Kalamazoo. The map showed a giant mullion structure, a rolling surface like this [demonstrating], that suggested that the upper plate of the fault had moved through these grooves down towards the Kalamazoo ore body. And then I did an archeological dig to excavate the samples which had been left in a mine adit and had been--

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Swent: --which had been welded together, you said.

Lowell: Yes. I collected the samples. All of the Pursell churn drill samples had been put in labeled paper bags and stored in a short tunnel, adit, on the property. The adit had a wooden door and a hive of wild bees were on the inside and had to be removed. Over the years, ground water from rains had dripped from the ceiling of the tunnel and caused these bags to weld together. The numbers were still visible on the bags, but the bags weren't intact. And so I hired a graduate student from the university, whose name was Will Chester, to--with a new set of bags and a spatula and a brush and whatnot--to excavate these bags, one by one, and rebag them.

I already had the logs that had been made by the Newmont geologist for the churn drill holes and given to Martha Pursell. But they hadn't logged the information that tied into my approach to determine the concentric zoning of a porphyry copper deposit, which were things like the silicate minerals, chlorite, epidote, sericite, potassium feldspar, quartz; and sulfide mineral information like percent of pyrite and chalcopyrite.

So we relogged all the samples. It was quite a significant job because there was probably 10,000 feet of drilling represented and 2,000 samples. When that was finished, eureka! it all fit into this picture of this pyritic halo around a chalcopyrite-pyrite ore shell and silicate zoning with chlorite and epidote in the propylitic alteration, sitting outside of the quartz sericite or phyllic zone. I felt the central barren area in the San Manuel ore body was potassic alteration. Later, in the publication that John Guilbert and I made, we actually named some of these porphyry copper zones. We coined the word "phyllic" and coined the word "potassic," which are now accepted names.

With the mullion structures on the fault and the evidence that the outcrop near Kalamazoo and the deep churn drill holes had intersected symmetrical alteration on the sides of the deposit and the fault lines pointed in the same direction, I was able to come up with an almost airtight picture as to where the ore body was, even though it hadn't been intersected by the drill holes.

I located a hole that was close to where the shallowest part of the Kalamazoo part was, close to the fault, like here [demonstrating] and went over to explain what I wanted to do to Quintana, and Corby Robertson said, "I don't like that location. If I find an ore body, I want to be sure that it's a huge ore body." So he made me move it [chuckles] all the ways back to the middle of the ore body.

I drove up on the surface once with Edith, and I said, "You know, if we're lucky, we may be sitting over the middle of a multi-hundred-million-ton ore body." I could at that point almost

say what the tonnage and grade was because it would be similar to the other half at San Manuel. We got a drill rig with sufficient depth capacity.

All this time the lawsuit was going on between the Pursell group and Jerry Bell. While we were drilling this first hole, before it had gotten to the depth to hit the ore body, Jerry Bell showed up out on the property, and Frank Salazar saw him and went up to the drill rig. Jerry Bell was up on the drill platform, and Frank Salazar said, "You're going to have to get out of here. You've got no right to be on that drill platform." Jerry Bell turned around and kicked him in the face [chuckles] and cut his nose, and had to have a couple of stitches in it.

Swent: Oh, my.

Lowell: When I heard about that a couple of hours later, I called the lawyer up and I said, "Jerry Bell has kicked Frank Salazar and he's had to have his face sewed up." And the lawyer said, "Oh, that's good! That's very good!" [laughs] "That will help our case." [laughter]

While our project was going on, the lawyer instructed us to hire several samplers who were to establish *pedis possessio*. They had to put their foot on each claim every day and make a record of this, to prove that we were really there, establishing *pedis possessio* [chuckles] on the ground. So after we drilled a couple of holes, that became--

"Like Shooting Fish in a Barrel"

Swent: Now, is it true that the first hole was the one--

Lowell: Well, the first hole had a long ore intercept. After that, it was just like shooting fish in a barrel. Every one of our drill holes had an ore intercept.

Swent: Was the first one drilled farther away, as Robertson wanted?

Lowell: Yes.

Swent: It had to be deeper, then.

Lowell: It had to be deeper, that's right.

Swent: If they had drilled where you wanted to, it would have cut in sooner.

Lowell: Yes.

Swent: I must say, when I was reading this report I thought it's a very exciting, dramatic document. It isn't often that a geology paper gets as exciting as that one, but it was very dramatic.

Lowell: Well, it was.

Swent: I got chills down my spine [chuckles] when that drill hole went down.

Lowell: But the really amazing thing was that I simultaneously had a project going for Newmont, on the Papago Indian reservation, which also found an ore body, the Vekol Hills ore body.

Swent: The same day?

Lowell: Well, it was maybe the same week. It was almost exactly the same time.

Swent: Did you go out there to these?

Lowell: No. By that time the Vekol Hills project had been taken away from me, and Newmont had sent in their own geologist to manage it.

Swent: What about the Kalamazoo one? Were you there when they drilled?

Lowell: Yes, yes. I was there every day on that one.

Swent: Could you tell from the cuttings?

Lowell: Well, it was kind of an agony of suspense. I had an office in our home at that time--

Swent: That's another question I was going to ask: where you were doing these maps and so on.

Lowell: Well, I had taken over part of the house on Rudasill Road as an office. We moved back in the Rudasill house and made part of the garage into an office, and I was doing the office work there. But the other half of the garage I was using for laying these trays of samples out. The propylitic zone in porphyry coppers is green rock, and the phyllic zone is grey rock. The sequence was from green, low-pyrite material to green, high-pyrite material, to grey, high-pyrite with a sniff of chalcopyrite, and then over a

short interval into ore-grade chalcopyrite-pyrite-porphyry-copper ore.

Swent: And what color is that?

Lowell: That's grey, light grey. So these samples were being laid out in our garage. Edith and the kids were anxiously looking at the color [chuckles] of the cuttings.

Swent: They were bringing them into your house?

Lowell: Well, yes. I think I had a sampler that was bringing them from the drill rig to the house. We had a Jones splitter, and we were splitting out samples to send to the assay lab. We were using Jacobs Assay Lab in Tucson. He was also noticing the ore grades--or the copper grades which were going from almost nil to .03 to .05 to .20 percent copper. And Mr. Jacobs commented on this, that it looked like the grade was going up, and I thought, well, with the lawsuit and all in progress, it's probably dangerous to have the ore samples assayed in Tucson because it might get back to the people on the other side of the lawsuit.

So when I thought we were about to get into the ore body and I could recognize chalcopyrite in the samples, I sent a set of samples to Union Assay in Salt Lake City, which was probably a good idea, but it didn't work out very well because the Greyhound Bus Company lost the samples in Kingman, Arizona [chuckles], for a week. I was just terribly anxious to find out what the grade was. But when the samples were finally found and the assays were made, why, it was half a percent or one percent copper.

Shortly after that, somebody from Quintana negotiated with Jerry Bell and bought him off to get rid of the lawsuit.

Swent: So it was settled.

Lowell: It was settled.

Swent: We should get it on the record, the naming, why it was called Kalamazoo.

Lowell: Well, I think that's probably in the little paper that I gave you. But Corbin Robertson and Wilhelmina Cullen had been sweethearts during the Second World War. He was a navigator on a bomber flying out of England to bomb Germany. This was the time of the big bands. Corbin was kind of a romantic guy, anyway, but he named projects after Glenn Miller songs. There was one called "String of Pearls" and I forget what all, but this was "The Girl from Kalamazoo."

Swent: Let's go back. So you got the assays, then, from Union in Salt Lake. That was pretty clear that you had found the other half of the San Manuel ore body, but did you pick up the phone and call Corbin Robertson?

Lowell: Oh, yes, we were talking every day. I talked mostly with their chief geologist.

Swent: Do we have his name?

Lowell: The mining property man's name was Tiger Morris, and Ronald Thompson was chief geologist.

Swent: So you called him and--

Lowell: Well, the first hole that they drilled in their minerals program--they eventually ended up spending maybe twenty or fifty million dollars in mineral exploration. The first hole--and they probably drilled hundreds or thousands of drill holes--but the first one they drilled found this Kalamazoo ore body [chuckles]. They weren't too excited about it. They thought, well, this is probably how it is in the mining business. In the oil business, you could expect to find one oil well out of five or ten holes. In the mining business, it's more like one out of a thousand or five thousand. So there was a certain amount of communication gap there.

Swent: They weren't as excited as they had a right to be.

Lowell: Yes. They got more excited afterwards. Well, they really were pretty excited.

Swent: What sort of arrangement did you have with them? Did you have a finder's fee?

Lowell: No, I didn't have an agreement, but they gave me a finder's fee anyway, which I thought was pretty decent of Quintana. But the finder's fee wasn't terribly large. I got, I think, a $120,000 fee from Quintana. And they were also paying me well as a consultant.

Swent: Well, that should have allayed some of your family's fears about going into business for yourself.

Lowell: Yes, but that was in 1965, and by that time--

Swent: That's a lot of money.

Lowell: Well, it was a lot of money, and we were very happy about it, but by that time I had really gotten well established in the consulting business, and I was already busy almost full time.

Swent: Did you have a fee, then, from Vekol Hills also?

Lowell: No. That's one of the dumber things that I've done. But Bob Fulton asked me if I thought I deserved a fee, and I said, grandly, no, I was working as a consultant [chuckles] on that. I could very well have gotten some kind of an interest in it, but since the deposit was never developed through a chain of unfortunate circumstances, if I had an interest in the production, it wouldn't have been worth anything.

Swent: Well, you wanted to stop. I have lots of other questions, but they'll keep. This might be a good time to stop. We've got Kalamazoo nailed down, and that certainly was the beginning of a long string of exciting discoveries.

Lowell: Yes. Well, all of them were to a large extent good luck, but it contributes to good luck when you stick your neck out and try innovative things.

Swent: I think what George Brimhall [Professor of Geology at the University of California, Berkeley] told me was that--and I hope I can phrase this the proper way--that one of the significant things here was that you pulled together two different views, on the concentric zoning and the breccia pipe--

Lowell: Yes. The tilted pipe.

Swent: They had been separate until then, that you were the one who pulled together the two ways of looking at this, the lateral and the vertical.

Lowell: Yes. It's surprising to me that somebody hadn't earlier had the same idea. It really wasn't a very complicated idea.

Swent: I guess that's the key question that we hope to answer, is why you did it and nobody else.

Lowell: I hear my canine friend yapping, which may mean that Edith is coming.

Swent: Your wife is coming. Let's stop here. This is a good time to stop.

IX BUILDING A WORLD-WIDE REPUTATION

[Interview 2: September 16, 1998] ##

A Scam Uranium Deposit in the Dominican Republic

Swent: We're continuing now on September 16th, 1998, with the interview with David Lowell. A big Mexican holiday [chuckles], but it doesn't seem to be affecting things here. First of all, we're going to just pick up some of the things that we overlooked yesterday. [consults list] One was when you were with the Atomic Energy Commission.

Lowell: Yes, one thing that was a big adventure at the time, and I have since done other things somewhat similar, was the Atomic Energy Commission was approached by the government of the Dominican Republic. At that time, the Dominican Republic was run by a dictator whose name was Trujillo. There was a certain amount of tension between various Caribbean countries. Mr. Trujillo was told that a uranium deposit had been found in the Dominican Republic, and this was very interesting to him because it conjured up the picture of an atom bomb, which would make him an important person among his Caribbean neighbors and so forth. I think it was all a little bit imaginary and impractical. But in any case, the Dominicans asked the U.S. government if they could send a uranium expert to the Dominican Republic to look at this so-called uranium deposit. So I was selected to go down and look at the deposit. The general manager of the exploration division of the Atomic Energy Commission, whose name was Ernie Gordon, decided it sounded like a nice junket, and he went with me. He was not a geologist but went down as kind of a manager.

It was my first overseas trip. We rode in a Constellation airplane to eastern U.S. and another airplane down to Santo Domingo. I believe I have the name right for the capital, but at that time it was called Ciudad Trujillo. Mr. Trujillo had named the capital after himself, and the name was later changed back. We arrived at the airport and were met by the secretary of the

state without portfolio, who escorted us through immigration and customs without even stopping. Then we were loaded into a black Cadillac limousine and driven to the Jaragua Hotel, which at that time was the number one resort hotel in Ciudad Trujillo. Then the secretary of state told us that he was turning the limousine over to us for our use while we were in the Dominican Republic, together with army driver and another gentleman with a submachine gun, who sat beside [chuckles] the driver. Our vehicle was equipped with a siren. In any cases of traffic jams, we turned our siren on, and the other drivers had to drive into the ditch to allow us [chuckles] to go by.

Swent: Pretty exciting.

Lowell: So then we waited to go out to look at this mineral prospect, and for several days nothing happened. I had to spend my time sitting at a table by the swimming pool in my bathing suit and moving every two hours when the shadow of an umbrella let the sun shine on the table, and drinking rum drinks. There was a troupe of chorus girls that performed at the hotel every night. Occasionally, somebody from the government would come to talk to us.

Then, finally, we made a trip out in the jungle to look at the prospect. The prospect had been identified by an Italian geologist who had gotten a contract with the Dominican Republic to look for uranium deposits. It immediately became clear that this was not a uranium deposit. I had come equipped with a Geiger counter and a scintillation counter, and neither of them made even the feeblest beep around this prospect, and there was no sign of uranium minerals. It turned out that the Italian had cooked this up as a scam to justify his salary and cushy position in the Dominican Republic.

We had a colonel from the secret police who was with us whose name was Colonel Calderón. He had a .45 automatic that he wore, and he took this out and looked menacingly at the little Italian fellow and said, "I think I'll solve this problem by *pistoleando this*," and he used an expletive [chuckles]. We thought that we were going to see an atrocity before our very eyes. Ernie Gordon said, "Now, wait a minute, Colonel. You have to realize that geology is not an exact science." [laughs heartily].

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Lowell: The colonel put this automatic pistol [chuckles] away. And the Italian geologist was immediately captured and watched by some of the soldiers that were with us. We went back to Ciudad Trujillo,

but I asked one of the officials about the origin of one of the soldier's submachine guns, and he said that it was made in Ciudad Trujillo and "here, do you want to try it out?" And so I had the pleasure of firing a number of bullets into a palm trunk [chuckles]. We went back to Ciudad Trujillo, and then there was another hiatus, while we rotated with the sun next to the swimming pool.

Then we were asked to go to the Italian geologist's house to look for other evidence that he had perhaps had taken us to the wrong prospect and there was really a rich uranium deposit somewhere. And that was a very awkward trip because the Italian geologist had taken up with a young Dominican girl who had a baby and was living in the house, and I checked all of his rocks and none of them were radioactive.

It finally turned out that the specimen that he had given the Dominicans had originated in a uranium mine in Czechoslovakia. He had a friend who was an Italian who was working in this mine or had visited it, and had given him a high-grade specimen. The last I heard was that he was tried and convicted and put in prison for a couple of years in the Dominican Republic.

Then they asked me to do a quick survey and see if I could find another uranium prospect for them. They hustled up a deHavilland Beaver airplane that was capable of flying at low level and fairly slow. I mounted my scintillation counter in the airplane, and we flew around, flying traverses over promising parts of the Dominican Republic and really didn't find anything and finally returned to the United States. All of our expenses while we were there were paid by the Dominican Republic, so it was something like a five-week-long, posh vacation [chuckles]. But that was probably the highlight of my employment with the Atomic Energy Commission.

Swent: That sounds like a good time.

Lowell: What's next?

Swent: About the newspaper: was this a significant activity in high school or college?

Lowell: No, it really wasn't. I was a member of the newspaper distribution department.

Swent: You did tell about your paper route.

Lowell: No, no. This was the University of Arizona newspaper.

Swent: I see. You worked on that.

Lowell: I had several pals among the people that were writing the newspaper, all girls, but I made no significant contribution.

Testing AFMAG Geophysical Method by Helicopter

Swent: And then you have something here about helicopter accidents. You haven't mentioned that.

Lowell: Well, in about 1961, towards the end of my employment with Utah Construction Company, Utah participated in a joint project with Stan Ward, who at that time was a professor at the University of California at Berkeley and with a geophysical group from Toronto, Canada, to test the AFMAG geophysical method which depends on natural earth telluric currents, which are theoretically distorted by buried sulfide ore bodies. The area of the test was in the Wasatch Mountains in Utah. I did the preliminary geological work to identify a prospective area to test with the AFMAG survey.

The technique involved a helicopter towing a bird, and a bird is a bomb-shaped device containing the geophysical sensor, and mounted in the helicopter was a console of instruments which we read, flying the traverses. The group consisted of Stan, myself, and the helicopter pilot, and a technician who was a German immigrant to Canada, whose name was Erik Kirschner. We had a Hiller Model 12-E helicopter. The nominal elevation of our survey lines was 12,000 feet, and the helicopter was capable of flying reliably to about 11,500 feet, which presented an immediate problem because we had multiple crashes of our bird hitting rocks and pine trees and so forth. Whenever that happened, another one had to be sent from Canada. We finally got down to the last one in existence on our survey.

The other thing that happened was that the helicopter engine stopped at 12,000 feet at one point. The elevation was higher than the elevation at which the helicopter could auto-rotate, so it immediately started to change from a flying machine to something like a rock dropping. But there was momentum stored up in the spinning rotor, and the helicopter pilot tipped it over and dived for the ground and came in at a tangent and with lots of loud noises and a certain amount of damage to the skids, but no one was seriously hurt.

We had another incident in which part of the rotor flew off into the bushes when we were warming up to take off, which would

have been a fatal accident if it had occurred in the air. Finally, by mutual consent of everybody involved, including the helicopter pilot, we all shook hands and went back to our respective home bases.

I later was involved in another helicopter accident in Peru, in which both engines on a military helicopter stopped in flight. My experience is that helicopters are very dangerous machines, and I've known three people who were killed in helicopters and quite a few others who had experiences like mine of non-fatal crashes.

Another Helicopter Accident, in Peru

Swent: Where was the one in Peru?

Lowell: The accident in Peru was out of Moquegua, Peru, in the southern Peru copper belt. It was a Bell Model 212 helicopter with two turbine engines. The automatic fuel control device malfunctioned, and the engine stopped, but the military pilot in just a matter of a few seconds was able to use a manual control and was able to restart the helicopter, and we made an emergency landing but we had to scramble around to get transportation back to Moquegua, which took about one day in various vehicles and so forth. That was also a situation where it was questionable that auto-rotation would be possible. It was also at high altitude.

The Crash of a Utah Construction Company Plane

Swent: Were you working for Utah [Construction Company] at the time of the airplane crash? The airplane crash that was so significant in Utah history; you might mention that.

Lowell: Oh, that's right. That was a trip in which several people from the San Francisco office were flying, I believe, to visit mining operations in Utah. I had nothing to do with the mining operations, but someone in the office mentioned that the Utah company plane was going and asked me if Dick Ellett and I would like to go along to see the mine. This sort of thing is commonly done in the mining business, to allow staff members to visit mining operations just for general information.

Swent: I think it was the Iron Springs Mine, near Cedar City, wasn't it?

Lowell: I think it was, yes. Iron mine. The airplane involved was a converted military airplane, and I don't remember what it was called. It was something like a Lodestar airplane, but it was a very high-powered airplane and not up to the normal civilian airline company airplane standards of safety. It was more built for combat-type conditions. I don't remember the circumstances of the crash, but the crash was probably caused by using the wrong airplane in the wrong situation.

Swent: How did you happen not to go?

Lowell: Well, I had another little job come up, and it would have interfered with my--this was a kind of a monkey-business trip for me and the other was something that I was responsible for doing, so I bowed out on the trip. Dick Ellett was also unable to go, and we have gotten together several times since to marvel about our good luck.

Swent: Fortunate.

Lowell: Yes [chuckles]. Well, you can get killed walking across the street at any time.

Engineer of Geology Degree, University of Arizona, 1959

Swent: That's true. You also mentioned that you did receive your Arizona professional engineering degree.

Lowell: Yes. The College of Mines for a long time had a policy of each year giving one degree in mining and one in metallurgy and one in geology to outstanding graduates of the College of Mines who had been in professional practice for at least ten years. They didn't give all three degrees every year, but--

Swent: This would be an honorary degree.

Lowell: Yes, honorary degree. But they usually gave at least a couple. In 1959--I had graduated in 1949--I was selected to receive the degree of Engineer of Geology. It was given at the graduation ceremonies of the university. There was some kind of a bright-colored hood and mortar board and so on, and it was quite a deal to receive the degree.

Swent: That was the first of several you've received.

Lowell: Well, the first of two, anyway [chuckles].

David Lowell receiving Doctor Honoris Causa degree from Manuel Paredes Manrique, Rector of the Universidad Nacional Mayor de San Marcos, Lima, Peru, August 14, 1998.

Doctor Honoris Causa, Universidad de San Marcos, Peru, 1998

Swent: Should we bring in the second one now?

Lowell: Well, the second degree was a *Doctor*--how do you pronounce that?--*Doctor Honoris Causa* degree from the Universidad Nacional Mayor de San Marcos in Lima, Peru. I had been peripherally involved with the Escuela de Minas of the university, which is a mines college which is in the process of being expanded into a more important organization with the build-up of mining in Peru in recent years under President Fujimori.

The San Marcos University itself is an interesting institution. It has about 35,000 students and medical college and architectural college and all the branches of a big university. It was formed in 1551, which makes it the oldest university in the Americas. A couple of years later, the University of Mexico was inaugurated, and the traditions at San Marcos go back very far, obviously. There's a lot of pomp and circumstance about the university.

At the ceremony--it was in the old university building in downtown Lima, which is now kept as--they have two or more museums in the building. The building goes back to--not back to 1551, but it goes back several hundred years. It is now being renovated by the Spanish government, which has a kind of paternalistic feeling about the Latin American culture and Latin America, and they have contributed money to try to put the buildings back in the original condition.

The room in which the ceremony took place has mural paintings in the ceiling which are very pretty. There were something like a hundred guests at the ceremony, and all of the *decanos*, which--*decanos*, I guess, means deans--and various people from the College of Mines and College of Engineering. They had the national police band, which played the American national anthem and the Peruvian national anthem, and a chorus which sang the Peruvian national anthem.

Swent: What time of day was it?

Lowell: It was kind of a typical Lima day, which is overcast.

Swent: What <u>time</u> of day was the ceremony?

Lowell: Oh, what time. The ceremony lasted from eleven o'clock in the morning until two o'clock in the afternoon.

Swent: Did you have to wear some special kind of clothing?

Lowell: Yes. I wore academic robe but not a mortar board. In Peru they apparently don't use mortar boards in their academic ceremonies. I am not sure what the explanation of this is. I think that perhaps it wasn't in vogue in Spain in 1551 and so hasn't been since.

Giving a Speech in Elegant Spanish about a Virtual University

Lowell: The ceremony involved a speech by the rector of the university and a speech by a representative of the College of Mines. Then I had to give a speech in Spanish, which I largely read, but it was twenty-five minutes long. I wrote the speech in English and sent it to my two staff people in Santiago, Chile, who are well educated and sophisticated, and they translated it into elegant Spanish for me.

Swent: We'll have to put that in the appendix.[1]

Lowell: [chuckles] It seemed to go over well.

Swent: What was the gist of the speech?

Lowell: Well, the gist of the speech was that my ties to Peru really extended back to the period before I was born, when my father worked as a mining engineer in Peru, and my sister was born in Peru and has returned since to visit Cuzco, which was the place of her birth. I talked about the problems of transfer of technology from developed countries to developing countries and how the process to some extent has reversed in some parts of the world, such as Taiwan and Korea and Brazil and Chile, and how the computer technology and Internet has made the possibility of virtual universities more possible now, and about a project that we are considering at the University of Arizona.

I'm a member of the Geosciences Advisory Committee at the University of Arizona, and we have talked about a project that I originally suggested, which is sort of a nonresident master's degree program in which master's candidates do only half of their study as resident students and the other half is done away from the university, using CD-ROMs and perhaps the Internet to take

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[1]See appendix.

part of their courses, which could also expand to other countries fairly easily.

That was about the gist of my talk.

Swent: Why were you given this degree?

Lowell: Well, according to the speeches that were given, it was because of my contributions to the development of the mining industry of Peru and also other countries through the discovery of new mines. In Peru, I'm more or less responsible for one large mine development, which is the Pierina gold deposit, and another deposit which is not in development but which will be at some time in the future, which is called Los Calatos. It's a copper deposit. And also, as a result of my participation with and assistance in developing the Escuela de Minas, which may have a link to the University of Arizona in the future. So that's the story of the Peruvian honorary degree.

Special Security Provisions Necessary

Swent: I think you might mention the special security provisions that were necessary.

Lowell: Well, I have worked a lot in Peru during the period when there was a great deal of *Sendero Luminoso* [Shining Path; terrorist organization] activity going on. When I began my project in 1991, there was an average of a car bomb every one to two weeks in downtown Lima and lots of other bad things happening through most of Peru. We were able to do our field work and other activities with a fair degree of confidence, but we were careful in which areas we worked in in Peru. But in recent years, Mr. Fujimori has pretty much stamped out the *Sendero Luminoso*, but--

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Lowell: The *Sendero Luminoso* has now become pretty insignificant in Peru as a terrorist problem, but I have noticed in other Latin American countries that it's a fairly easy transition for an idealistic, communist terrorist to become a practical capitalist bandit, and there are a lot of those in Peru and lots of robberies and quite a few kidnappings. At the time of my next-to-last visit to Peru, a gentleman I had met who was president of the Hochschild company was murdered and his son kidnapped the day before I arrived in Lima.

It occurred to me that because the honorary degree had gotten newspaper publicity and lots of people in Peru knew that I had collected a large amount of money from the sale of the Arequipa Resources company that I would be a prime target at the time of the honorary degree ceremony. So for the first time in my life, I lined up a Peruvian security firm to furnish cars and security planning and some bodyguards to accompany myself and my wife in the trips around Lima for the two days we were there. It was probably unnecessary, but I think it was a wise thing to do under the circumstances.

Swent: I would think so. You might mention the things that you have as mementos of that occasion.

Lowell: Oh, they insisted on giving me the academic robe, and the ceremony involves a colored ribbon and a medallion hung around your neck, which makes you a member of the university. What's it called?

Swent: I think in English it's cloister. *Claustro* in Spanish.

Lowell: *Claustro*. My wife, who is better informed about things like this than I am, said that it had a kind of a religious group connotation, she thought. In the conversation in the ceremony, they said something which indicated that now that I was a member of a *claustro* that I could participate in similar ceremonies as one of the robed, serious-looking gentlemen standing in a row [chuckles]. I received a diploma or certificate on parchment, certifying me as being *Doctor Honoris Causa* and lots of photographs. There were three professional photographers. I came back with fifty or a hundred prints of photographs. It was all a very pleasant experience.

John Guilbert, Consultant on Theoretical Aspects of Kalamazoo Geology

Swent: Very exciting. So now we have to go back and retrace the path that led to that eminence. Yesterday you had been talking about the discovery of the Kalamazoo ore body. You haven't said anything about Professor [John] Guilbert, and I thought you might want to.

Lowell: The discovery of the Kalamazoo ore body was really related to my theoretical ideas about the concentric zoning of porphyry copper deposits. There was also a structural interpretation which was important in it, but the more important part was realizing the concentric zoning idea and identifying evidence of it first in the San Manuel ore body, which was a mirror image half of the

Kalamazoo ore body, and then finding evidence of the zoning in old drill holes and outcrops in the vicinity of the location of the Kalamazoo ore body.

John Guilbert didn't become involved in the project until after the discovery had already happened.

Swent: Was he one of your teachers when you were in school?

Lowell: No. John Guilbert is about the same age as I. He was an acquaintance. I felt that the deposit required more academic documentation than I was able to supply. John Guilbert had worked in the Anaconda research laboratory at Butte, Montana, for a number of years, and he was already at that time an expert on silicate alteration and porphyry copper deposits. I asked him if he would care to do consulting work for Quintana on the theoretical aspects of Kalamazoo, and he agreed.

John is a very enthusiastic, energetic fellow and is an inspiring teacher. He has been the standout ore deposits professor of the University of Arizona and is internationally famous. In the course of our meetings on the documentation of the description of the deposit, we decided to compare notes and build the Kalamazoo example into a composite, general model of porphyry copper deposits, using--as it were--his academic background and my experience background because at that point I had looked at a lot of porphyry copper deposits in the field. And so we decided to do this.

A Benchmark Paper on Concentric Zoning in Copper Deposits[2]

Lowell: We put together a paper which turned out to be much more successful than we had thought it would be at the time. For quite a few years, it was the primary reference for geology of porphyry copper deposits.

Swent: This is the paper in *Economic Geology*.

Lowell: In *Economic Geology*. This paper has been referenced in other papers probably several hundred times, and it has been translated into Japanese and Chinese and turned out to be a kind of a benchmark publication, probably largely because of the timing. There were similar papers published a year or two later, but this was the first one to pull all this information together. John and I have since collaborated on several other, shorter, less important papers and worked together on other projects.

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[2]J. David Lowell and John M. Guilbert, "Lateral and Vertical Alternation-Mineralization Zoning in Porphyry Ore Deposits," Economic Geology, Vol. 65, No. 4, June-July, 1970.

Swent: You have done a number of papers for *Economic Geology*, and you were an editor later on. Do you want to talk about your association with that?

Lowell: Oh, sure. I'm not sure how many *Economic Geology* papers I have written, but there's probably half a dozen all together. I have published fifty papers in total. There was a period in the 1970s when I was a member of an informal group of theoretical geochemists that met for conferences on the average of once every year or two.

Associate Editor of *Economic Geology*

Swent: How did this come about?

Lowell: Well, just casually. I'm not sure how it was really done. Some of the people in this group were Hal Helgeson in California and Paul Barton in USGS; Hugh Barnes and Wayne Burnham, Penn State; Heinrich Holland, Charlie Meyer, and others. Several of the meetings were in the form of Gordon or Penrose conferences. One was a meeting at Princeton and one at Penn State and a couple of meetings in Massachusetts. In the course of this, I became acquainted with Brian Skinner, who was the editor for many years of *Economic Geology*, and I was invited to be a member of the editorial board and associate editor of *Economic Geology*, which I did for five years. I think that's the term of this editorial board. It consisted of reviewing papers submitted to *Economic Geology*. I also wrote reviews of other publications in other journals.

I might talk a little bit about my involvement with the Society of Economic Geologists. I've never been on committees or been an officer of SEG, but I was a Thayer Lindsley distinguished lecturer for the SEG.

Thayer Lindsley Lecturer for Society of Economic Geologists

Swent: What did this involve?

Lowell: Well, it involved giving lectures in universities in--I believe, all my talks were in the U.S. One was a university in Florida, another in Colorado. There was a third one in Massachusetts.

Swent: Did you give the same lecture?

Lowell: Well, the job involves preparing two lectures and give one or the other of them. I was also given the Society of Economic Geologists' silver medal for excellence in mineral exploration in 1983 as a result of the La Escondida discovery.

Canadian Mining and Metallurgical Society Distinguished Lecturer

Lowell: Another kind of similar type of lecturer job was the Canadian Mining and Metallurgical Society distinguished lectureship, which involved giving lectures. I think I lectured in five or six universities in eastern Canada: Ontario and Quebec. That was at about the same time.

Swent: Did you do these lectures yourself, or did you have help with them?

Lowell: I did them myself. I prepared the lectures. They were all related to porphyry copper geology, which was in vogue at that time.

Swent: How did you feel about all this lecturing?

Lowell: Well, for many years, it was a painful process to give lectures. I'm not a talented public speaker. But I've become better at it and a great deal more relaxed. I have given talks in lots of different parts of the world. I've given talks in Australia and China and Japan and Mexico and Peru and Chile and France and England and finally have half-learned how to do it.

Swent: What is the rationale behind these lectures?

Lowell: Well, different things, but there's a lot of writing of articles in the geology and exploration business, and some of the talks--the most recent talk in England was at a meeting of the Rio Tinto exploration group. It was an exploration management group, and their exploration program was so large that that still included sixty people. I have given similar talks to the exploration group for Cyprus Minerals and Western Mining, from Australia. And I've been an invited speaker in a number of meetings.

Swent: Is there a benefit to you from these experiences?

Lowell: You know, I think it's a very good education to have to write a paper and organize your thoughts and do library research. As far

as professional advertising, my feeling is that in the earlier stages of my career, the talks were very useful to sort of present my name to the industry. I think in recent years it's a little questionable as to whether I received any benefit of that sort. That's the rationale.

I've never been very academically oriented. I don't have a great deal of sympathy with university activities and politics and so forth, but I have been very interested in applied science and I have devoted a lot of time to trying to convert scientific ideas into something that works in a practical way in the field. Probably the majority of my effort in this area has been private work that didn't necessarily result in publications or lectures.

Swent: This might be a place just to mention something--the word "networking" is so popular now--is there any local club or group that has been particularly helpful to you in which you've been active, for meeting people? Something like the Geologists Society or something that meets locally? Or even a country club.

Lowell: Well, that also has evolved during my career. There was a period, maybe twenty years, in which I was an active member of the Arizona Geologic Society, which has a meeting and a talk once a month, and I was president of the society for one year and gave several talks myself there. That meets in Tucson, and I haven't attended a meeting for quite a few years because: (A) it's kind of difficult to make the round trip to Tucson for an evening meeting; and (B) Tucson has faded in importance as an exploration center, and it's really no longer very important at all. So the group and also the subject of the talks are no longer as interesting as they once were.

Building a Reputation: Knowledge More Important than Advertising

Swent: I'm thinking--and we'll get back in a minute to your career path--but when you were beginning, out on your own, I was wondering how you made contacts and how the word of mouth was spread about you. Was there a meeting, some sort of venue around here where people found out about you?

Lowell: That's a difficult question to answer. The mechanism that brings offers to do consulting work to a consultant is very much dependent on personal knowledge and not on advertising. I didn't understand that in the early stages of my consulting career and tried to get the word around about my availability and my competence.

Swent: How did you do that?

Lowell: Well, I had a professional card in *Mining Engineering* magazine, the journal of AIME. I also wrote letters to prospective clients. After I had been in business several years by myself, I joined forces, first with Jack Still, who was a mining engineer, and later with Jack and his son, whose name was Arthur Still, who was a geologist. They have both passed away since. Art Still and I once went to considerable trouble to put together a brochure describing our experience and capabilities and where we had done work and so forth, and had one or two hundred of these brochures published. My feeling afterwards was it was a total waste of time and effort. It didn't accomplish anything.

The way that work actually materializes is through word of mouth and personal contacts. Much of consulting geological work is really more contract work than consulting in the sense of advice. They look around for who they think can do the work and is available. And that's how it happens.

Swent: Fortunately, in this country you don't get shot if you guess wrong.

Lowell: [laughs heartily]. Well, that fellow in the Dominican Republic--a good argument can be made that he might have deserved to be shot. [laughter] I know a few in North America that fall in the same category [laughs].

Swent: It seems to me it's kind of a chicken and egg thing, though. You do difficult work to develop a reputation, but you can't develop it unless you get some chances to do the work.

Lowell: That's right. And I think in my career I created the chances, with malice aforethought, by using some of my own time to become knowledgeable about known ore deposits in North America and elsewhere.

Swent: These visits that you made to mines you think were very important.

Lowell: Yes, I think so.

Swent: In your own education and also in contacts that you made?

Lowell: Well, probably more in my own education than in the contacts. It's a talking point to say, "Gosh, I visited fifty porphyry copper mines," but the more important thing is that some ideas have gradually seeped into your head [chuckles] from seeing similarities and differences between a large number of examples.

The Importance of Mapping the Mullion Structure and Concentric Zones

Swent: You mentioned the mullion structure that you became aware of when you did the maps. Is this not visible from observation?

Lowell: Well, basically, no. These are large grooves in the San Manuel Fault that might be fifty feet wide and ten feet deep. That fault line is so chaotic when you look at it that you can't tell anything except that there's a big, hundred-foot-thick zone of mashed rock [chuckles].

Swent: Is there surface evidence of zoning?

Lowell: Well, this is not zoning. This is the grooves caused by a big block of rock sliding over another big block.

Swent: I guess that's another question, the concentric zoning. Is this something arrived at, or is it visible on the surface?

Lowell: It's visible, but there's a little problem of a flea mapping the surface of an elephant.

Swent: I see. It's just that it's so huge.

Lowell: It's so huge you have to put your observations down on a map and then view the map. You can't see it very well on an individual outcrop. Both of these features were missed by the USGS geologists who spent months or years studying the area.

Swent: Both of which features?

Lowell: Both the concentric zoning and the mullion structure in the San Manuel Fault. So they were obvious if you were looking for them, but they weren't obvious if you weren't looking for them.

Swent: So it was your synthesis of these things that was so important.

Lowell: Yes.

The Vekol Hills Project, Southern Arizona

Swent: Let's get back to the list. Where did you go from Kalamazoo? That was kind of a hard act to follow, wasn't it?

Lowell: Yes. As it happens, both of these--

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Lowell: --projects sort of crystallized at the same time. One was Kalamazoo, and the other was the Vekol Hills project in the Papago Indian reservation in southern Arizona. The Vekol project I was involved in on behalf of Newmont Mining Company, and the way that came about was--for a couple of years, Newmont was my principal consulting client, and most of my work for Newmont was consulting in the sense of being given an assignment to map an area or evaluate a deposit. I was working for Bob Fulton, who was vice president in charge of exploration in New York. Newmont had a relatively small staff of geologists and very few people who were doing general exploration work. That was a slot that I fit in, and Newmont asked me to evaluate the Lakeshore deposit, which was later developed by Hecla Mining Company. It's also within the Papago reservation.

While I was doing the work at Lakeshore--and I incidentally recommended that they acquire Lakeshore and they declined to acquire the property, which may or may not have been a mistake because it later developed into a large copper ore body, but, perhaps because of bad management decisions, it has never made a significant profit.

But the Lakeshore project involved my becoming familiar with that part of that district, and I suggested to Bob Fulton that I expand my work and do a little bit of regional work, which I did. In the course of doing this, I talked to a fellow whose name was Mo Kaufman, who had a small company--I think it was out of Spokane or somewhere--that had obtained some kind of exclusive exploration permit for part of the Papago reservation. His work was based almost entirely on geophysics, which I have never felt was a very effective way to look for porphyry copper deposits. But they had anomalies and some limited geological and geochemical information in two targets in the Papago reservation at the time I talked to him. They had decided that neither one justified additional investment, but he asked me if I would be interested in taking over their option or permit with the Indians.

I looked at the data, and both of these looked mildly interesting, and I called Bob Fulton and asked him if Newmont was willing to take over this project, which basically cost them very little but required immediate decision because the deadline was a week or two later. Bob Fulton was a very decisive fellow. By this time we had had some period of association and kind of understood how each other thought, and he said, "Yes, do it." So I did, and did a little mapping job. This wasn't a typical big

company, exhaustive project. I think the total time I devoted to each project was probably less than a week of field work.

Swent: Did you do this yourself?

Lowell: Yes. I did it by myself, with no field assistant. In the case of the Vekol mapping, I slept on the ground in a sleeping bag in an old mine working [chuckles] while I was there. It was kind of hard-core type of exploration work. At that time, I had some understanding, but an imperfect understanding, of porphyry copper-silicate alteration and peripheral zoning, and I saw some evidence of that at Vekol. The Vekol ore body is in a quartzite rock, a porphyry intrusion into quartzite, but the outcrop is just quartzite. Quartzite consists of 90 percent quartz (silica), and when it is subjected to phyllic alteration, which is quartz sericite alteration, it doesn't make a very obvious change in the texture and appearance of the rock.

So this was a tough one to map. Most of the area was covered by postmineral rocks. But in the course of mapping in a very small gully in an inaccessible place, I crawled down the gully and I found a postmineral dike, something like a fresh andesite dike. But the reactive fresh feldspar crystals in the andesite had precipitated some malachite, secondary oxide copper mineral. This was the deciding clue for the Vekol deposit, which wasn't coincident with the geophysical anomaly but near it. This small occurrence of oxide copper indicated that copper was migrating in the groundwater and had been precipitated by the reactive feldspar in the andesite dike.

Then I went back and puzzled over the quartzite outcrop, and there was some stockwork of veinlets that looked more significant in view of some known copper. So I said, "Let's go for it." I wrote a report. Turned down the other prospect. Wrote a report recommending a drill hole in the Vekol deposit. Newmont sent a geologist who lived in a house trailer in the summer in the Papago reservation, where it's very hot and very far from town, and he was very unhappy [laughs].

Swent: What was his name?

Lowell: He later became a state geologist in Nevada. I don't remember his name. Joe somebody or other [chuckles]. They drilled a hole that went into a chalcocite ore body under the quartzite outcrop. The Vekol deposit has something like two hundred million tons of .7 or .8 percent copper, and with modern leaching, solvent extraction-electrowinning technology, it would be a very attractive, medium-sized copper mine.

But subsequent to our project, the Papago Indians have become more closed and reclusive and hostile to outside development on the reservation. I think Newmont could have developed a mine at the time, but they let it sit around, by big company habit, for a number of years, and when they went back, the Papagos in effect said no, we won't let you develop the mine.

Copper Versus Saguaro Fruit

Lowell: There was an interesting little sidelight to that. When they went back, they had a very carefully orchestrated presentation to the local community council of the Papagos for that district of the reservation. They had a community hall, which was, if I remember correctly, sort of octagonal shaped, like a Navajo hogan and in an isolated part of the reservation. The Newmont people from New York and Denver and other big cities had a number of charts and enlarged aerial photographs and film clips, and several different people presented their portions of the proposal for most of the morning, to demonstrate how pleasant it would be to have a mine there and how many Papagos would be employed and how happy they would be and how happy the other Papagos would be with their newfound royalties.

The Papagos didn't say anything at all, and when the presentation was finished, they got up and walked out. The Newmont group thought that they were having a caucus outside, and they waited and nothing happened for half an hour and then an hour, and then somebody went out and looked out the door. What had happened is that the Papago council members had gone outside, gotten in their pickups, and gone home [laughs], without saying a word [laughter].

Swent: Oh, dear. Were you there?

Lowell: No, I wasn't there, but I was told that [laughs]. And that was the end of Vekol. So it was a scientific success, but a practical failure [chuckles].

Swent: Did this personally disappoint you when this happened?

Lowell: Yes, yes. It was disappointing to me. I think the Indians made a mistake in not allowing the mine to be developed. They had agreed to the exploration contract. One of the arguments I later heard that came back was that one of the council members said that that was a particularly good place to harvest saguaro fruit, and the number of saguaro cactuses in the mine area times yearly

production of fruit would be worth maybe one-one thousandth or one-one millionth of what the value of the jobs and the production from the mine would be worth. But that was the sort of thinking that they had.

Swent: A different way of looking at it.

Lowell: Yes. I guess they were buying peace and quiet [laughs].

Kalamazoo Sold to Magma; Relations with Newmont

Lowell: Both the Kalamazoo and Vekol discoveries were in 1965. I was heavily involved at Kalamazoo for two more years, until 1967. At that time, we completed an ore reserve calculation and a feasibility study. Quintana decided, probably correctly, that it wasn't a proper job for an oil company to develop this large underground mine, and they invited various major companies to look at the data, including Newmont, which operated the San Manuel deposit as Magma Copper Company. Newmont decided to make a cash offer for the deposit, and they offered $27 million, which in 1967, was maybe equivalent to close to $100 million now. Quintana elected to sell it lock, stock, and barrel to Magma.

Years later, Magma developed the deposit, and it's now the principal source of ore for the San Manuel mill and smelter. It's a deep underground mine, and the price of copper is lower in terms of constant dollars now, so it isn't at the moment a great success, although I think for the previous several years they made a good profit from mining at Kalamazoo and will in the future.

Swent: Now, both Magma and Utah have been acquired by BHP, so they are all in the same stable now.

Lowell: That's right.

Swent: Was there ever any indication that Newmont--well, how should I put this?--was there any ill feeling to you for Quintana getting it and not Newmont?

Lowell: Well, they didn't tell me that they did, but I'm sure there may have been some. The staff at San Manuel had been very friendly to me. A funny little incident occurred after we had drilled a number of holes. I talked to the Quintana management and said, "You know, I think it would be a good idea to let Newmont know what is happening so that they will have some lead time to get

their wits together in case they want a joint venture with us on the deposit."

At that point, I knew beyond a shadow of a doubt that there was nobody in Quintana that knew anything about mining [chuckles], and it didn't look like a very good idea for them to jump into a major, difficult mining operation themselves, on short notice. So Bob Fulton and Arthur Brant came to Tucson, and I think one of them had called me and told me that they were going to be here. I met them for breakfast. They knew that we were drilling holes there, and I said to Bob, "I think we've found the other half of the San Manuel ore body."

They asked me what we had found in the drill holes, and I told them. They said, "What led you to drill in this spot?"

I said, "Well, we relogged the Pursell churn drill holes, and I had contoured the Schwartz data," and they both simultaneously said, in horror, "Contoured the Schwartz data?!" [laughs] "My God, why didn't we do that fifteen years ago?"

So there was reasonably amicable feelings, I think, with Newmont. I think they correctly deduced that I was kind of a friendly go-between between Quintana and Newmont, which eventually led to Newmont's buying it.

Swent: It might well have gone another way. It could have been a rather ugly situation.

Lowell: It could have been, yes. But it really wasn't. I did at least some later work for Newmont, and they in part later funded my Covered Area Project.

[In 1970 I received the Daniel Jackling Award from the SME division of the AIME [American Institute of Mining Engineers]. This award was a result of the Kalamazoo discovery and is the AIME's most prestigious award for a mining engineer or geologist. I gave a lecture entitled, "Copper Resources in 1970," which among other things predicted future copper production and copper prices. Within a couple of years I was very sorry to have made these predictions.][2]

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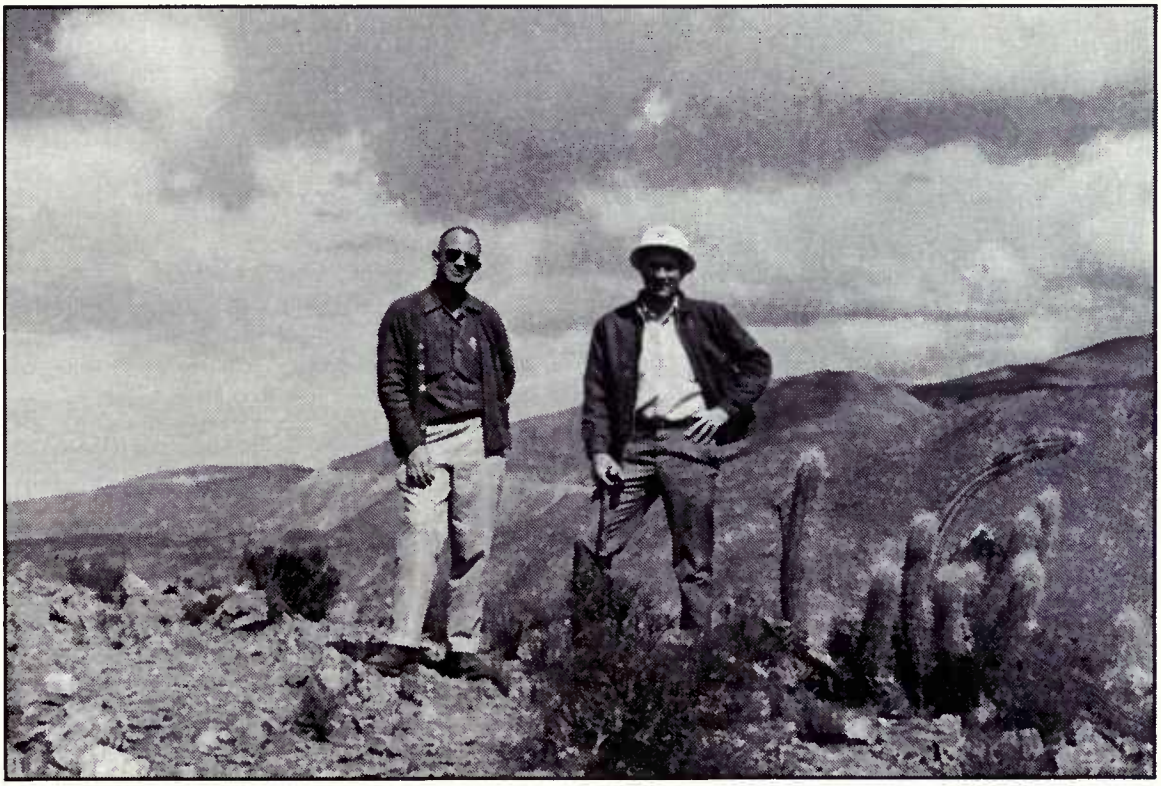
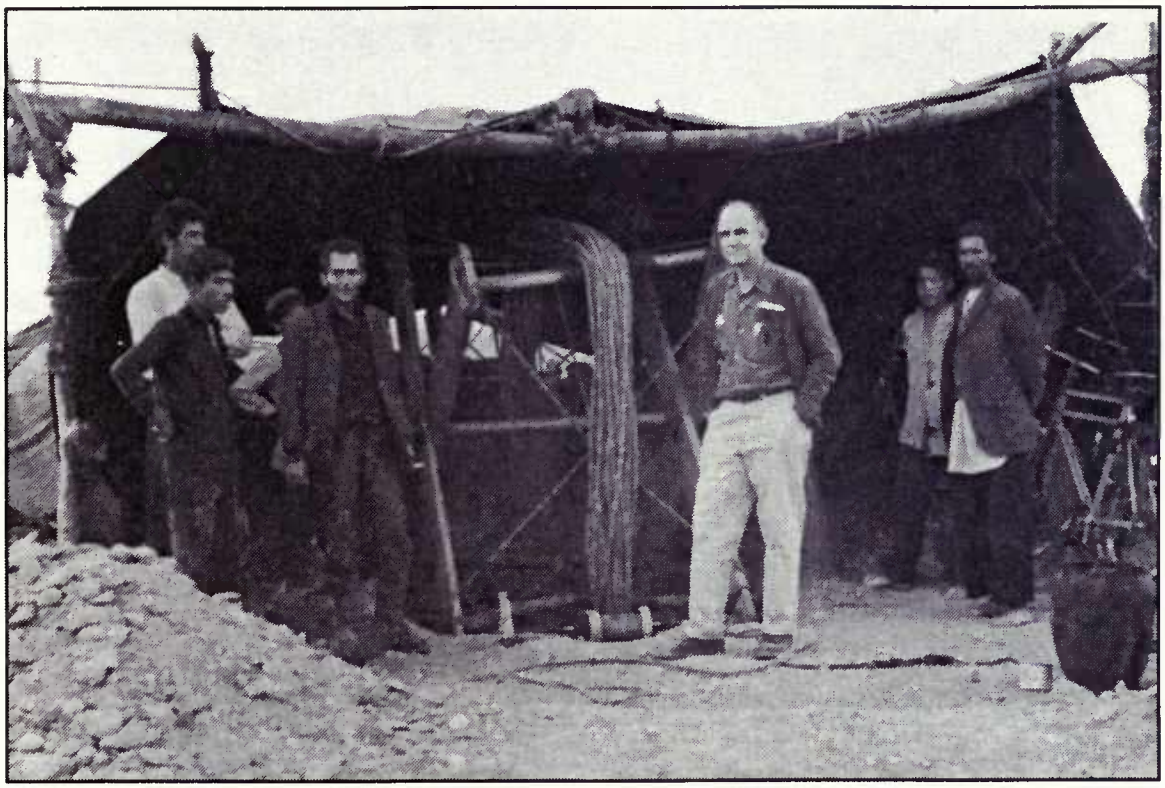
[2]This paragraph was added by Mr. Lowell during the editing process.



David Lowell and Peter Davies in San Juan Province, Argentina, 1969.

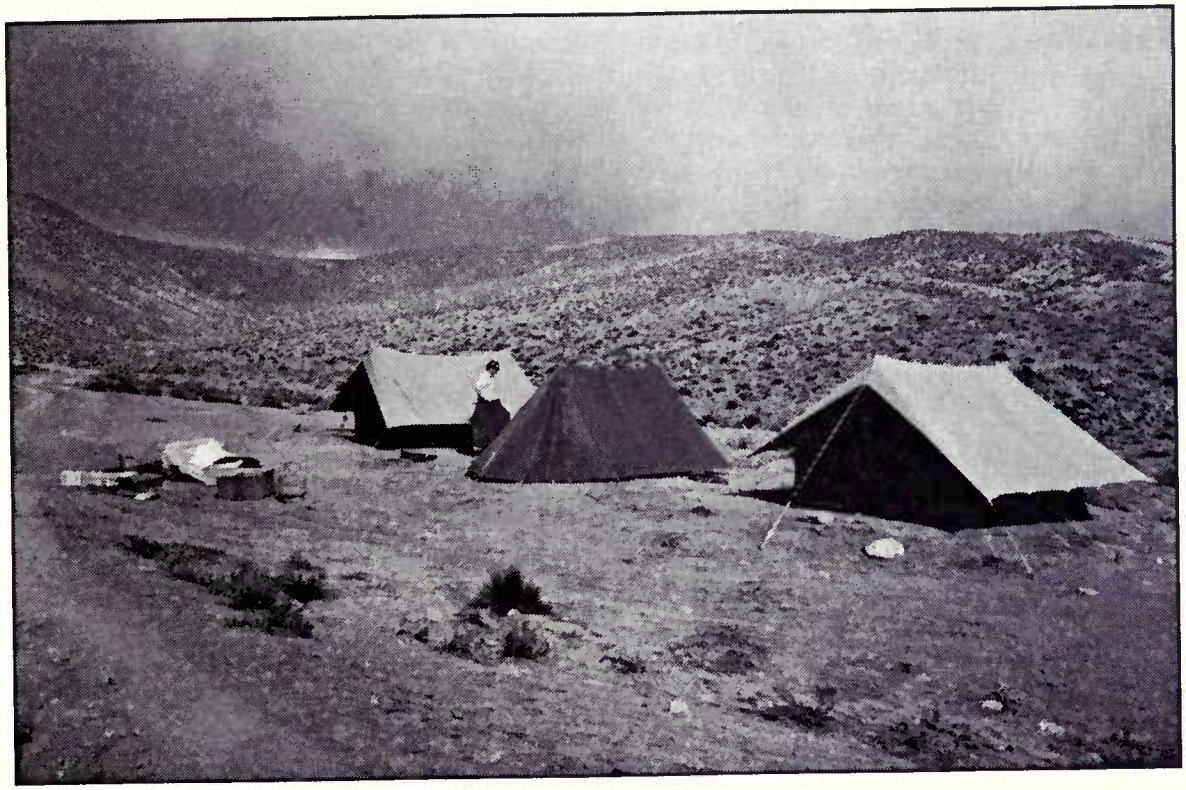


Qanat shaft in Iran, 1970: David Lowell with shaft sinking workers. Shaft is part of a qanat gravity water development system.

La Caridad, Mexico, March 14, 1970. From left to right: John Guilbert, C.E. Beverly, J.D. Lowell, J. de la Luz, B.E. Kilpartrick, R.M. Corn, and J. Contla.

Sinoloa, Mexico: exploration by horseback, 1974.

David Lowell at a copper prospect in Jamaica, 1977.



Camp at Maria Rosa prospect, north of Collahuasi, Chile, 1982.

X DOING HALF-TIME CONTRACT EXPLORATION

A Unique Career Formula in the Industry

Lowell: In the late 1970s, as a result of the Kalamazoo project, I hit on a formula which I really followed for all of the next fifteen or twenty years, and the formula was to keep one foot in the consulting business but to also do contract exploration. And my formula was, and maybe still is, kind of unique in the industry. It was first to spend nominally 50 percent of my time doing contract projects and 50 percent doing consulting work.

The contract projects were projects that I dreamed up and decided, "Well, what should a major company be doing in Arizona, or in Chile, or in Peru, or in Mexico?" And I figured this out and said, "Well, if they did A, B and C, they'd have a good chance of finding a large copper deposit." And then I asked myself, "Which company should be doing this?" And I came up with the answer, "Well, Kennecott or Asarco or Amax or Utah." Utah's name progressively changed from Utah Construction to Utah International, and I think there was another name.

Swent: Utah Construction and Mining.

Lowell: Utah Construction and Mining, and eventually they were bought by General Electric and then by BHP. But I went through this process, and then I--

Swent: Excuse me--what's the difference between contract exploration and consulting? What was the differentiation there?

Lowell: Well, the contract exploration is--my brand of contract exploration--was to plan the basis for a project and then plan the nuts and bolts as to how it should be done, develop a budget, all before the major company has any involvement, and then bring this project to them and say, "Okay, guys, you put up seven hundred and fifty thousand or a million or a million and a half or two million

dollars a year to finance this program, which I will manage, and I will get paid for my time plus a finder's fee."

I've had a number of these projects, but a typical format is that we will set up a technical committee and every three months we will meet with you or submit a fairly detailed report and say, "This is what we have done in the last three months, and this is what we plan to do in the next three months. Speak now or forever hold your peace." I have had maybe a half a dozen of these contracts, and they have spanned close to twenty years. The large company has almost never objected or offered their own suggestions on how it is done.

Mineral Exploration: Drilling, Land Acquisition Important Too

Swent: Did you build up your own staff for this?

Lowell: Yes. I really did. There have been several geologists that have worked for me off and on. A couple of key members of the team are a landman and a drilling specialist. The land work and the drilling supervision sometimes loom larger than the geologic input. Mineral exploration is something that is often erroneously referred to as geological in nature. Geology is only one part of the picture. Some of the best explorationists that I have known have not had a geology degree or even studied geology in school. Spud Huestis in western Canada probably acquired more mines than any other individual--

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Lowell: Spud died ten years ago. He was a high school graduate who was a prospector and promoter in western Canada. He had a very impressive talent for recognizing mineral prospects that might be potential mines. At one time, I tallied eight or ten mines that he was really responsible for developing. A fellow in Arizona, who was president of Banner Mining Company, Allen Bowman, had a similar record. He was responsible for the company acquiring several major copper deposits, including Twin Buttes and Rosemont, and one other, whose name I forget, in southern Arizona and one near Lordsburg, New Mexico.

The point of this is that it isn't as simple as getting a Ph.D. in geology and leaving the university and saying, "Eureka! This is where we should drill for an ore body." In fact, an argument could be made the it's a handicap to have too much academic background.

But getting back to my story, I had a drilling specialist that had earlier worked for Newmont and worked a total of something like twelve years for me, whose name is Bill Mounts. Bill is also a non-college graduate but a very intelligent, observant, capable guy who does miracles with drill rigs.

Swent: Where is he based, here in Tucson?

Lowell: Well, he for the past several years has worked for Barrick Gold Company, and I'll mention him again when we talk about Pierina. He, early in his career, learned about drilling, working for Newmont at Carlin, Nevada, and then worked for me, and then he returned for several years to Newmont and then to Barrick where he is now living in La Serena, Chile.

The land work in connection with exploration projects is sometimes absolutely crucial to--it's very blessed to figure out the geology and find an ore body, but it's more blessed still to acquire the ore body [chuckles]. Probably the majority of the major discoveries that I have been involved with also involved some controversy or sometimes even lawsuits in connection with the ownership of the property. This was true, as I mentioned, at Kalamazoo; and at Vekol, more effective negotiation with the Indians would have allowed the ore body to be developed into a mine.

At Escondida, there was a long wrangle about ownership that involved the lawsuit after I was no longer involved in the project. This also included the nearby Zaldivar deposit; and the San Cristobal deposit that we found and was later developed as a gold mine in Chile was more a triumph in signing up the property owners than the geological work, I think. The Leonor deposit in Chile revolved around ownership problems. So it's a consistent theme to have difficulty in acquiring title.

Swent: Would you like to detail those problems now or wait till you come to each one in turn?

Lowell: I'll talk about them when we talk about the exploration projects.

The Advantage of a Small Organization

Lowell: But getting back to my exploration team, part of my strategy in doing exploration is to try to do it on as low a budget as possible and as low a profile as possible and as small an investment in secretaries and offices and vehicles and the window dressing that

is commonly used in major company exploration. For example, right now I'm doing a project, a joint venture, with Rio Tinto Mining Company, the former RTZ, the largest mining company in the world. We have two parallel programs of roughly the same scope going on in Chile. In our program, we have two vehicles; Rio Tinto has fourteen. We have a little office above a car rental place in Santiago, two-room office; and they have a palatial office in Santiago on two floors [chuckles] of a high-rise building and another large office with thirty people in Antofagasta.

I have always felt that a modest, small approach is really better and it's better if nobody knows you're working and notices you. So I have always tried to put more than 50 percent of the budget into direct exploration drilling costs and less than 50 percent into the everything else, including geologic mapping and head office and travel and infrastructure and so on. In Arizona for a long time we were using one and a half geologists, and I was the half that was working half-time on the project; and one drilling specialist and one or two field assistants, samplers, and one secretary or one half-time secretary and one part-time draftsman. And that was it. It was a pretty small, lean, mean organization.

We have done the same thing in other countries, in Chile, and some similar projects in Peru. On an early project I had four senior Peruvian geologists working in the field. We didn't have a full-time secretary, we didn't have an office, we didn't own a typewriter, and we didn't have a bank account. I was paying for things out of my hip pocket in Peru [chuckles]. So it's a little different world.

Swent: It obviously has succeeded.

Lowell: Well, yes, through smartness or luckiness. It's a little difficult to be sure.

The Covered Area Project; Casa Grande West, Arizona

Lowell: But this consulting and half-time contract work: I started doing this with Quintana in Arizona, and in 1973 I put together a program which we called the CAP, the Covered Area Project. It continued for about five years, but the intensive part lasted for three years, 1973 to 1976. You were asking if there was bad feelings from Newmont. Newmont was the original funder of the CAP Project, about eight years after the Kalamazoo discovery, so they obviously didn't feel too cross about it.

Newmont originally signed the contract with me. Then they asked to bring in Hanna Mining Company to split the risk. Then a year later Newmont essentially got totally out of the copper business, and they bowed out of our project, which was a copper project--as it happened, only a couple of months before the Casa Grande West discovery, which might have changed their mind.

Swent: This was here in Arizona.

Lowell: In Arizona. Hanna Mining Company brought in Getty Oil Company, so the CAP was originally Newmont, then it was Newmont-Hanna, then it was Hanna-Getty. Getty paid their bills, but there is some question in my mind as to whether that was good luck or bad luck that they became involved in Arizona and then later in Chile because they tended to be a "disorg," somewhat in Arizona, and to a greater degree in the Atacama project in Chile. Getty had the same deficiency that Quintana had of almost total ignorance about the mining business. But the Quintana people were basically intending to be friendly and kind and fair. The head of the Getty exploration group was a fellow named Sig Meussig, who probably [chuckles] had none of the characteristics that I have listed as group characteristics for Quintana. The result of this was that--

Well, I'm getting ahead of myself. I'll go back to the history of the CAP project. At the time, the logic for the project was to use a more or less original mapping technique to project silicate alteration zones and geochemical anomalies in premineral outcrop under areas of postmineral cover, and then drill scout holes on wide spacing to see if the alteration zone could be extrapolated.

The annual budget was $750,000. We operated very cheaply and efficiently, I think, and we had drilled twenty prospects. We had drilled--in two years, '73-'74--actually, it was two years from the time the contract was signed until the Casa Grande West project. We had drilled twenty targets, and we had drilled 120 individual drill holes that were rotary drill holes at that time. And we had one strong smell of mineralization but no hits. The twenty-first project was the Casa Grande West project. It was based on the fact that we were aware that Asarco's Sacatón ore body was bottomed on a flat fault, a large displacement, low dip-angle fault, kind of along the lines of the San Manuel Fault, but a flatter fault, almost horizontal. Part of my knowledge dated back to earlier work in the district for Southwest Ventures and Utah.

We were aware of the fact that some mineralization had been found in scout drill holes in the Casa Grande Valley, and we were aware of the fact that farmers had, in quite a number of water

wells in the valley, had found pebbles of oxide copper mineralization from the holes that were drilled as water wells. This relates back to my first article about mapping stream directions in sedimentary rock.

Swent: How do you become aware of these kinds of things? Did you check with water drillers?

Lowell: Oh, it's through conversations with geologists, with other companies. It's kind of through--

Swent: I was wondering where these conversations take place.

Lowell: Oh, when you get together to have lunch or at geologic meetings or telephone calls.

Swent: You say you knew there had been these things found in the Casa Grande Valley. I'm just wondering how you find out this sort of thing.

Lowell: That's a good question. Our exploration at Casa Grande West was maybe the fourth round in that area or the sixth round. It wasn't a new idea that there might be another piece of this ore body. A number of other companies had worked there. A typical habit of exploration geologists is after they try something themselves and it doesn't work, they chat with their friends about it afterwards. That's where the first part of the information came from.

But our project was predicated on drilling scout holes, so we had a little project to compile all the information we could get on this area. It was actually one of our earliest projects in the Covered Area Project. The twenty previous projects that we drilled were the ones that at any given time we thought was the most favorable, and so this project kept dropping to somewhere in the middle of the pile but not being rejected. We finally got around to the Casa Grande project, and we compiled all the information from scuttlebutt and published information that we could get. On that project, we even went so far as to go to the county recorder and develop a chronological history of when mining claims were staked and where and by whom in that area, so that we had a historical record of where Asarco's interest was, for instance, after they found that the Sacaton ore body was bottomed by a fault. Asarco was the individual company that had been most interested in that target area and had done the most work there.

Well, then I went back to my experience on the Colorado Plateau in mapping directions of--ancient stream directions. We had a program mapping along principally the east boundary--this was the east side of the Santa Cruz River drainage. The Santa

Cruz River dies out and goes into a distributory network. It probably originally connected with the Gila River near Gila Bend but doesn't now; it just flows out into the valley and stops.

We mapped stream directions, and in the course of doing that I talked to a friend whose name is Spade Cooley, who was a USGS geologist based in Tucson for a while. He no longer is. I knew that he had worked in the vicinity of Casa Grande, and I compared notes on stream directions with him.

Swent: This is current streams or ancient streams?

Lowell: Ancient streams. Ancient but postmineral. The age of the mineralization is approximately sixty million years old, and there are outcrops of rocks that range from modern streams to streams maybe fifteen million years old in that district. Spade told me something which was very surprising, and that was that his work suggested that the Santa Cruz River had reversed directions twice in its history, that it had originally flowed from south to north, and then it had flowed from north to south, and then it--it now flows from south to north again.

So I took this information and went back to our plotting of the locations where the copper pebbles had been found in the water wells, which had not formed a very obvious pattern based on a south-to-north flow, but they made a very neat pattern, a wedge-shaped pattern, on the basis of a flow from north to south.

So on this basis, we went out to the key area and acquired property. Some of the ground that we staked had originally been staked by Asarco, and they had allowed their claims to lapse. They later said, Well, we were interested in this area all along, and you're just unethical latecomers and so on. But the evidence really didn't support that because they had allowed their claims to lapse.

So we went to this key area and drilled several holes and immediately found evidence of porphyry copper mineralization. The first hole intersected some leached capping, which is a material over a porphyry copper deposit, from which the copper has been leached and carried down to form a secondary enrichment blanket. But there was no ore--we found weak copper mineralization but no strong mineralization.

We moved around then. The trail got hotter and colder and hotter--we were six miles from the nearest outcrop of pre-mineral rock, so geologic mapping was of no use, but subsurface interpretation was what we were doing. While we were doing this, the "jungle telegraph" operated in the opposite direction and

Asarco heard that we were drilling out there, and they got excited and came back out and started competing with us.

Our fifth hole was near ore grade, and our seventh hole was definitely ore grade. It became apparent that one quarter-section of land might be the center of the ore body and was possibly available property. This was land in which the surface owner owned both the surface rights and the mineral rights, and the owner was a congressman from Dallas, Texas, who had bought the land for speculation purposes--not for mineral but for real estate.

Swent: What was his name?

Lowell: Don't remember. I may have that in my files. But we had borrowed Bill Mounts from Newmont Mining Company, and then he elected to resign from Newmont when they dropped out, and worked for me. We had borrowed a land man from Getty, whose name was Don Nichols. Don Nichols was a retired Marine Corps fighter pilot, a very aggressive sort of guy, and--

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Lowell: --an aggressive land man. Most of his land work, I think, had been done in the oil business, but he was a good negotiator. We called this congressman, who was a kind of a self-important, successful politician, successful businessman, and he wouldn't talk to us, so I asked Don to make a trip to Dallas and go to see the congressman. He went to his office and explained to his secretary who he was and what he wanted to see congressman Joe Blow about, and the secretary talked to the congressman, and the congressman said he was too busy, to go away. So Don Nichols sat down in the chair in the reception room, and he waited there all day [chuckles] until this guy came out, and then he buttonholed him and, with his charm, was able to talk to him and make a deal. So we got this quarter-section of ground, which turned out to--

Swent: Did you actually buy it or just get the rights to it?

Lowell: We bought it. And it turned out to contain something like 500 million tons of one percent copper, in one quarter of one square mile. So we drilled through 1977. My experience in a number of occasions is that when some prize is found in a project like this, a major company develops almost irresistible urge to take the project over themselves. So Hanna and Getty said, Thanks very much, but we'll continue the development. Hanna was the operator of the project. They spent $20 million drilling at Casa Grande West, which was an excessive amount to spend. They drilled it

out on too-close spacing, trying to bend over backwards being over-conservative.

But what should have been done at an early stage was sink a shaft. The shallowest part of the ore body was 1,200 feet deep, which would be an expensive shaft but they could probably have done that for not much more than $20 million, and they would have had the start of a mine. Instead of that, they drilled an excessive number of drill holes and were never able to make the hard decision to go underground.

This was partly because they were not a copper company and didn't have experience in this, and Getty was almost totally ignorant about mining. The net result of this was that they sat around and agonized for years, and in the meantime real estate development encroached, and the environmental movement became stronger and stronger. It finally was no longer practical to try to develop the copper mine there, and the ore body may be lost forever. It's the most important copper discovery in Arizona in the last thirty years, probably. So that's the long, sad history of the Casa Grande West project.

Swent: So your contract was just to do the original work?

Lowell: Yes. My contract said that a bonus would be paid when a minable deposit was found, and we had a long argument about whether or not this was a minable deposit. It's kind of--beauty is in the eye of the beholder. An aggressive company would have thought it was minable, and a timid company would not. So they ended up paying part of the bonus payment in my contract. I think if Newmont had still been involved in the project and if they hadn't changed their policy about mining copper, they would have probably gone ahead and developed it.

Negative Effects of the Environmental Movement

Swent: This is the first time you've mentioned the environmentalists. Of course, really, the 1970s is when they began to be a major influence in mining.

Lowell: I guess that's right. I never heard a date, but--

Swent: That's when the Environmental Protection Act was passed.

Lowell: Ah, yes. That's an interesting timing.

Swent: The big force of the movement began in 1970.

Lowell: Well, it has resulted in almost eliminating all mineral exploration in Arizona, which means that when the current mines are depleted, there won't be a mining industry here, so they have killed mining in Arizona and, for the most part, in the United States. Maybe that won't be important during the next twenty years, but I suspect it may be important from the viewpoint of the longterm welfare of the country.

There's a group in Tucson called the Southwest Center for Biologic Diversity. Its modus operandi is to get money from Ted Turner and various foundations to file lawsuits. They have filed ninety-nine suits and have active lawsuits against the Forest Service and the Bureau of Land Management, and they had a suit against the University of Arizona. They have prevented the construction of a high school in Tucson. They prevented the reopening of the Ajo Mine by Phelps Dodge.

In that instance, Phelps Dodge got all of their permits approved, and it was an old mining camp with minimal possibility for damaging the environment, and they were using an environmental-friendly concentration process. They had to build a new high-tension power line from Gila Bend to Ajo, within the easement of the existing power line. They got a permit from the Bureau of Land Management to do this, and there was something like a 120-day period for public input, and the Southwest Center for Biologic Diversity, 119 days and twenty-three hours later, in order to make it as difficult as possible for Phelps Dodge, filed a lawsuit against the Bureau of Land Management to prohibit the construction of this power line, which it's hard to think could have caused any problem whatsoever. It would have been right beside the other power line.

Shortly after that, Phelps Dodge announced that they weren't going to reopen Ajo. This resulted in the loss of hundreds of jobs in the mine and in service jobs related to the mine. So this is how business is done. The head man for this Southwest Center--his name is Suckling. They were previously centered in Silver City, New Mexico, and Mr. Suckling was arrested for shoplifting and fined, maybe put in jail for a while, so they moved from Silver City and now Tucson is blessed with this creep [chuckles].

The Forest Service has more than fifty lawsuits that have been filed against them by this group. If I sound like a rabid anti-environmentalist, it's because [chuckles] I am.

Swent: Right. It's a very difficult thing to work against, or with, isn't it?

Lowell: That's right. It's very stylish to be in favor of clean air and clean water, but I can't see how this is promoted by shooting down high school construction and all the other silly things that are being done. The Forest Service is really, as federal agencies go, quite a reasonably good organization, and they've been brought in Arizona to almost a total halt by these lawsuits.

Swent: That's a shame.

Lowell: Well, where are we?

Swent: Have we reached a good stopping point?

Lowell: Yes.

[tape interruption]

A Project for Kaiser Aluminum in Argentina, 1969

Swent: All right. We're continuing now after our lunch break. We finished talking about Casa Grande West, and now let's move on.

Lowell: I would like to backtrack a little bit, to a project I had in Argentina in 1969 for Kaiser Aluminum Company.

Swent: How did that come about?

Lowell: Well, I think Kaiser contacted me pretty much out of the blue to do a porphyry copper reconnaissance of the Argentine side of the Andes.

Swent: Did you know anybody at Kaiser?

Lowell: I knew Joe Derek, who had previously been chief geologist at the Morenci Mine for Phelps Dodge in Arizona.

This project lasted about six months. I probably only spent three or four weeks of that time in Argentina. But I had a two-man crew working on the project. It was largely aerial reconnaissance, looking for alteration zones and following up on field trips. The two people were Peter Davies, a Welshman who was working for Kaiser, a mining engineer, and Clark Arnold, a geologist who had previously worked for me in Arizona.

The first step in the project, which was a little self-serving on my part, was a reconnaissance flight from Lima, Peru,

to Santiago, Chile, in a small plane, with the object of over-flying all of the known porphyry copper deposits and undeveloped prospects that I could learn about. I did library research to locate all of the prospects that I could find any record of.

Swent: What were some of them then?

Lowell: They were all of the southern Peru copper belt deposits: Cerro Verde, Cuajone, Quellaveco, Toquepala. And in Chile, Quebrada Blanca; at that time, the next one was Chuquicamata, and farther south was El Salvador, and then Cerro Blanco, which is now called Andina. At that time, El Teniente was called Braden, and there was the Disputada Mine.

The trip began by chartering a twin-engined, fairly ancient, small--I believe it was a Piper--airplane that was flown by a fellow named Capitán Perez, who was a moonlighting Peruvian army pilot. We left Lima airport, flying towards Arequipa and Tacna, Peru. Capitan Perez crossed himself, but did no pre-flight check before he took off. One of the engines went out on the airplane, and we had to make an emergency landing at Pisco, Peru, and spent the night there and got the airplane running the next day and flew down to Tacna, and went by automobile to Quellaveco and Toquepala. I think we did not visit Cuajone but only overflew it.

We began to get intimations that we weren't going to be able to arrange a permit, as we had been promised, to take the Peruvian airplane into Chile. There is a long-standing animosity between Peru and Chile, going back to the War of the Pacific in 1876. We waited around for a couple of days in Tacna, and finally Capitán Perez and our airplane disappeared, and we were left in Tacna. We got a taxi and rode in the taxi to Arica, Chile.

I was the best Spanish speaker of our group of two, and did most of the negotiating for us. I inquired around Arica and was told that there was a Spanish immigrant to Chile who was a blacksmith in Arica, who was a pilot and would fly us in a *Club Aereo* (Flying Club) airplane. We talked to him, and he seemed like an impressive, intelligent, sensible guy, so we made a deal [chuckles] with some trepidation. It turned out very well. The airplane was almost new, the pilot was much better than the army pilot, and we flew from Arica, visiting some of the Quebrada Blanca and other prospects.

Swent: You actually landed and visited them?

Lowell: No, we overflew most of them. We were trying to learn to recognize porphyry coppers from the air. And we flew as far south as to overfly Chuquicamata, and then we turned west to Antofagasta

and landed at Antofagasta. I called the Chuqui exploration office. Chuqui at that time was owned by Anaconda. In the meantime, the fixed-base operator at the airport told us that he would, without any doubt, be there at seven o'clock to fuel the airplane. So we got up early in the morning and drove to the airport in a taxi. We were waiting at seven o'clock and no fuel man. Eight o'clock came and no fuel man. Then eight-thirty.

So I called the Anaconda exploration office. These telephone calls were far from easy in isolated locations and no easy way to pay for the calls and another language and so on. I finally got the secretary in the exploration office who spoke English, and I said, "I'm terribly sorry and upset. This fellow was supposed to be here at seven o'clock, and it's almost nine."

She said, "Mr. Lowell, is this your first trip to Chile?" [laughter]

We eventually got to Chuquicamata, had a nice visit, courtesy of Anaconda. Then--

I had written to Lew Gustafson, who was the geologist at Salvador and had gotten no reply, so I assumed that we were not going to get a visit to Salvador, but we overflew Salvador and looked at it from the air and then turned west again to Chañaral, a little town on the coast, and checked into the hotel. By the time we got checked in, it was dark and it was a little, small hotel in a remote location, and the lights were poor in the hotel and we couldn't see very well. We ordered a scotch and were sitting there chatting, and a fellow walked up to me, and he said in Spanish, "Are you Mr. Lowell?"

I said, "Yes," thinking there's no one in the world--not anybody that knows that we should be [chuckles] in Chañaral. He said, Well, Mr. Gomez (or some name I've forgotten) wants to see you down at some place name, and if you can come with me, we'll go see Mr. Gomez.

I thought, "What kind of thing am I getting into?" [laughs] So I decided what the heck, and got in the car and we drove down, and it turned out that the place we were going to was Anaconda's office in Chañaral, which was a kind of a port city for importing --not a city; it's only a village, but a port for the Salvador mine. Lew Gustafson had seen the airplane fly over and had deduced, from the letter that he hadn't answered, that it was me. And so he sent this fellow to tell me if I could come the next day, we could get a mine tour [laughter].

We flew cn down, looking at other prospects. I took pictures and kind of studied the color zoning, which reflects the alteration zoning. And finally got to Santiago, where we paid the charter pilot, who had done a great job for us.

One of the things we spotted in this flight was an Inca or pre-Inca temple on a high mountain peak, maybe at an elevation of seventeen or eighteen thousand feet. We then went from Santiago over to Buenos Aires and back to Mendoza to begin the project, which consisted, as I mentioned, of largely aerial reconnaissance work.

Swent: Was Kaiser Aluminum wanting to get into copper?

Lowell: They said they were, but when they actually got their chance, they chickened out. The only prospect that came out of this program was Bajo Alumbrera, which was a couple of years ago acquired by Mt. Isa Mines in a joint venture with Rio Algom and I think North Mines is the other one. Two of them were Australian companies.

I actually negotiated the deal with the entity that owned Bajo Alumbrera called YMAD. Came back at the end of the project with a deal signed by the Argentine government entity that was supposed to own it. The Kaiser lawyer said that he doubted that these people had the authority to make the deal, and on that basis they (Kaiser) were going to back out of the deal. But it's a large copper-gold ore body. Whether it would have been profitable to mine at that time, I don't know. It was barely identified and certainly not drilled out, and now it is the largest copper mine in Argentina, but the current economics are uncertain.

Swent: How was Kaiser to deal with?

Lowell: Kaiser, aside from welching on buying the mine, were fine to deal with. I later did some work for them in Iran also. I have pleasant personal recollections of the Kaiser people.

Wild Experiences in Reconnaissance Flying

Lowell: We had some kind of wild experiences in the reconnaissance flying. We ran into the same problem as with the Peruvian airplane, that the aircraft maintenance was in general poor in Argentina, and some of the pilots were not well trained. We were doing high-altitude flying without oxygen, and sometimes flew as high as 18,500 feet, which is a little dangerous for the observer, but it's very dangerous with respect to the pilot controlling the

airplane. And I remember on at least one occasion, we were having mechanical problems with the airplane, and an ambulance raced down the airstrip beside the airplane [chuckles].

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Lowell: One humorous incident that occurred was when Peter Davies and Clark Arnold were trying to charter an airplane in Chile by telephone. Peter Davies had a heavy Welsh accent and was not very good at speaking Spanish, but he understood it quite well. And Clark is a fellow who is a natural mimic of sounds, and he was able to pronounce Spanish words with a reasonably good accent, but he wasn't able to understand it, listen to it. So they hit on a scheme to work out a dialogue for renting an airplane. Clark would read the statement from their end and quickly hand the phone to Peter, who would listen to the reply and tell him what it was, and then Clark would speak the next line [chuckles] on the dialogue; and they succeeded in renting an airplane this way. But there are lots of funny incidents.

Drawbacks of Mineral Exploration in Argentina

Lowell: I concluded after that experience that I was not enthusiastic about doing mineral exploration in Argentina, and I really never--

Swent: Why was that?

Lowell: Well, the Argentineans, as somebody told me at the time, are very good for singing and playing musical instruments and cooking, but they are not very good people to actually get anything done or to do business with [chuckles]. And they're also not very reliable in business deals.

Swent: What was the situation in Argentina at that time?

Lowell: Well, it was in a kind of a stable, average condition, with no real political problems but no very productive government.

Swent: Do you think it might have improved since then?

Lowell: I hope so [chuckles], but I'm a little skeptical. There have been some serious incidents by mining companies doing work in the last couple of years. In the case of Bajo Alumbrera, for example, Mt. Isa made what we thought was a very clear-cut deal, and I think by now they've invested the best part of a billion dollars--

Swent: Billion?

Lowell: Billion. And just a few months ago the officials of the province in which the deposit is located informed Mt. Isa, "By the way, we would like something like a 5 percent royalty for the province, in addition to the other terms," which is still being argued about, but if they make it stick, it will probably make the operation uneconomic. There were lots of little problems that we ran into somewhat along the same lines, so it's not really a very good place to do business.

Corruption and Doing Business in the "Third World"

Swent: At some point we might address the issue of bribes and doing business in other countries, and perhaps you want to talk about that.

Lowell: Well, in regard to corruption as it relates to doing business in Third World countries, in my experience the worst place that I have been is Mexico, and I have spent a short, unpleasant time in Nigeria, which is also terribly corrupt. Nigeria is said to be the worst country in the world for corruption. But the corruption comes--I'm sure there is some corruption in the United States or anywhere else, but the asking for bribes is not very obvious in most parts of the world. The corruption comes in in getting governmental officials to agree to process your application and things of that sort.

I have never paid a large bribe to anyone anywhere. In Mexico I've contributed my five dollars at the inspection station to get my car passed through, which most other people are also doing, but I sense the existence of this kind of corruption, especially in countries like Argentina and Nicaragua and probably Ecuador.

A Number of Little Problems in Peru

Lowell: Certainly, there is some of this in Peru, but it didn't appear to be very widespread in Peru. Peru, in the four-year project that we had, we came to the conclusion that the top levels of the federal government were pretty straight-arrow, and the lowest levels of government were relatively straight, but the corruption

showed up in the middle level. Things like provincial governments and the Peruvian equivalent of middle-level judges.

Swent: How did it manifest itself? How were you aware of this?

Lowell: Well, we had a prospect in Peru that was owned by a gentleman--I believe his name was Chavez. It was an attractive-looking gold target. We tried to make a deal and got promises and a certain amount of runaround, and then we went into sort of a careful, almost detective study of the situation with Mr. Chavez, and we found that he had made--we had a tentative deal for a 50 percent interest in the prospect, with some hope of acquiring what we thought was the other 50 percent. But it turned out that he had made deals for a total of 250 percent of the ownership of his property. Part of this was built around a lawsuit that he had with another partner, and they had successively offered *propinas* (tips) to the local judge, and the judge, upon receipt of a larger tip, would announce that he thought either Mr. Chavez or his antagonists were in the right, and the take of the judge gradually built up over a series of months. That was the worst example that we ran into.

Swent: What was the outcome finally?

Lowell: Well, I don't know. One of the five 50-percent interests was owned by Mr. Chavez's estranged wife. At one point, both Mr. Chavez and the wife were put in jail [chuckles].

Swent: But you backed out of it.

Lowell: We backed out about the time that we learned there was 250 percent out. But we had other little problems of that sort. Peru, at the time of our project, had just adopted a new mining code, which in many respects is one of the simplest and most effective anywhere in the world. They had divided the whole country up into one-kilometer square blocks, on the basis of UTM coordinates.

Swent: UTM is what?

Lowell: The "M" is military. Universal something-or-other military coordinates.

Swent: I can look it up. [Universal Transverse Mercator]

Lowell: It's a kind of international coordinates system. Each kilometer-square block was given a number. This was computerized, and each number (square kilometer) was available for something equivalent to an unpatented mining claim by payment of two dollars per hectare, or two hundred dollars for a square kilometer. In

theory, you can go into a mining office, ask for a certain number, like 1753, and they would punch it into the computer and they would say It's available, and you could pay your $200 and immediately have priority to have mining rights on that square. Or, if someone else had it, they would tell you that.

But the flaw in this system was the old claims that were not filed on the basis of north, south, east, west kilometer squares. We noticed that these old claims had a strong tendency to float around, like plate tectonics plates [chuckles], depending on the part of the district that a stranger was interested in. There were lots of problems on that score. We found some evidence of collusion between property owners and officials in local mining offices. These are the things that--

Swent: Collusion in what sense?

Lowell: Well, passing of information about other claims and a getting together--one fellow would say, "Pancho, it would really be very helpful to me if my ABC claim could fly about three hundred meters to the north, where Barrick Gold is getting ready to have a drilling project." The appropriate coordinates might appear in the records to take care of this, and presumably some money or obligation would pass between the two Peruvians.

Swent: So Barrick would have to pay a higher price?

Lowell: Yes, they would have to buy the claim, whereas otherwise they wouldn't have to.

Swent: I see.

Lowell: We had a number of little problems like that, but on balance Peru seemed to me to be a place that was very possible to do business in. Peru, in my opinion, is a much better environment than Argentina and probably better than Mexico also.

Chile Was a Very Straight Place, But Has Deteriorated

Lowell: In Chile there is a certain amount of this going on, maybe at about the same level as the United States or maybe it's a little worse than the United States. My early work in Chile was done during the period of the Pinochet government. During that time, Chile was really a very straight place.

Swent: It was a military government, wasn't it?

Lowell: It was a military junta government. The laws were obeyed, and the laws were enforced, and it was a good environment for doing business. I might add that I never saw a single instance of human rights violation myself or a first-party report of human rights violation under the Pinochet government. Pinochet just--as a little soapbox addition--but Pinochet was kept in power by a plebescite eight years after the junta took over the government, winning 70 percent of the popular vote. The transparency of these plebescites was certified by outside observers. The first time that he lost public support, he retired as president as had been specified in the constitution. In my opinion, he did a very good job as president. Did not enrich himself. There was little to no corruption in the Pinochet government.

But we noticed--well, after he went out, the level of corruption noticeably increased. People started asking for bribes. The law and order situation deteriorated. Santiago went from being a very safe place to walk through at night, to a dangerous place.

Swent: When was this?

Lowell: Oh, it was about, roughly, seven or eight years ago.

Geographical Variations in Corruption in Chile

Lowell: The other interesting thing about corruption in Chile is the central and southern part of Chile has been Chilean since the time of the revolution against Spain, but the northern maybe one-quarter of the country, from Antofagasta north, was captured in the War of the Pacific--part of it from Peru and part from Bolivia. It has a different ethnic makeup and also different traditions in terms of population and so forth. Even during the Pinochet period, Arica, which is the northernmost city, was understood to be a difficult place from the standpoint of honesty and fair dealings. It's more so now. That's kind of a geographic variation in corruption within one country.

Swent: You get into smuggling, of course, in border towns always. It seems to be kind of a given at a border town, doesn't it?

Lowell: That's right. And you see the same thing here in Nogales, Arizona, and Nogales, Sonora.

Swent: So that's a little different from other kinds of corruption. It's still corruption, but it's a specialty, I guess, a subset [chuckles] of corruption.

Lowell: We had a group of mining claims intentionally misfiled by the mining court clerk in Arica and a set covering the same area inserted in place of ours in the name of a friend of the clerk, which is certainly an example.

Swent: So what do you do in a case like that?

Lowell: Well, we had a suit, which we lost. We eventually had to make peace with the other claimants and give them part ownership in the property. But it was an unpleasant experience.

Swent: Yes, indeed.

Lowell: I was talking earlier about land men. That's the sort of problem that you hope a capable land man will avoid in working on your behalf.

So that isn't a very coherent discussion of corruption, but--

Swent: Well, it was apropos of your experience in Argentina. So you have never gone back to Argentina.

Lowell: No, I haven't. I recently reviewed a property that had been explored by a large company and finally bowed out.

Looking for Bargains in the Mining Industry

Swent: Was it at their invitation that you reviewed it?

Lowell: Yes. It was a major company that had had a drilling project and had found some ore but not enough to be of interest to them. In fact, two of these boxes I'm sitting beside are data from this project. They invited me to look at it from the standpoint of a smaller miner with lower standards, but it didn't fit with my objective there.

A friend of mine once made the remark that the biggest bargains that are ever encountered in the mining industry are mining properties that major mining companies decide, for company political reasons, to drop. And they can't wait to get rid of the property when that kind of decision is made. They may even pay

you [chuckles] to take the property. I have, in my career, looked for bargain opportunities of this sort.

Swent: But this wasn't one.

Lowell: This wasn't one. The number of mineral prospects that actually develop into mines is very small, and nobody has a specific, accurate figure. I have a number of friends in Japanese mining companies, and one of the vice presidents from Mitsubishi told me once that the Japanese rule of thumb is that there are three mines that come out of a thousand good mineral prospects, or one in three hundred and thirty-three. I've heard numbers like one in five hundred, but it's all just a guess, but there are very few that actually make it.

Expert Witness for the Arizona Highway Department

Lowell: Let's see. One other thing that happened about the same time as Kalamazoo and Vekol Hills was I was selected to be an expert witness on a continuing basis for the Arizona Highway Department in suits involving mineral properties. I ended up being a witness in something like eight different lawsuits on the side of the assistant attorney general, who was defending the suits for the State of Arizona. This was a very different kind of activity from anything I had done before, but it turned out to be exciting and many times a lot of fun.

The assistant attorney general that I worked with mostly--name was Stanley Z. Goodfarb. Stan was a very good trial lawyer, and we won in every suit that I was involved in. I felt that the reason for the high success rate was hard work. Stan would rehearse me for a couple of days before the suit and write endless series of hypothetical questions and answers, and answers that I couldn't make I would go to the library and look up, and then I would make hypothetical questions for the other side's expert witness. Every time we got in the court, it was a rout. We knew the answers, and they didn't, and so we would win. This was a little side interlude in my mining career.

Swent: What sorts of suits were they?

Lowell: Well, they were suits in which a highway alignment crossed mining claims, or I remember in one case a gravel pit was said to be really pozzolan, which is a relatively valuable material that is used in cement manufacture. In another case, riprap, which are blocks of broken stone that are used to reinforce road grades--the

riprap contractor asked for special conditions on his contract because the rock wouldn't break the way the highway engineer said it was supposed to break. Things of this sort.

A Frightening Accident in an Arizona Mine

Lowell: Let's see. Somewhere along the line, I was involved in a mine accident. That was, I believe, shortly after I left the employ of Utah Construction Company. I was working for them as a consultant with the Utah geophysicist whose name was Don Hansen. We were looking at a mineral prospect that had some underground mine workings that had been submitted to Utah in the Black Canyon area in Arizona. I got in trouble by trying to be a nice guy. The owner of the mine had offered to pump out a winze--a winze is an interior shaft--that was full of water.

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Lowell: It was full of water. He had an electric sump pump that weighed a hundred pounds or more and was attached to a steel cable. There was a staging in the shaft (staging is like a timber platform), and he couldn't make the sump pump work. It wouldn't raise the water, and he was trying to lift it up and down to get the pumping process started. I went by maybe ten feet above him in the mine drift and asked him what he was doing, and he said the pump was too heavy to lift and told me what he was trying to do.

So I climbed down onto the staging and got ahold of the cable with him, and we pulled together. Unbeknownst to me, the staging hadn't been put in very well, and when we pulled hard on the cable, everything came loose, and the mine owner and I and a bunch of heavy pieces of timber all fell down the shaft together.

We fell about thirty-five feet to the water and hit the water and then went a long ways below the surface. I had a little ordinary flashlight that I happened to have in my hand, which continued burning underwater. I looked around, and I saw this other fellow floating in the water, and I grabbed ahold of him and swam back up to the surface. He was unconscious, and I draped him over one of the timbers. The whole shaft was full of pieces of timber, some of which were ten inches square, big pieces of wood.

Then we had to hang onto the timber. Don Hansen had expected to meet me, and when I didn't show up, he came looking. I was able to yell to him as he went by, and he found a ladder and got it hung in the shaft, which was no mean trick. In the

meantime, I noticed that my shirt was bloody, and I found out that I had broken my elbow, when I either hit the side of the shaft or a piece of timber had hit me on the way down or after I was in the water.

So it turned out to be quite a hectic experience.

Swent: I was just thinking, too, you probably had a battery around your belt and--

Lowell: No, it was a very casual trip.

Swent: I would think it would be awfully hard to get back up to the surface of the water if you had mine boots and--

Lowell: That's right.

Swent: --battery and all those things.

Lowell: I hadn't thought about that, but that's exactly right. It was a chip fracture of this bone [demonstrating]. Broken, and it was painful, but not particularly debilitating. I was able to drive home after getting out of the shaft.

Swent: Well, that's a scary one!

Lowell: Yes! It's a good example for why the safety rules should be followed.

Swent: Yes.

Mules, Grizzly Bears, and Elephants[1]

Lowell: Explorationists who work in the "bush" tell tall stories about dangerous animals which usually cast the teller in a heroic light. If the field work is in Latin America, the dangerous animal is likely to be a mule, or maybe a poisonous snake. In Canada and Alaska the animal of choice is the grizzly bear, although it's also possible to be chased by a black bear. However, in Thailand there are even more dramatic animals like wild elephants and king cobras. Anyway, these are some of my bush tall stories:

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[1]This section was rewritten and inserted by Mr. Lowell during the editing process.

I made many muleback trips into the mountains in Mexico and the Dominican Republic and Honduras and Ecuador, and many trips in the Andes of Peru and Chile on mules and horses. Horses are dumb and excitable and buck you off and fall on you (I have a 14-inch stainless steel plate attached to my right femur), but mules, while being less inclined to buck and more intelligent, are MEAN. They are vindictive on the basis of indignities suffered up to years earlier, or perhaps it is some sort of ancestral vindictiveness about being domesticated.

In the late 1960s I made a trip to Honduras to look at two copper prospects owned by an airline company and prospector in Tegucigalpa named Bill Lady. Bill was a very nice guy, but as I learned, had a bad temper. He also was very proud of his bush lore and told me about his expertise in mule handling and mule riding. This was also bandit country and Bill carried a very large revolver on the trip.

We went to the jumping off point for one of the prospects and Bill rented two mules from a little ranch and we started off. It was immediately clear that the mules were only half broken. My mule, at one point, spun with me on a narrow trail with a cliff on one side and I made many revolutions until I was able to jump off on the uphill side, but I managed to ride him all day. Bill's mule caused constant problems and finally succeeded in banging Bill's knee very painfully on a boulder. I was fifty feet ahead on the trail and Bill jumped off and hobbled after the mule in a fury. He pulled out his revolver and cocked the hammer and said, "I'm going to kill you, you dirty son of a bitch." This alarmed me, not through any benevolent desire to save the mule's life, but because I was in the line of fire. I asked Bill to wait a minute until I climbed a few feet up the slope, but by this time his knee hurt a little less and he decided not to shoot.

In the early seventies I had a consulting assignment to look at some copper prospects in the Dominican Republic in a combination helicopter-mule expedition in the mountains. I was dropped by the helicopter at a ranch in the jungle where some mules had been lined up, and together with Vreeland Johnson, the claim owner, and a Dominican arriero, we were to ride all day visiting a prospect and would be picked up late in the day in a clearing on the other side of the mountains where the helicopter would land. I made several mistakes that day, and the first was in telling the arriero that I was a good mule rider--this resulted in my getting the worst mule who from my first move to get on went through his bag of tricks which included biting, kicking, spinning, and bucking. We had a who-is-in-charge tussle for the first half hour and then settled into a clippity-clop trot on a trail in the jungle along a river bank.

It was a warm morning and I began to daydream when I saw something in the corner of my eye. When I looked to the right there was an attractive young Dominican woman, bare to the waist, washing clothes on the river bank! It took a second or two to bring this picture into proper focus, but that was plenty of time for the mule to realize my guard was down and swerve off the trail towards a tree with a limb about six inches higher than the saddle.

When he broke into a run I felt the acceleration and saw the limb and threw my legs up and lay back on the mule's rump and slithered under the limb, but for a while couldn't get back in the saddle and galloped by the partly clad lady rotating in horizontal circles on the mule. I have wondered since what she thought of the performance. I was able to get back into the saddle without falling off and we continued clippity-clopping on.

The prospect was in a little mountain range, and in the afternoon we were going down a steep trail when the gurapera on the saddle broke. This is the strap on a mule saddle under the mule's tail which keeps the saddle from slipping forward over the mule's shoulders. This is necessary because a mule's shoulders are narrower than a horse's. I didn't realize that the gurapera was broken until I noticed that the mule's ears were almost in my face. I then climbed frantically backward until I could grab the mule's tail. The mule was unable to bite, kick, spin, or buck because he was just as anxious to not fall off the cliff as I was. We came to a condition of equilibrium with the mule's legs spraddled out and me lying backwards with a death grip on the tail. The arriero observed after this second performance, "Señor, you are a very agile gringo!"

In the course of our adventures during the day, our package of ham and cheese sandwiches had been totally mashed into a flat tortilla of homogeneous ham, cheese, bread, and wax paper, and we declined to eat it at lunch, but when we arrived at the clearing and the helicopter had not arrived, we cut the mess up into three pieces and ate it. About dark the machine arrived and we flew to a small airport with a one-room terminal building. When the pilot circled to land next to the building, Dominican soldiers ran out of both doors waving their arms and pointing to a spot on the airstrip. I asked the pilot what that was all about and he said, "Oh, that area must have been mined because there is a current threatened invasion by another Caribbean country."

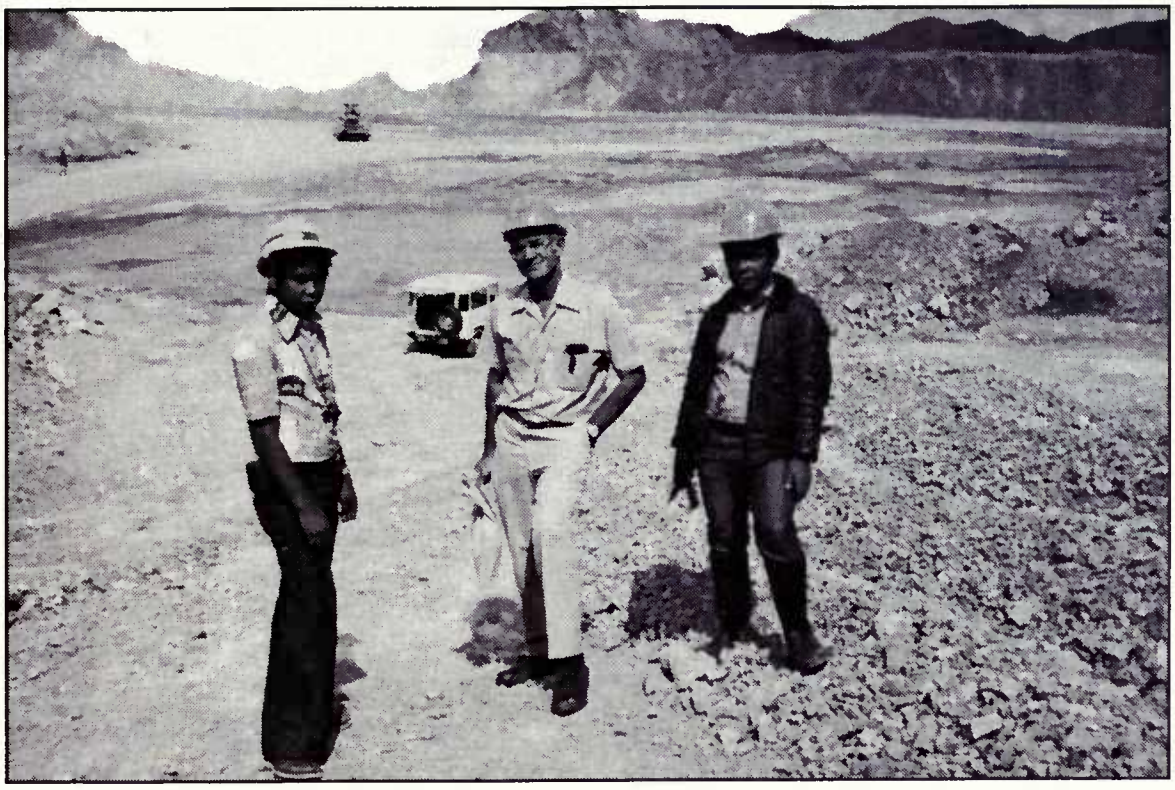
Vreeland Johnson, the claim owner, was an American who owned a Dominican flying service and had spent all of his career in the Dominican Republic. He was killed in a helicopter crash after I knew him. I asked Vreeland how he happened to settle in the

Dominican Republic. He told me that during World War II he was a navy PBY pilot and assigned to a base in the Aleutian Islands, an area which is said to have the worst weather in the world. He said it was a miserable life with no feminine companionship and nothing to do. He said they took off from the base in the middle of blizzards and flew out over the ocean in bad weather looking for Japanese ships and on the rare occasions when they found one, they were shot at. On their return flights they had great difficulty finding the base and often also landed in a blizzard. Vreeland said a questionnaire arrived from the Navy Department and one of the questions was, "In what capacity do you think you could be of most value to the United States Navy?" Vreeland filled this out: "As a military attaché in a Caribbean country." The other pilots laughed, but two months later he was transferred to Santo Domingo and when the war was over, he stayed.

In the early 1970s I was asked to visit two porphyry copper prospects in the Atlin district near the British Columbia-Yukon Territory border. My son, Doug, was twelve years old and I asked him if he would like to go since it sounded like an interesting trip. We spent several days flying in a helicopter in the bush and it was during the salmon run which is also when grizzly bears congregate on salmon rivers. The first day we flew into a sport fishing camp on the Taku River which we planned to use as a base camp for the mineral prospect visits. We saw six grizzlies from the air before landing. The pilot landed on an island in the river a hundred yards from the camp instead of on the river bank. When I asked why, he said grizzlies sometimes tear up helicopters and the theory is that they remember being chased and when they find their enemy on the ground, they get even.

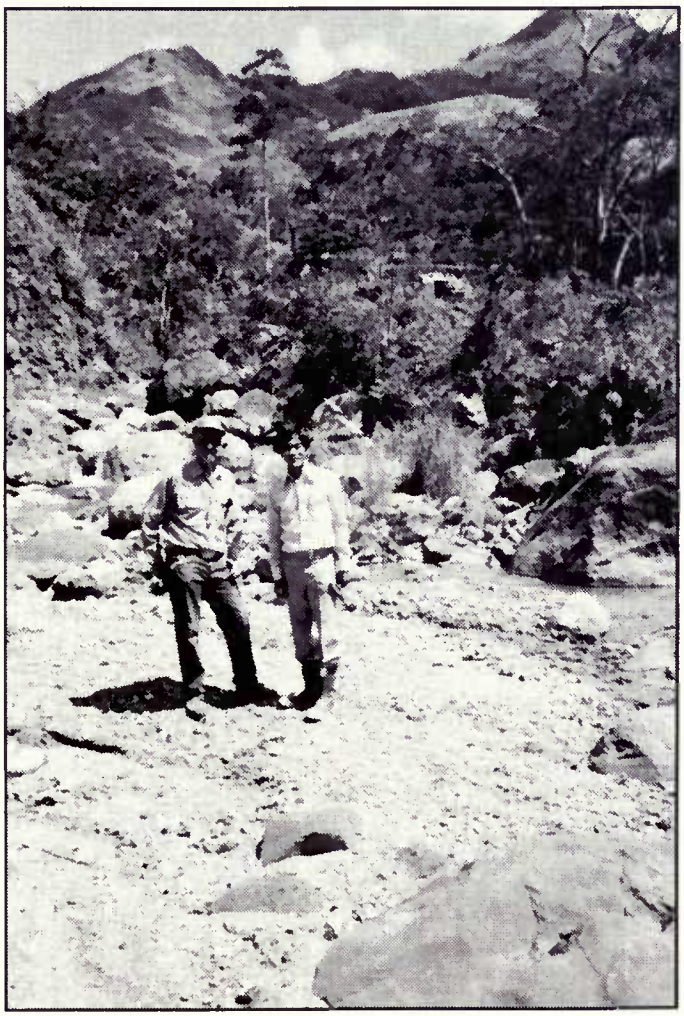
There were no fishermen in the camp, only a guide and a cook. The guide had had a frightening confrontation with a big sow grizzly shortly before we landed and we heard hours of bear stories. Doug borrowed a fishing rod and thrashed the water and the fishing was exceptionally good. He got up to start again at dawn while I was still mostly asleep. I heard what sounded like pigs grunting, then a shout, and then a little later the same sequence of sounds followed by a shot. At this I piled out of my tent in my underwear to see what was happening. There was a little (300-pound) dead bear at the edge of camp and the guide was holding a 30-06 rifle and Doug was climbing down from a pine tree. Three yearling cubs had walked into camp on the river bank, and Doug had run up a tree, and the guide had yelled at the bears and they ran into the bush, but they reconsidered and came back out in their fighting stance walking on their knuckles, and the guide shot the lead bear between the eyes and the other two ran.

1973 visit to copper prospect in northern Luzon, Philippines--Bontoc country. Airstip is WWII Japanese fighter plane strip. From the left: Louis Albarracin, unknown geologist, Al Faretta, and David Lowell.



David Lowell in Atlas Carmen pit: Cebu, Philippines, 1975.

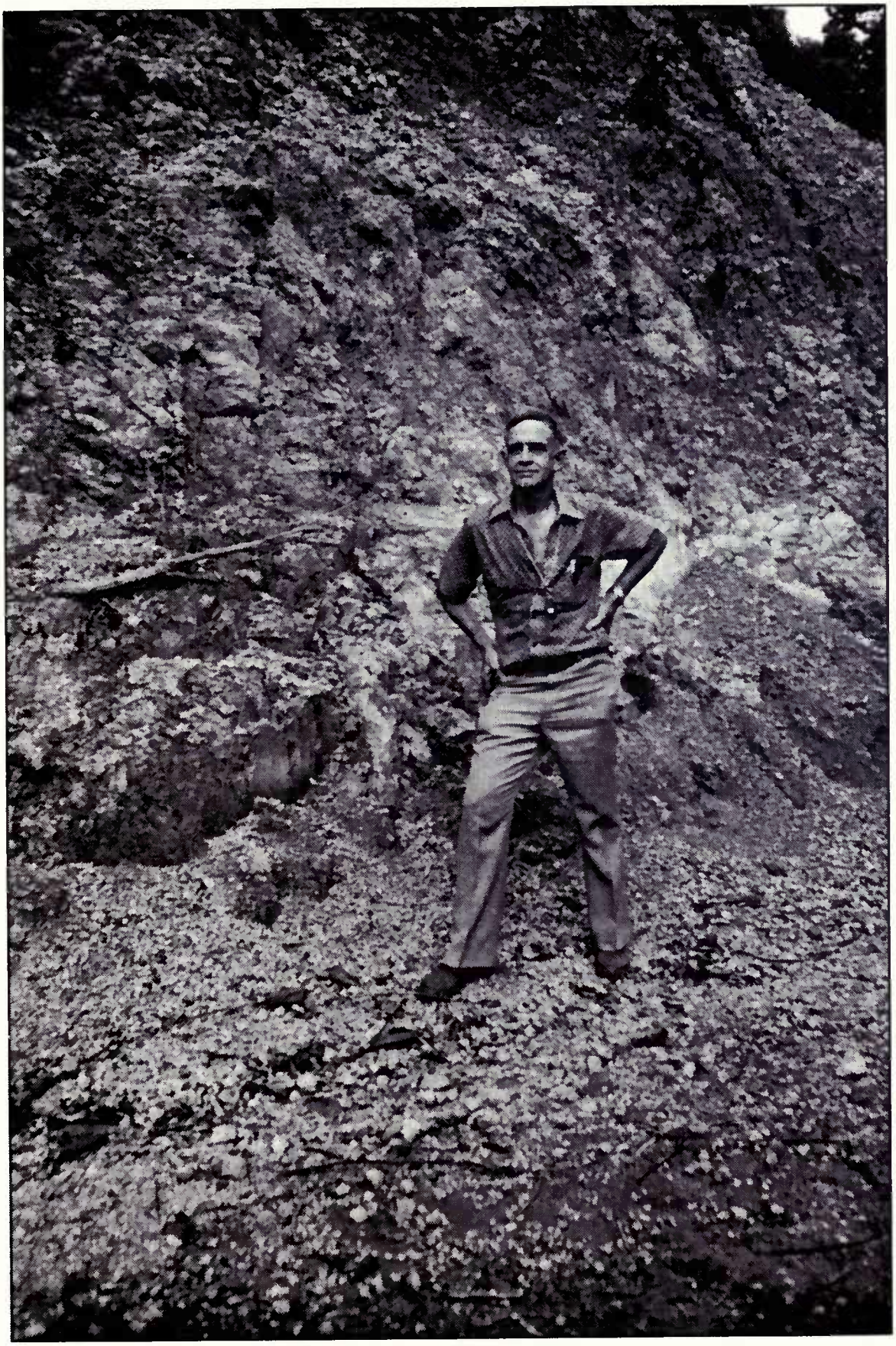
Above: David Lowell with a group of "Negritos", a small indigenous Negroid native group at a Benguet copper prospect east of Subic Bay, 1983. This area was covered by a 200-meter-thick layer of volcanic ash in the later eruption of Mount Pinatubo.



Right: Luzon, Philippines: Mount Pinatubo copper prospect, 1983.

David Lowell and Louie Albarracin.

Visit to Dizon prospect, 1978, resulting in Benguet's decision to develop the Dizon mine. Left to right: Burl Worley, unidentified Benguet geologists, Louis Albarracin, David Lowell, Earl McCarthy, and Al Faretta.



David Lowell in the Dizon pit, 1982.

In 1982 I made two trips to Thailand to work on porphyry copper and disseminated gold deposits near Loei. The Thai geologist I worked with was named Wat, and when I arrived he gave me an orientation which included how to deal with dangerous animals which in that district included wild elephants and king cobras. Wat said that there were three things you could do if chased by an elephant. If you were in a flat area and there was a nearby bamboo grove, run into it because elephants break the bamboo shoots and the sharp broken shafts puncture their pinkies so they don't chase geologists into bamboo thickets. If you are in an open flat area look for a big tree too big for the elephant to push over and run around it close to the trunk. The elephant with his wide wheel base has to run farther out on a much longer path length and tires out sooner than the terrified geologist. If you are chased by an elephant on a steep hillside you must remember that the elephant can run much faster than you uphill, and downhill. However, with his wide wheel base he cannot run horizontally or he would roll down the hill, so you must run along the contour line.

King cobras, according to Wat, are encountered in tall elephant grass and normally rise suddenly to confront you at eye level. They can travel faster than a man and if you run will chase and kill you, so what you do is stand perfectly still and stare into the king cobra's eyes. After a while, according to Wat, the cobra will get tired and drop down and slither off. I wasn't so sure about Wat's stories, but we did once see some huge, dinner-plate-sized tracks which made me nervously try to remember the three sets of elephant instructions.

We ate breakfast every morning in Loei in a little "greasy spoon" restaurant and were served by a pretty young waitress. The last day I was in Loei the waitress and Wat had an animated conversation and when we left I asked him what they were talking about. Wat said that she observed that winter was coming on and that a man would suffer from the cold at night if he didn't have a warm female to sleep with. Wat said he told her that he thought that he would just buy a blanket![2]

Adventures in the Philippines

Lowell: Other kind of exciting things that have happened to me: I in the 1970s did a lot of work in the Philippine Islands for Placer

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[2]End of inserted and rewritten section.

Development Company and Benguet Corporation and Atlas Consolidated Mining Company and Lepanto. I worked for most of the large companies working in the Philippines on porphyry copper deposits. The law and order situation in the Philippines has never been really very good since the Second World War. It gets worse and better, but we had various little exciting experiences.

There was a Philippine group called the New People's Army, which was a communist insurgent terrorist group, not as bad as *Sendero Luminoso* in Peru but with some of the same kind of ideas. I remember at one time, on a trip to look at an Atlas gold prospect on Masbate Island--the Filipinos tend to be kind of sneaky about telling you what they think you ought to know and not what they think you want to know. On this occasion, they took me out in an NPA training area, where they had some kind of a truce arrangement with the insurgents. They didn't tell me where we were going until we were already there. We drove over a jeep trail in the jungle for an hour or more to look at some prospects, and then at the end of the day we drove back out.

We had come through a dip. It was a dirt road, but they put in a cement dip to provide a crossing for a stream. There was an open area on the other side of the dip, and on the trip out we drove down and stopped. The driver stopped just before going into the dip. I was sitting in the right front seat, and there were several other geologists; it was a Toyota Land Cruiser automobile. Nobody said anything, and nobody got out. Probably a full minute went by. I said, "Why did we stop?" And the driver said, "Well, somebody has put a log across the road." There was a big coconut trunk across the road, which I hadn't noticed.

What had happened was that these communist insurgents had put this across the road, knowing that we were there, to make us stop. Nobody knew what the next step [chuckles] in the play was. Finally, two of the Filipinos got out very slowly and walked very slowly through the dip and very slowly moved the log off the road, but there were undoubtedly some people with automatic rifles in the tree line, watching us while this went on [chuckles]. We never saw them, and nothing happened to us, but it was kind of a worrisome experience.

Swent: I'm sure it was.

Lowell: We drove on to the next town. We were supposed to go to the end of the island to visit a gold mine. And the plan had been to drive up the highway to the gold mine.

We had gotten a little behind in the schedule, and we got to the town, and one of them told me, "We think it might be nice to go to the mine in a *banca* canoe."

I said, "Why is that? Isn't there a paved road all the way?"

And they said, "Yes, but it's our policy not to drive on that road after dark." This because of the possibility of being attacked.

So we hired a motorized *banca* canoe with an outrigger--kind of typical Philippine boat--and went--we had to go maybe a half mile out to sea and then up the coast. The water was fairly rough, and we all got totally soaked. My suitcase was soaked, and we came in at the mine camp, which was on the coast. I guess they called ahead, and somebody was there to meet us. But it was a little bit like the movie, "The Time Machine," where the morlocks are out at night.

And I had other experiences. I visited the Kingking prospect in Mindanao Island several times. They had had people killed in the camp and drill rigs burned by the terrorists. On one occasion, we went in by helicopter, and the manager said that he wanted to pick us up at different points because their policy was not to return to the same place with the helicopter for fear that these fellows would be waiting for the second opportunity to get a crack at you.

On one of the trips to Kingking, we stayed in a hotel in Dávao city. We had--some of the drill core was stored in an abandoned sawmill in the flat country. We debated whether to look at the drill core first and then go to the prospect, or vice versa. We went to the prospect with the intention of going to the sawmill the second day. In the newspaper the morning of the second day was an article that said that the insurgents had held up a bus at the sawmill the day before, and they had marched out--I think there were something like fifty Filipinos--men, women and children--on the bus, and they had lined them all up and told them to take off all of their clothing; they were looking for money and watches and whatnot [chuckles]. I tried to imagine what would have happened if we had been there and thought of myself in this lineup of naked [chuckles] victims. I don't think anybody was killed, but it couldn't have been a very happy experience.

Swent: No.

Lowell: On another occasion, I went to the Lepanto mining camp with the chief engineer at Lepanto, Roger Concepcion, a Filipino. Lepanto

had a guest house which was quite nice, where I had stayed before. Roger said, "I'm not going to be able to stay with you tonight. I'm going to stay with friends." He said, "They have made up a death list at Lepanto, and I'm one of the names on the list. My policy is to stay in a different place every night." [chuckles]

Swent: Oh, my.

Lowell: I decided at about that point that life is too short to continue doing work in the Philippines.

Hobbies: Spear Fishing and Skin Diving

Swent: Also at about this time, you were mentioning some kind of perilous hobbies that you were taking up.

Lowell: Well, not really perilous. I guess my principal hobby most of my life has been spear fishing and skin diving. We used to make several trips a year to Mexico and camp on the beach in Sonora. After we had a small plane, we would fly across the Gulf of California to fishing hotels on the Baja California peninsula.

Swent: Did you start this after you were married, or were you doing this as a boy?

Lowell: After I was married. We did mostly free diving with a face plate and a snorkel and a weight belt. We sometimes did tank diving, scuba diving. But it was difficult to have enough tanks to do very much spear fishing with tanks, so we usually did free diving. Most of our fishing was done at a depth of twenty or thirty or, rarely, forty feet, which is difficult to do without a tank.

Swent: Who was doing this with you?

Lowell: Well, Wayne Wallace, who was a Kern County Land Company, later Tenneco, geologist, often went diving with me. And Lee Vought, who was another geologist who had a business and didn't work as a geologist and has been a friend through most of my life. He used to go. And Bob Thurman, the co-discoverer of the Pima Mine, went with us a couple of times. There were sometimes other people that went, but the hardcore group was Wayne, Lee Vought, and myself.

Swent: It wasn't a family interest?

Lowell: Yes, they were usually family trips, with kids. Usually, we were the only ones that went diving. The kids and the wives didn't.

We fished primarily for grouper. The typical size of fish that we got were ten- to thirty-pound groupers. I on two occasions got really large groupers, over a hundred pounds.

Swent: Ooh!

Lowell: It gets to be a real rodeo to get a fish that big up to the surface. We had very pleasant times camping. Cooked our meals on campfires. We used to buy Oso Negro Mexican rum and have rum and Coca-Cola or "*Cuba libres*". We would sometimes catch shrimp--or catch lobsters and cook them also. Back in those days it was quite safe to camp out in the country in Mexico. I understand now that it no longer is because of the law and order situation.

Owning and Piloting Airplanes for Geological Reconnaissance

Swent: You mentioned flying. Did you pilot your own plane?

Lowell: Yes. I originally acquired a Cessna 182 airplane, which I had equipped with a Robertson short-field kit. With the Robertson kit the ailerons and flaps are geared together so that it makes a flap the whole length of the wing, which allows much slower flight. My original airplane, which had an N number of 8949 X-ray had oversized tires and beefed-up landing gear for landing in rough fields. Airplane would slow down to a flying speed of twenty-five miles an hour, quite slow for a fairly heavy airplane.

I did a lot of reconnaissance flying, sometimes piloting myself and sometimes using a professional pilot. We flew low and slow over the country to map geology, look for alteration zones and--

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Swent: I think we may have missed just a speck. What were you looking for on these flights?

Lowell: In the aerial reconnaissance we were mapping geology from the air, identifying rock types and sometimes structural features like faults and folds. And also hydrothermal alteration zones, which show up as color zones.

Swent: You were able to map and fly at the same time?

Lowell: No. But there would be somebody with a map and a pencil in the airplane. On some occasions, we would land on a dirt road or a

field to get out and look at the rocks, but usually it was all done from the air.

Swent: Where did you do your flying lessons?

Lowell: Well, in Tucson. A friend of mine, who was a geophysicist whose name was John Sumner, was a flying instructor. Taught me to fly. John had been a Marine pilot in the Second World War and the Korean War and had a very large number of hours as a pilot. He had his own small plane. He and his wife were killed in a flying accident in Mexico a few years ago. But John taught me to fly. He had done some instructing in the Marine Corps. He said once that he liked the Marine Corps training system. They had a joystick instead of a wheel to control the airplane. The student pilot was in the rear seat. He said when the student pilot did something dumb, like I had just done, that he would instruct him to put his head in his lap, and then he would pound on his forehead with the other joystick [chuckles].

I had different models of airplanes at different times--two Cessna 182s and one Cessna P-210, which was a pressurized, six-passenger, high-speed, higher-altitude plane. It would fly up to 21,000 feet. But I didn't ever have a chance to use that one very much, and I never felt my proficiency was quite up to the airplane.

Swent: Do you still fly?

Lowell: I had a 182 when we started spending most of our time in Chile. It was hangared for a year, and then I flew it in for an annual inspection and discovered that I was really no longer a competent pilot. The rule of thumb in flying is that unless you fly every couple of weeks, or at least every month, the edge goes off your proficiency and you become dangerous to yourself and anybody else. And so I sold my airplane at that time and haven't had one since. I've done some flying with--taking over the controls on charter flights since, but--

Swent: Do you have a landing strip here at the ranch?

Lowell: We had a landing strip for ten years or more. It was pretty short and hairy. It was fourteen hundred feet long. You had to be careful to get down in that distance. We then had a chance to convert that mesa into an irrigated pasture.

Swent: Oh, that's the one we passed.

Lowell: Yes. So we no longer--

Swent: So you take your chances on the highway instead.

Helping with Two Ore Discoveries in the Philippines

Lowell: Getting back to my work in the Philippines, I was involved in a peripheral way in two ore discoveries in the Philippines. In neither case was I really directly responsible for the mine. The first was the Dizon project for Benguet Corporation. I was working as a consultant for Benguet when the Dizon project was submitted to Benguet. I was in the first group to visit the property. It had already been explored briefly by the Nippon Mining Company, who had driven a short adit and had drilled several holes.

I felt that it looked encouraging, but the Benguet chief geologist disagreed, and we had a debate that lasted for a week or more about this. The Benguet management decided to take my side of the argument, and they acquired the property and began a drilling project and drilled out an ore body which was developed into a large open-pit mine and was very profitable for the company. I'm sure that had this not happened exactly this way, some other group would have eventually done the same thing at Dizon.

Swent: How did it come about that you worked for Benguet?

Lowell: Well, my original job in the Philippines was for Marcopper, which was a mine operated by Placer Development Company. For a period of several years in the early 1970s, I was Placer Development's in-house advisor on mine geology, and I worked in all of their mines at that time, with the resident geologists, reviewing the systems being used to collect geological information and ore-grade information and drilling technology and so forth.

I worked at the Endako molybdenum mine in British Columbia, and Gibraltar, and Cragmont. All three of these were in British Columbia, Canada.

Marcopper was in the Philippines. I made many trips to Marcopper. In the course of that work, the word got around that I was helping Placer Development, and the managers from some of the other companies invited me to do work on the same trip for other mines.

Swent: Is this where you got acquainted with the Japanese?

Lowell: Some of the Japanese. But I also worked as a kind of a long-term advisor for Bethlehem Copper Company in Canada. Bethlehem was one-third owned by the Sumitomo Company, and I met a number of Sumitomo people at that time. I also visited Japan a couple of times and met people there. The Japanese porphyry copper number-one expert was a fellow named Shunsho Ishihara, who came to visit me a couple of times in Arizona. He worked mainly for the Japanese Geological Survey and one of the universities.

Swent: I kind of interrupted you there. I'm sorry. You were talking about Marcopper.

Lowell: At Marcopper I had a very indirect input in the discovery of the San Antonio ore body, which was found by Geoff Loudon, who was the resident geologist. Geoff was Australian. The thinking that resulted in the discovery was entirely Jeff's, but I was able to support him in getting the deposit drilled out and accepted by the Placer management later.

Several years later, I did work on a deposit that was called the Far Southeast deposit of Lepanto Consolidated Mining Company. I wasn't involved in drilling the first hole that found the ore body, but I planned the development drilling, or a good part of it, later.

The "Godfather" of Lepanto's Far Southeast Ore Body

Swent: When you say "planned it," what does that mean?

Lowell: It means that I selected the location of the drill holes or participated in selecting the location of the drill holes. In modern times, the success or failure of an exploration project is normally whether or not holes are drilled in the right place. Ore bodies are almost always found by drill holes, so it's very important as to whether the right logic is used in planning.

In any case, at some point, Lepanto hired a geostatistical firm in Vancouver--I think they were called the International Geostatistics Limited or something--to perform an ore-reserve calculation on the holes that had been completed. Far Southeast was very deep. It was a thousand meters (over three thousand feet) minimum below the surface. Each drill hole was very expensive. At that point, it still missed being a definitely minable deposit.

I was asked to go to Vancouver. Roger Concepción came from the Philippines. We looked over the data, and I think the Lepanto general manager, Art Disini, was there also. The geostatisticians presented their data, and they said, "We have deduced that the grade of the ore body is decreasing with depth."

Swent: Excuse me. What kind of drills were you using?

Lowell: These were diamond-drill holes.

Swent: So you were looking at core?

Lowell: At core, and assaying the cores for copper and gold and molybdenum content. It was obvious to me that the grade was *not* decreasing in depth; it was increasing.

Swent: What made it obvious to you?

Lowell: Well, it's a difference between believing the black box and believing your brain [chuckles].

Swent: Were you looking at the actual cores?

Lowell: Well, not in Vancouver, but I had looked at the actual cores. I would get off into a technical description of the geometry of the ore body to really answer that question, but I was sure that the grade was not decreasing. I was able to convince the Lepanto manager that that was the case. This was a case in which statistics proved something that is untrue, which I think may happen fairly often. In any case, as a result of this meeting, they decided to drill deeper holes, and they found a larger and higher-grade ore body, which will definitely be mined at some time in the future. Later, the president of Lepanto referred to me as the "godfather of the Far Southeast ore body." Not the one that hatched it, but the one that saved it [chuckles].

Swent: Well, that must have made you feel awfully good.

Lowell: Yes, but it's kind of ancient history at this point. So those are three deposits that I had a minor involvement in finding.

Finding the JA Ore Body, British Columbia

Lowell: There was another one called the JA ore body in British Columbia that was found by Bethlehem Copper Company. It's another one that I was partly or largely responsible for finding, simply because I

had recommended a grid of wide-spaced drill holes in the covered area between known ore bodies. In a simple-minded way the most likely place to find a new ore body is directly between old ones. The JA ore body was drilled out, and it was a relatively large ore body, with grade similar to the Jersey pit that Bethlehem was mining, but the development costs were higher, and the copper price began one of its periodic decreases, and it was never developed as a mine.

So these are all in the category of maybe I was responsible for ore bodies A, B, and C. The human personality in mineral exploration always rationalizes that your contribution was the important part [chuckles], so there always are many more discoverors than discoveries.

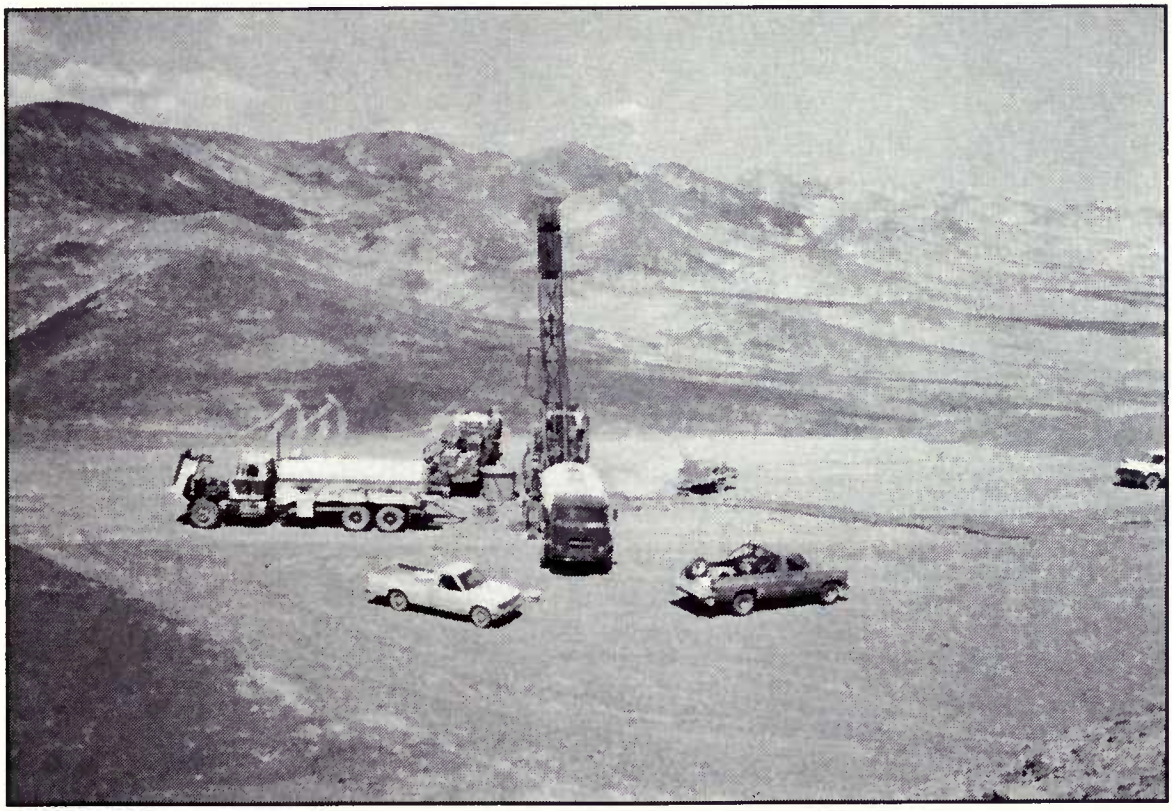
Ore Deposits Consultant for Codelco, 1974-1980

Lowell: Moving back to Chile again, in the period following the Allende overthrow, which was in late 1973, the Allende government left the large, state-owned mines, which had been earlier expropriated, in shambles. They did a very poor job of operating the mines. The average age of the average mine manager, I was told, was either twenty-four or twenty-five years old. The reason was that there was a great shortage of people who had studied mine engineering who were also communists. They collected some of these young political-type mine engineers and made them managers of mines like Chuquicamata and Braden, and it didn't work.

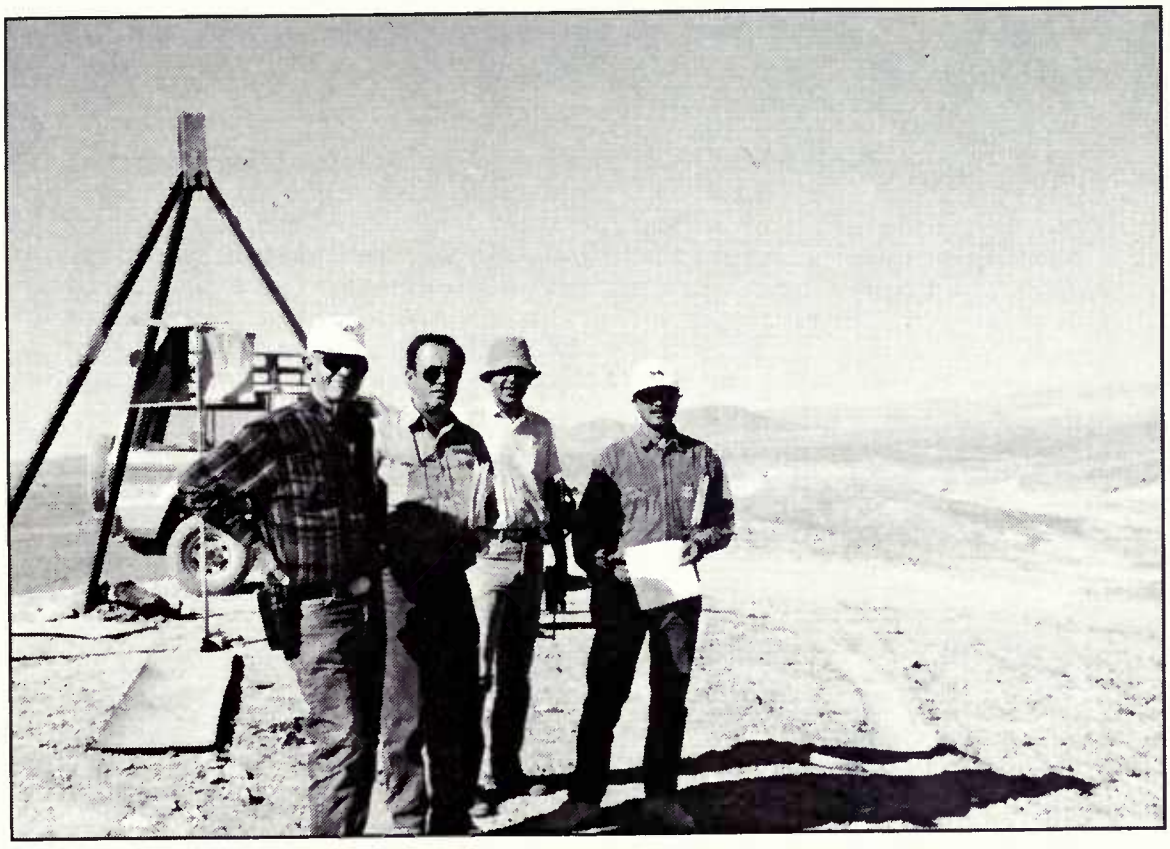
When Pinochet took over, the mines were practically destroyed. The Pinochet government hired a large number of consultants and contractors to come in to put things back in shape. There were contracting firms from half a dozen countries at any given time, working at Chuquicamata, and a lot of different engineering and geology consultants. I was the principal ore-deposits consultant for Codelco for maybe six or eight years. That was the period, 1974 to 1980, roughly.

But during that time, I had an opportunity to work in every one of the Codelco mines and visit in the field almost every copper prospect in Chile. The principal copper mining area in Chile is the Atacama Desert in the First and Second Regions, which is the northern part of Chile. I had begun the CAP project in Arizona in 1973, exploring below postmineral cover. It became obvious, visiting prospects in Chile, that Chile was a more favorable place than Arizona for this approach to exploration.

The ideal situation for this type of exploration was a narrow structural belt that controlled the position of the ore bodies, which is present in northern Chile, and a ratio of about 50:50 between postmineral cover and premineral outcrop. It's possible to map alterations and sample for the edges of geochemical anomalies in the 50 percent of premineral outcrops and extrapolate this into postmineral cover where there may be a hidden ore body.



Typical drilling project in the Atacama Desert, 1990.



Tesoro District of the Atacama desert: Leonor property, 1990. From the left: David Lowell, Ernesto Egert, Luis Rodriguiz, and Guillermo Contreras.

XI THE ATACAMA PROJECT AND ESCONDIDA MINE, CHILE

Launching an Exploration Program with Utah International,[1] 1978

Lowell: In 1978 I decided to just go ahead and launch a program of this sort, and I put together a plan and budget and approached several major North American companies, including--I think Utah was called Utah International at that point. Bob Wheaton, who was at least temporarily the exploration manager, I had known a long time. He had been a classmate in college. I had proposed a budget of a million and a half dollars a year for three years and had a series of steps that involved reconnaissance geologic mapping and reconnaissance geochem sampling through a 500-kilometer-, 35-kilometer-wide block between El Salvador and the Chuquicamata Mine.

Bob Wheaton agreed to fund it. And then, unfortunately for me, he decided that four and a half million dollars was a pretty large expenditure for Utah, and he came back and asked me if I would agree to bring Getty Minerals in, who had lots of oil money and were looking for joint venture projects. I agreed, and the project was set up. We did reconnaissance, compilation of mapping, and after several months I hired a Chilean chief geologist. Through most of the project, the staff was entirely Chilean, who were living in Chile, with the exception of Bill Mounts, who spent a good part of his time there, and myself.

We hired several university professors in Chile to assist in compiling the geology and do some fill-in reconnaissance mapping. At a point early in the project, I filed mine claims over the whole 500-kilometer-long belt. One of these claims covered most of the Escondida ore body, as it turned out later, and another covered about half of the Zaldivar deposit.

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[1]See Alexander Wilson, interview in process 1999, Regional Oral History Office, The Bancroft Library, University of California, Berkeley.

The Atacama Project

Swent: You said you filed these claims.

Lowell: Yes.

Swent: Personally?

Lowell: Well, in the name of the project. I was the project manager. The project was called the Atacama Project. We contracted a little bit of drilling with a local drilling company that was a branch of Boyles Brothers drilling company. It was called Boyles Geotech. Their drilling costs were substantially higher than what we had been getting in Arizona, so in consultation with Bill Mounts, we did a search for a North American company that was willing to go to Chile, and we found a company called Harris Drilling Company, who had done a good job in projects for us in Arizona.

The Success of Harris Drilling Company

Swent: Boyles Brothers is also an American company.

Lowell: Yes, yes, it is.

Swent: So that's not in contrast--

Lowell: No.

Swent: You just wanted another American company.

Lowell: That's right, although the Boyles Geotech was pretty Chileanized at that point. The manager of the Harris Drilling Company was Hugh Harris, whose office is in San Diego, California. We made a deal with him to bring the drill rig and all the supplies and spare parts and pickups and flatbed trucks and camp, and it was all loaded on a ship in Houston and hauled down to the port of Antofagasta.

Swent: Did you use Utah ships for this?

Lowell: No, no, it was whoever was available. The Harris group unloaded their drill rig and assembled it and unloaded all their supplies, drove over a hundred kilometers out in the desert, and had finished their first drill hole in two days after coming in sight of Antofagasta. And they got it through Customs, which at that

time was relatively easy. It was the Pinochet government. The drilling part of the project proceeded along the same lines, through the rest of the project. We had one drill rig running continuously almost 365 days a year. We averaged to drill something like 800 feet per twenty-four hours through two years.

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Lowell: We drilled a huge amount of footage in Chile. Our drilling costs were almost exactly 50 percent of what we had gotten before. The deal involved our paying for the mobilization, for the shipping cost of equipment, but we were to be reimbursed for this amount over, I believe, eight months, so after eight months it had cost us nothing to get the new drilling company to Chile. They're still there. They're one of the principal drilling companies still in Chile. They now have something like eight drill rigs operating.

Helicopter Program for Sampling Didn't Work Well

Lowell: We tried to complete a geochem survey in which there would be one rock geochem or stream sediment geochem sample every kilometer in east-west profiles about thirty-five kilometers long, which had a north-south spacing which averaged maybe five kilometers between profiles. We started off planning to do this out of helicopters. Pancho Ortiz, who was the fellow that I hired as chief geologist, and I tried for two or three days to do the helicopter sampling in order to establish a protocol for the helicopter sampling, and it became pretty obvious that it was both dangerous and expensive to do that.

Swent: How would you do sampling from a helicopter?

Lowell: Well, you would have several samplers. If the helicopter would carry the pilot and three samplers, the pilot would drop a sampler and then fly a kilometer further and drop a second sampler and fly a kilometer further and drop a third one.

Swent: And they would pick up--

Lowell: They would collect the samples. Then he would turn around and fly back and pick up the first and the second and the third sampler, and drop them farther along. Kind of a--

Swent: Leapfrog?

Lowell: --leapfrog process.

Swent: But they were actually just manually picking up the samples.

Lowell: Yes. And this kind of utilization of helicopters is--it wasn't a new idea. It's commonly done in various parts of the world, where there is not good road access. But the problem that we ran into was the first area, which was fairly representative of our whole project, was at an elevation of about 12,000 feet, and the performance of a helicopter gets worse and worse at altitude. The Andes are famous for being a windy part of the world, especially in the afternoon. The pilot was having trouble making quick landings at each point on our traverse at that altitude, with those wind speeds. And it began to look distinctly dicey to do it.

After two or three days, I said, "Forget it," and we sent the helicopter back to Santiago and did the sample collection from jeeps or on foot. A lot of the sampling was done by driving to one end of a thirty-five-kilometer traverse and dropping the sampler and then driving to the other end and pick him up at the end of the day.

Tyler Kittredge Meets the Sampling Challenge

Swent: He was walking thirty-five kilometers a day?

Lowell: Yes. That's about twenty miles. It's fairly easy walking there, through most of the desert, but it's also pretty strenuous.

Swent: I would think so.

Lowell: We had a problem--you put your finger on an important part of the problem, which was getting somebody physically able to do this. It wasn't working very well, and somebody told me about an American geologist named Tyler Kittredge, who lived in Panama, who was a kind of a Rambo-type of fellow. He had been shot three times in the chest in Vietnam and had then throttled the fellow that had shot him [chuckles]. I called Tyler on the telephone and asked him if he was interested in this job, and he said he was, and he did all of the sampling. He actually personally collected most of--I think it was 2,500 samples.

Swent: How could you get your drill rigs in there?

Lowell: Well, after building a road. We used a bulldozer--

Swent: What were these samples from?

Lowell: The samples were from whatever was present at the one-kilometer interval. If there was a rock outcrop of--

Swent: Oh, it wasn't drilling samples that you were collecting.

Lowell: No, no.

Swent: Oh, this was a person who was going along--

Lowell: It was surface sampling.

Swent: Grab sampling.

Lowell: Yes.

Swent: All right, okay.

Lowell: So that was one of the rings of the circus, was this sampling program. We had some land problems also, but we started out an assembly line of drilling prospects that were represented by geochemical anomalies and/or geological evidence of a possible porphyry copper system.

The first prospect that we drilled was called El Tesoro. It turned out to be a near miss. The ore body that maybe ten years later I drilled out, called Leonor, was in our project area. A continuing argument with Sig Meussig began at El Tesoro. Sig didn't--Sig was a sedimentary rock geologist, a soft rock geologist, who had never found a pound of ore. He has a Ph.D., but he really didn't understand very much about hard-rock geology or ore deposit geology, but thought he did [chuckles].

Swent: He was with Getty?

Lowell: He was with Getty. He was the exploration manager for Getty. And he couldn't understand why we were drilling at El Tesoro. There has since been an ore body found there and a large mine is being developed. We drilled four other prospects. The fifth one was Escondida.

Swent: You said there were some land problems. How did you resolve them?

Lowell: Well, we had one Chilean engineer, whose name was Donaldo Rojas, who was our land guy. His brother, whose name is Nivaldo Rojas, was a geologist. Nivaldo was probably the best exploration geologist that I had in Chile during this project. He since worked for BHP and has been in charge of their work in Argentina.

Nivaldo--I'm off on a tangent--Nivaldo was not a university graduate. He graduated from a two-year technical school.

Swent: In Chile?

Lowell: In Copiapó, Chile. At one point, I tried to talk him into going back to the university and offered to pay a half-time salary while he was in the university, but he had a family and decided he didn't want to do that, but it didn't hold him back at all. He has done very well. And his brother also was a very competent guy in the land work and surveying.

Each land problem is a separate problem. They most commonly revolve around trying to negotiate option deals with landowners. Sometimes the logistical problems of locating mining claims--the bulk of the work in Chile is in determining the land status. The records in Chile are not very systematically kept, and it's sometimes very difficult to find out who owns what property.

Swent: Are these in the region, or did you have to go to Santiago?

Lowell: Both, both. And that's part of the difficulty. I'll come back to our biggest land problem in a minute, but we drilled four prospects. The first one we got some suggestion of an ore body.

Swent: This is El Tesoro?

Lowell: At El Tesoro. But nothing in the second, third, and fourth targets drilled. And the fifth was Escondida. Escondida had been--we were the sixth company to do work at Escondida.

Escondida Mine

Swent: It already had been named?

Lowell: No, we named it, and that's part of the story. None of the previous five companies had found anything encouraging enough to drill a hole in, and it's now the largest copper deposit in the world.

Swent: [laughs] These are the stories that keep you all going, right?

Lowell: Yes. I looked at it the first time with Pancho Ortiz, who is also a very capable, smart geologist. Pancho has a master's degree from Stanford University and worked on, but did not complete, a

doctorate at Colorado School of Mines, and he has a degree from University of Chile.

Swent: Had he looked at this before?

Lowell: No, he had never been there.

Swent: Had he been involved with Escondida?

Lowell: No. But there had been five companies there. On our first visit, the group consisted of Nivaldo and Pancho and myself. It fit part of the criteria for one of our projects. There was some of the right kind of hydrothermal alteration, and there was concentric zoning, including lead-zinc occurrences and scarn in the outer edges of the system, and a couple of weak showings of oxide copper in places on the surface. But the leached capping wasn't typical; the iron oxide minerals that remain after ore has been leached at the surface and the copper carried away, usually downward--there's a whole science in interpretation of leached capping. This leached capping didn't look very favorable, but the occasional piece of it did look good. There was a copper geochemical anomaly in our regional work in this place, and a molybdenum anomaly.

As a cross check, I--well, the first thing I did was collect I think it was something like 150 leached capping samples on a grid pattern, sampling on the surface. And the second thing was asking Harold Courtright, who was supposed to be the world expert on leached capping, who was a friend of mine who had previously worked for Asarco and was then doing consulting work, to give a second opinion on the leached capping. I asked Utah if they would be in agreement of sending him to Chile to look at the capping, and they said no, that they were willing to pay a couple of days of his time to look at rock specimens but they weren't willing to have him sent to Chile, which was--

Swent: You couldn't do this on your own, under your contract?

Lowell: At that point in the contract, no. There had been a disagreement in the El Tesoro project, and I had bulled ahead on the rest, but we were having louder and louder decibel arguments between myself and Sig Meussig. The operator was Utah, but Meussig represented a 50 percent partner in the financing. This whole story is a little bit a comedy of errors, but that was the situation with Harold Courtright's work. I sent him a map and a collection of samples.

The part of the picture that he didn't understand was that this was not a typical Southwest climate, but it was the Atacama Desert, the driest climate in the world. There is a process that goes on which Hans Langerfeld, a Chilean geologist working for

Anglo-American, named "super leaching." That is a leaching process which is probably the result of capillary migration of water from deep levels to the surface of the desert, where it evaporates but it has carried salts in solution, which crystallize when water evaporates, and the crystallization causes an expansion. It's a diurnal variation--expansion-contraction--in the rock.

This has the effect of plucking limonite out of the leached capping, so instead of having all of the limonite and the right textures, you end up with part of the limonite in a sort of a melting of the silicate textures, in which the original pyrite pseudomorph cube shapes become spherical, like scoria, which is a rock that has little spherical cavities in it.

I understood something about this process but didn't understand it very well at that time, and Harold had never seen it. I was also more impressed by the porphyry copper zoning which had an indirect effect on interpreting the probability of an ore body being represented by the leached capping. There's a very large area that represented concentric bands of rock that would have been typical of a big porphyry copper system. He didn't visit Escondida, and he didn't have exactly the same understanding nor opinion of some of these other features which were an ougrowth of the Lowell-Guilbert porphyry copper model. All he had were a collection of 140 pieces of rock.

He wrote a report and said, "In my opinion, this rock does not represent secondary enrichment of chalcocite. It may represent high-level vertical zoning over primary ore at a depth of maybe 1,000 meters," which would have been much lower grade and would not have been minable ore in this circumstance and which was not what we were looking for. So this was a real setback in the project. We did more sampling. I returned again to look at the outcrop and decided to go ahead and drill it anyway on the assumption that the leached capping at Escondida did represent chalcocite.

The place where we got the leached capping specimens is not within the current Escondida ore reserve and open pit; it's on the edge of it. But it is underlain by what would be good copper ore in almost anywhere in the world, in spite of that. The Colorado Grande hill where the leached capping was exposed was held by a Chilean lawyer whose name is Pedro Butazoni. It's an Italian name. Pedro Butazoni is an acquaintance of mine. He was deputy minister of economics of Chile in an earlier administration.

We approached Pedro and said, Could we make some kind of a deal with you on your property? This property was held by an

exploration permit--at that time there were four levels of validity of claims. These were--this *concesion de exploración* was the least valid; and the next one was called *manifestación*; and the next one was called *manifestación constituida*; and the last one was called a *mensura*. The *mensura* is analogous in the United States to a patented mine claim, where you own surface rights and everything.

Swent: That means "measuring."

Lowell: Yes. And it's measured because it has been measured by a *perito*, who is equivalent to a U.S. mineral surveyor. He's an officer of the government, really.

Swent: Expert.

Lowell: It's a cadastral survey and done very precisely. His title to the ground was pretty flimsy with this type of claim, but we offered to buy it, and he said, "No, I'm talking to somebody else, and it's not for sale at this time." It turned out that the people he was talking to were the Prussag Company, a German mining company.

Swent: May I ask another question? Were there time limits on these various levels of claims?

Lowell: Yes.

Swent: And you were having to meet deadlines on each of them?

Lowell: Well, our claims were *manifestaciónes*, but--

Swent: Did you have to go to the *mensura* stage within a certain limit of time?

Lowell: Yes, that's right. You had to go through the various steps. *Construida* is a later stage than the *manifestación*, and then later you have to go to the *mensura* stage. But we had overlapping: *manifestaciones* that overlapped his claim. I probably shouldn't get into a long-winded discussion of Chilean mining law, but there are various *tramites*, red-tape things you have to go through. If you have a claim and somebody stakes over you and starts through this process of going to a *construida* claim and publishing their results, and if you don't follow suit, even though you have priority in time, the other person gets title to it. I think Chile is one of the few places where this kind of regulation is in force, but it certainly is the case in Chile.

This is a loophole that we decided to try to follow. So we had a late-night meeting, and we had a bottle of scotch and sat around a table until something like one o'clock in the morning.

Swent: Where was this?

Lowell: In our office in Antofagasta. Trying to come up with a strategy to acquire this prospect.

Swent: Who is "we"?

Lowell: "We" was Pancho Ortiz and Donaldo Rojas and myself. The two people with the strongest votes in this at that point were Donaldo and me [chuckles]. I was responsible, and Donaldo was the guru of Chilean mining regulations. Donaldo proposed that--at that time, if you were a company, you had to submit a survey with UTM coordinates and so forth that would clearly indicate the location when they were published. But if you were a small miner, you could just describe it: I see over to the northwest the Cerro Blanco, and I'm close to what they called the *quebrada negra* and so on.

Filing the Claim and *Mensura* Survey with Unseemly Haste

Lowell: So Donaldo said that what we should do is write up a claim in the language that a small miner would use. We talked about that, and I said, "Why don't we call it the San Francisco claim?" And Donaldo said, "No, no. A small miner is more romantic than that. He wouldn't call it San Francisco. He would call it something like La Escondida, the hidden one." I said, "Okay, you know more about it than I do." So that was where the name came from, even though the claim itself didn't ever become valid.

So then we wrote up a claim notice in the name of our janitor, who was a--

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Swent: So you wrote up the claim in the name of your janitor [chuckles].

Lowell: Yes. He was a retired miner, a very nice old guy. His last name was Torres. I think his name was something like Manuel Torres. He said, "I, Manuel Torres,"--

Swent: He didn't know you were doing this?

Lowell: Yes, yes [chuckles]. He had to sign the claim. It said, "I, Manuel Torres, miner, single man, have found a claim which I call La Escondida, and it's in the Agusto Victoria district, and I see in front of me generally to the south a black hill that is sometimes called Cerro Negro, and I see to the southwest a red hill that is sometimes called Cerro Colorado." I've forgotten the language of this, but it was something like that. And it was a relatively modest-sized claim, but it was right on top of this leached capping, and on top of Pedro Butazoni. So we filed it, hopefully--it's kind of like putting a fishing line out. Pedro or Pedro's man was alert and caught this and went to the next step in his process, which saved himself from being trumped [chuckles] by Mr. Torres's claim.

So we didn't give up. We had another conference, and either Pancho or Donaldo came up with another strategy. This strategy was to do this detailed--I guess it was a *mensura* survey. We went out in the field and turned all the angles and taped all the distances and had a finished claim ready to go. We published it something like the day before Christmas, and there was something like a ten- or fifteen- or twenty-day period to--I think we did this on one of the claims that we had filed a year or two before, when we staked the whole belt. It was a *mensura*.

We went through all these steps in rapid-fire order. We filed the claim, got it published in a day or two in the *Boletín Minero*, and by the time the New Year's holiday was over, we already had this nailed down [chuckles]. Anyway, then Pedro Butazoni sued Minero Utah, which was the name we were operating under, and in his brief he said, "This work was done with unseemly haste during the holiday season and not according to the traditions of mining in Chile." [laughs]

Swent: Very true. [laughter]

Lowell: But he lost, but he didn't really lose because he eventually got paid six million dollars for part of his other claim, which covered part of the Zaldivar deposit. But anyway, that was part of the history.

The Drilling Project: Nine Holes Showed a 250-Million-Ton Reserve

Lowell: And then the drilling project itself was--the Zaldivar outcrop had phyllic alteration, and the Cerro Colorado, where the leached capping was, had phyllic alteration. We constructed a hypothetical zoning picture since these were just little islands

of outcrop with gravel between, that the strongest alteration would be between the two. It would go from phyllic to potassic, back down to phyllic. So our first five holes were drilled in a line across this covered area. They intersected a lot of pyrite and copper mineralization up to a quarter--one of the holes averaged a quarter of a percent copper, but far less than our target ore grade.

What we didn't know was that the Zaldivar deposit was a separate occurrence and not contiguous with Escondida. But the sixth hole was in the Cerro Colorado area, and it intersected a long interval of chalcocite mineralization, which the Chilean geologist sitting on the drill rig, whose name was Jaime Orzún, didn't recognize. He thought it was manganese. The samples that night went down to Antofagasta, where Nivaldo Rojas happened to be, and he wasn't directly involved in the project, but he poked through the samples and recognized that it was a chalcocite zone.

I think we drilled nine holes, and the sixth and seventh and the ninth all had good ore intersections. It was something like an average of 150 meters of 1.4 percent copper average. That wasn't good enough to be part of the final Escondida ore reserves because it was so much better farther to the south. But at the time, on the basis of those holes, I was able to infer an ore reserve of 250 million tons of 1.4 percent copper which was already a world-class copper deposit.

I was out of Chile--I had been there when the drilling started, and I was gone when it was completed. Jim Bratt, whom you met in California, had been hired to replace me as manager of the project, under the pressure of Sig Meussig. I still maintained my rights to finder's fees and so forth, but would still have worked on the project, had not Sig Meussig's animosity resulted in this, which was also in direct violation of my contract with Utah and Getty.

As it happened, it was kind of bad luck for Jim Bratt because he couldn't claim any authorship of the project because the discovery had been made the day he was hired and before he ever visited the project. Also, as it happened, none of the Utah or Getty geologists or other employees had ever been to Escondida. It was only our group that had selected the target and had done the work. They immediately took the project away from me, and I didn't get any chance to participate in the fun part of it, which was getting the spectacular ore intersections. Bratt almost immediately terminated the drilling contract with the fast, cheap contractor and brought back the slow, expensive contractor. Such are the ways of large companies.

The ore grade during the first couple of years of mining at Escondida was 3 percent copper, and it's still, I think, something like 2 percent now. It's a beautiful ore body.

Swent: You had the contract for three years. Did you stay the full three years?

Lowell: I don't think so. I think my last work--I did some work for them for six months after the discovery, but the total was a little less than three years.

Swent: I shouldn't say contract, but you had laid out a three-year plan, you said.

Lowell: Yes, and they really didn't follow it after the discovery. Neither Utah nor Getty ever found another ore body in Chile after that and I think they would have if they had lived up to their contract.

The Zaldivar Mine

Swent: Now, what about the Zaldivar?

Lowell: Well, that was drilled. I think of these two as being the same target because they are nearby. Zaldivar was drilled, and the history of that is also kind of amazing. Utah drilled several holes on the claims that we had, and Pedro Butazoni filed another suit against them with respect to his original claim, which covered half of what finally became the Zaldivar ore body. By the time the suit was settled, it had become apparent that Escondida was a multibillion-ton ore body. The Utah manager--and I think his title was president of Minera Escondida at that point--when he talked to Pedro Butazoni, Butazoni said, "Well, I've won the suit, but I'll give you my interest in Zaldivar for one million dollars." The Minera Escondida manager said, "Listen, we have all the reserves we could possibly use, and I'm not interested in buying it."

A little later, Pedro Butazoni sold his interest for six million dollars to Pudahuel Mining Company, and then Pudahuel Mining Company sold the same interest to a bank for (I believe) twenty-eight million dollars, and then--no, it was sold by the bank to Outokumpu for twenty-eight million dollars. And then Outokumpu a little later sold a half-interest in it to Placer Dome for a hundred million dollars.

I was hired a number of years later by Fluor and Placer as a geological consultant in the Zaldivar feasibility study.

Mistakes Made by Minera Utah

Lowell: By the time Escondida was developed, it became obvious that they had a space problem and they needed this other ground for their surface plant. They had saved a million dollars but lost probably [chuckles] several hundred million dollars.

So anyway, there are lots of stories of this sort about many of the old mining districts.

Swent: But you had a pretty good arrangement, I'm sure.

Lowell: Well, my arrangement was a 5 percent interest in any discovery but with a cap of $3.75 million per discovery. Minera Utah and later Minera Escondida were afraid of making an investment in Chile. Escondida was the first big mine development after the Allende period. They made a policy decision that they were going to hold out for project finance; in other words, get financial groups to put up 100 percent of the investment and they wouldn't risk anything in development.

That was a mistake. It was a large mistake which probably cost on the order of billions of dollars in the long run. They did multiple feasibility studies in order to justify sitting on this large natural resource. They did a total of twelve feasibility studies before they finally lined up--it was then Rio Tinto Zinc and a group of Japanese companies in a consortium and the World Bank put in a little bit of money, so as to get 100 percent of the finance. They gained in the area of finance, but they lost several ways. The biggest one was they lost in time. The net present value of a project depends on when the annuity from the project starts to flow, and in the case of Escondida they lost at least five years of time. If you calculate the effect on the present value of putting the production off for five years with Escondida, it's a huge amount of money.

They also lost 35 percent of the ownership by getting partners in to put up part of the finance money. So that was also part of the comedy of errors.

Swent: Did you get credit for two discoveries then?

Lowell: Well, that was the next part. I got credit for one-and-a-fraction discoveries. The president of Minera Escondida said, "We've got so much ore at Escondida that this other one will never be mined," so we compromised on a partial payment.

Swent: For Zaldivar?

Lowell: Yes. And if I had been a little smarter, I would not have done that. But the other hindsight idea I had was that when we were negotiating the original deal, I asked for 5 percent carried interest, and they agreed to it but with this cap on the value of it. The cap was $3.75 million per discovery. But I'm quite sure that they would have agreed to 3 percent without a cap [chuckles]. If I had done that, the difference would have been tens or hundreds of millions of dollars [laughs]. But I was happy to get what I got.

Swent: Hindsight is always clearer, isn't it? Sometimes it doesn't make you feel a lot better. But that was a great success story anyway.

You don't want to name the president of Utah? Was it Keith Wallace?

Lowell: No, it wasn't the president of Utah. It was the president of Minera Escondida, and his name was Bob Hickman.

Swent: Oh, yes. Anyone who wanted to look it up could find out the name.

Lowell: Yes. He did a lot of things well, but he didn't in that case.

Swent: He didn't have a crystal ball.

Lowell: Let's see. It's 4:10. I'm willing to go through the rest of--

Swent: It's fine with me if you're able to.

Lowell: Okay.

Swent: Is your throat getting dry? Do you want a glass of water or something?

Lowell: I might get one.

[tape interruption]

Another Example of "Penny Wise, Pound Foolish"

Swent: We're continuing with Escondida now after a little break.

Lowell: Well, another little criticism viewed from the outside: the original Escondida mill, concentrator, was 40,000 tons a day. The ore body is the largest copper deposit in the world. I asked the Escondida chief engineer how they had hit on a 40,000-ton operation. It seemed to me they might very well have started with 100,000 or 200,000. He said, "Well, it was perfectly logical. We were operating in the Island Copper deposit on Vancouver Island at a 40,000-ton rate, and we had the plans for the mill all ready in the file." [chuckles] This is for a development that cost a billion dollars or so, and the plans might have cost a million dollars. [laughter]

Swent: And you actually heard this yourself?

Lowell: Yes, I was told that.

Swent: It wasn't just hearsay?

Lowell: No, I was told that by the Escondida chief engineer. I think that's a beautiful example of penny wise, pound foolish.

Just a side comment about controversy in successful exploration projects: I've been involved in somewhere upwards of nine discoveries, and in almost every case there has been a controversy about who gets credit that has ranged from a mild argument to a very acrimonious argument. In the majority of these discoveries and also others that I know something about but was not involved in, there also is some kind of litigation about ownership. It's my feeling that it's kind of the syndrome of the Treasure of the Sierra Madre, that when something of great value, either from a money or fame or status standpoint, shows up, people's normal ethics disappear, and they scrap like dogs over a bone.

Swent: What about--because I have heard it said that there was a controversy between you and Courtright over the interpretation of this, and I know that you wrote a paper praising Courtright's work. Was that before or after this?

Lowell: It was after the Escondida project. I was one of Courtright's many admirers. I think he was one of the best exploration geologists of his generation. The basis of that controversy was--I reviewed previously. It was whether Harold Courtright's negative report was the basis for drilling. It is absolutely

certain that it was not the basis for drilling. In fact, if we had believed the conclusions in his report, we would not have drilled. But I really don't want to get into that in this oral history.

Swent: Okay. What about your relationships with Sig Meussig?

Lowell: Well, I have no respect whatsoever for Sig Meussig. I think he is definitely not a friend of mine and never has been.

Swent: Has he stayed with Getty?

Lowell: Yes, until Getty folded up. And had Sig done a better job as manager of their mining division, it might still be in existence.

Bob Wheaton, who was his counterpart as exploration manager and later vice president and development manager for Utah International--I believe Bob has passed away, but I had a lot of respect for him.

Swent: These personality things do enter in, don't they?

Lowell: Well, they do, personality or character.

Swent: You can't help it.

XII SAN CRISTOBAL AND LEONOR MINES, CHILE

Compania Minera del Inca

Lowell: The next ore body on my list is called San Cristobal. That's a gold deposit in northern Chile between towns of Antofagasta and Calama. San Cristobal was found by a small company that I was a partner in. The company was called Minera del Inca. It was formed as a kind of a lark at a cocktail party in Santiago. Two people that I was acquainted with were at the party. One, who was kind of the principal force in Minera del Inca, was a lady whose name is Julia Aspillaga.

Swent: That was the question I was going to ask: if it was Julia or Julio. I thought it was Julia. That's usually a woman's name, and it *was* a woman. Okay!

Lowell: She is still in Santiago. Julia is an unusual person. I think of her as a small steam roller who is a very effective executive who gets amazing things done by a combination of charm and force of personality. Over the years she has worked herself into an important position in the Chilean mining industry as an associate in the small miners association and an associate of Herman Buchi, former Chilean Minister of Hacienda, and Minister of Economy who now works as a consultant to several other Latin American governments. She has represented Chile in international mining investment meetings.

The second person at the party was Pat Burns, a Canadian geologist, who had worked for me for a short time. At the end of my part of the Escondida project, I had hired Pat Burns as a drill superintendent to work with the American drillers in the Harris drilling company. We were talking about--
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Lowell: --the fact that at that time--and this was about 1983, I believe--that there were no junior mining companies in Chile, and some attractive opportunities. This was in the early part of the gold boom, bulk low-grade cyanide-leach gold deposits, which were developed extensively in Nevada and Australia and various parts of the world. In the course of the evening, we talked about how this might be possible in Chile, and somebody said, Well, why don't the three of us form a company? Julia, who is a very aggressive sort of a person, immediately hustled back to her office and in a day or two had a specific proposal for the company.

Swent: Did she have mining interests already?

Lowell: Yes. She had been working for Anglo-American Company and Bernstein and Thompson in Chile, who had been responsible for developing several--well, developing at least one mine at that time, which was El Indio Mine. They had found several gold occurrences in the Maricunga district in northern Chile. Julia is a very intelligent person, and she knew a lot about mining finance and accounting and Chilean mining regulations, and knew many of the mining people in Chile.

So a day or two later, she said, "Well, I've made some of the preliminary arrangements for a new mining company," which was a surprise to me [chuckles]. We looked around for somebody to put money into it. A friend of mine, who is an entrepreneur in Vancouver, Canada, who had various interests--he had owned the Tonto Drilling Company and was in the soft drink business and real estate and oil and various things. Chuck is a chartered accountant by education.

Swent: What is his name?

Lowell: Charles Croft. We talked to him, and he agreed to put up $106,000 for a one-year budget, which is a subminimal-size exploration budget, but--I agreed to contribute some of my time, and I worked in the planning and evaluation and managed the work. Julia did the office part of it and much of the negotiating, and Pat Burns agreed to do some field work. As it worked out, he wasn't very industrious or reliable, and he was eventually drummed out of the partnership by the other three partners.

San Cristobal Mine

Lowell: But we looked at a number of prospects. One was a prospect which the Anaconda Company had been looking at and had made some trenches in, in the San Cristobal district in northern Chile. Anaconda was in their final death rattle at that time, and this was the last prospect that they looked at in Chile and one of the last or could have been *the* last as a company, that they had anything to do with. They didn't carry their work as far as optioning the property. They were looking at it without any ownership position. Had not agreed on terms and so on.

The prospect was disseminated gold in a porphyry intrusive body. Anaconda's work was very preliminary, and they had not delineated the surface outcrop of mineralization or done systematic sampling or done any drilling on San Cristobal. It was just simply an interesting outcrop. I learned a couple of years

after our project started that the actual identification of gold mineralization at that site had been made by two Anaconda geologists something like thirty years before, who were working at the Chuquicamata Mine. One of their names was Perkins, and I don't remember the other name. I might be able to find that in my file.

But we learned about their having worked there, and they had already abandoned their project at the time we looked at the prospect. We did a minimum amount of geologic mapping and quite a systematic job of sampling. We made more than 400 hand-dug pits on fences of pits across the deposit and in the course of that work found a second, parallel anomaly, which turned out after drilling not to be ore grade. But we drilled twelve shallow, diamond-drill holes at San Cristobal with our meager budget.

Swent: What do you call a shallow hole?

Lowell: Oh, a hundred meters deep, maximum. I think these averaged more like eighty or ninety meters, which is equivalent to a 300-foot deep hole. I believe that seven of the twelve holes had ore intersections at about the same grade as we had found on the surface. On this basis, we decided to shop this around and see if we could find somebody that would buy the property from us. We made a deal with another small North American mining company, Glamis Gold, that operates a mine called the Picacho Mine near the Arizona-California border, in California, near Yuma, Arizona.

They did a more extensive drilling project and did some test leaching, and then Niugini Mining Company from Australia took over their position, and also bought out the Minera del Inca ownership.

Swent: When did Bob Shoemaker come into the picture?[1]

Lowell: Well, at about that time. Bob Shoemaker was a consultant--I had worked with Bob Shoemaker in projects with Bechtel Company, feasibility studies that I was hired to be a team member in feasibility work as a geologist. And Bob was brought in as a metallurgist by our group. I worked on a number of Bechtel projects over several years, and I don't remember which ones I was with Bob--

Swent: We haven't mentioned those yet, and that's one thing we do want to bring in--later, perhaps.

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[1]See Robert Shoemaker, interview in process 1999, Regional Oral History Office, The Bancroft Library, University of California, Berkeley.

Lowell: Some of those projects were at Chuquicamata; two feasibility studies at Chuquicamata. One at a place called Quartz Hill in Alaska, and another was Stillwater Mine which I believe is Montana.

Swent: And Quartz Hill was for U.S. Borax?

Lowell: For Borax, yes. But I was working for Bechtel. I'll have to check my records. I think there were one or two other--

Swent: I think you said there were six.

Lowell: Anyway, Bob Shoemaker came down to offer a metallurgical opinion on a couple of the prospects we were looking at, one of which was the San Cristobal mine. Part of the work that we did was to negotiate property deals. There were two owners on parts of the San Cristobal ore body that we outlined on the surface.

Chile has a different attitude towards debts and bad checks than the United States. They had things analogous to debtor's prison. If you don't pay your debts, *carabineros* come and collect you and put you in jail until some family member or friend pays up for you. There was a local Chilean who owned one of these claims and a key part of the property, who was in this position. They hadn't captured him, but he was in a position where he would have to go to jail if found because of nonpayment of mortgage payments.

And so we had to--it was kind of a cloak-and-dagger deal to get in contact with this fellow through friends. He showed up for a meeting in the back of a van where he couldn't be seen [laughs]. There were various clandestine arrangements to talk to him. I can find his name also. After we made the deal, he was able to get together enough money to become legitimate again [laughs]. He probably ended up making more net out of San Cristobal than Niugini Mining did.

The deposit had a mineral fabric that made it very difficult to control the grade of the mill heads. It was relatively easy to calculate grades from drill hole interpolation and extrapolation, but it was much harder to maintain the necessary grade from the pit. Nuigini had limited mining experience and was unable to cope with this problem. This problem finally resulted in their mining a larger tonnage but lower grade ore than had originally been calculated in the feasibility study, and this had a serious impact on the return from the Niugini mining operation. Niugini was a small mining company without very much in-house mining experience.

My return from San Cristobal was something like a million-dollar profit. The Minera del Inca operation turned out to have

been a somewhat chaotic experience but reasonably profitable for me [chuckles].

Swent: It makes chaos worthwhile, I would say.

Some Unsuccessful Exploration Projects

Lowell: At about the same time, a year or two later, I participated in a Kennecott regional exploration project in Chile for a year or two as a consultant and with a finder's fee arrangement. We were unsuccessful, and I didn't collect a finder's fee. The project was a little bit of the tail-wagging-the-dog problem. The project was originally set up as a project based on geology largely, and it ended up being based almost entirely on geophysical surveys and was unsuccessful.

Shortly after that, I had another small project for Amax. It consisted of--

Swent: Was this Amax before they merged with Cyprus?

Lowell: That's right. It was a kind of a small-scale, largely reconnaissance project with a little bit of drilling done. We were looking for gold deposits in the Cordillera of the coast in western Chile. We found several apparent small deposits but nothing large enough to be of interest to Amax.

The Leonor Claim, a Property Problem

Lowell: Following that, I did some similar work for Niugini Mining Company. [This association came about because of my long-time friendship with Geoff Loudon. Geoff is an Australian geologist and in the early seventies when I was Placer Development's in-house consultant for geology in their mining operations, I was to some degree Geoff's supervisor and mentor since he was chief geologist at the Marcopper mine in the Philippines. I was impressed by Geoff because he was an independent thinker and a confirmed maverick. He was entirely responsible for the discovery of the large San Antonio ore body near Marcopper where he drilled the discovery hole in violation of instructions not to drill in an area which had been certified by Placer's exploration department in Vancouver to contain no ore and in which they were building a tailings pond. The tailings later had to be removed.

Predictably, when the discovery was made the exploration manager came back and claimed credit.

This is much like my later experience at La Escondida with Sig Meussig. I had some influence at that time with *Economic Geology* and arranged for Geoff to publish a paper on Marcopper and San Antonio, but I think it caused me to lose my Placer retainer. Geoff went on to find two more large mines for Placer in PNG [Papua-New Guinea] and Australia and then went on his own and as president of Niugini found the large Lihir Island gold deposit in Papua New Guinea in a joint venture with Kennecott. He has one of the best exploration track records in the world. In the late 1980s he asked me to put together an exploration program in Chile and he also bought the San Cristobal deposit. Geoff is a much better explorationist than manager and the San Cristobal mine was not very successful.][2]

The Niugini work resulted in one ore body, which is called Leonor, which I brought to Niugini. It's back in the El Tesoro district, where I had long been interested in the ore possibilities. Leonor is an exotic copper deposit, and the ore reserve that we drilled out was roughly fifty million tons of 1.5 percent strippable oxide copper, which was leachable with good recovery from acid leaching and solvent extraction, electro-winning.

The problem at Leonor was a property problem. We had a clear title in the Leonor claim, but the ore body extended to the borders of Leonor, and the surrounding ground was held by a Chilean captain of industry whose name is Andronico Luksic. He is now the richest man in Chile and I am very well acquainted with him--probably to my detriment. Soon after we began drilling at Leonor it became pretty obvious that it was going to be an ore body, and we started negotiations with the owner of the adjacent ground, which at that time was not owned by Luksic, but he owned a minority interest. It was called the Sorpresa claim, Surprise.

There's a story that I'll tell in a minute about the relationship between Leonor and Sorpresa. Sorpresa had a horseshoe shape around Leonor. The majority interest was held by a lady whose name was Mrs. Camponetti, an Italian name but longtime Chilean family. Mrs. Camponetti agreed to terms for a sale of her property to us, and an agreement was signed by her lawyer as her agent. The night that the agreement was signed, Mr. Luksic paid the lawyer something like $230,000 cash and paid Mrs.

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[2]Bracketed section was inserted by Mr. Lowell during the editing process.

Camponetti something like $800,000 cash for her interest in the property. Mr. Luksic acquired the property, and we lost out. I looked into the possibility of the lawyer being disbarred from practice but was discouraged from trying to do this.

But in any case, that made mining the Leonor deposit difficult. Mr. Luksic's company eventually entered into a partnership with a company that inherited the Niugini property and he now has, I believe, a 61 percent interest in the composite mine, whose ore reserves are larger than ours were but lower grade and less profitable. But the credit for the discovery of the Leonor should properly largely go to one of the owners, Claudio Segura, from whom we bought the claim, who sank a decline into the ore body and also drilled a hole that intersected the mineralization.

Swent: How did you come out then?

Lowell: Well, I made nothing out of Leonor [chuckles], and neither did Niugini. Niugini at that time was a subsidiary of Battle Mountain Gold Company. Battle Mountain Gold hired a consultant who wrote a report, which concluded that fifty million tons of 1.5 percent leachable copper was not economic, which was ridiculous, but it was an excuse to not get involved in the development. Another factor was that the stock market puts a relatively high price-to-earnings ratio on gold mining companies and a lower ratio on copper companies: if a gold company opens a copper mine, their stock price drops.

Getting back to the Leonor and Sorpresa claim, Mrs. Camponetti's father--father or husband; maybe it was her husband--was a partner with another Chilean in the Leonor claim. They had an informal arrangement that any ground that they staked in the district would be jointly owned. But Mrs. Camponetti's husband decided that there was nothing written, and so he staked the horseshoe claim around Leonor, which he called the Sorpresa, or the Surprise claim. "Surprise, I've cheated on our agreement."

The other partner responded to this by getting a pistol and going to see Mr. Camponetti and killing him. And so Mrs. Camponetti became a widow and for that reason was an owner of the ground when we were doing our exploration project.

Swent: They played rough, didn't they?

Lowell: Yes [chuckles].

Swent: My!

Lowell: The contribution that I made to the Leonor deposit was in recognizing that it was--could be a large deposit and drilling the grid of holes that delineated this good ore reserve, and I also had metallurgical testing done and a feasibility study which suggested that it could be mined alone, independent of the surrounding claim.

Shall we cut it off?

Swent: Well, I wanted to ask when you were in Chile did you ever have any contact with Bob Haldemann?

Lowell: Yes, I did.

Swent: Because I did Bob's oral history.[3]

Lowell: Well, I knew Bob. Not very well, but--

Swent: He was with Pudahuel.

Lowell: Yes. I talked to him maybe as many as five times in Chile. He was a fellow who was very well respected in Chile and did a lot of productive work in the country.

Swent: I didn't know whether he had been involved with you on any of these ventures or not.

Lowell: No. I never had any kind of a joint effort with Pudahuel.

Swent: Do you think this is a good stopping point?

Lowell: I think it is.

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[3]See Robert M. Haldeman, "Managing Copper Mines in Chile: Braden, Codelco, Minerec, Pudahuel; Developing Controlled Bacterial Leaching of Copper from Sulfide Ores; 1941-1993," Regional Oral History Office, The Bancroft Library, University of California, Berkeley, 1995.

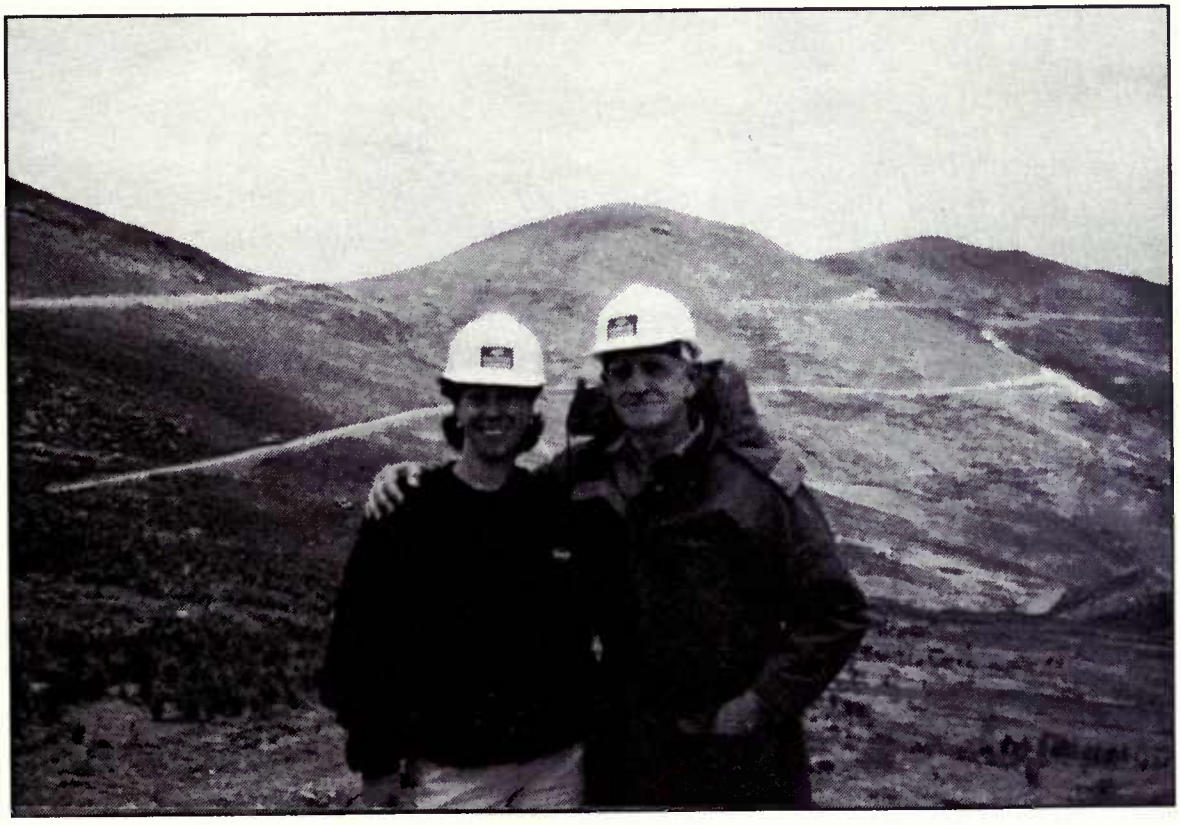
David Lowell exploring a southern Peru copper prospect, 1993.

David Lowell, 1994. Los Calatos prospect, southern Peru.
Chartered Peruvian Army helicopter in background.

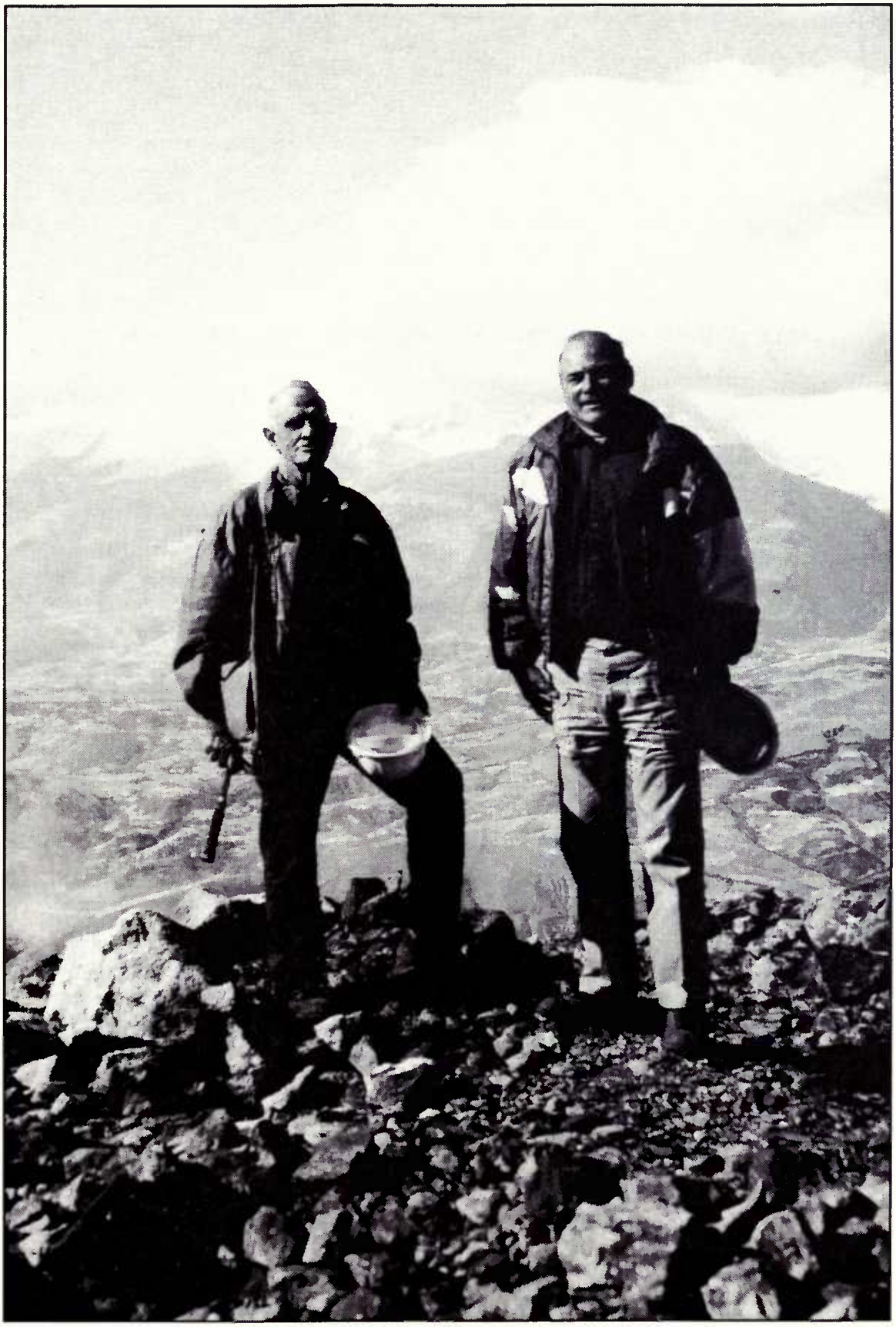
Chartered helicopter reconnaissance which found first anomalous Pierina samples, 1994. David Lowell, Rigoberto Soto, and Fredy Huanqui.

David Lowell and Fredy Huanqui, Pierina property, 1995.

Pierina Tunnel One, 1996. From the left: two unidentified Peruvian samplers, Norberto Socolich, Rigoberto Soto, David Lowell, and Pat Hillard.



Katie McLeod and David Lowell at Pierina, September 1996, when the project was transferred to Barrick.



At Pierina: David Lowell and Alan Hill, Barrick Gold Vice President of Development, September 1996, when the property was transferred to Barrick.

XIII ACUARIOS MINERA, AREQUIPA RESOURCES, AND LA PIERINA MINE, PERU

[Interview 3: September 17, 1998] ##

Investigation of Porphyry Copper in Southern Peru, 1985

Swent: This is now Thursday, September 17th. We finished with Leonor yesterday, and we're ready to move on.

Lowell: Well, I would like to talk for a little while about my project in Peru. I have been, through most of my professional career, a specialist in porphyry copper geology and porphyry copper exploration. In Chile the principal belt of copper occurrences is mid-Tertiary age, on the order of forty- to five-million-year-old mineralization. Almost all of the large copper deposits--Andina, El Teniente (which was originally called Braden) and Disputada, Rio Blanco, and Pelambres and El Salvador, Escondida, Chuquicamata, and the Collahuasi deposits and Quebrada Blanca--all fall in a narrow belt, which is pretty obviously related to a continental-scale structure.

From an exploration standpoint, this is an enormous advantage, and the discovery of the Escondida deposit was based on the assumption that new deposits, new, very large deposits, would fall in this same belt, which could be interpolated between known occurrences. The belt may or may not extend all the way to the Peruvian border to the north, but it appears that this may be the case, perhaps with an offset, in-echelon belt that includes deposits like Cerro Colorado and the Mocha deposit.

Swent: Are those in Peru, Cerro Colorado and Mocha?

Lowell: No, those are in northern Chile, in the First Region of northern Chile. We have worked on a couple of other prospects that could be large copper deposits north of the Mocha deposit. When you get to the border of Chile and Peru, the continental margin abruptly

swings from basically north-south to a northwesterly direction. The porphyry copper belt in Chile parallels the continental margin, and the southern Peru copper belt also parallels the new alignment of the continental margin. For my type of exploration, this is another obvious target, looking for new deposits within the narrow belt in Peru.

This belt is marked by the Incapuquio Fault on the northwest side and the Incahuasi Fault on the northeast side. There are four known large deposits there: Toquepala, Quellaveco, Cuajone, and Cerro Verde. This occurred to me in my first reconnaissance trip in 1969 over the belt and had stuck in the back of my mind ever since. In 1985 I returned on a little reconnaissance trip to southern Peru and determined at that time that it looked pretty hopeless from the political/foreign-investment viewpoint to invest any time or money in Peru. This was during the Alan Garcia period in Peru.

Visa and Permit Considerations in Chile and Peru

Swent: Let me ask: Did you have to get a special sort of permit to go to these places? Could you do these sorts of things on a tourist visa?

Lowell: Yes, yes. I never had any problems in Peru or Chile with immigration visas. Mexico used to be much stricter and threatened draconian penalties for visa violations.

Swent: You had done all this just on the tourist visa?

Lowell: Yes, much of the time.

Swent: Even when you were living there?

Lowell: Well, when I was living in Chile, after a couple of years my Chilean lawyer started hounding me to get a different kind of visa, and I finally did. I obtained an immigration visa, as a temporary resident in Chile. I would have been able to convert the temporary resident visa into a permanent resident visa after five years, even get a Chilean passport, which I thought some about doing but never did.

In Peru I never obtained anything other than a tourist visa, which had a block to mark whether you were there for business or pleasure, and I sometimes filled in one box and sometimes the other, or both, in Peru. But in 1985 I did a several-day

reconnaissance and library research in Peru, feeling the temperature of the water. Later I had--

Library Mining Research in Peru

Swent: What sort of library research did you do in Peru?

Lowell: Well, the Peru mining literature is surprisingly good. They have published bulletins on quadrangles that cover most of the part of Peru that's interesting from an exploration standpoint, and there had been various congresses, mining congresses, with a number of published mining geology articles, and there is quite a bit to look at. They had, in about 1989 or '90, had published a metallogenic map of Peru, which is probably one of the best in the world. There is no similar map I'm familiar with in the United States, and there is not an equivalent map in Chile.

Swent: And they have a national archive or library that you go to?

Lowell: Yes, there's--I've forgotten what the name of it is, but it's a Department of Mines--

Swent: I see. Do they have anything equivalent to our USGS?

Lowell: Yes, they do. It's not as well financed, and the geologists are probably not as well qualified as far as education as the USGS, but there is a similar organization. Also, in Chile the current organization in Chile is called *Sernaciomin*, and the earlier one was called Instituto de Investigaciones Geologicas. The earlier organization was modeled after the USGS, and I believe in most respects was better than the later organization, but they did quadrangle mapping and compilation of data and had an impressive library. Two reasonably capable USGS geologists spent several years in Chile helping get it started. The director of the earlier organization, Carlos Ruíz, was a close personal friend of mine. I co-authored several articles with Carlos Ruíz ten years or more ago.

Swent: So this metallogenic map of Peru was put out by their mines department?

Lowell: Yes, and it showed all of the principal known ore deposits and lots of the prospects; all of the principal known prospects also were located on the map, with a reference, and would make it possible to, beginning with the map, to go back to the library and get a running start on exploration in this given district.

Exploration in Southern Peru, Beguinning in 1991

Lowell: In 1985 I elected not to do any work in Peru, after my visit. But a few years later I had a Peruvian geologist working for me in Chile, whose name was Luis Montoya. Luis had worked for Asarco a number of years in Peru and was a pretty well-trained exploration geologist and a very intelligent fellow, but unfortunately not very reliable or honest, as I learned later. But his family was living in Lima, and he had lots of contacts in Peru. This was during the Alan Garcia period and later the first years of Alberto Fujimori's tour as president.

The *Sendero Luminoso* terrorism reached a peak probably around 1988, '89 and '90 and was a real obstacle to working in Peru. Through Luis--I used him as sort of a listening post for the situation in Peru and also read whatever showed up in the Chilean newspapers, which was quite a bit about the political situation in Peru. In any case, in January 1991 I decided that it was a strategic time to begin an exploration project which was financed solely by myself, in Peru.

I made a trip to Peru and used Luis Montoya in the early part of the work and set about exploring the southern Peru copper belt. At this point, I was very much in the vanguard of foreign exploration in Peru. I was almost the only one doing work in Peru. Peru was in a better condition than it had been a couple of years earlier but was still in a very chaotic condition. When we began working, as I earlier mentioned, there was an average of a car bomb exploding once every one to two weeks in Lima. The hotel that I stayed in on my first trip was called the Hotel Condado, and before I returned the second time, it had been blown up by a car bomb, and some of the clerks killed. But it was surprising that it was possible to continue doing business, in spite of the political problem.

We began doing library research and aerial reconnaissance. We chartered an airplane in the town of Arequipa, which is the principal town in southern Peru and also the second-largest city in Peru.

Swent: "We" is you and Luis Montoya?

Lowell: Yes. By that time, I had hired two or three other Peruvian geologists. It was easy to get the cream of the crop in the way of geologists at that time because there was a shortage of jobs and the country was in a very poverty-stricken condition. Salaries were low, and I hired everybody on the basis of salary, which was somewhere above the going rate, plus an incentive

discovery bonus, a finder's fee type of arrangement, which appealed greatly to some of the Peruvians.

But Peru had been a socialistic country for the past twenty years, and many of the people--many of the professionals--really had a kind of a dim view, a dim understanding of capitalist arrangements--finder's fees and shares and options and all that sort of thing. But we began work in southern Peru, and we identified a number of prospects.

Swent: How did you do this? Did you fly over first?

Lowell: Fly over first, and investigated the literature. Some of these were referred to in earlier reports. The geologists that I hired were a pipeline into scuttlebutt in the industry. We looked at and sampled and did aerial reconnaissance on a large number of prospects in the first year. We began a regional geochemical prospecting program in which teams collected wide-spaced rock, geochem samples and stream sediment samples--

Swent: It's awfully tough country to get around in.

Lowell: Yes. There's lots of long hikes by foot. This was in the north end of the Atacama Desert, and in some areas there were horses and mules available but usually not because there wasn't enough vegetation and water to use horses.

Swent: Could you use jeeps?

Lowell: Well, in Chile most of the area is accessible to four-wheel-drive vehicles. In southern Peru most of the area is not accessible, for two reasons: One is that the terrain changes and it's more rocky, dissected by large *quebradas*, steep canyons. And the other reason is that Chile is a more developed country, higher standard of living, more advanced government; and the result of this is more road construction by the government, or private individuals. But it was kind of catch-as-catch-can as far as access goes.

The availability of aircraft and particularly helicopters is also poor in Peru. We used helicopters a number of times, and it was pretty obvious each time that you were sort of risking your life to ride in the helicopters. Most of our helicopter chartering was from the Peruvian air force, and the maintenance of the helicopters was poor. The capability of the pilots was uncertain but also questionable.

Later, a British company called Dollar Helicopters came into Peru with three high-altitude Lama helicopters, and in the course of a year all three crashed and the company elected to leave Peru

at that point. The maintenance and pilotage was much better in the British company's operation, but also not conducive of a great deal of confidence.

Los Pinos Prospect

Lowell: In the course of the first year, we did a pretty thorough reconnaissance, a first-step reconnaissance of the southern Peru copper belt and the extrapolation of the belt south to the border of Chile and north towards Lima. We identified one prospect which we called Los Pinos, near Cañete, Peru, which we acquired in an option agreement. We filed claims covering a large number of porphyry-copper-style alteration zones in the southern Peru copper belt and in the southern projection of the belt.

During this period we didn't establish an office in Peru, we didn't have a bank account, and we didn't hire any service employees other than field assistants for the senior geologists who were working almost entirely in the field. I paid all the bills in cash and using credit card and maybe on some occasions a U.S. check.

Swent: Did you pay your geologists in dollars?

Lowell: Yes. They were paid in dollars. We accomplished a lot during that period. A person that I became acquainted with, also at a cocktail party in Chile, was Catherine McLeod. Catherine was a professional mine finance person who had a commerce degree from a university in Canada--she's a Canadian--and was sent down to Santiago to open an office for a Canadian brokerage firm who had intended to get their foot in the door in Chilean mining industry, acting as a broker to finance Chilean mining companies. She was there for less than a year and resigned from the company that she was working for.

I had known her only casually, but she had heard through the grapevine that I had started an exploration program in Peru and also knew that I had a good track record for finding mines. She then pursued me into Peru to try to talk me into forming a Canadian company. In the meantime, I had, at about the end of the first year, I had formed a company called Acuarios Minera in Peru, only for the purpose of holding mining property. It was a wholly-owned company.

Forming Acuarios Minera

Swent: Where did you get the name?

Lowell: Well, the name was picked by the agent that formed the company. I just asked for a company to be formed. I think the name came from the song, "Age of Aquarius," but I wasn't terribly happy with the name, but it didn't really make any difference. At about that time, we also established a very small office. No secretary, but we opened a bank account.

Swent: Who was your partner?

Lowell: I didn't have a partner.

Swent: I see. You've noted here that you took in a partner.

Lowell: Well, that was a little bit later. And that is a somewhat sensitive question. I'm not willing to tell you who the name of the partner was [laughs]. I'll skip ahead a couple of steps. The partner was a friend I had known for many years who was a mining executive. He offered to match my investment in Peru but said he wanted to keep his name confidential because he might be criticized because of his company association for investing in this project.

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Lowell: This didn't worry me at the time, but it later became an issue after the Canadian company, which was called Arequipa Resources, was formed. One of the reporters from a Canadian scandal-sheet-type mining newsletter, *Stock Watch*, made a big point of trying to find out who the partner was, and it was never divulged. There was nothing illegal or unethical about the arrangement. That's the story on the partner.

Catherine McLeod and Arequipa Resources

Lowell: But going back to Catherine McLeod, she proposed that a Canadian company be formed, and I declined at about the beginning of 1992, but the money that I had put in and the partner later put in began to run out later in 1992, and I agreed that a company be formed. It was called Arequipa Resources. The structure was a private placement by several individuals in Canada, totalling two million dollars Canadian, was put into the new company, which would buy a

50 percent interest in my portfolio of properties in Peru. There was a provision in the arrangement that, with the agreement of both sides, a merger would be later made with Acuarios, and the other 50 percent would go into Arequipa Resources. I didn't personally receive any of the two million dollars; the two million dollars Canadian, which at that time was about one and a half million U.S., was all spent in exploration expenses in Peru. At the time of the merger, other underwritings were done in Canada to supply additional funds.

We, step by step, began to resemble a conventional company, more and more, with secretaries and larger offices and accountants and so forth--and lower efficiency, I might say [laughs].

An Unknown Partner

Swent: You were able to do all of this without ever having your partner's name made a matter of public record somewhere?

Lowell: That's right. That's exactly right.

Swent: In Peru you could form a company without registering the names of the partners?

Lowell: The company was formed in my name.

Swent: You couldn't do that here, could you?

Lowell: Well, it would probably be possible here, also, to have an informal verbal agreement. I don't know that much about U.S. corporate law, but I think that's correct. But this arrangement was unbelievably casual. The money was delivered to me, with no written agreement of any sort. I spent it, and my partner had confidence in my honesty. It turned out very well for him. He ended up with a profit of several tens of millions of dollars. That's the story of the unknown partner.

Swent: Well, if there's trust you can do a lot of things, can't you?

Lowell: That's right. In the second year, in a continuation of the reconnaissance and the geochem work and the ground geologic mapping, our sequence of steps was to identify a prospect from library research or, more commonly, from aerial reconnaissance work, and file a claim covering it, and then do the ground reconnaissance and geochem sampling. We had planned to follow up

with test drilling, and we did some of that, but most of it was done by major companies later, on a farmout basis.

Los Calatos Deposit

Lowell: About a year after beginning the project, we were flying between known targets south of Arequipa and north of the Cuajone mine, southeast of Moquehua, Peru, and I noticed a concentric color anomaly out the window of the airplane. This was not a unique event because we had found by then twenty or more. We spotted the anomaly. The aircraft was equipped with a GPS [Global Positioning System] instrument, and we had an arrangement for finding GPS coordinates on the map by programming them into the aircraft GPS instrument, and when we found something of interest we would ask the pilot to punch it into the machine, and then we would later pick up these coordinates from the aircraft's instrument, and that's what we did on this occasion.

This prospect turned out to be a deposit which we named Los Calatos from a geographical name on the map. This means the bald ones. It's in very much a desert environment, with almost no vegetation. A few cacti. And in a very inaccessible place. It required a full day's walk to get to Los Calatos in the beginning. This later turned out to be a copper deposit which probably contains on the order of fifty million tons of one percent copper in a sooty chalcocite-style mineralization, which is leachable, which would result in a smaller capital investment because it's a less complicated concentrating plant.

We did a detailed geochem survey on Los Calatos, and we later negotiated a joint venture agreement with Phelps Dodge Corporation to explore Los Calatos. Phelps Dodge did a lot of geophysical work at Los Calatos, relatively little geochemical work or surface geological work, which were the two techniques that I have emphasized in my porphyry copper exploration. In the middle of the Phelps Dodge work--

Swent: Who were you working with at Phelps Dodge?

Lowell: A fellow whose name was Jorge Benavides. Jorge is a nephew of Alberto Benavides, who is sort of the dean emeritus of Peruvian mining. Alberto Benavides is a fairly good friend of mine. He has a degree, either a master's or doctorate, from Harvard University and was at one time the chief geologist at Cerro de Pasco Corporation, a very intelligent, capable guy. He's

president of Buenaventura Mining Company, which is, I believe, the largest mostly-Peruvian-owned mining company in Peru.

His nephew is also a very well-educated fellow and was picked as Peru manager by Phelps Dodge Corporation. But in the middle of the Phelps Dodge project at Los Calatos, a scheduled flight, something like a 727 airplane, crashed at Arequipa and everyone was killed, including the manager of the Calatos project and either one or two of the geologists working on it. This stopped the project for a month or more and also sort of permanently interrupted the momentum of the project.

The result was that the exploration really wasn't properly completed. There were only two drill holes drilled in the ore body itself. Most of the drilling was in IP [induced polarization] anomalies that had been found by the geophysicists and which turned out not to be related to copper ore.

But in about the middle of 1993 there began a flood of foreign companies coming into Peru, and most of the southern Peru copper belt was blanket-staked by various of these big companies. It pretty much shut down our exploration, our regional exploration in the southern part of the country.

Swent: Why was that?

Lowell: Our work was based on looking for alteration zones and then acquiring them by staking. After everything was staked, we couldn't continue with this strategy. We weren't sufficiently well financed to enter into a lot of option agreements in which substantial cash payments had to be made. But in the course of our work, we had begun to appreciate the fact that there might be a regional structure analogous to the Falla Este [East Fault] in Chile, with an extension on the order of a thousand or more kilometers of strike length.

It was represented in the south of Peru by the southern Peru copper belt and in the north of Peru by the recently-discovered Yanacocha gold deposit of Newmont, and other deposits that formed a northwesterly-trending gold belt near Cajamarca, Peru. These included deposits like Maquimaqui and Taltahuantay and the Michiquialli porphyry copper deposit, originally owned by Asarco, and other deposits.

Research and Reconnaissance for Gold in Northern Peru

Lowell: But between this belt of known deposits and at the copper deposits in the south of Peru was a long gap. I began another library research and reconnaissance project to define a gold belt in northern Peru. We identified all the gold deposits in Peru on maps and noted the concentration of belts in a band south of Cajamarca and then did more or less the same sort of exercise that we had done in copper reconnaissance, which was doing a land-status investigation to determine areas open for location and the owners of ground that was held, and compiled the existing geologic reports on deposits, and compiled geology from various maps and followed this up with some aerial reconnaissance, but the aerial reconnaissance was not as effective in northern Peru because you go from the Atacama Desert to sort of a rain forest with lots of vegetation and soil, which is not favorable for identifying the types of features we were looking for.

Swent: Were you getting over onto the east side of the Andes then?

Lowell: No, on the west side. We had also shifted gears from being porphyry copper geologists to being epithermal gold geologists, sort of bulk, low-grade gold occurrences that are common in Nevada and to some extent California and/or show up in various parts of the world. The Yanacocha deposit was one of these, as was Tantahuatay and Maquimaqui. I was the only one in the group who had any experience with epithermal gold deposits.

Our attention became concentrated in a segment, and my recollection is a little hazy as to how long the segment was, but something on the order of one hundred to one hundred and fifty kilometers in length, south of Cajamarca. We looked at lots of gold prospects, and we did detailed work on some of them. We had at least one drilling project.

Countering Terrorism

Lowell: The security problem became--even though the *Sendero Luminoso* by this time was on the decline because of effective efforts of the Fujimori government--there were still some areas in northern Peru that were distinctly dangerous. Our policy was to talk to the counter-terrorist people in the Peruvian army. I went to see their counterpart in the American Embassy. We had one major in the Peruvian army who was a kind of a contact guy that we got information from. But I thought about accepting the offer of the

army to provide soldiers as guards in our field work, but we decided that was not the most effective solution.

What we actually did was send somebody to a new district to talk to the storekeepers and the mayor of the town to find out if there was suspicious activity going on, and they always had a lot of information. In a couple of cases, we elected not to work in a district because of this problem. One district that we began doing work in, the geologist came to me and said, "You know, I really don't feel comfortable."

They were talking to the people and whatnot, and I said, "Well, forget it. Let's go somewhere else." This happened to be a place where a geologist working for a Canadian company, maybe even on the same prospect, was killed just a short time afterwards. So this was a kind of logistical problem for our project.

We moved into a district between Huaráz and Caráz, which is a graben structure, a downfaulted large block bordered by northwest-trending faults on the east side and the west side. On the east side of the--this is called the Yungay graben, or the Callejon de Huaylas Valley--on the east side of the valley is the Cordillera Blanca, in which is the highest topographic point in Peru, which is called Huascarán. There also are a string of glaciers and snowfields in the Cordillera Blanca. A beautiful area. It's very popular for international mountain climbers to visit, to climb some of these peaks. I think Huascarán has an elevation of something like 22,000 feet.

Swent: There was a devastating earthquake there just not too long before that.

Lowell: Well, the Yungay graben is probably named after the town, or former town, of Yungay, which was buried by a mudflow that was caused by an earthquake. That was--

Swent: In the eighties, wasn't it?

Lowell: In the early eighties, or '70-something. This town--there's still a church steeple and some palm trees projecting out of the mud. Twenty thousand people were killed. The west side of the graben is another mountain range called the Cordillera Negra. The Cordillera Blanca is a white-looking mountain range, and the Cordillera Negra is a black-looking mountain range.

One of the geologists that worked for me, whose name is Fredy Huanqui--all of the geologists were Peruvians up to this point--and he had worked for Centromin, which is a Peruvian

government corporation which was formed to take over the nationalized Cerro de Pasco properties. He had done work in this district for Centromin, and he pointed out hydrothermal alteration zones which occurred in both the Cordillera Blanca and the Cordillera Negra sides of the valley. The district fit kind of precisely my preconceived model for exploring the gold belt.

Swent: Is it at all similar to your copper model?

Lowell: No, not very similar. Really quite different. The gold deposits are low-temperature formation and formed nearer the surface at the time of the mineralization and have a different, kind of a totally different mineral assemblage. The exploration techniques are different. I had already had some experience in other countries with this type of exploration, so it was not a totally new problem.

[I had previously worked on epithermal gold deposits in Nevada, California, Malaysia, Philippines, Ecuador, and Chile, but never for more than a few days at a time, and never in depth as in my porphyry copper self-education when I made an effort to understand the theoretical basis. Epithermal gold-silver deposits are typically an order of magnitude smaller in area than porphyry coppers and are much less homogeneous and more erratic and less predictable than porphyries. There is some peripheral alteration zoning consisting of quartz, allunite, clay, disseminated pyrite, chlorite, et cetera, but it is not as homogeneous and predictable and reliable as the porphyry alteration zones which John Guilbert and I documented and quantified. Epithermal deposits are usually flat-tabular deposits which are found at the surface or at relatively shallow depth. Porphyry deposits, on the other hand, tend to be vertical cylinder-like in shape, sometimes with a vertical dimension of as much as 20,000 feet. We use geologic mapping and broad-scale geochemical surveys and grid drilling to find porphyries. Our competitors use geophysical surveys and remote sensing which are stylish, but almost always unsuccessful. Epithermal gold exploration uses geophysics somewhat more successfully but relies mostly on close-spaced geochemical sampling and recognition of silicate alteration assemblages. Luck and persistence are the most important techniques together with many, many drill holes.][1]

[1]This paragraph was inserted by Mr. Lowell during the editing process.

Paron Gold Deposit

Lowell: The first deposit that we visited in the Caraz-Huaraz district was called Parón. We did some sampling and determined that there was at least a limited amount of epithermal (epithermal means low-temperature) micron-gold-type mineralization. We eventually negotiated a tough option deal with the owner. The business relation with the owner was not a very happy one. We found that he had been untruthful in what he had told us.

Swent: He was a Peruvian?

Lowell: He was a Peruvian. This was about the point where it also became evident that Luis Montoya had been working both sides of the street and making personal deals with property owners, including the Parón owner, so I had to let him go. But this didn't interfere very much with the project. We continued to operate efficiently; in fact, more efficiently. But the significance of the presence of a number of elongated hydrothermal alteration zones parallel with the regional structure, together with the known occurrence in at least one spot of epithermal gold mineralization (at Parón), was really very exciting at that point. This was the first time that epithermal gold mineralization had been recognized in the district.

We had heard that a couple of major foreign companies had recently visited this district, which provided a time urgency in the availability of property, so on the spur of the moment--

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Swent: You were talking about Parón and you were saying that other companies were coming in, so on the spur of the moment you--

Lowell: I decided to do extensive claim staking in the district. We filed claims on all of the known alteration zones. All of the known gold mineralization was on the east side of the graben, in the Cordillera Blanca, but from a genetic standpoint, the west side contained a number of mineral occurrences and also looked permissive for the occurrence of epithermal gold deposits, so I elected to file claims covering all of the alteration zones on both sides of the graben.

Swent: Which side was Parón on?

Lowell: Parón was on the east side, in a flank of the Cordillera Blanca. Pierina was on the west side in the Cordillera Negra.

Swent: How high was it?

Lowell: The elevation at Parón was about 14,000 feet, or 14,500.

Swent: Pretty high.

Lowell: It was about 4,000 meters.

Swent: Tough exploration up there.

Lowell: Yes. At that time, I was in my late sixties age-wise, and I found it pretty strenuous to climb the hills at 4,000-meter elevation.

Swent: How did you get up there? There was a highway up the valley.

Lowell: Well, there was a road almost to the Parón deposit. Some of our other prospects on the east side of the valley were only accessible by foot or on horses.

Swent: Did you ever go to a place called Pashpap?

Lowell: Well, we flew over that.

Swent: I went to Pashpap, and that was--the last bit we did on horseback, and I was so nervous that I got off the horse and walked--and I had had a lot of experience with trails in Mexico, but that was really hairy.

Lowell: It's very rough country. I looked at that. I read a report on Pashpap and did aerial reconnaissance over the area.

Swent: That was on the west side of the graben.

Lowell: Yes. It was a molybdenum deposit in the Cordillera Negra. I'll ask you later how you happened to be there.

Swent: Well, I wondered myself at the time [chuckles], but I know what very precipitous country that is.

Lowell: It's difficult country logistically.

Swent: Oh, yes.

Lowell: We eventually found three occurrences of epithermal mineralization on the slope of Cordillera Blanca in a northwest-southeast belt, and we had a continuous line of claims about forty kilometers long in the Cordillera Blanca belt. We did surface sampling and mapping at Parón and later had a small drilling project with a hand-carried diamond drill and found that the grade at depth was

significantly lower than at the surface and that the deposit was a manto-type occurrence, a sub-horizontal tabular deposit and we gave up our option. Part of the reason for not continuing was the business difficulties we had had with the owner.

But after the large claim-staking effort, we had acquired a total of almost twenty individual alteration zones. This work was during 1994, and near the end of 1994 we chartered a Dollar helicopter and took a few wide-spaced samples in every one of the alteration zones. These were kind of calibration samples to get an idea about the distribution of mineralization.

Swent: Where were you sending your samples?

Lowell: Well, we were having our analytical work done in Lima, in a couple of Peruvian labs, and we sent check samples to Bonder-Clegg Lab in Vancouver.

Swent: That took you quite a while, then, to get them back.

Lowell: No. Curiously, it was a pretty fast turnaround. We had sample preparation done in Peru and sent samples by FedEx, pulp samples to Bonder-Clegg, and they faxed back the results. We had a turnaround time of something like a week or ten days.

The results of the helicopter sampling program showed a number of anomalous samples.

Helicopter Sampling

Swent: Helicopter sampling. You were again dropping people from a helicopter?

Lowell: From a helicopter. And I did some of this myself. There were three of us, including Rigoberto Soto and Fredy Huanqui, that worked out of the helicopter. We got a number of anomalous samples, and the next step was a follow-up program of ground checking of the anomalous samples, and some of the alteration zones were of interest because of existence of other known mineral deposits.

One of these samples--or two of these samples--were on a claim that had been named--each of these claims had a name. A typical size of an individual claim would have been on the order of, say, three by four kilometers or twelve square kilometers, although they varied in size. One of these claims, which

contained two anomalous samples, was called Pierina. Pierina was the name of Fredy Huanqui's daughter. Most of the claims had girls' names.

The Pierina Claim

Lowell: The two samples were anomalous in silver and zinc, neither of which were our target metal, which was gold, but these things are often associated with epithermal gold deposits. These samples were north of an abandoned mine, whose name is Santo Toribio. Santo Toribio is almost due west of the town of Huaráz, which was a sizable community: 60,000 people.

During the next several months we didn't get back to--we were working in other parts of Peru and on the Parón deposit. Another one of our properties was called California Cuatro (California Four) claim. We didn't get back to the regional reconnaissance. We did a bleg survey, which is a type of regional gold stream sediment geochemistry which was developed in Australia. And we didn't find any anomalies with that that turned out to be significant.

Pat Hillard, Geologist

Lowell: But in the summer of 1995 I felt that our field work was not going as fast and as systematically as I had hoped, and I decided to add a gringo, a North American geologist, to the Peruvian staff. His name is Pat Hillard. Pat is a kind of a loner type of guy who has a large tolerance for unpleasant living conditions and mountain climbing and so forth. He had done a lot of work in Papua New Guinea and Spain and Patagonia in South America and is a good exploration geologist.

When Pat arrived on our project, which was August 1995, I asked him to push the follow-up surface work for the claims that had been staked in alteration zones. The top of the list that I gave Pat to work on was the Pierina samples, which I thought were somewhat more interesting than any of the other anomalous samples. Pierina is on the west side of the graben. Pat worked with Fredy Huanqui. The story differs on how they actually found the first anomalous gold samples on the Pierina claim. I'm inclined to believe Pat Hillard's story and not Fredy Huanqui's story.

Swent: How did they differ?

Lowell: Well, they did it by hiking and riding on horseback long distances and collecting wide-spaced samples and looking at the rocks.

Fredy Huanqui and an Alternate Version of the Discovery

Swent: How did the stories differ?

Lowell: Well, Pat told me that he and Fredy Huanqui were together when they took the significant samples, and Fredy Huanqui had the story that I've heard any number of times in exploration, which was, "Well, I knew it was there all along, and I told Pat Hillard to go to this spot where I knew there was a gold deposit."

The outcrop of the Pierina ore body was--I was there shortly afterwards, and the outcrop was very interesting because it was very nondescript looking, kind of a grey, gnarly, siliceous rock outcrop. There wasn't a pit or an adit or a cut or evidence that a geology hammer had ever broken a rock on the outcrop. It was a totally virgin outcrop. The reason for this was that the size of the gold grains was micron (one millionth of a meter) or sub-micron size, and the gold could not have been panned by an Inca prospector or a Spanish prospector or a Peruvian prospector, and it had never been found.

There was an area about four hundred by six hundred meters in size of strongly anomalous gold mineralization. The first samplings indicated a gold grade averaging about 1.6 grams per metric ton, which is above minimum bulk low-grade gold mining grade, which is about one gram. But experience indicates that the surface grade is not a reliable indication of the grade at depth because gold can either be leached out of the surface by a solvent which is probably humic acid, or it can be enriched at the surface by physical concentration of gold as erosion planes down the original deposit.

My experience in other parts of the world suggested that the second process is more common than the first, that it's more likely that you'll find better surface grade than what is present at shallow depth, but it could be either way. I, by trial and error, had determined that the best first-stage exploration technique in the Andes is to make hand-dug pits big enough to get below this surface effect. So I insisted that some pits be made. This was, by this time, late in the fall. Fourteen wide-spaced pits, about one and a half meters deep, were dug, and the samples

were sent out shortly before the Christmas vacation. The results came in on December 28th, 1995, and I happened to be the only person in our whole group that was working at that time.

Pit Samples Averaged Seven Grams of Gold

Swent: Were you in Lima?

Lowell: No, I was here in Arizona. I received the assay return by fax. The fourteen samples averaged about seven grams of gold, or more than four times the grade at the surface!

Swent: Oh!

Lowell: So I made a copy of the assay return and made a pencilled note on it, and I said, "Pat, do you believe this?" Signed, Dave. Sent it to him by fax, and he was just as surprised as I was. We both thought that there was probably an assay error. As soon as our fellows went back to work after New Year's Day, I sent them back to resample the pits. The second set of assays came back the same as the first. And then we did a detailed pitting of the outcrop area, and I think we made ninety-two pits. They were made deeper, all a minimum of two meters deep. Those came back with pretty much the same grade. I think they averaged between six and seven grams, and there was only one pit that was below one gram. This is unusual style of mineralization for these disseminated deposits because gold mineralization is usually very erratic.

Swent: At that altitude, did you get snow in the winter?

Lowell: A little snow, but not much. There was a--

Swent: You could still work in the winter.

Lowell: You could still work in the winter. The obstacle, the climatic obstacle of working was rain, not snow. The bottom of the snow line was somewhere around 4,500 meters, around 15,000 feet.

Swent: Above you, then.

Lowell: But from December through the middle of April is a heavy seasonal rain season, which interferes with road building and to some extent with diamond drilling. This all happened in January of 1995 that we really realized this was very probably a major gold deposit. We decided that road building couldn't begin until April or May. Because this is in an area of cheap hand labor and also

good mining expertise, I arranged for a small contractor in Caráz to drive two adits, and they were called Tunnel 1 and Tunnel 2.

The contractor got a small air compressor to the site by hiring forty Quechua Indians who towed it with ropes to the site. The access at that time was by horseback and by foot to the site. We began driving these two tunnels about the beginning of February 1995. The advance was good, considering the rock conditions and the access problems. One of the tunnels eventually went in a distance of 176 meters. We assayed the rock as the tunnels were driven. They were both in continuous ore-grade mineralization. Both of them averaged maybe five grams of gold or higher.

At the same time, we were putting in the pits and arranging for road building to begin at the end of the rainy season. We got a road completed in about late May, I believe. At that time, drilling equipment was hard to contract in Peru. There was a shortage of drill machines. We had one drill contractor who performed very badly and had to be replaced with a second one, and we eventually completed eight drill holes on wide spacing.

A Revolutionary Drilling Program on Wide Spacing

Lowell: One of the significant events in the history of the Pierina project was we were unable to get the geologic mapping done up to my standards for a drilling project. The mapping really had to be done before the drill sites and the drill access roads were completed. In about the beginning of June, I finally lost patience with my guys that were there and laid out a pattern of drill sites on hundred-meter grid spacing. This was 333 feet square grid between drill sites, which was a revolutionary way to drill epithermal gold deposits because they normally have an erratic nature and the holes have to be closer together and based on detailed mapping and so forth.

But I felt, based on the continuity of the mineralization that had shown up in the surface samples and pit samples and adits, that this was an unusual sort of deposit and that we could go to wide spacing. This was predicated in part by limited financing and so forth.

Swent: What was the surface terrain?

Lowell: Very steep. It was a steep slope.

Swent: So was your grid horizontal?

Lowell: Well, the grid was based on horizontal distances, but of course going up hill a hundred-meter-laterally-spaced hole might be fifty meters higher in elevation. At some point I should go back and talk about the corporate part of Arequipa Resources, but in any case, we were able to build these drill sites and get a total of nine holes completed, all of which intersected ore--let's see. That's probably a mistake. I don't think all of the nine holes intersected ore; one did not.

Lack of Geologic Mapping a Problem

Swent: Were the holes going straight down?

Lowell: They were mostly vertical holes. I think a couple of inclined holes were in that group. In fact, maybe eight of the nine holes had ore intercepts, and one didn't. But I'm a little hazy now about that. But the geologic mapping turned out to be a very large obstacle in the Pierina project. There were two reasons for it: One, it was hard to do and required some background knowledge of epithermal geology, which the Peruvian geologists did not have, and Pat Hillard's understanding was also not very good on this type of epithermal gold deposit. In any case the gamble of going to a broad-spaced grid of holes probably resulted in a huge, many times increase in the sale price of Arequipa Resources when Barrick made a hostile takeover a short time later. If the drill spacing had been fifty meters, for example, in the limited time and drilling capability which we had, we would have been able to develop only one fourth as many tons of reserves and Barrick's offer would have been much lower.

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Lowell: I afterwards concluded that I had made a mistake in not moving to Huaráz myself for several months during the drilling project, but I thought that I would be able to do it by remote control from Arizona.

Corporate Organization of Arequipa Resources

Lowell: Going back again to the corporate organization of Arequipa Resources, in the early stages of it I had appointed a Canadian fellow that I had known for a long time--his name was Henry Ewanchuk--to be president and run the office in Vancouver. Hank in a way had the same problem that the gringo geologists had of not really understanding how to operate in Latin America. He had had a very successful career in exploration and mine management in Canada.

Catherine McLeod, a Very Competent Manager

Lowell: Catherine McLeod, whose nickname is Katie, understood the problems of Latin American operations much better, on the basis of her tour in Chile. She was also--Catherine's father was a miner, and she had grown up in Canadian mining camps and listened to mine talk at the dinner table all her life. She is a very competent mine manager type.

And so, after the first year of the existence of Arequipa Resources, which she had a big hand in forming, I asked her to take over as president in Vancouver. And I had the title through the whole history of it of chairman of Arequipa.

Swent: What was Ewanchuk's title?

Lowell: President also. Hank is a very competent person and had been president of Bethlehem Gold and other Canadian companies, but he was at a great handicap in Latin America.

The Difference Between Operating in Canada and Latin America

Swent: He was the president of Arequipa. What *is* the difference between operating in Canada and Latin America? What makes such a difference?

Lowell: Well, I could spend a couple of hours answering that question. The legal code in Latin America is Napoleonic law which says you're guilty until proven innocent, and it says that a verbal agreement has no basis in law, and not even a written letter of agreement is valid; it has to be an agreement that is rewritten

and recorded by a *notario*, who is basically an officer of the court.

The other dimension of this is the philosophy and ethics and customs of Latin Americans are much different than Anglo-Saxons.

Swent: Is this a fundamental difference?

Lowell: Yes, yes, I think it is a fundamental difference. This is not to say the Americans are honest and Chileans are dishonest; you could almost make an argument on the other side [chuckles]. But in doing business, it's quite a different ballgame. In any case--

Swent: You could give some examples.

Lowell: Well, we at times made verbal agreements with property owners and followed up by a letter saying, "We'll just write out these terms. That's a $20,000 payment on signing and $50,000 at the end of a year, and $100,000 at the end of two years." If that is what we agreed, he said yes, so we both signed the letter. This was a mutual agreement.

Then we would turn this over to a lawyer to write up an agreement, and the property owner would then say, "Well, you know, I believe that this agreement should say a $50,000 down payment, and I believe the agreement should say a 4 percent net smelter return royalty."

The lawyer and we would say, "Well, gosh, Pablo, you signed this other thing."

He would say, "Yes, but I talked to my brother-in-law and he said he didn't think that was really very fair. Take it or leave it. I'll have to have $50,000." This, in part, is related to Napoleonic law where to be valid it has to be written and recorded. No baloney about, "his word is his bond."

Hank Ewanchuk was unable to understand this and said, "Well, this guy is a goddamn crook, and I sure don't want to be any part of dealing with him. What do I tell the shareholders?" But in Rome, do as the Romans do. You have to understand the philosophy of the people. Your letter of agreement is worthless.

I mentioned the story about the lawyer who took a bribe in order to give our property to Andronico Luksic. When I talked to the other Chilean lawyers, they said, "Boy, he's really a crook. We'll agree to that. But there's no question of disbarring him or having him charged with a crime." That maybe in a nutshell is--

And Catherine really did a marvelous job after she took over, in various areas. The operations in Peru were entirely under my management, but she did most of the corporate part: the communication with shareholders and prospective shareholders, and negotiation with underwriting companies for financing, and filing reports with the securities commissions, and going on road shows to visit prospective investors, and attending trade shows. She probably talked to on the order of hundreds of financial institutions. Our shares in Arequipa Resources were held mostly by institutions--things like retirement funds and banks and mutual funds--and the percent owned by individuals was relatively small.

[I remember on one occasion Katie and I were in England together talking to several institutions, one with Harry Oppenheimer who headed a large mining empire which included the De Beers diamond group. We met him in his paneled office and he had a lunch brought in, but I gave a talk about Arequipa and was too tense to enjoy the lunch. One of his engineers had visited Pierina and Mr. Oppenheimer offered to invest $10 million, but we decided that it would be awkward to have a major as a relatively small minority partner and we declined. Oppenheimer invited us to visit the De Beers diamond display in the same building. We were shown the diamonds by an elegant English gentleman with no sign of security (although there must have been elaborate measures). In the display were hundreds of millions of dollars of diamonds including the largest in the world of some classes and colors, mostly loose so that they could be handled. The manager passed Katie a cupful of large cut stones and she let them dribble through her fingers into a plate, and I watched closely to be sure they all ended up on the plate!][2]

Katie was also very helpful in negotiating agreements, joint venture agreements, with major companies, of which we had a total of at least half a dozen or ten. So that's how the corporate part worked. I attended meetings, but I really didn't throw my weight around very much in the corporate part until really the last week of the story, which--I'll get there in a minute.

Informing Prospective Investors

Lowell: But our policy in regard to Pierina was that we probably would not end up developing the mine ourselves; we would end up as a partner in development by a major company or would sell the deposit or

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[2]This paragraph was inserted by Mr. Lowell during the editing process.

sell the company to a major company. And so, for that reason, before we started to drill we invited everybody that was interested to visit the prospect. There were a total of something like forty mining companies that sent groups to look at it, and the reason for this was that by this time it was pretty obvious that it was going to be an important gold mine. We had good surface information, and we had a third dimension represented by these adits, which were going back into the mountain. It was an ideal spot for someone to look at because they could go collect their own samples in the pits and collect their own samples in the adits. When we began drilling we stopped the visits to the project because of the insider information problem.

So by the time nine holes were completed, we weren't allowing companies to visit the drilling operation, but we were announcing the drill results as they came in, which excited the prospective investors, and the price of the stock went up to--it had been about a dollar a share, and it went up to over thirty dollars a share at the time nine holes were completed.

Swent: Which exchange was it on?

Lowell: It was on the Toronto exchange. It had originally been the Vancouver exchange, and it was listed later on the Toronto exchange, which is a more conservative and prestigious exchange.

At that point, with nine holes completed, we had an annual meeting, and the share price was something like thirty-two dollars. I gave a talk about the results of the exploration. I had insisted that we be conservative in all of our announcements. My talk was a fifteen-minute talk, and it was relatively conservative. There were a number of brokers in the audience, and I noticed that they started getting up and leaving--

Swent: Where did you give this talk?

Lowell: In Vancouver, in--I don't remember the location. It was a rented hall somewhere. Shortly afterwards--shortly being fifteen minutes or half an hour--Catherine told me that she had heard that our stock had dropped from thirty-two dollars to fifteen dollars [chuckles]. I had expected that it would go up because it was good news, but it was good news presented in a reasonably conservative way, and the Canadian stock fraternity assumed that everybody was going to lie and exaggerate [laughs].

Swent: And they discounted what you were saying.

Lowell: Yes. But the other thing that happened at that point that was even more dramatic was that part of the time I traveled with

Catherine on these road shows, and we went together at various times--I believe twice to England and once to France, and we had shareholders from institutions in both countries that owned part of the stock. On this occasion we went to talk to a bunch of--I remember one was the Royal Bank in Toronto, who were one of our shareholders, and several mutual funds and brokerage houses.

These were really exhausting trips. We would have eight meetings in one day. I think we had some meetings the day before, and we had a breakfast meeting with one of these groups in the Prince Edward Hotel. I think we were both staying in the Prince Edward Hotel. We had this breakfast meeting, and before the meeting we got a call from Bill Bigger, who was a vice president in charge of finance for Barrick Gold Company. Barrick at that time was the largest gold producer in North America and I think the second or third largest in the world.

Bill Bigger asked if he could talk to us. We said, well, our schedule is completely filled up. He said, "How about breakfast?"

And we said, "We're having breakfast with so-and-so."

He said, "Where are you having breakfast?"

We said, "In the Prince Edward Hotel."

Swent: What city was this?

Lowell: In Toronto. He said, "Well, it won't take very long. Could we meet you in the lobby when you come out from breakfast?"

We said, "Yes." We thought that was a little bit funny.

It was Bill Bigger and Allen Hill. Allen Hill was the vice president in charge of development for Barrick. Bill Bigger, who is a little bit more suave than Allen, was kind of the spokesman. He said, "Well, could we sit down here in the lobby in a place that's a little bit private?" We sat down, and he said, "Well, I don't know exactly how to tell you this, but we have launched a hostile takeover for Arequipa Resources. We have offered to buy all the shares of Arequipa Resources for twenty-seven dollars Canadian per share."

Barrick Launches a "Hostile" Takeover

Lowell: And he said, "Peter Munk wanted me"--Peter Munk was the chairman and CEO of Barrick--"asked me to tell you that this is technically a hostile takeover, but we actually want it to be as friendly as possible." The success of their takeover depended on more than 50 percent of the shareholders accepting the offer. This immediately presented a huge problem for Catherine and myself because if we advised the shareholders to accept the offer and it turned out that the deposit was really worth forty dollars a share instead of twenty-seven, our shareholders could sue us for having been incompetent.

On the other hand, if we advised the shareholders not to accept twenty-seven dollars and that turned out to be a generous offer and it killed the deal, then they could sue us for incompetence in that direction [chuckles]. Since I was chairman, for the first time I was in the hot seat for the Canadian corporation. Bill Bigger said that Peter Munk, who was a legendary figure, had said that he would be happy to talk to us that morning.

We had the problem of whether to--we had our lawyer with us on the trip--to take the lawyer along. I've always been a little bit suspicious of lawyers, John Lacy excepted. I said, "I don't want a lawyer along. I want to make this an informal conversation." So we met with Peter Munk, and he brought in Bob Smith, who was president of Barrick at the time, and we discussed the Barrick offer. It was a very friendly, amicable conversation.

Peter Munk said, "The thing I admire most about you is your insisting that no lawyers be present." [laughs]

Deciding to Advise the Shareholders Not to Tender Their Shares

Swent: That was a good call.

Lowell: [chuckles] So we had a meeting of the directors, and our directors had been almost totally inactive in the company up to that point, although there were several people that had very responsible mining jobs. One of them was Tony Petrina, who had been CEO of Placer Dome Company, and Chet Idziszek was president of a substantial Canadian company, and so on.

We had an immediate telephone directors meeting, and then convened a meeting in Vancouver of everyone that could be present. There were seven directors altogether. Both Catherine and I were directors. We decided that we might squeeze more than twenty-seven dollars out of Barrick, and so we advised the shareholders-and there were newspaper articles and whatnot. A bunch of newspaper reporters in Toronto at the time that the offer was made talked to us. But we advised the shareholders not to accept the twenty-seven dollars, not to tender their shares to Barrick.

Then I launched an intensive drilling campaign to try to drill as many holes and develop as many tons of ore as possible before the time ran out for this hostile takeover. The time was prescribed by regulations in the Toronto Stock Exchange or the Ontario Securities Commission. I believe it was something like thirty-five days. We succeeded in completing forty holes before the deadline and almost all intersected ore. When the deadline neared, we had a directors meeting in Toronto.

We had hired the top merger corporate lawyer in Canada, and I think we had three or four law firms involved by this time. I had retained one of these expensive lawyers to represent me personally because of this liability issue. We had a directors meeting that lasted, oh, about four days. On one occasion we met for fourteen hours without eating anything [chuckles]. It was very stressful stuff.

At that point, I took over firmly as manager of the directors' activities because I had the legal liability myself. We were getting messages as to what various friends of friends had reported that the Barrick people were doing, and there were various little clues as to whether they might increase their offer or not increase it. And we were receiving counter-offers from other major companies.

Placer Dome Nearly Gets in the Act

Swent: That's what I was going to ask. Weren't there other companies getting in the act?

Lowell: Well, there were a total, I think, of six that had made proposals of various sorts. The biggest perceived threat to Barrick was Placer Dome, whose head office is in Vancouver. In the middle of one of these sessions, our chief guru--whose name, I believe, was David Jackson, a lawyer in Toronto, kind of an elderly, white-haired, overbearing [chuckles] sort of guy, but very smart--said--

right in the middle of a sentence he said, "I think we should all go right now to Vancouver and continue the meeting there, and Barrick will think that Placer Dome is about to close a deal with us."

This was a little bit true, but it wasn't [chuckles]--

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Lowell: We had decided on the spur of the moment to move our directors meetings from Toronto to--we were meeting in one of the law offices in Toronto--to our little company office in Vancouver. We checked airline schedules and rushed to our hotels and grabbed our suitcases and checked out of the hotels and all--it's a fairly long trip to Vancouver. We flew to Vancouver and got started again with the meeting in our office.

In the meantime, we were getting under-the-counter communiques from the Placer Dome office. Placer Dome had called a spur-of-the-moment meeting of directors that week because of this Pierina deal. One of their directors had come all the way from Australia, and some had come from the United States, and they were having their meeting. We got under-the-counter reports from somebody in Placer's office about who had arrived and what the rumor was that they were doing [laughs].

David Jackson said, "I predict that Barrick will show up here tomorrow."

I thought, well, this is taking a lot for granted to think that will happen. We started our meeting early in the morning. We were really kind of frantic. We didn't know what was going to be the best thing to do. I got a phone call at about seven o'clock in the morning, and it was a kind of a slightly garbled voice on the call, and it said, "Hello, David? This is Bob Smith." [president of Barrick]

I said, "Hello, Bob, where are you?"

He said, "Well, I'm on our corporate jet [chuckles], and we're going to arrive in Vancouver in forty-five minutes." They had left in the middle of the night and had flown to Vancouver.

So then we had another meeting, and--

Consummating a Billion-Dollar Deal

Swent: Placer had not come up with a counter-offer?

Lowell: Well, they were agonizing about that.

Swent: You had not heard from them.

Lowell: But we had not heard from them. Bob Smith--we had a meeting then. I think it was in the hotel. Yes, it was in their hotel, where they checked in. The meeting was just between Bob Smith and Catherine and myself. We talked for a couple of hours, and he offered to raise the offer to thirty dollars from twenty-seven. Catherine and I had a little huddle, and I said, "Okay." [chuckles] The thirty dollars translated into one billion dollars Canadian, or a little over a billion dollars. Bob Smith, when we shook hands and left, said, "Well, Catherine, thanks a million." And she said, "No, Bob, thanks a billion." [laughs] That was kind of the end of the Arequipa story.

Swent: You decided then to recommend it to your stockholders?

Lowell: Yes, and they signed up just about 100 percent. I have later done some consulting work for Barrick and have had two trips to Pierina in a Barrick jet, sort of progress visits.

Swent: Excuse me. Did this force you out, then, as a stockholder, too?

Lowell: Yes, yes.

Swent: There was no--it didn't allow you to continue.

Lowell: No, no. I was some kind of a director for a couple of months, but I was forced out and have participated a little bit but in a very minor way, in the planning of their work in Peru. I think they've done a very good job. The mine is going to go into production very soon. The first gold will be poured in November or December of this year (1998), which is some kind of a record for speed in a large mine of this sort. The production costs of the gold will be maybe the lowest of any large gold mine in the world. It's going to cost less than fifty dollars an ounce to produce the gold. The total reserves are about eight million ounces. Barrick calculated that their purchase price would result in a break-even operation at three and a half a million ounces, so it has turned out to be very profitable for them.

Swent: And none of your stockholders came back to you with a complaint.

Lowell: No, nobody complained.

Swent: All happy.

Lowell: And everybody lived happily ever after [chuckles].

Swent: A win-win situation. This, of course, is why you received the award--or one of the reasons that you received the award from the university.

Lowell: Yes, right.

Swent: It must have been pretty exciting.

Lowell: Oh, it was very exciting, that week in Toronto--that was one of the worst weeks in my life.

Swent: I'm sure.

Lowell: Continuous directors meetings.

Swent: Had Barrick been one of the companies that you would have liked to have seen take it over?

Lowell: Yes, yes.

Swent: They had visited the property. Had you discussed this with your directors or with Catherine which company you would like eventually to sell to?

Lowell: No, we hadn't.

Swent: You hadn't targeted anybody.

Lowell: No. Well, we were negotiating with several companies. Each company had a different sort of an offer. This was the only cash-on-the-barrelhead buyout that we had considered. I had, years before, given part of my Acuarios stock to my three children, so I had a lawyer's advice on how this should be done.

Swent: So your participation was through Acuarios.

Lowell: It was originally through Acuarios and then through Arequipa, but by their getting the stock early, it was very advantageous tax-wise. They had to pay capital gains tax on the proceeds, but otherwise we would have had to pay twice as much tax.

Swent: Why does--well, I guess it's kind of irrelevant--I'm trying to think why Barrick did what they did. I assume it might have been

easier for you if they had just offered to merge or to buy the company, instead of going through this hostile takeover.

Lowell: Yes. I think from our point of view it turned out very well. It was great good luck. This was at a euphoric period in Canadian mining. There were three companies that were getting lots of publicity at that time: Pierina and Voisey Bay, which was a base metal deposit in Newfoundland, and Bre-X--

Swent: [chuckles]

Lowell: Bre-X later turned out to be a scam. This is a little side note in the story, but after the sale was consummated, Barrick was one of the companies that was trying to make a deal with Bre-X on this imaginary huge gold deposit in Indonesia. Barrick asked us to write a letter to David Walsh, who was the president of Bre-X, telling Mr. Walsh what a pleasant experience it has been dealing with Barrick, to try to help Barrick in making the deal. We passed a draft of a letter back and forth by fax, and the last draft that I sent back to Catherine was typed out, and I wrote in pencil down at the bottom, "P.S., Mr. Walsh, is Bre-X a scam?" [chuckles] This was a joke between Catherine and myself, and it was before the scandal broke on Bre-X, but I had been suspicious from the sound of it that it might be a phony project, and I turned out to be exactly right [chuckles].

Swent: Yes, yes.

Lowell: But it wasn't of any particular interest to me. I had never considered buying stock, and I was never involved in it.

Swent: But had this offer not come from Barrick, you still would have been trying to sell or make some sort of merger or deal.

Lowell: Yes. And I would probably have opted to make a deal with somebody like Placer Dome or Newmont.

Swent: And allowed them to do the operations?

Lowell: Yes. We would probably have received stock in one of the major companies from somebody else, or a good part of the payment would have been in the form of stock, which also, in retrospect, would have turned out to be unlucky for us because all the mining company stocks have gone down since.

Swent: This way it was over and done with.

Lowell: Yes.

Aftermath of a Windfall Fortune

Swent: Right then. But you had to take a chance.

Lowell: I actually--we had an option to receive part of the payment in Barrick stock, and Barrick asked me to do that. They didn't demand that I do it, but they said it would be helpful to them if my particular ownership was in the form of cash plus Barrick shares because it would help--image-wise, would be a vote of confidence in Barrick. I did that, but I soon afterwards sold the Barrick shares, which also turned out to be a lucky break, because the gold stocks have gone way down, and Barrick is worth less now than it was then.

What do you say we break for lunch? [tape interruption]

Swent: We're continuing after a little lunch break here. You've had a few further thoughts about Barrick.

Lowell: Well, just a little postscript to the Arequipa story. Because of our finder's fee arrangement, the Arequipa Pierina discovery and the sale to Barrick resulted in quite a number of millionaires in our group. I think the total was something like seven or more people that worked in Arequipa ended the story with a windfall profit. One of them was Katie McLeod, the president of Arequipa in the last stage. She is a gal now about thirty-six or thirty-seven years old.

Swent: Oh, a young woman.

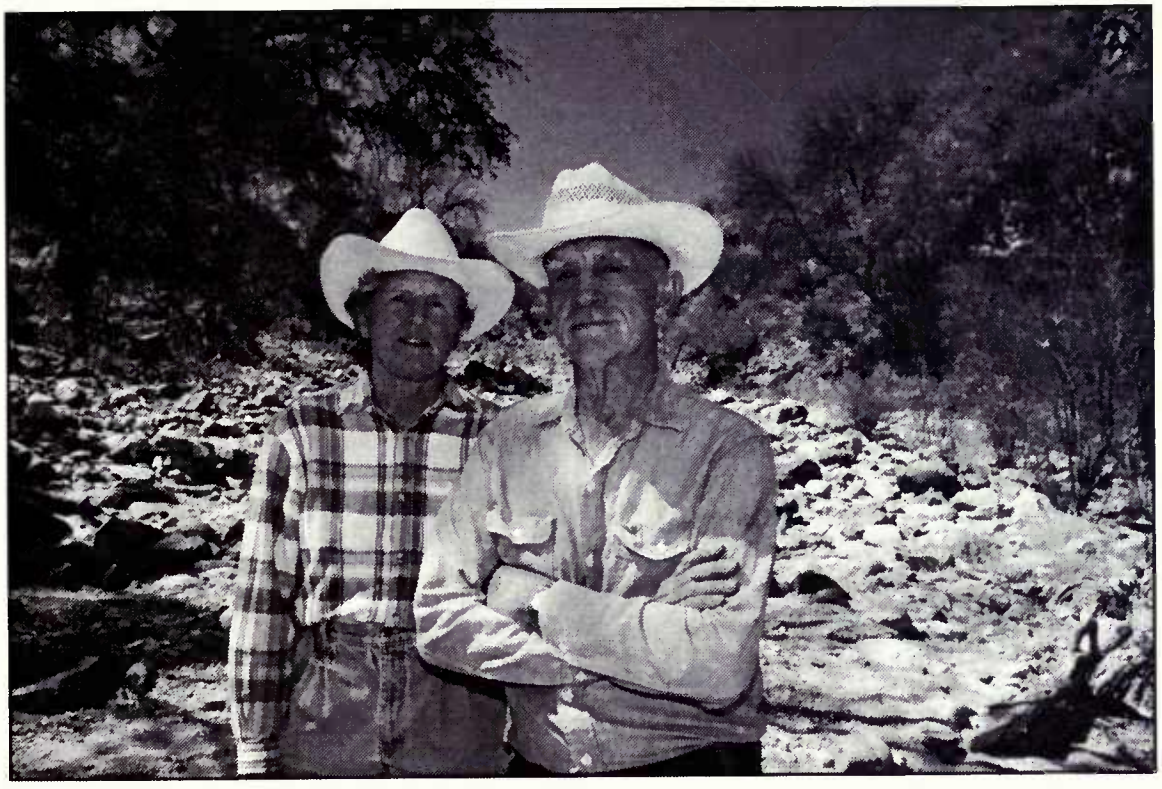
Lowell: She ended up with a big house on a golf course in Vancouver, and a very nice husband and a Labrador retriever pup. She has become director of a number of different Canadian companies and CEO of one. There was an article in *London Financial Post*, I believe, with the title, "Golden Girl."

Swent: Did she have the husband before she got so rich?

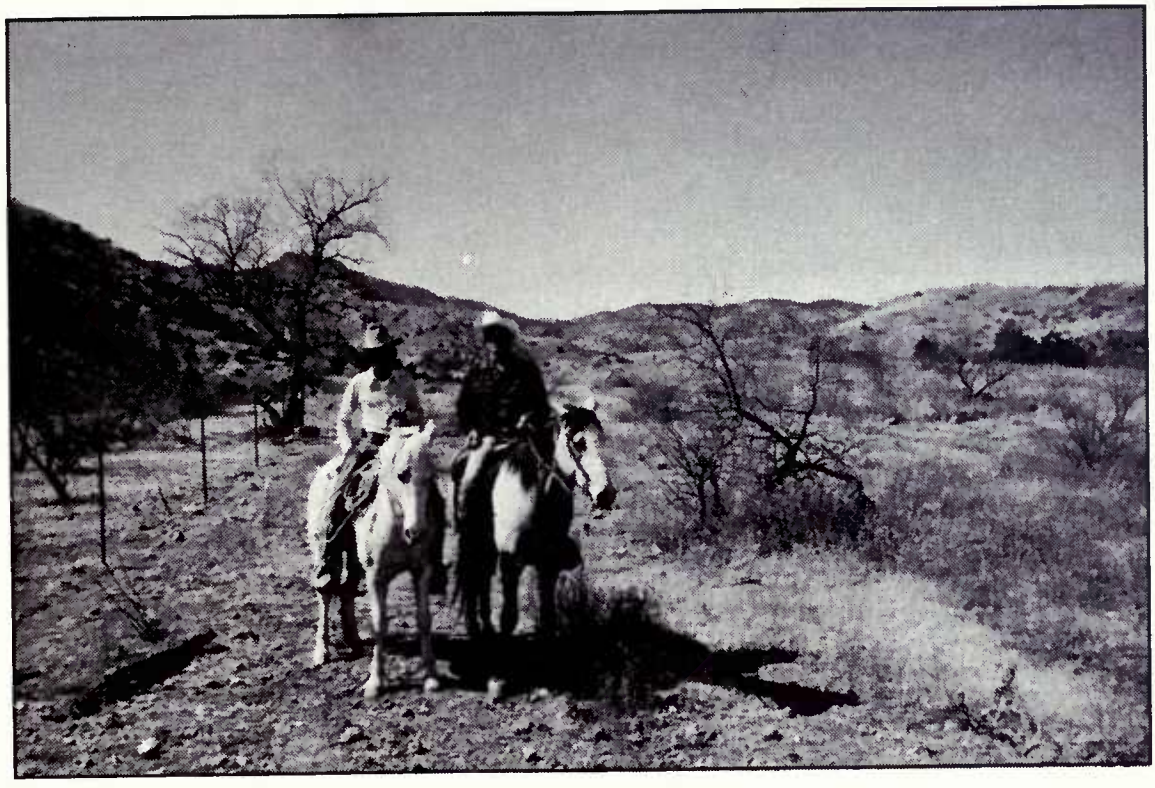
Lowell: No, they were friends before, but were married after the sale of Arequipa. So that's all I have to say about the adventure in Peru.

Swent: You got an awfully nice windfall from it, too.

Lowell: Well, I did. It actually didn't really change my standard of living or affect my life too much, but some aspects of it have been fun and some kind of worrisome, but it was an exciting experience.

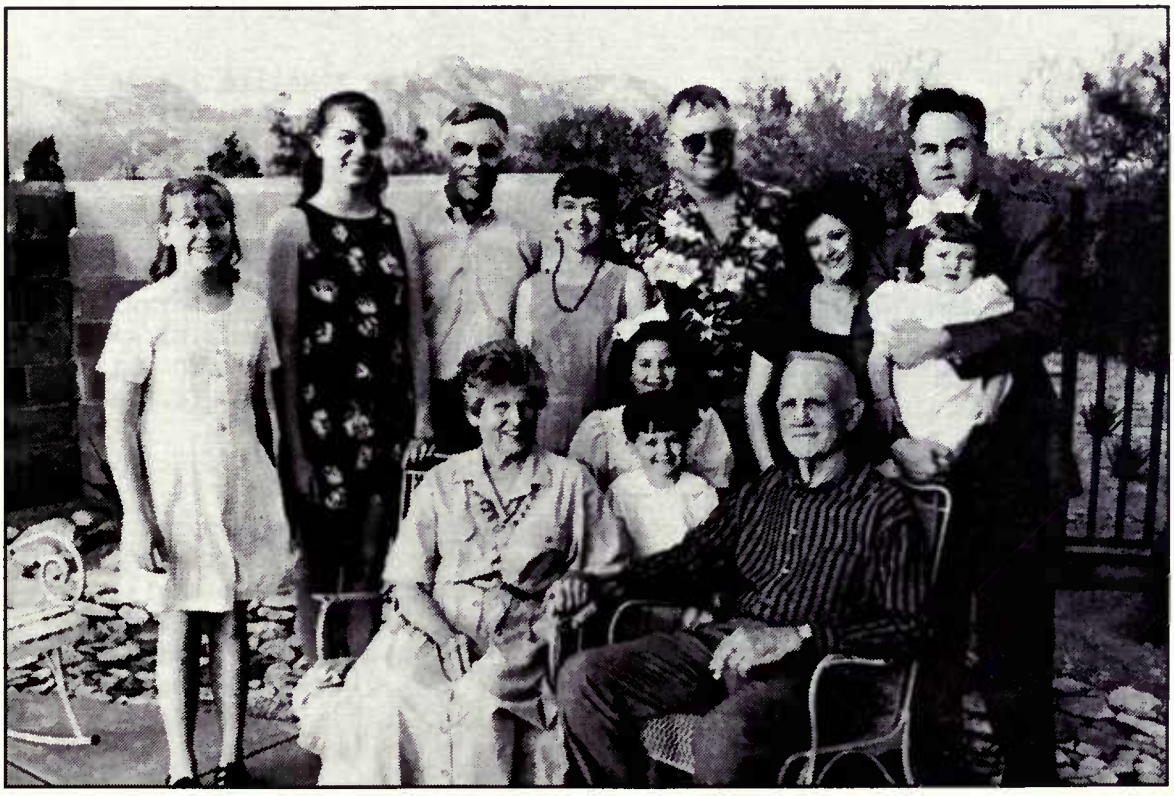


Edith and Dave, Atascosa Ranch, 1996.



Humberto Leal (ranch foreman) and David Lowell, Atascosa Ranch, about 1985.

Dave and Edith, Atascosa Ranch, 1983.



50th Wedding Anniversary, 1998. Top, from left: Mary, Anna, Ross, Susie, Marcella, Bill, Roxy, Doug, and Michelle. Bottom from left: Edith, Glenton, and Dave.

XIV INDEPENDENT PROJECTS, FAMILY, ATASCOSA RANCH

Strategic Alliance with Rio Tinto

Lowell: I, at the present time, have gone back to my habit of doing independent exploration projects. A good part of my work now is in a joint venture or strategic alliance type of joint projects with Rio Tinto, an English company, which is the largest mining company in the world, I guess. They own Kennecott Copper and U.S. Borax in the U.S. and various companies in other parts of the world. They're now a part owner in the Escondida deposit. They have a 35 percent interest in that.

Swent: Is this how you made your contact with them?

Lowell: No. My contact with them came through people that I know who are with Kennecott Copper or were with Kennecott Copper. The principal one of this group is Tom Patton, who was vice president in charge of exploration for Kennecott and later Rio Tinto's manager in South America. I have two projects underway in which Rio Tinto is contributing part of the financing. One is North America, mostly in Arizona and Sonora, Mexico, looking for porphyry copper deposits; and the other one is in northern Chile in South America, also looking for porphyry copper deposits.

Most of the people working for me in both places are long-time former employees. [Ernesto Egert is an old associate and friend who participated with me in the projects for Kennecott, Amax, and Niugini over a period of fourteen years. Ernesto has a degree from the University of Chile and an M.S. from Stanford University. He was a geologist with the Instituto de Investigaciones Geologicas and mapped several Chilean quadrangles and also taught in the University of Chile. When he left the Instituto he worked for multinational mining companies. He is a highly respected, very honest memeber of upper-class Chilean society, as is his wife, Valentina, and is one of the most

competent exploration geologists I have worked with anywhere in the world.

Maria Elena, Santiago office manager, has worked with me almost as long as Ernesto and is also both an associate and a friend. Everyone, without exception, likes Maria Elena. She is a member of a Chilean upper-class family that was ruined by the Allende government through expropriation of almost all of their property. She is a very intelligent person who has taught herself first to be a first-class secretary, and then to be an office manager, accountant, property expert, and highly skilled computer operator. Maria Elena is married to an attractive, successful husband, and has three promising children.

Lucho Rodriguez is a very nice guy who has the unlikely background of two years of theology in the university and then served as an officer in the Chilean army. He has also worked for me for more than ten years as a field assistant, expeditor, and drilling supervisor.

Sergio Bulganio has a two-year degree from a mining technical school at Copiapó, Chile. He is a competent, serious, industrious field geologist who has identified a couple of key outcrops in our current project. He has also worked more than five years in our group. Our project is blessed by a staff of four who are somewhere between very competent friends and close family members!][1]

These are projects that are sort of low-budget, low-profile, low-technology projects of the sort I've always done. We're optimistic that we'll find an ore body somewhere which might turn out to be sort of a swan song for me.

Swent: What sort of arrangement do you make with Rio Tinto?

Lowell: Well, the projects are 75 percent owned by Rio Tinto and 25 percent owned by me. During the first two years, they're supplying most of the finance, but I'm contributing part of it. If deposits are found, they would--if they meet their minimum size standards, which are huge--they would put the deposits in production, and I would be a small minority partner. If they don't meet the standards, the hypothetical discoveries will belong to me, and I would be free to do something else with them.

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[1]Bracketed section was inserted by Mr. Lowell during the editing process.

I might talk a bit about my family and general philosophy of life and so forth.

Exercising to Relieve Stress and Stay in Condition

Swent: Before you do that, just one little thing that--when I was having lunch just now with Marcia she told me that in the winter you and Edith and Marcia are accustomed to taking a walk after lunch to relieve your stress. [laughter] I thought you might want to mention how that came about. I think it's a very intelligent way to cope with stress.

Lowell: Well, it came about probably more by accident than by shrewd planning. But I have had an exercise program pretty continuously for maybe the last thirty or forty years. The main reasoning in my case is that my work is erratic. I may work in the office for two weeks continuously and then the following day be asked to climb a 14,000-foot-high mountain. It's a survival technique to try to stay in at least minimally good physical condition. Marcia is also an exercise person. I think it was she that got us started taking a walk at lunch hour. We walk about two miles. We have an exercise machine in the office and another one in our house for getting a little exercise now and then.

Swent: So you didn't just jump on the fitness bandwagon recently, then.

Lowell: No, no, I've been doing that for a long time.

Marriage and Family

Swent: That's wonderful. Well, let's hear some more about your family. You've mentioned their births, and that's really all that you've said about them.

Lowell: Well, as I mentioned before, I was married at an early age, twenty years old, when I was about to finish my third year of college.

Swent: You had quite an elaborate wedding, I gather from the picture.

Lowell: Well, it was a big church wedding. My theory is that big weddings are designed to preserve the marriage because the husband involved can't face the thought of having a second one.

Swent: [laughter] Where were you married?

Lowell: In Tucson.

Swent: In what church?

Lowell: It was an Episcopal church. I believe the name of it--it's now gone--but I think it was called St. Andrew's Episcopal Church. I've been an Episcopalian all my life, but I'm not much of a churchgoer. I average once or twice a year.

Edith[2]

Lowell: I met Edith in 1945 when I was about to enter the University of Arizona and she was beginning her sophomore year at the university. It would be hard to find two more different people. I was very shy, had been very poor, but was also a confirmed maverick ready, even eager, to go against the current. I was not socially confident, but enjoyed rough-and-tumble sports and hunting and had been in a few fist fights. I played on the University of Arizona varsity football team in 1945 and rode bulls in university rodeos, but was only a very marginal engineering student my first two years.

Edith, on the other hand, came from a polite, refined family which obeyed all the rules and didn't get in trouble and had had a secure income through the Depression. Her grandfather was Godfrey Sykes, F.R.G.S., and in addition to his long period of work for the Carnegie Institute, he wrote a very readable autobiography entitled A Westerly Trend, which was published by the Arizona Pioneers Historical Society. Her father was a second-generation English immigrant who had gone back to England for part of his education. He was in the British army in World War I and was city engineer of Tucson when I met Edith. Her mother was very well educated and had been a high school English teacher. Her grandfather had been a well-known geographer with the Carnegie Institute. They were proper Democrats, and I had been beaten up passing out Alf Landon buttons as a ten-year-old.

Edith, however, liked sports and earned her girls' athletic letter sweater at Arizona and always liked camping and field trips. She was also a very good student who was a Phi Beta Kappa

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[2]This section, entitled "Edith," was rewritten and expanded by Mr. Lowell during the editing process.

in her junior year, and a Phi Kappa Phi, and a member of every honor society in her course of study, and the girls campus honor societies. She had an anthropology major and geology and Spanish minors, and later returned to get a Spanish master's degree. She had an opportunity in Chile to write an archaeological article which was published in the United States about *tabletas de rape*, which are stone or wooden tablets or trays that were used in hallucinogenic drug ingesting in ancient times in South America, and her work proved that these were also being used in Mexico and Arizona a thousand years ago.

Anyway, opposites must attract because we were married while we were both still in school during Easter vacation, 1948. We had almost no money, but I had a summer job in 1948, and Edith got a job as secretary of the English Department to support us during the 1948-1949 school year before I graduated in 1949.

I have many times wondered what factors have fallen together which might explain the very good luck I have had professionally and in business ventures during my career. Near the top of the list must be Edith, who has been a balance wheel who has tried to brake some of my wildest schemes. Her perceptions regarding human relationships and feelings and reactions have been an indispensible asset in putting together staffs and negotiating deals and preventing arguments and disputes which has made my career possible. To say nothing of her child raising and the development of the children's sets of values and the family friendships which we have enjoyed. Her kindness and consideration towards me--and towards the family and all the rest of the world--has been a very large part of my life.

Daughter Susan

Lowell: Our oldest daughter was born when we were both very young, and as a result we have a granddaughter who is of college age this year and another one--

Swent: Let's get their names. We have Susan's name already, but what are the daughters' names?

Lowell: The daughter who is now in Princeton is Anna. Anna is a very impressive gal and was a National Merit finalist on the basis of grade average. I might just hop back to Susie, who was born October 27th, 1950, in Chihuahua City, Mexico. Susie has always been a very serious child, and she was kind of precocious. Learned to talk and read a little bit ahead of schedule. Through

her childhood she was very much an older sister with her brothers. Has been a very good student. She was valedictorian in her high school, National Merit scholar, and Presidential scholar. She's always been a little bit on the shy side, but had a summer job as a newspaper reporter--

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Lowell: For two years. She got a B.A. degree in English from Stanford and M.A. from Stanford in creative writing, and married Ross Humphreys, who was also a summer newspaper photographer at the same time she was with the newspaper. Susie went ahead to get a Ph.D. from Princeton University in English literature and taught English and creative writing at the University of Texas and then the University of Arizona. She has published--I'm not sure of the number, but I think seven or eight books, most of which are children's books, and they have been well received. She has won a total of five literary prizes. One of her children's books has been published in more than 700,000 copies.

Swent: Which one was that?

Lowell: That was *Three Little Javelinas*.

Granddaughters Anna and Mary

Lowell: She has two daughters. Oldest, Anna, who is in Princeton; and younger, Mary, is in junior high school. Her husband is a graduate of Wharton School of Finance. Was a McKenzie management consultant and now owns and operates a publishing company in Tucson.

Son Bill

Lowell: Our second son, Bill, was born April 18th, 1952, in Tucson. Bill has had a variety of dyslexia, which interferes a lot with his life. He did reasonably well through high school but struck out a couple of times in college. He learned to be a welder and diesel mechanic and worked with that for a long time. He most recently, as a result of shares of stock that he had in Arequipa, has returned to Tucson and is now taking some liberal arts classes in the University of Arizona. He has a pilot's license and a helicopter license and does a lot of flying.

Son Doug

Lowell: Our younger son, Doug, was born June 6, 1956, in Prescott, Arizona. Doug is another one that has been very precocious in terms of learning to walk and talk early. He's kind of a fast thinker, fast talking, always doing unexpected things. We had to take him to the emergency ward four times by age twelve, including once when he rode a motorcycle over a cliff.

Swent: Before he was twelve?

Lowell: Before he was twelve [chuckles]. He was invited by a motorcycle dealer to participate in motocross racing for the dealership. He's also the child that I probably have the closest relationship with of the three, although there are quite a few people that thought it might be a good idea to kill him between age six and twenty. But he was a National Merit finalist in high school, and when he graduated from the University of Arizona he was admitted to Harvard Medical School. He got an M.D. from Harvard and a certification in general surgery at Chase Presbyterian in Chicago and a cardiovascular certificate, University of Indiana. Spent a year doing pediatric heart surgery at Brompton Hospital in London. He's now practicing in Tucson and has been a success. Was a Tucson Physician of the Year. Currently has the best open-heart survival statistic in southern Arizona. He's married to the daughter of a friend of ours in Nogales who lives in Tucson. They have three daughters and a son, ranging in age from three months to ten years.

Swent: What is his wife's name?

Lowell: Doug's wife's name is Roxanne Chernin. Roxy was a cheerleader and prom queen. Has a master's degree and taught very successfully in junior high and managed a business. The kids' names are Marcella, Glenton, Michelle, and Paloma. Marcella is the oldest. The second one is Glenton, a boy. The third is Michelle. And the last, who is only a couple of months old, is Paloma.

Swent: A little girl, I presume.

Lowell: Yes. And they're all fun kids.

Swent: Oh, I'm sure. It's a lovely family.

Marcia Racine[3]

Lowell: Our Arizona secretary-office manager-exploration administrator-cow handler-accountant-notary-paralegal for the past thirteen years is Marcia, whom you have met. She is a very smart person, charming, a quick learner, and has a near photographic memory. Before moving to Arizona she worked nineteen years for a law firm where she became qualified as a paralegal and this has been useful here with the numerous mining contracts that we wrestle with. She also has become a competent self-taught bookkeeper-accountant, and working with Edith a competent computer operator and cattle computer records person. While we were living mostly in Chile, Marcia ran the Atascosa Ranch also. Her piece of the Arequipa Resources windfall has made her very well off. Her husband, Randy, is a retired public utility electrical foreman. I am not sure whether Marcia works for me or I work for her, and whether she is an employee or a member of the family, but it was a piece of good luck when we met her thirteen years ago.

A Pragmatic Philosophy of Mineral Exploration

Lowell: You mentioned saying a little bit about philosophy; I have always been interested in science but not much interested in pure science and really only interested in applied science. My modus operandi is to try to think of ways that scientific advances can be applied to practical mineral exploration, and I've had some success at that. But I've also had several--worked on several blind alleys, things that didn't work out. I've had a very pragmatic attitude, cost-benefit, regarding how to do exploration. I've been asked on five or six occasions to give talks at professional meetings about exploration philosophy and have written articles on this subject.

I started off, as I mentioned, as a mining engineer and worked at that for a couple of years, and later part-time as a mine manager. I've always felt that it was a big advantage to understand something about the production side of mining while looking for new mines. Mining is essentially based on economic principles and not scientific principles; ore is rock that can be mined at a profit. I think this has been a big advantage to me in exploration, and I've talked to other people with similar backgrounds who have the same feeling.

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[3]This section, entitled "Marcia Racine," was inserted by Mr. Lowell during the editing process.

I have also made a point of not following conventional dogma and trying new ideas and accepting risks and going against the current. I've always liked the poem: "He either fears his fate too much, or his deserts are small, who dares not put it to the touch, to gain or lose it all."

I've tried to be honest and ethical in my work. I've never been arrested or charged with a crime or sued in the course of my career. I have tried to operate on the basis of "do unto others as you wish them to do unto you." That has a kind of a particular application in mineral exploration because it's very much a dog-eat-dog business. My feeling is that a person should try hard and fight hard but remember the rules while you're fighting.

[There are obviously a long list of people who have contributed to my career, but three I will mention are Chuck Pillar, Alex Sutulov, and Nicolas Tschichow.

Chuck Pillar is a mining engineer from Rolla School of Mines in Missouri and is now about eighty-five years old. I first met Chuck when he was assistant manager of the San Manuel mine in Arizona. He was given most of the technical credit for developing the block caving system at San Manuel which was a pioneering effort. He later went on to work as a consultant in most of the block caving mines of the world and for a number of years was considered the world expert on block caving. In about 1970 he became vice president of operations for Placer Development Mining Co. in Vancouver (now Placer Dome). He hired me in 1970 on a several-years retainer to be Placer's geology consultant on mine operation problems and as a sort of supervisor for all of their resident geologists. When he retired from Placer he joined me for several years in a consulting firm we called Pillar, Lowell and Associates. Chuck is a very honest, determined, decisive person who has a genius for solving mine development problems. More than anyone I have known, he is able to separate the important parts of a problem from the unimportant and put his finger on a specific, often very simple, solution. It was very valuable in my professional development to work with and to observe Chuck Pillar's thinking and management skills.

Alexander Sutulov was the person who hired me as a consultant to work for Codelco and other Chilean government divisions in 1974 after the Allende group was thrown out. Alec was director of CIMM (Centro de Investigaciones Mineras y Metallurgias). His father had been a general in the Russian army who fled Russia when the Bolsheviks took over. Alec had degrees in metallurgy and emigrated from Europe to Chile, probably in the 1950s, and had had a successful career as a metallurgist and mineral economist, but had to leave Chile when Allende came into

office. Alec was hired as a metallurgy professor by the University of Utah from 1970 to 1973.

I became a close friend in Chile of the Sutulovs and used Alec as a sort of advisor and mentor. At the time of his death in about 1990 he had published over thirty books. He was an internationally famous mineral economist and probably the world expert on the refining and economics of molybdenum. He asked me to write a section in one of his books and he gave me advice and encouragement in various ways.

Nicolas Tschichow is a Russian immigrant to Chile who was born in Leningrad (St. Petersburg) about 1936. Both his father and mother were professors in the University of Leningrad and his father became an unwilling officer in the Russian army who was wounded in the siege of Stalingrad. In the shuffling of the German-Russian lines during the battle Nicolas and his mother and father were caught behind the German lines and then became displaced persons who progressively migrated across Europe, and at the end of the war immigrated to Chile. Nicolas (Nic) was something of a prodigy and obtained a chemistry degree in Chile and an M.S. in metallurgy in the U.S. He went to work for Codelco and was rapidly promoted. He had to flee from Chile when the communist government came in 1970 and he was given a job as a mill superintendent in the U.S. by Hecla Mining Company. When the Pinochet government came in, Nic was hired as general manager of the Chuquicamata Mine, then the largest mine in the world. He managed Chuquicamata for a number of years and was then manager of the Disputada Mine for Exxon.

I first met Nic when he was working for Codelco and we later became close friends and went on many trout fishing trips together in southern Chile. Nic is my closest friend in Chile.][4]

I can't think of anything else to add to that. Do you have some questions?

Swent: That's a wonderful summation, and you've surely proved that you can be successful and humane at the same time. There were a few more little detailed questions that I have. You didn't mention anything about going to China. Bob Shoemaker had spoken of the trip that you took with him to China, and maybe you took others.

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[4]Bracketed section was inserted by Mr. Lowell during the editing process.

Travels to China

Lowell: I've made two trips to China, and I'm currently called a special adviser for a company called Zen, which is trying to develop mines in China.

Swent: That doesn't sound very pragmatic [laughter].

Lowell: I'm fond of most of the Chinese people that I have met in China, but--

Swent: What was the occasion for your trips?

Lowell: Well, the first trip was a people-to-people sort of junket trip. I was talked into going because a couple of friends--one were going and asked me to go. One was Charles Meyer, who was at Berkeley.

Swent: He was on our original advisory committee for this oral history series.

Lowell: Well, that's interesting. Another was Harold Courtright.

Swent: He [Meyer] died too soon, unfortunately.

Lowell: Charlie Meyer was one of the handful of best porphyry copper geologists and also said to be a very good teacher.

Swent: So you went to China with Chuck and Virginia Meyer.

Lowell: Yes.

Swent: I see. And the Courtrights.

Lowell: I gave a number of talks in China, on that trip. We had a Chinese interpreter whose name was Mrs. Chin, who was a young lady who is a very bright, well-educated gal. She had been assigned the job of shoveling coal into a furnace during the Cultural Revolution and almost died as a result. Edith got sick during our trip, got something like pneumonia on our first trip to China, and she had to be dropped off at a hospital. They left Mrs. Chin with us to help out. She was in the hospital for two days, I think. First and last, we got very well acquainted with Mrs. Chin. She's written letters to us a number of times, and we get pictures of her little boy and Christmas cards and so on.

The second trip was for DuPont. I participated in that one, I think, as a result of Bob Shoemaker's suggestion. Bob Shoemaker

is a very well-known metallurgist who was president of American Institute of Mining Engineers, Society of Mining Engineers. Bob and I worked together for Bechtel on feasibility studies and have since had other projects in common. Bob was one of a couple of people that went over to China as metallurgical specialists. I wrote a paper called "Geology and Mining of Gold" for the symposium.

We had talks for two or three days in Chingdao and then went out and visited gold mines and plants and so forth. One of the DuPont people with me was a young fellow named Tom Kuo. Tom was a super-impressive American of Chinese ancestry and had a degree from Caltech and a degree from MIT and was a very charming fellow. He was grandson of one of Chiang Kai-Shek's generals in the civil war in China. He took us--took Edith and myself--over to see Chiang Kai-Shek's summer home, which was at Chingdao.

He still had relatives in China and relatives in Taiwan, and he was able to give us a very interesting insight into the evolution of the Chinese political situation and the relationship of offshore Chinese to people living in China.

Swent: When were these trips?

Lowell: Well, I don't remember. The first trip was probably about 1980 and the second trip about 1990.

Other Travels in Asia and the South Pacific

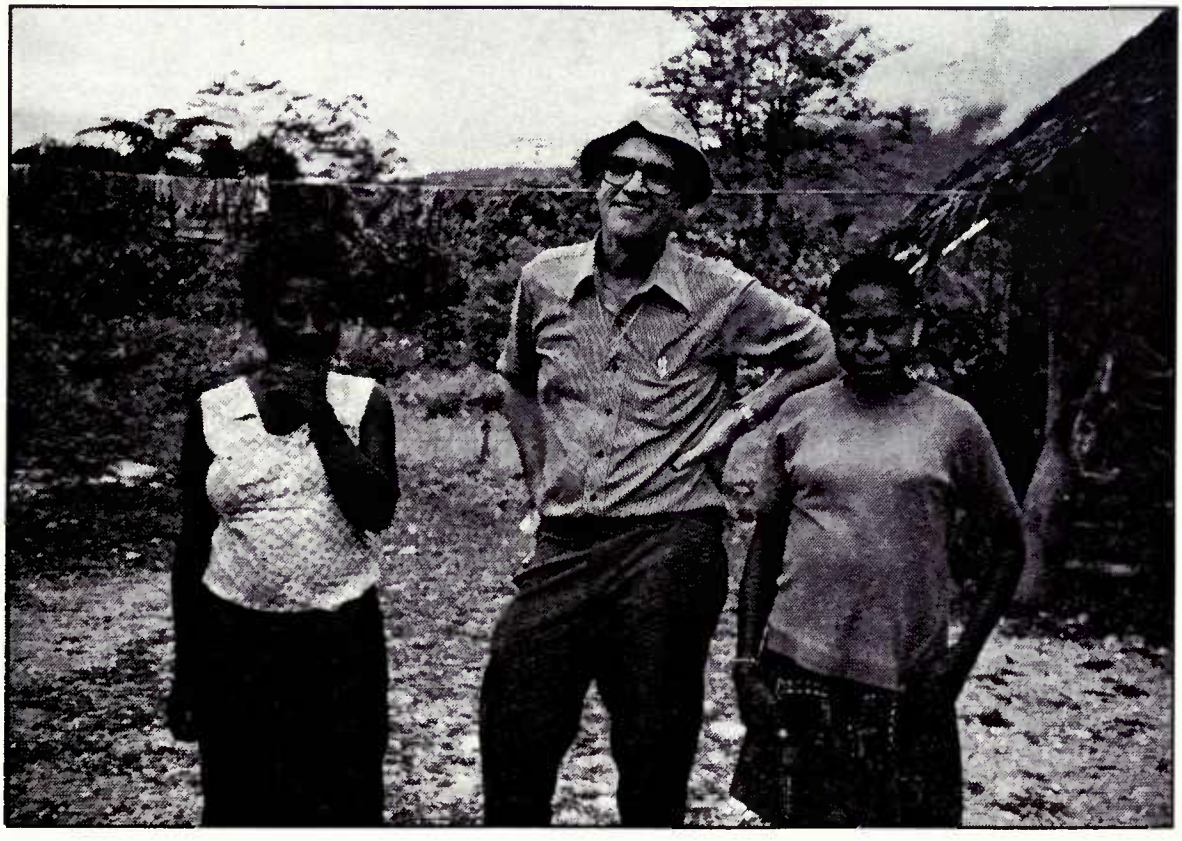
Lowell: I've also worked elsewhere around the Orient. I've made a couple of trips to Thailand and did a little work in Taiwan and worked in Fiji Island and Australia, and have been to Papua New Guinea a number of times and spent a few days at Bougainville during the construction phase of the Bougainville Copper Company.

Ok Tedi Mine

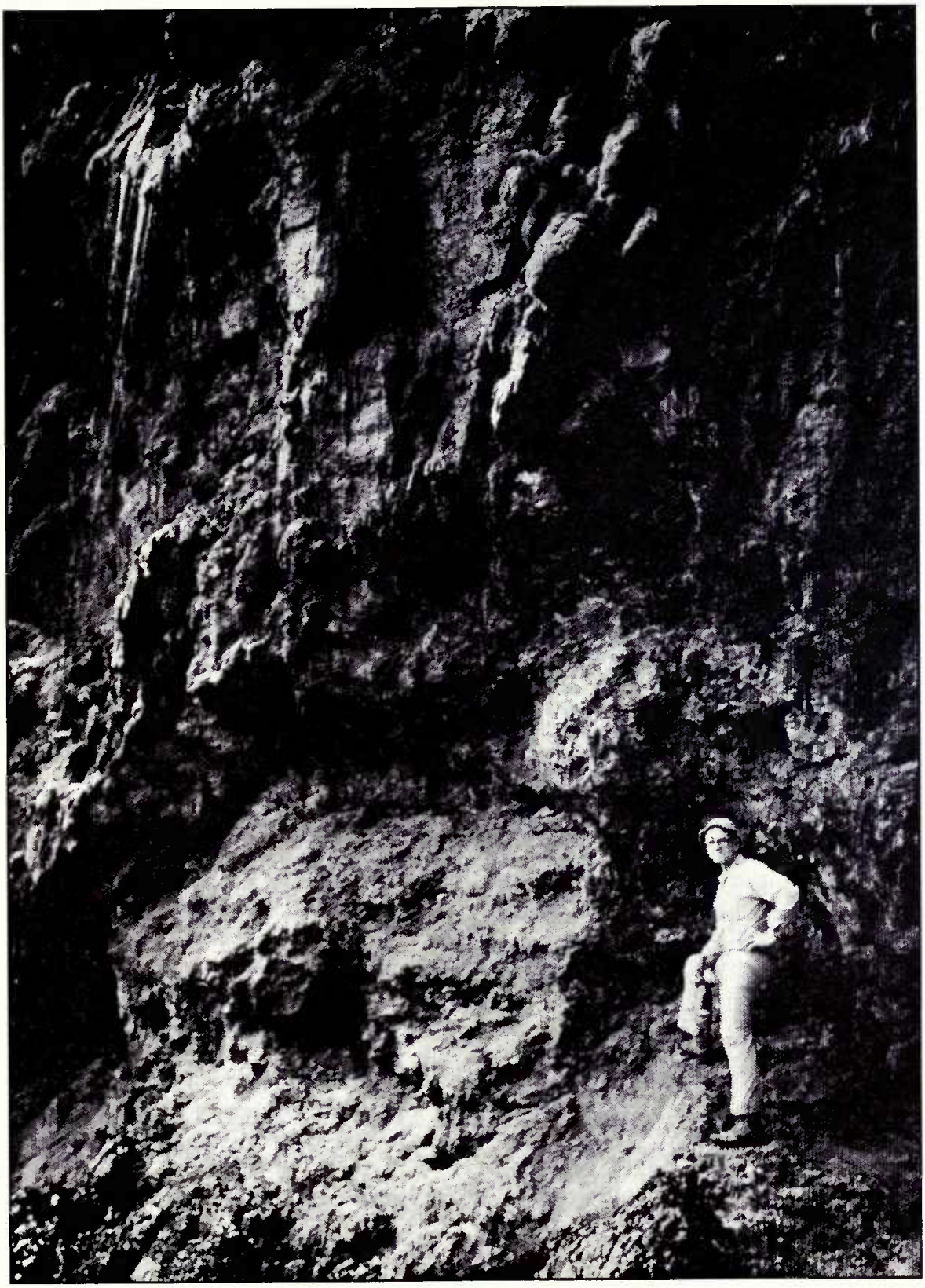
Swent: Do you want to say anything more about any of those things?

Lowell: Well, I worked twice at Ok Tedi before construction started at Ok Tedi. It's in the Star Mountains, central part of the island of New Guinea, and at that time was an extremely isolated location. It's on the Fly River, a huge river. Of course, that's not

Visit to Migilsimbip Village near Ok Tedi, Papua New Guinea, 1973.



David Lowell and Migilsimbip natives.



Ok Tedi, New Guinea, 1973: David Lowell on outcrop of the Gold Coast scarn orebody.

exactly true. It's near the Fly River. They were doing water monitoring, streams, as a preliminary to building a plant when I was there. It's a real jungle area. The year I was there, the rainfall was over 500 inches. It was the highest rainfall of any weather station in the world at that time. Traveling around was difficult. We moved around mostly by helicopter.

I became acquainted with the hydrologist who was checking weirs and creeks and so on, rain gauges. I had inquired if it would be possible to see any of the natives while I was there. The hydrologist invited me to go with him on a helicopter trip one day to visit the only native village that was near Ok Tedi. Papua New Guinea was not by any means densely populated. The jungle is a very unproductive place for human habitation, and there were only small villages, widely scattered, in that part of New Guinea.

The one we went to was called Migilsimbip. They had had their first view of white people something like eight years before. They were still probably practicing cannibals. Fairly unclothed as far as clothing goes, not totally naked but largely so. We took along an interpreter who was from that village, and who spoke pidgin English as well as local language. He showed us something that was called the boys' house. It's a place where boys are put to live when they're something like six or seven years old and they stay there until they become men and they're taught to be warriors and do all the things that they're supposed to do.

Another house was the only building that was painted. There were probably a total of fifteen buildings in this village. I asked the interpreter what that was, and he said, "That where we keep the bones of the people and the pigs." The pigs were a food source, but they were also considered sort of part of the population. We saw some women that had one elongated breast. The interpreter said that that was caused by suckling pigs.

Swent: Oh, my goodness!

Lowell: So they were pretty primitive stuff. In the boys' house there were some little packages tied up in leather on the wall, and spears and axes and stuff, and bows and arrows. I asked the interpreter what these little obviously sacred packages were, and he said, "Well, they're parts of the enemies." [laughs]

Swent: Oh, my. That was quite an experience. But they weren't any threat to you.

Lowell: No, no. In my various trips to--the only sort of threatening natives that I ever saw were on Bougainville Island, which is

politically part of New Guinea but is really a different culture. They looked like pretty mean customers, sort of glowered and threatening. I was with a Bechtel engineer, and there was a fellow going down the street with an umbrella in one hand and a bow and arrow in the other hand. I said, "Stop. I would like to take a picture of him." I thought it was kind of a humorous picture. He said, "Oh, I wouldn't advise you to do that." He said, "I tried to take a picture of a fellow with a bow and arrow once, and when I got the camera focused he had the arrow notched and was pointing it at me." [laughs] And later the same group rebelled against authorities and took over the mine, and CRA has never gotten the mine back.

Skin Diving in Truk Lagoon

Lowell: My principal hobby has been skin diving. In some of my commuting back and forth across the Pacific, I arranged to stop at Truk Lagoon. I was by myself, but I was able to hire a Trukese fellow who got us some tanks, and we dove for a couple of days on sunken Japanese ships. One of the interesting things he knew about was in the hull of a Japanese transport. We had a light and went back through stairways and passageways. There was a Japanese Zero airplane stacked in with gasoline barrels. I was able to climb with my tanks into the seat of the Zero [chuckles], ninety feet below the surface of the water.

Swent: That's quite an adventure.

Lowell: The Japanese had come back after the war and put up a shrine in that ship, part of the Shinto religion.

Frisco Mines ##

Swent: One more thing on my list was Frisco Mines.

Lowell: Frisco Mines is a medium-sized Mexican mining company. It is a company that some time ago asked for my help in a consulting capacity, and I've made a number of trips to Mexico and gotten well acquainted with some of the managers of Frisco. I guess for me the interesting thing about Frisco Mines is how good a job they do. There's a kind of a rule of thumb in the mining industry that the people who need consultation least are the ones that ask for it most. Frisco is a case in point. They know enough about their

problems to understand that it is cost-effective to find specialists and experts in various little problems to bring in to help solve the problems.

At the time I worked in Mexico, from 1949 to 1951, in general the level of capability of Mexican-educated mining engineers was significantly lower than American-educated mining engineers. But now, forty-five years later, I think that this is not as much the case. A number of Frisco engineers would be top-notch guys in most any mining organization, and their geologists also do a good job. Factors like the Frisco tons per man-shift in underground mines are very impressive.

Swent: Are these people who have received their training in the States or have been trained--

Lowell: No, they've been trained in Mexico. I think there may be one or two that have gone to graduate school in the U.S., but they're by and large Mexican-educated engineers.

Comparing Mexico and Chile

Swent: We're getting short of time, but you had said earlier--you said something rather disparaging about Mexican government and you thought the Chilean government was the best. In fact, you implied it might even be better than ours. You were kind of joking, I think [chuckles], but you might just say a little bit about comparing them.

Lowell: Well, I think a common misconception of Americans is if they've been to Juarez or Tijuana they think they know all there is to know about all of Latin America.

Swent: That's unfortunate, isn't it?

Lowell: I have worked in eight or ten Latin American countries, and my impression was that every one was, in general, very different from the others. Mexico is unique also. Part of the history of Mexico that I think influences its culture is its uncomfortable proximity to the United States. It's kind of a love-hate relationship. It's Americanized, which improves their level of efficiency, but the Mexicans remember clearly the two wars that they fought with the United States and lost.

I don't know whether that in itself has anything to do with the level of corruption, but I have never been in a country where

the frequency of asking for bribes is as high as in Mexico. On the other hand, the people tend to be artistic and hospitable and do a lot of singing and dancing and give better parties than anybody anywhere.

Chile is a totally different ballgame. Eighty percent of the Chilean population is of European ancestry, like the United States. The mix of countries of national origin is large in Chile, as in the United States. The principal countries of origin are Spain, England, Yugoslavia, Switzerland, the United States, Germany (there's a big German colony), and a lot of French people. Chile has had a selected immigration. Beginning a hundred and fifty years ago, they accepted people only who could demonstrate that they had a trade or were educated or had a profession or were landed immigrants that had money to begin a business. In that sense, Chile is different from almost all of the other Latin American countries. Chile is often compared with Argentina, but the immigration in Argentina was more selectively from Italy. That's not the case in Chile.

When we lived in Chile, we had season tickets to the opera. We're not real opera fans, but that was one of the entertainments available there that we had not had a chance to have in Arizona. In one of the operas we attended, there was a ceremony that commemorated the hundredth anniversary of the opera house in Santiago. It occurred to me that a hundred years ago in Arizona what people there were were living under trees or in trees [chuckles].

It's a very civilized country, and the quality of the public education is significantly better than in the U.S., and the general culture of the people--they're more courteous and polite and there are much stronger family ties, and they're more religious. At least during Mr. Pinochet's time as president, the level of crime was much lower than in the United States. Now it's about the same. When Pinochet was voted out of office and replaced by Aylwin, one of the Chileans made the remark to me that "we say we're having an attack of democracy." [chuckles] That's about right.

So what else would you like to--

Swent: That's very interesting and very good to have on the record, I think, that you had such a fine experience in Chile.

Lowell: I've frankly felt pretty comfortable in almost every country that I've worked in. The one notable exception is Nigeria in Africa.

A Negative Experience in Nigeria

Swent: You mentioned that you'd been to Nigeria. What were you doing there?

Lowell: I was there talking to the government about possible mining contracts. It became immediately apparent that I wasn't cut out to work in Nigeria [chuckles]. Left a few days later.

Swent: What made it so apparent?

Lowell: Oh, they were just frankly, unashamedly talking about dividing up the loot between government officials and various officials in the foreign company, and there were crimes being committed in all directions.

Swent: When was this?

Lowell: It was about eight or ten years ago.

Swent: Fairly recently. Lagos, you said?

Lowell: Yes. Awful place!

Swent: You were thinking of going in as an individual, independent?

Lowell: Yes. Well, with backing by a company.

Swent: I see.

Lowell: That's kind of the name of the game in exploration, is to find opportunities that have opened up in other parts of the world.

I worked twice, for a few weeks each time, in Iran. This was during the period of the Shah of Iran. I mistakenly thought that Iran was a very progressive, well-organized, peaceful country. But as soon as a religious fanatic element got control, it evidently changed a hundred and eighty degrees.

Swent: And now you've come full circle, right back to living a few miles from where you were born.

Lowell: That's right.

Swent: That's pretty wonderful. You have traveled all around the world and been everywhere and done everything, and you're right back where your roots are.

Lowell: Well, that's partly true and partly not true. In two days I'm leaving for Chile on a trip.

Swent: [chuckles] No, I don't mean that you have stopped at all. But you have remained--I think it's wonderful that you've been able to maintain your connections here so strongly with all of this traveling.

Lowell: It's kind of "Be it ever so humble, there's no place like home." [chuckles]

Collecting Mine Lamps

Swent: That's right. You haven't mentioned your lamp collection. We've been looking at it.

Lowell: Well, human beings are divided into two groups. There are lumpers and splitters, and there are junk collectors and junk thrower-outers [chuckles]. I'm firmly in the category of being a junk collector. I have a collection of mine lamps that come from Arizona and Nevada and Philippines and Peru and Chile, and I have a couple of oil lamps from Iran. It's a kind of a hit-or-miss collection. Probably half of my lamps are oil lamps, were originally whale oil lamps in the 1800s; and half are carbide lamps. Ignoring the very old Persian lamps, which probably weren't used in the mines, but the others range in age from maybe two hundred and fifty or three hundred years old to a few years old.

I have a carbide lamp from Chile. The small, independent miners are called *pirquineros* in Chile. I have a carbide lamp that was in use at the time I acquired it, made by a *pirquinero* out of two tin cans. A small-diameter tin can in the middle and a large-diameter upside down on the outside. The inner can has a small hole punched in it, and there's a hasp, a ring to hang the lamp. You put the carbide in the middle and the water outside, and there's a device on the top for adjusting the pressure between the two cans to regulate the flow of water. It works quite well [chuckles].

Swent: Very ingenious.

Lowell: I suppose I have a total of about, oh, thirty-five or forty lamps.

Swent: And a whole wall full of awards. We've mentioned most of those, I think, in the text, or you have them listed in your notes here. The lion. Did you--is that something you hunted? Mountain lion.

Atascosa Ranch

Lowell: Yes. That's a lion that I shot in a cave on our ranch. Mountain lions are relatively abundant. There are now more than there ever were because of less hunting. They're a significant economic problem in raising cattle. We had twenty-one calves killed by lions one year, and we probably averaged a few every year in the twenty-five years that we've had the ranch.

You want to hear a Wild West story about shooting the lion?

Swent: Do we have time?

Lowell: Yes, we do.

Swent: And we also didn't mention your acquiring the ranch. So tell about the lion first.

Lowell: Okay. This particular lion--a first cousin of mine, whose name is Douglas Cumming, owns the ranch immediately north of ours. For many years Doug had a pack of black and tan hounds that he used for hunting lions, which happened every time calves started being killed. I had been riding on our ranch--this all happened fifteen or twenty years ago--one day and came in. I got a call from Doug saying that he had wounded a lion that was in a cave up on a very rough part of his ranch, and asked me if I would like to go up with him, and we'd have to dispatch it after dark, probably.

When he thought he had shot the lion, he had had one or two of his dogs with him, who had cornered the lion. I guess the story was it was first in a tree and he had had a little .22 pistol in his saddlebag, and he had shot at the lion and thought he had hit it, and it jumped down from the tree and ran into a cave. He thought it might still be in the cave.

I was already tired, but I got another horse and rode with him. It was a two-hour ride, I guess, up to the place where the cave was. We had flashlights and we shined the lights in the cave and crawled in. There was a back door to the cave that he hadn't realized, and so the lion hadn't been cornered in the cave. It had run in one side and had sneaked out the other side. There was

no evidence that it had been shot, either. As it turned out, it had not been shot.

Doug, who was kind of an expert lion hunter, thought that it might still be around in the vicinity. This first cave was a slab of rock in a slope where a cliff had caved off some time in the past, and there were many large rocks, some of which had spaces underneath that made caves. So we had four or five lion hounds and one little terrier-beagle hound cross, whose name was Gypsy, who had come along for the expedition.

So we started looking under these other rocks, and they were spread over maybe two hundred yards and on a steep slope. It was hard to get up the slope. I carried Gypsy under my arm, and I had a .30-.30 rifle and a flashlight also. We had to boost the lion hounds up some of these little cliffs in order to get them up. Each rock we came to I inserted Gypsy's nose under the rock to watch for her reaction, and she didn't react until finally, some time later, we found a house-sized rock, and I was ahead of Doug, and I stuck Gypsy's head under the rock, and she cringed.

I called down to Doug and told him that. He said, "Well, that isn't necessarily a lion. It could be a bobcat or a javelina or a coatimundi." And he was going through this list. And then there was a noise that went "WRRRRAAOW." And he said, "But in this case it is a lion." [chuckles] By this time, it was getting dark. We looked under the rock. There were two openings under the rock. We shined our lights. Couldn't see the cat. There was a crack in the rock, and Doug got up on top with a lasso. Tied a rock to the end of it and banged it around.

I was at the second opening, kind of cowering behind a little six-inch-diameter oak tree. In case the lion ran out that way, I might get a shot at it. Doug was by the original hole, but the lion would growl when the rock banged around, but wouldn't come out. We did this for a couple of hours. The lion had killed a calf that day, and I finally decided to crawl in the hole and with my flashlight and rifle, I crawled in a ways and I could finally see part of the lion.

Lined the rifle and the flashlight up and shot it. There was lots of thrashing around, and I scooted out as fast as I could.

Swent: And this is the lion?

Lowell: This is the lion.

Swent: It's a beautiful pelt.

Lowell: By that time, it was pitch dark, and we skinned the lion with considerable difficulty. The slope was a steep slope. Then couldn't see anything to guide the horses, but the horses found their way back without--

Swent: Where did you shoot it? Because there's no sign of--

Lowell: Well, it was--the first bullet [moving to the animal] hit just about the tail and angled back this way.

Swent: It's in beautiful shape, isn't it?

Buying the Atascosa Ranch

Swent: You bought the ranch, you said, in '74?

Lowell: Seventy-five.

Swent: And it had been your uncle's ranch.

Lowell: Yes. An uncle of mine had been co-owner of the ranch back in the 1920s. This was an uncle who died before I was born. At the time of his death it had gone out of the family and had had a couple of different owners. We bought it back in 1975.

Swent: It must have been a great pleasure.

Lowell: Yes. We were optimistically thinking we were going to make a profit from raising cattle. We have a number of years, but cattle ranching has gotten less and less profitable with the increasing number of regulations and environmentalists and low beef price in the United States.

Swent: It's a wonderful place to live, though.

Lowell: Yes, that's the reason.

Swent: We're going to have to stop. I've had a wonderful time here taping these interviews. Thank you very much for sharing your recollections.

Lowell: Good.

Transcribed by Mim Eisenberg/WordCraft
Final Typed by Shannon Page

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ON THE ROOF OF THE WORLD.

A Santa Cruz Girl in the Heart of the Andes in Peru.

A letter has been received from Mrs. A. C. Lowell (nee Lavina Cumming) from Peru. After a journey of 43 days, which has taken her over the Andes, she finally reached her destination near the head waters of the Amazon. "Minas de Santo Domingo Carabaya." She writes:

The trip over the Andes was wonderfully beautiful and fearfully cold. When we reached the pass, a snow storm met us. Oh, the bitterness of that piercing cold! The air at 17,000 feet. So thin and penetrating. No amount of clothing seems any protection. The pass is indescribably beautiful. Snow covers everything except the two lakes below. One gleams green and the other blue. I wonder why.

Some of the peaks have snow banked against them in places 30 feet deep. Before reaching the pass we drove thru the ruins of an Inca village. Altho millions of acres of level land were near enough for them to use, they, in preference to using them, terraced off the mountainsides, as is done in China. I wondered at this until a Peruvian explained to me that plants growing on a hillside are in less danger of freezing than those in the open. I don't think I will ever tire of looking at these wonderful mountains. As Mrs. Adams says: "Peru may be likened to a tall, gray stone house, with a steep flight of steps leading up to the roof. From this bleak roof rises the highest chimney peaks of the Americas." But beyond this drab house lies nature's loveliest garden.

Within an hour after starting down the eastern side a difference is noted in the temperature. The trail winds around and around—always the last loop is hundreds of feet higher than that part of the trail on which one is standing. Sometimes the river is so far below that even its roaring can not be heard. At other points the trail drops so near to the river that one wonders if there are any trout in the deep pools so close.

are fast on the edge of it. However, we have bananas, pineapples, wild parrots, monkeys and boa constrictors. We are quite satisfied to enjoy these features of the jungle without seeking farther for me. No fevers here ever. This place was written up in the November, 1916, number of the Ladies' Home Journal. The article was entitled "Sliding Off the World's Roof." The naturalist, Mr. Watkins, is still here and a very active member of our little colony.

In some places the canyon narrows so that the trail crosses to the other side, and the intervening space is spanned by means of swinging bridges hung on cables. Some are only baby affairs like the bridge at the Big Trees, only none has railings, while others of the 14 are very long, and they sway like hammocks as one rides over (I sometimes walked). This (Aoualani) canyon is said to be one of the loveliest in the Americas. Every variety of tropical verdure is found here. Countless silvery water falls come tumbling down the mountainsides. Only a few of the most beautiful ones have names. Of these I think the Lagrimas de Marie (Tears of Mary) is the most beautiful.

Red, rose and white begonias are on every side, and, in places swaying from the banks over the trail, wild cosmos, great, gorgeous crimson lilies and countless flowers, trees, ferns and bushes, that I have never heard of before, much less know the names of. And the loveliest flowers of all are the orchids. I would like to watch the expression on Dr. Parker's face as he walked along one of our trails here in camp and discovered the real, rare ones. The first Sunday that we were here Arthur climbed down a very steep mountain side and chopped a clump of crimson beauties from a tree for me. I carefully planted my first orchid plants in a box and enjoyed them all evening. Next morning I placed the box out doors so that our daily shower would dampen the earth around them. Soon along comes Jerry Brinkman (a mule) and my crimson orchids were a memory!

Our rainfall is truly great. Last year it was 256 inches, or over 20 feet. This is the dry season, and it has rained every day since we have been here. G. Caesar! If this is the dry season I expect we will both be web footed before the wet season is over!

This is not the jungle proper. We

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1959 - E. Geol., University of Arizona

1961-Present: Consulting geologist 100 U. S. and foreign mining and engineering companies and governments. Consultant on geological, mine design, and grade control problems. Participated in 13 major feasibility studies. Managed contract exploration projects which discovered Kalamazoo and Casa Grande West orebodies in the U.S. and La Escondida, Zaldivar, and San Cristobal orebodies in Chile. Member of discovery teams for Vekol Hills, AZ; JA BC Canada; Dizon and FSE-Lepanto, Philippines; Leonor, Chile; Los Calatos & Pierina Peru. Director, IMDI S.A., operator San Cristobal 10,000 TPD gold mine in Chile. Former Chairman of the Board Arequipa Resources Ltd., Vancouver, Canada.

1959-1961:	District Geologist, Utah Construction Co., San Francisco and Tucson.
1956-1959:	Chief Geologist, Southwest Ventures, Tucson, Arizona, Mine Manager, Menlove Dalton Mine 1956-57.
1954-1956:	Graduate Student, Stanford University
1951-1954:	Geologist to District Geol., USAEC, Grand Junction, Colorado
1949-1951:	Engineer to Mine Foreman, Asarco, Santa Eulalia, Mexico
Memberships and Awards:	Member AIME; Society of Economic Geologists; Arizona Registered Geologist and Mining Engineer; 1970 AIME Daniel Jackling Award; 1972 Distinguished Citizen Award University of Arizona; 1974 Distinguished Lecturer Canadian Institute Mining and Metallurgy; 1975-80 Associate Editor Economic Geology; 1977 Thayer Lindsley Distinguished Lecturer Society of Econonic Geolgists: 1982 Society of Economic Geologists Medal for excellence in mineral exploration. 1994 American Mining Hall of Fame Medal of Merit recipient.

BIBLIOGRAPHY OF PUBLICATIONS, J. DAVID LOWELL

"Application of Cross Stratification Mapping to Problems of Uranium Exploration"; Economic Geology, 1954.

"Occurrence of Uranium in Sethlakai Dietreme"; American Journal of Science, 1956.

"Mineralized Breccia Pipes, Copper Basin, Arizona"; W.P. Johnston and J. David Lowell, Economic Geology, 1958.

"Highway Geologic Map of Arizona"; J. David Lowell, Chairman of Publication and Editorial Committee, Arizona Geological Society, 1967.

"Geology of the Kalamazoo Orebody"; Economic Geology, 1968, Vol. 63, pp 645-654.

"Potassic Alteration in Porphyry Copper Deposits"; J. M. Guilbert and J. David Lowell, GSA Annual Meeting Abstracts, 1968.

"Zoning in Porphyry Deposits"; GSA Annual Meeting Abstracts, 1969.

"Lateral and Vertical Alteration-Mineralization Zoning in Porphyry Ore Deposits"; J. David Lowell and J. M. Guilbert, Economic Geology, June-July 1970, Vol. 65, No. 4, pp 373-408.

"Copper Resources in 1970"; AIME Daniel Jackling Award Lecture published in Mining Engineering and in Transactions of AIME, 1970.

"Zonaición de Depositos Porfídicos"; J. M. Guilbert and J. David Lowell, Abstracts of Annual Meeting of the Mining and Metallurgical Society of Mexico, 1972.

Book Review: "Molybdenum Deposits of Japan"; Economic Geology, 1972.

Book Review: "A global Approach to Geology"; Economic Geology, 1973.

"Regional Characteristics of Porphyry Ore Deposits of the Southwest Province"; AIME Preprint, 1973.

"Variations in Zoning Patterns in Porphyry Ore Deposits"; J. M. Guilbert and J. David Lowell, CIM Bulletin, 1974.

"Regional Characteristics of Porphyry Copper Deposits of the Southwest"; Economic Geology, August, 1974, Vol. 69, No. 5, pp 601-617.

"Three New Porphyry Copper Mines for Chile?"; Mining Engineering, November, 1974, pp 22-28.

1974 CIMM Distinguished Lecture "the Unique Character of Porphyry Intrusions"; J. David Lowell.

"How the Kalamazoo Was Found"; J. David Lowell, Case Histories of Mineral Discoveries, Vol. 3, pp 29-32, Benchmarks in Geology, 1974.

"Geology and Economics of South American Porphyry CU Deposits"; World Mining, June, 1975, pp 32-37.

1975 University of Chile Short Course, "The Practical Aspects of Mineral Exploration"; J. David Lowell, University of Chile, Santiago, Chile.

"Strategy of Mineral Exploration"; Proceedings of N.S.F. Workshop, Pennsylvania State University, October, 1976.

"Trends and Techniques in Southwest Porphyry Exploration"; World Mining, October, 1976, pp 55-59.

"Land Availability and Governmental Controls as Related to Exploration of Specific Ore Systems"; Leo J. Miller and J. David Lowell, S.E.G. Meeting, Vancouver, April, 1977.

Book Review: "Proceedings of the First international Conference on the New Basement Tectonics", Economic Geology, May, 1977.

"The Porphyry Model"; chapter in Encyclopedia of Molybdenum, 1978.

1978 Soc. Of Econ. Geol. Thayer Lindsley Distinguished Lecture: "Structure and Alteration Setting of Porphyry Coppers".

"Metallogenesis and porphyry deposits of North America and the Pacific Region"; J. David Lowell, Proceedings of International Geological Congress, Paris, France, 1980.

"Geology of the Casa Grande West Porphyry Copper Deposit"; J. David Lowell, L. C. Arnold, S. Van Nort, John Stone & Robert Blair, Paper given at the Arizona Section AIME Meeting, 1981.

"Exploration for Basemetal Deposits"; AIME Surface Mining Volume, in press.

"Evolution of Geologic Techniques in Exploration", J. David Lowell, Paper at the Soc. Econ. Geol. Annual Meeting, March, 1985.

"Exploration of the La Escondida Porphyry Copper Deposit; Chile"; J. David Lowell, James A. Bratt, Francisco Ortiz, Nivaldo Rojas, Patrick Burns, Paper at the Soc. Econ. Geol. Annual Meeting, March, 1986.

"Chilean Ore Deposits and Mineral Belts"; Carlos Ruiz F. & J. David Lowell, Paper at Soc. Econ. Geol. Annual Meeting, March, 1986.

"El Yacimiento Aurifero San Cristobal"; J. David Lowell & Julia Aspillaga, Revista Mineria, Santiago, Chile, Nov., 1987.

1987 "Geology and Mining of Gold"; J. David Lowell, Preprint, China Gold Technology/NaCN Safety Seminar, Quingdao, China.

"Gold Mineralization in Porphyry Deposits"; J. David Lowell, Mining Engineering, 1989.

"The La Escondida Exploration Project"; p 263, Proceedings Vol. III, Pacific Rim Congress, 1990.

"Chilean Ore Deposits and Mineral Belts"; Carlos Ruiz Fuller & J. D. Lowell, p 275, Vol. III, Pacific rim Congress 1990.

"Discovery of the Escondida Orebody"; Economic Geology, Monographs 8, 1991, pp 300-313.

"Potential For New Giant Copper Porphyry Deposits in Peru"; J. David Lowell, Randol International Conference, October 30, 1993, Vancouver.

Keynote Address. "Comparitive Prospectivity in the Andes: Where are the New Discoveries?"; J. David Lowell, Investment Opportunities in the Andes Conference, Melbourne, Australia, August 1993.

"Foreign Mining Investment in Peru"; J. David Lowell, Investment Opportunities in the Andes Conference, Melbourne, Australia, August, 1993.

"The Richards and Courtright Era and Why Some Exploration Programs Are Successful"; J. David Lowell. Arizona Geological Society Digest 20. 1995, Porphyry Copper Deposits of the American Cordillera.

"Strategy In A Venture/Exploration Company"; J. David Lowell, Corporate Strategy in Mining 1997 Mineral Economics Symposium, Cordillera Roundup, Vancouver, B.C. Canada.

"The Low Tech, Low Budget, Exploration Approach"; J. David Lowell, Pathways '98, Vancouver, B.C., Canada, January, 1998.

The 1970 Jackling Award Lecture

J. DAVID LOWELL

Recipient of the 1970 D. C. Jackling Award

For his contributions to the field of mining geology, a striking example being his brilliant interpretation of the complex geologic history of the San Manuel District (Pinal County, Arizona) which resulted in the discovery of the Kalamazoo orebody, and for his lecture, "Copper Resources in 1970."

COPPER RESOURCES IN 1970

J. David Lowell

Consulting Geologist, Tucson, Arizona

On a low desert ridge six miles south of Cairo lie the remains of the world's earliest known mining town, Maadi of predynastic Egypt. Copper artifacts, including ingots and an ax head which was spoiled in casting, indicate that copper ore was smelted in Maadi, and radiocarbon dating has placed the activity at least as early as 3300 B.C. This is the oldest documented date for the use of smelted copper, the first industrial metal used by man.

Copper was mined and smelted almost as early in Asia Minor and on the island of Cyprus, but the greatest development of the budding copper industry was in Egypt, where specific historical records show that about 10,000 tons of copper metal were produced in the period from 1850-1580 B.C. Contrast this production of 35 tons per year with the present world production of about 7 million tpy.

Evolution of the Copper Industry

The copper ore mined by the ancients was high grade, and the copper produced was expensive. The copper industry began with narrow high-grade veins, but has evolved to the point where massive earth-moving equipment can be operated in huge, low-grade open pits. Indian pits dug before 3000 B.C. in the Lake Superior district were in ore which averaged 15% Cu. Historical research done by Arthur Brant has shown that copper cost in the Middle East in 1840 B.C. in terms of 1970 labor dollars was about $25 per lb. The copper mined in northern Europe in 1540 in the time of Georgius Agricola averaged about 8% Cu, and the cost in 1970 labor dollars was about $10 per lb. Average ore grade had dropped to about 6% Cu in 1890, and the cost of copper in the U.S. in 1970 dollars was about 45¢ per lb. Butte, Mont., was a good example of the efficiently operated vein mines of this time.

In 1906, Daniel Jackling made a dramatic entrance into the copper scene with the Bingham Canyon open-pit copper mine and proved that more profit was possible mining 2% porphyry copper ore on a

large scale than had been previously made mining 6% vein ore. By 1910, the cost in 1970 dollars had decreased to 31¢ per lb. Jackling was the Henry Ford of the copper industry. He reduced the pounds-per-ton number and increased the tons-per-day number and in so doing reduced the cost of copper. Jackling's important contribution was simply the realization that in a very large tonnage operation fixed unit costs would be reduced to a minimum. This simple concept increased the world's copper resources by several hundred percent and was an important step in the progressive evolution which had begun in 3300 B.C.

Rising Efficiency Offsets Declining Ore Grade

In 1945, average U.S. ore grade had dropped to 1.3% Cu, and cost in 1970 dollars was about 26¢ per lb. Open-pit mining efficiency had improved, and several of the porphyry copper deposits which had been originally developed as block-caving operations were being converted into open-pit mines.

In 1970, open-pit mining has evolved further by dint of huge rock-moving equipment and some automation, particularly in copper concentrators. Now, however, the swing away from bulk underground mining is being reversed, since increasing depth of exploration is revealing new porphyry copper deposits which are too deep to strip. Block-cave mining is being tentatively planned for three new deposits in Arizona, and others are certain to be found. Average U.S. grade is 0.65% Cu, and cost is about 32¢ per lb.

The impact of technology has been much less marked in the remaining vein-type copper deposits where it is not possible to apply bulk mining techniques, and as a result vein-type mines are becoming rare in areas of high labor cost. In 1936, over 500 underground mines, mostly narrow-vein, were in operation in Arizona, but in 1970 there are only about ten in operation.

Fig. 1, in which grade of ore and cost of copper in 1970 dollars are plotted against time, reflects the evolution of copper mining. The slope of the copper price curve deviates from the copper grade curve in 1932 and reverses its downward trend.

Occurrence of Copper in the Crust

The following are a series of large numbers intended to demonstrate that copper is a relatively abundant element in the earth's crust: in the first mile of depth there are approximately 3×10^{15} tons of copper metal, or about 500 million times the current annual world copper consumption. Obviously, the relatively concentrated portion of this copper is only a small fraction of the whole, constituting, say, 10^{10} tons concentrated in deposits with grades in excess of 0.25% Cu, of which approximately 4%, or 400 million tons, have been mined to date.

Of the relatively concentrated 10^{10} tons of copper, perhaps three billion tons are in the form of high-grade veins and replacements, three billion tons in widespread strata-bound and red-bed deposits, and four billion tons in disseminated deposits including porphyry copper, magnetic segregation and massive magnetite-copper deposits. The disseminated deposits are bulk low-grade deposits in which deposit dimensions are sufficiently large to allow the application of large, highly mechanized, highly efficient rock-moving equipment.

Known bulk low-grade orebodies include many porphyry coppers and relatively few magmatic segregation and magnetite-copper deposits.

Geology of Porphyry Copper Deposits

Porphyry copper deposits are large, low-grade, roughly equidimensional, disseminated deposits which contain chalcopyrite, pyrite and at least trace amounts of molybdenite, silver, and gold, and which sometimes contain chalcocite and bornite. The deposits tend to have either a vertical-cylindrical or flat disc shape and are hypogene, hydrothermal deposits always related to intrusive rocks including porphyry rock units. Mineralization can occur in either the host intrusive or wall rocks.

The copper grade of primary porphyry deposits is commonly less than 0.4% Cu, and with a few exceptions the grade is always less than 0.8% Cu, but these primary deposits also tend to have a vertical cylindrical shape which may have a large vertical dimension so that their overall tonnage is large. Exploration in the San Manuel-Kalamazoo and Bingham Canyon deposits has indicated that this vertical dimension can reach many thousands of feet, and it is probable that bulk underground mining will eventually be necessary in deposits such as Bingham Canyon and Morenci. The porphyry copper deposits in which secondary enrichment has taken place have variable enriched ore grades which often exceed 2% Cu, but these orebodies generally have a flat, blanket shape with a vertical dimension which is seldom over a few hundred feet. This usually results in ore tonnage of a lower order of magnitude than the tonnage in large primary-ore-grade deposits.

Climatic conditions and glaciation in Canada have not favored secondary enrichment, and most of the porphyries discovered in British Columbia are primary-ore-grade deposits. A recently discovered porphyry prospect, the Casino deposit in the Yukon Territory, is probably the first example of significant chalcocite enrichment in Canada. The primary deposits in British Columbia tend to be of marginal grade under present economics, but several have potentially large tonnages. Preliminary estimates suggest that British Columbia could have the greatest concentration of large-tonnage porphyry deposits of ore grade or potential ore grade found anywhere in the world. As copper consumption increases and marginal ore grade declines during the next 30 years, Canada will assume increasing importance as a source of copper.

Consideration Regarding Porphyry Copper Genesis

Ore deposit geologists have been trained to believe that hypogene ore deposits are found by correctly analyzing structural controls of ore deposition, but there is reason to believe that little or no direct control of mineralization is exerted by preore structures in many porphyries. The typical cylindrical orebody shape fits very poorly with the hypothesis that hydrothermal fluids migrated upward along a large-scale fissure.

In several districts, of which the Peru-Chile mineral belt is the best example, porphyries show a distinct tendency to be aligned in a narrow belt, but no distinct, continuous structure can be mapped between deposits along these linear trends, and it must be concluded that the apparent structural control is a second-derivative effect of a deep-seated, large-scale structure perhaps located in the lower part of the crust. This unseen linear feature controlled the positions of a series of intrusive bodies which in turn, by differentiation, may have expelled bubbles of mineralizing fluids which migrated to form cylinders of porphyry copper mineralization.

Porphyry copper deposits seem to occur as individual deposits and clusters distributed along several large belts. The best known of these forms a narrow but rather continuous string of porphyry occurrences extending for at least 1500 miles north from central Chile. Widely separated occurrences are found along the further projection of the belt into northern South America and Central America. The occurrences increase in density along the west coast of Mexico and finally form an oval-shaped cluster of deposits in northern Sonora, southern Arizona and southwestern New Mexico. The trend can be traced northward by occurrences in northern Arizona, Utah, Nevada, Idaho, Montana and Washington, and on into British Columbia where another roughly oval cluster occurs. From there it projects northward

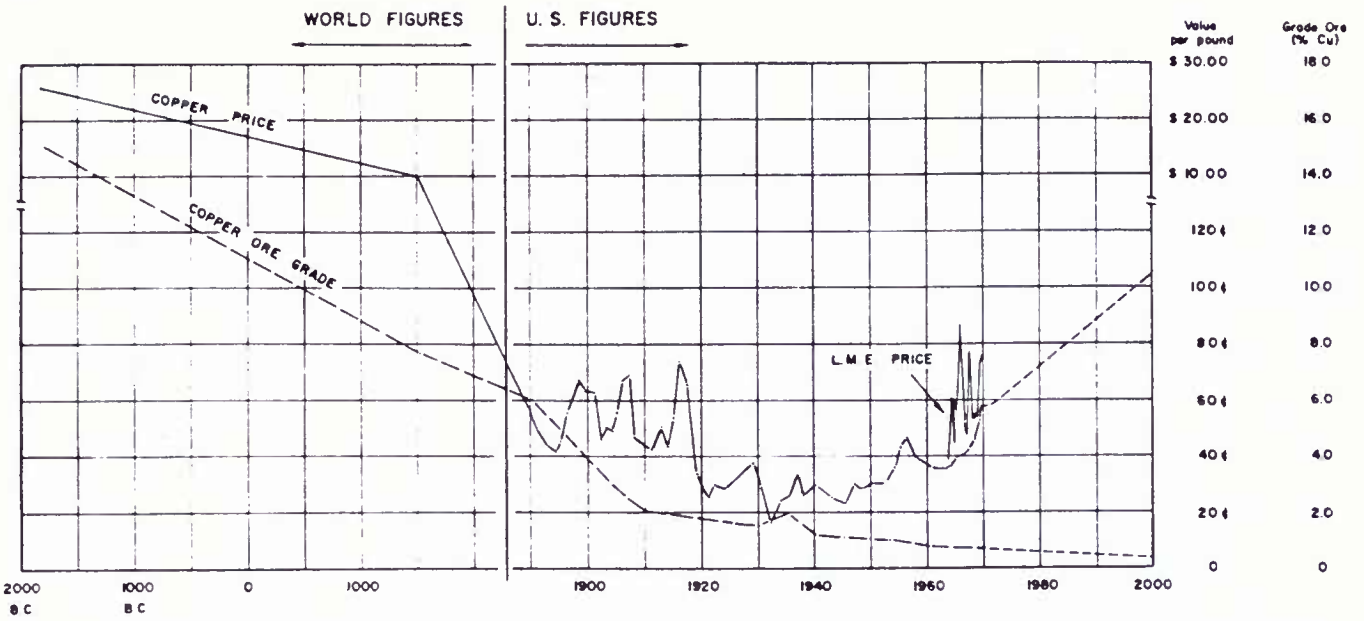

Fig. 1—Average grade of copper mined and price of copper in 1970 dollars. For over 5000 years, copper prices and ore grades drifted downward together, but in 1932, the price trend turned up while grades continued down. The divergence is regarded as permanent. Note that grade is expected to decline to 0.25% Cu by the year 2000 A.D.

with scattered occurrences into the Yukon Territory and Alaska. A similar but less-well-known linear trend of porphyry copper occurrences apparently extends along the Pacific "ring of fire" in a southeasterly arc from the Philippines through New Guinea and the Solomon Islands. There is probably another belt present in the Near East which passes through Iran, where recent exploration indicates another possible cluster of porphyry occurrences, including large copper orebodies. Distribution of porphyry-type occurrences in the USSR suggests a belt or cluster of porphyries in that area also.

Copper deposits of probable porphyry copper affinity are either known or in production in southern Europe and Turkey. It is interesting to note that most porphyry copper belts occur on the western margins of continents, a fact which may relate to current theories regarding continental drift and ocean-floor spreading.

Size Makes the Big Difference

Perhaps the most distinctive difference between porphyry copper deposits and other metal deposits is the huge size of the porphyries, where mineralization can sometimes be measured in cubic miles of rock. Their typical dimensions more nearly match those of a stock rather than the dimensions of a vein or replacement orebody. The geologist examining a large porphyry deposit is in the position of an ant examining the surface of an elephant, and it is often difficult for him to see the problem in proper prospective.

History of Porphyry Development

The first group of porphyry copper deposits were brought into production in the 1905-1915 period in Utah, Arizona, New Mexico, Nevada, Mexico and Chile. Most of the orebodies had been long known, but only as geologic curiosities. What could one do with several million tons of 2% Cu ore in 1900? Exploration consisted of mapping and sampling, and the technique of leach capping interpretation developed during this period by Augustus Locke and Roland Blanchard and others proved to be particularly effective in evaluating chalcocite blanket deposits. Others who made significant contributions included Daniel Jackling, Ira Joralemon, Robert Gemmell, William Braden, J. Parke Channing and James Douglas. These original porphyry copper operations which began 60 years ago have all remained in production.

Relatively few other porphyries were brought in until after 1940, when a new generation of deposits was developed under the stimulation of World War II and the high post-war copper consumption. These orebodies were located in Arizona, Peru and Chile, and most discoveries resulted from careful geologic mapping by men such as Harrison Schmitt, Kenyon Richard, Harold Courtright, Bill Swayne and B.S. Butler.

In recent years porphyry copper deposits have been put into production in Arizona, Nevada, Chile, British Columbia and the Philippines. Other new deposits have been discovered but not yet developed in some of these areas and in Peru, the Solomon Islands, Iran, Puerto Rico, and Mexico. Most discoveries during this period were made by teams of mining company exploration men, and a list of men who have participated in successful exploration would be long. A group organized by Kenyon Richard and Harold Courtright has been particularly successful in the Southwest and South America. Excellent basic and applied porphyry copper research has been accomplished by groups organized by C. H. Burgess and Paul Bailly, and by V. D. Perry. Two non-geologists who have contributed to porphyry copper discoveries are Allan Bowman and Spud Huestis. Most of the recent discoveries have resulted from geologic mapping and offset drilling of known mineralization, and this has been aided by geochemical and geophysical surveys. Discovery of the Pima orebody was a direct result of geophysical work.

Exploration for Porphyry Coppers

The trend since 3300 B.C. has been toward larger, lower-grade deposits, and there is every reason to assume that this trend will continue for the coming 30 years. In addition to mining efficiency considerations, such deposits will tend to be exploited not only because they can be mined more efficiently, but also because they will be easier to find. It will obviously be cheaper and easier to locate, at deep drilling depths, a disseminated orebody with an area of one square mile than to locate a high-grade orebody with an area of one-tenth square mile.

Geophysics has been a successful tool in exploration for several types of ore deposits, but to date its value has been limited in the porphyry copper search. Porphyry copper ore

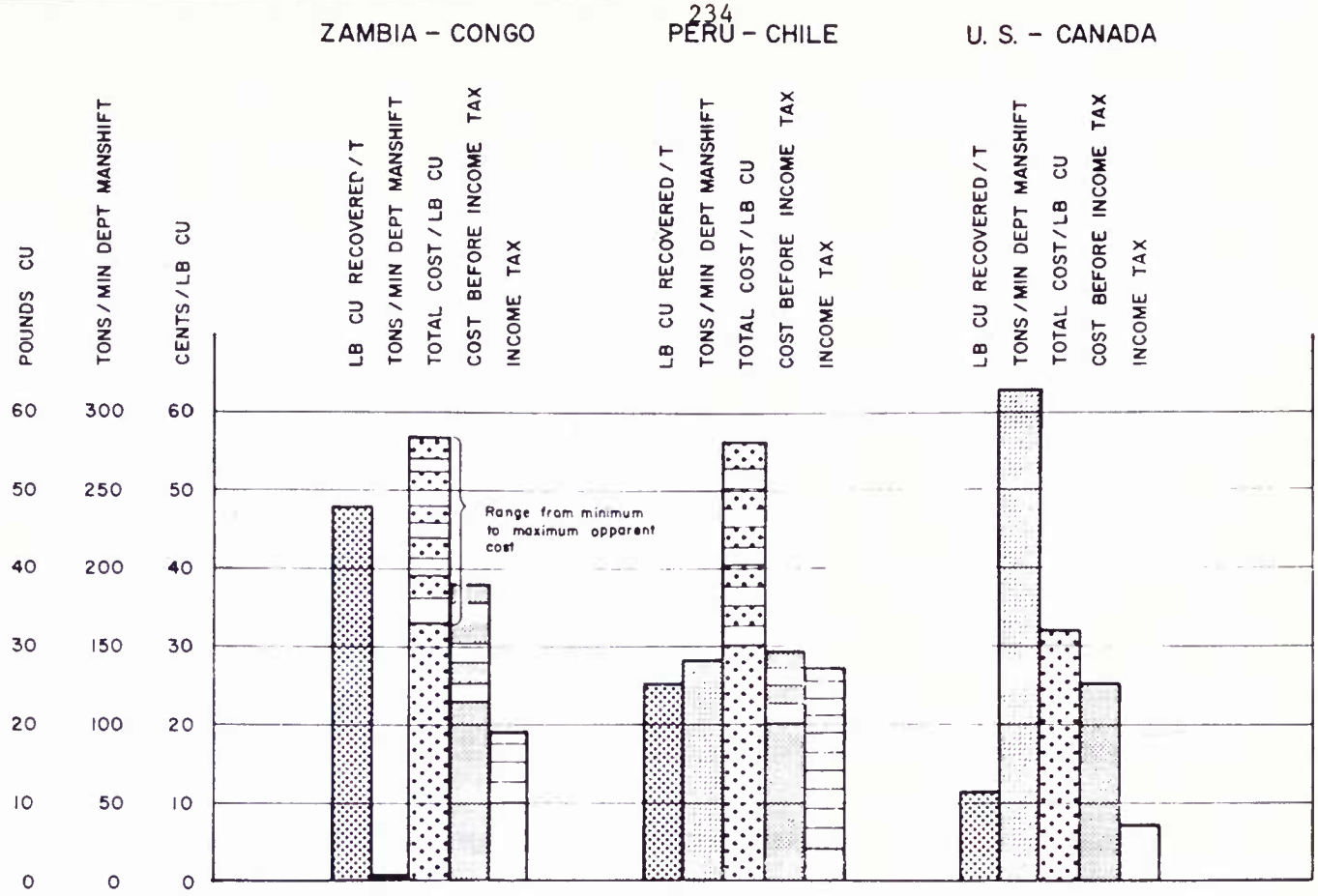

Fig. 2—Copper cost figures for the major producing areas. After-tax cost appears highest in the Zambia-Congo area and lowest in the U.S.-Canadian sector. The former has the lowest cost per man shift, but this advantage is dissipated by a high labor cost per pound of copper.

has some physical properties that are sometimes detectable by electrical geophysical techniques which were developed by Arthur Brant and T. R. Madden and others, and it is probable that with further refinement these methods will become an important means for prospecting covered areas.

Geochemical prospecting techniques have sometimes been effective, particularly in tropical areas such as Central America and Puerto Rico. These methods are severely limited, however, by the fact that copper and molybdenum will apparently migrate upward only a few feet through soil. An increasing amount of porphyry copper exploration is being done in areas of postore cover where targets are selected on the basis of geologic projections from outcrops or on the basis of geophysical or geochemical anomalies. At an earlier or a later stage in these projects, it is usually necessary to drill exploration holes, and various drilling techniques are used depending on whether prospecting information or precise sampling information is required. A number of drilling innovations have been borrowed from the petroleum industry in recent years. As exploration moves into progressively deeper cover, it becomes increasingly important to decrease the cost and increase the speed of exploration drilling, and the mining industry would be well advised to budget research and development money to develop better drilling equipment.

Many Deposits Await Discovery

It is, of course, not possible to predict the total number of porphyry copper deposits that will ultimately be exploited in the various districts, but a crude approximation may be possible if one compares the number of known deposits in each district with the percentage of the district in which the preore surface has been prospected. The area prospected ordinarily would include the preore outcrop plus that portion of the area of postore cover which has been adequately tested by drilling. On this basis, one could make the following approximations assuming present minimum mining grades: in the Southwest area approximately 30 deposits have been found in the 30% of the total preore surface which has been prospected, leaving 70 deposits undiscovered. In Chile and Peru, approximately 12 deposits have been found in the 50% of the mineral belt which has been prospected, leaving 12 undiscovered deposits. In British Columbia, 13 deposits have been found, but only 10-15% of the preore surface has been explored, so that 100 deposits may remain to be found.

These figures will be affected by a great number of variables which include: the assumed minimum ore grade, incidence of orebodies in covered versus outcrop area, the occurrence of blind orebodies below the preore surface, and finally the economic-political factors in different copper-producing countries. For example, if it were possible to mine 0.5% Cu in Chile and Peru, several times as many deposits would probably be in production and several times as many would remain to be found. It should be emphasized that the mere presence of a deposit at a depth of 5,000-10,000 ft does not mean that it will necessarily become an orebody which can be mined at a profit, first because of the large expense of discovering it, and second because of the costs and engineering problems involved in mining it. Deposits under deep cover which can be eliminated as prospects include half of the Southwest group, a third of the South American deposits and perhaps a fifth of the western Canada group.

It is interesting to speculate that when serious exploration of these covered areas is underway, geologists will probably find deposits which are substantially different in grade and profitability from those of the last generation of new porphyry coppers. The majority of new mines developed since 1915 have not

really been "found," they have simply "evolved" into orebodies as improving technology made it possible to mine progressively lower-grade ore, as was shown in Fig. 1. For this reason, most of the mines brought in at any given time have been just a little better than marginal grade. Most of the recent U.S. and British Columbia deposits, for example, have been in the 0.5% Cu range. If a virgin deposit is discovered under postore cover, however, it could be a high-grade, high-profit, chalcocite blanket in Arizona, or a Braden in British Columbia. Original ore reserve figures for Bingham Canyon in 1905 were quoted at a grade of 2.2% Cu, and Miami's reserves in 1911 were 2.59% Cu. Braden has produced very large tonnages containing over 1.5% primary copper.

The preore outcrops in the Southwest and in parts of British Columbia have been so thoroughly prospected that now only indirect exploration techniques offer much chance of success. However, there are still porphyry copper leached capping outcrops in South America, Iran, Oceania and elsewhere that remain to be evaluated by the older methods.

Included in Fig. 1 is a graph showing the average grade of copper ore mined in the U.S. with a projection to the year 2000. One can question the fact that average grade will decrease to 0.25% Cu by 2000, but this grade looks reasonably good even now with a low stripping ratio, optimum low mining and milling costs, and a 70¢ copper price.

An inverse proportion exists between grade and size of porphyry copper orebodies, and if the present average copper ore grade were to decrease to 0.25% Cu, the average orebody area would approximately double. Larger orebodies tend to have lower stripping ratios which tend to increase the possibility that a given deep deposit can be mined by open-pit methods.

Porphyries Will Predominate

Present figures suggest that most copper production in the next 30 years will come from porphyry copper deposits, and that an increasing percentage of this will be from bulk underground mining rather than from open pits. Consideration of current U.S. mining costs suggests that at a waste-to-ore stripping ratio of approximately 5:1 the underground block-caving method becomes competitive with open-pit mining. Expressed another way, if 0.5% Cu is marginal open-pit ore with a 0:1 stripping ratio, then marginal block-cave grade under ideal conditions would be about 0.6% Cu.

As world copper consumption increases, the impact of the development of individual new deposits decreases. In 1920, the impact of the yearly production of a Sierrita or Valley Copper or Bougainville would have been 27% of the world's copper production, but in 1970 this amount would be only about 3%. Current copper consumption requires the discovery of the equivalent of 1.4 billion tons of 0.5% Cu ore per yr.

Money for mineral exploration tends to flow to districts where geologic possibilities for ore occurrence are good, where economic conditions favor a large margin of profit, and where political conditions give maximum security for large capital investment and stability in terms of operating expenses and tax load. These considerations have resulted in the concentration of porphyry copper exploration activity in the southwest U.S. during the past 20 years. During the past five years, the flow of exploration money has tended to shift to western Canada, which has become a comfortable exploration environment, but this might change again with a change in the Canadian tax structure. Little exploration is now in progress in Chile in spite of the area's geologic favorability.

U.S. Could Be Self-Sufficient But Factors Weigh Against It

U.S. per capita copper consumption appears to have partly leveled off, and at the same time the opportunities are good for discovery of substantial new copper deposits in the U.S. It would appear at first glance that there is a possibility that the U.S. might again become a net exporter of copper, or that the combination of U.S. and Canadian production would be sufficient to more than supply U.S. and Canadian industrial requirements in the remainder of the century. This may not be the case, however, due to two facts. First, the U.S. dual price structure and the U.S. Department of Commerce balance of payments program, together with the impotence of the U.S. State Department and the lack of a national mineral policy, has given American industry no chance to compete with the aggressive, closely coordinated Japanese industry-government combination, and as a result the new Canadian copper production has been routed to Japan rather than to the U.S. This reliable copper supply originating in a nearby stable country friendly to the U.S. has been lost. The second factor which may inhibit the development of self-sufficiency is the increasing tendency of the U.S. public and Government to oppose development of mineral resources within the United States. The U.S. Government's withdrawal of large areas from mineral entry each year and the threats of repressive legislation encompassing tax rates, mining claims, environmental controls and groundwater all reflect an increasingly unfriendly environment for exploration in the U.S.

The World's Large Copper Districts

The large copper provinces of the world in past years have been the U.S., Chile, Zambia and the Congo. But with changes of ore grade, technology and labor costs, and with rising nationalism in underdeveloped countries, the large copper provinces of the next 30 years will include, in addition to the foregoing nations, Canada, Peru, Iran and the Oceania belt, including the Philippines, New Guinea and the Solomon Islands.

Zambia and the Congo can be lumped together for purposes of this review in terms of their relatively high-grade but narrow orebodies and relatively large amount of mining labor per ton of ore, and similarly from the standpoint of their underdeveloped national status and relatively unstable and strongly nationalistic governments. At the present time, rising production costs and increasing tax loads have raised the average cost of copper from these areas considerably above that of U.S. or Canadian copper.

Peru and Chile can be considered together in spite of their rather dissimilar histories and national characteristics. Both countries have relatively underdeveloped economies, relatively high-grade, porphyry copper type ore, and semistable governments. Peru, at least until recently, has honored its commitments to foreign companies, while Chile has not. The present taxation policy for foreign mining companies in Chile and Chile's policy for regulation of export copper prices are a repetition of a series of actions taken by the Chilean Government prior to World War I—actions which eventually contributed to the death of the Chilean nitrate industry.

The U.S. and Canada can also be considered as a unit. On the basis of past copper production, the U.S. is far ahead of Canada, but on the basis of potential copper ore reserves this may not be true. Both countries share the characteristics of high labor cost, high labor productivity, low-grade ore, and stable governments. The Canadian Government, however, has shown a much stronger inclination to support its domestic mining industry than has the U.S. Government.

The characteristics of the different copper-producing areas are tabulated in Fig. 2 in an effort to compare the cost of producing copper from each area. Fig. 2 shows for each principal copper-producing area the following factors: pounds of copper recovered per ton of ore, tons of rock per man-shift in the mining department, total cost per pound of copper, total direct cost and tax load. You will note that the apparent cost after taxes of producing copper is highest in Zambia-Congo and lowest in U.S.-Canada. Cost per man-shift, incidentally, is

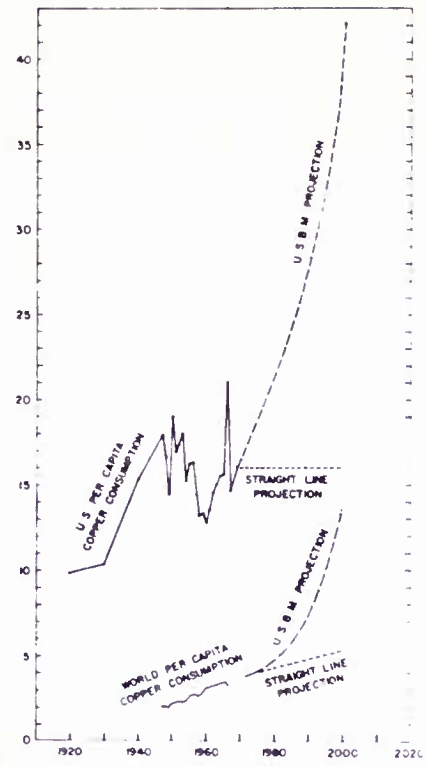

Fig. 3—Graph showing the annual number of pounds of copper consumed per capita with projections (dashed lines) to the year 2000. In each case, two projections are presented—a conservative one which shows no rise in U.S. consumption and only a moderate increase in world consumption, and a USBM projection showing a steep rise in both. At present, the more conservative estimates appear to be more likely. U.S. consumption, since the boom before and after World War II, has shown a tendency to level off, and world consumption, held down by exploding population and slow economic growth, has risen far less rapidly than optimists predicted ten years ago.

lowest in Zambia-Congo, but the resulting labor cost per pound of copper is several times that of U.S.-Canada. Cost before taxes is probably similar in Peru-Chile and U.S.-Canada.

Keep in mind that some mining operations and governments such as Chile (which derives 60% of its foreign exchange from copper) are vulnerable in times of decreasing demand and decreasing copper price. The vulnerable groups are those with high direct or total copper costs after taxes. For example if the cost of copper produced by U.S. mines became higher than the world copper price, the U.S. mines would shut down. If, on the other hand, the Chilean total copper costs became substantially higher than the world copper price, would, or could, the government give up its heavy tax load on copper production? Since Chile produces about 13% of the world's copper, and Chile and Zambia together about 26%, it appears that these governments are in a position to control the world copper price, and it appears that they cannot afford to let the price decline. The formation of the Inter-Governmental Council of Copper-Exporting Countries (Chile, Congo, Peru and Zambia) is certainly an effort intended to keep the copper price high.

Consumption and Price

Fig. 3 is a chart showing per capita consumption of copper in the U.S. and the world equated against time. The left portion of the U.S. curve reflects the explosive expansion of technology in the U.S. preceding and following World War II which resulted in a greatly expanded consumption of copper per capita, but this consumption per capita has since shown some tendency to level off, so U.S. per capita consumption is projected as a level line. Various USBM projections have been made, but higher recent projections assuming a 5.8% growth rate suggest that per capita consumption may climb in a steep curve and reach approximately 42 lb by the year 2000.

The curve for per capita consumption of copper in the world shows copper consumption increasing in a rather steady gradient in recent years. Higher USBM projections assume that this curve will also steepen, but here, also, the author prefers the more conservative straight-line interpretation. Economic development in Latin America, Asia and Africa has taken place far more slowly than was anticipated ten years ago. Exploding population tends to stifle rate of economic development.

Much has been written recently about the accelerated advance of technology. It is frequently noted that the sum of human knowledge is doubling every ten years, and that 90% of all scientists who have ever lived are alive today. It is predicted that the per capita consumption of goods and services in advanced countries in the year 2000 will be four times present consumption.

Population Stunts Growth

On the other side of the coin is world population—also increasing in an exponential curve—which has in some respects already outstripped the ability of the world to provide food. Limits on some commodities, and on water and even on air, are in sight. Something will have to give, and many authorities predict that the population growth curve must soon flatten, if from no other cause, from mass starvation.

Population growth has been more rapid than was anticipated ten years ago; if this trend continues for 30 years, world population could be as high as 7.5 billion people including

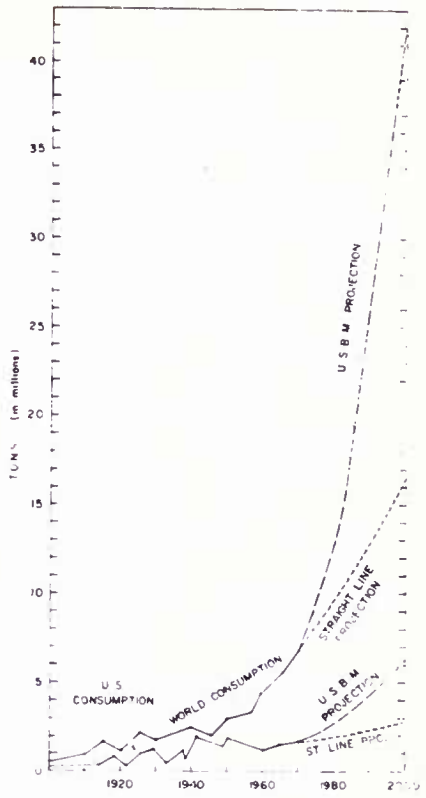

Fig. 4—Total U.S. and world consumption of newly mined copper in millions of tons. As in Fig. 3, there are two projections to the year 2000. The lower or straight line projections are based on past trends in consumption and population growth. The higher USBM projections rise to a copper consumption of 6½ times the present figure. These represent an outside estimate in which it is assumed not only that the world population will grow, but also that it will enjoy a vastly higher standard of living buoyed up by a phenomenol technological capability. Even the more conservative projections to 2½ times present consumption presage a challenging 30 years for the copper industry.

6 billion in underdeveloped nations. This would be about double present world population.

Fig. 4 shows U.S. and world consumption of newly mined copper. It includes a curve based on the USBM higher projected increase to about 6½ times 1970 consumption by the year 2000, and also an interpretation based on the previous per capita consumption curve and population increase which still indicates an increase to 2½ times the 1970 figure. The higher projection should be considered as a tentative upper limit toward which consumption could climb—if non-U.S. population is able to greatly increase its standard of living, if greatly increased substitution for copper uses does not take place, and if copper is found to be available in almost unlimited quantities in deposits of reasonably high grade. To put these figures into

better prespective, assume that additional copper production will come from the present copper-producing districts. Then an increase to 6½ times present copper production would require 104 major copper mines in Arizona. It is difficult to visualize where the professional talent would be found to handle the exploration, the mine development and the mine operations for this scale of enlargement of the industry, or even, for that matter, for an industry 2½ times the size of the present one.

An Age-Old Trend is Reversed

A projection of copper prices to the year 2000 in terms of 1970 U.S. dollars is shown in Fig. 1. A price of $1.05 per lb in 2000 is suggested by the chart, but the price will be much higher with a large increase in consumption. It appears almost certain that the long-range copper price must progressively increase as relatively high-grade and relatively near-surface deposits are worked out. This increase, which reflects an increase in capital investment and energy consumption per unit of metal output, will be a reversal of the trend which began in 3300 B.C. and continued to 1932, as shown in Fig. 1, and it will be a permanent reversal. Ira Joralemon has pointed out that one of the largest factors contributing to higher copper cost is the increasing cost of building copper production capacity. In 50 years the price of copper (not considering inflation) has increased by 3½ times, but the cost of building a plant to produce a unit amount of copper has increased by over 12 times.

Copper Can Survive Substitutes

Substitution of other materials for copper is a real factor in the copper market. It is not a new problem, however, as witness L. C. Graton's comments in 1926: "When aluminum began to be produced on a commercial scale in the early nineties, it was thought that it might make serious inroads into copper consumption. . . . About 1909 some of the largest copper companies were spurred to take up, through their research departments, investigation of aluminum competition."

Neither is substitution necessarily a sinister problem. In a speech given in 1965, James Boyd said ". . . I for one fail to be frightened by threat of substitution. I can only say, thank God for aluminum or other substitutes, for we as an industry could not possibly have met the explosive demands of modern society unless some substitutes had come along to help us."

And finally, substitution is not necessarily an irreversible process when one considers that 9 kw-hr of electrical energy are required to produce 1 lb of aluminum. The world supply of hydroelectric power and fossil fuel has definite limits, and world consumption of electricity is increasing at a much faster rate than consumption of copper and aluminum. A recent Federal Power Commission report estimates that U.S. electric power consumption will increase by 12 times in the period from 1960 to 1990.

The Copper Market

Copper has traditionally been a strongly cyclic commodity subject to violent upward and downward fluctuations of price and consumption. This market uncertainty has to a large extent been caused by the fact that copper resources have been divided among several geographical areas and several national groups among which there has been relatively little cooperation and coordination. The copper industry has often allowed market regulation to be brought about by the wasteful means of strikes, and the industry has traditionally been quick to cut prices and, prior to 1957, slow to curtail production to stabilize the copper price.

The function of government in the copper business has been of uncertain value. The U.S. stockpile, in addition to serving as a strategic copper source in wartime, would be a potential stabilizing factor in the copper market if copper were bought during periods of oversupply and sold during periods of shortage, and if the government were required to do this by the stockpile law. A study of the copper stockpile history by N. N. Reddy indicates that government buying probably has tended to stabilize the copper market to some extent. Uncertainty regarding government stockpile policy has sometimes in the past tended to make the stockpile a sword hanging over the market during times of price weakness, but this effect is minimized at present because of the comparatively low quantity of copper in the stockpile.

Price Variations Continue

The Presidential price guidelines of the past five years have been partly responsible for the existence of the weird phenomenon of a dual copper price, with the London price sometimes 100% above the U.S. producer's price (Fig. 1). For some time a substantial percentage of U.S. production has been marketed at a price greater than the producer's price, particularly in the integrated operations. This suggests that the bulk of the copper market, even in the U.S., is now pretty thoroughly conditioned to a 50¢ copper price. Hopefully the dual price structure may soon be discarded. The actions of the governments of Chile and Zambia in the copper market have been, and will be, directed towards holding the price of copper at high levels. This, to a large extent, is exactly what the U.S. Presidential policy has been intended to prevent.

As pointed out earlier, first, Chile and Zambia may be in a position to control the world copper price and, second, copper revenue constitutes such a large percentage of the national income of both countries that it is difficult to see how these countries can afford to allow the price to drop, particularly since they seem to be in a poor position to compete during times of low copper price. On the other hand, it seems doubtful that they would be capable of the self-discipline necessary to voluntarily limit production in periods of oversupply or voluntarily limit price to prevent substitution in periods of shortage. This attitude will tend to maintain a profit margin for the U.S. and Canadian copper mines during periods of low world copper price.

Conclusion

What conclusions, then, can be drawn from this review? The future of the copper industry in the rest of the 1900's appears generally bright, but probably hectic. Consumption will increase by several times, with this increase limited only by the supply of relatively cheap copper. The copper price in 1970 dollars will probably at least double, and the average grade of ore mined in North America will decrease to less than half of present grade. Substitution for copper will increase, but this development will also provide elasticity to the market in periodic times of shortage.

Porphyry copper deposits will provide the bulk of copper production during the next 30 years, and many deep porphyry discoveries will be made in covered areas which will require bulk underground mining. This will stimulate development of more effective mechanization of underground mining, particularly in the U.S., where a serious shortage of underground miners and mining engineers has already developed. Economic and political considerations, as well as geologic factors, will tend to shift copper exploration and mining away from some of the traditional copper districts of the world. Western Canada, Oceania and Iran will emerge as major copper sources.

The copper industry will be buffeted by stronger pressures and more rapid change than it has ever experienced. It will be asked to increase production by many times, but will lack space in which to operate. It will be attacked alike by nationalistic governments and domestic conservationists, but unprecedented opportunities will also open to the industry. The keynote to the next 30 years for copper will be challenge!

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Born: February 28, 1928, Nogales, AZ

1949	BS, Mining Engineering, University of Arizona
1957	MS, Geology, Stanford University
1959	Eng. Geol., University of Arizona
1998	Doctor honor causa, University Mayor de San Marcos, Lima, Peru
	Lowell Mineral Exploration LLC, Arizona, Manager
	Lowell Mineral Exploration Ltda., Chile, Manager
	Exploraciones Mineras Lowell S.A. de C.V., Mexico, Manager
1961-date	Consulting Geologist, 100 U.S. and foreign mining and engineering companies and governments. Managed contract exploration projects which discovered Kalamazoo and Casa Grande West orebodies in the U.S. and La Escondida orebody in Chile
1959-1961	Utah Construction Co., San Francisco, CA, Sr. Geologist to District Geologist
1955-1959	Southwest Ventures (subsidiary of Ventures Ltd., Canada), Tucson, AZ, Chief Geologist
1951-1954	USAEC, Grand Junction, CO, Geologist to District Geologist
1949-1951	ASARCO, Santa Eulalia, Mexico, Engineer to Mine Foreman

Member: MMSA; AIME; SEG; Arizona Geological Society; Inst. de Ingenieros de Minas de Chile; Registered Geologist and Registered Mining Engineer, AZ

Awards: 1970 AIME Daniel Jackling Award; 1972 Distinguished Citizen Award, University of AZ; 1974 Distinguished Lecturer CIM; 1975-1980 Assoc. Editor, Economic Geology; 1977 Thayer Lindsley Distinguished Lecturer SEG; 1983 Society of Economic Geologists Silver Medal

Twelfth Annual American Mining Hall of Fame Awards Presentation, December 3, 1994, sponsored by Mining Foundation of the Southwest, Tucson, AZ.

AMERICAN MINING HALL OF FAME

1994 MEDAL OF MERIT RECIPIENT

J. DAVID LOWELL

Dave Lowell was born on a ranch in Southern Arizona in 1928. He graduated from the University of Arizona, B.S. Mining Engineering, 1949, Stanford University, M.S. Geology, 1957, and was awarded the University of Arizona's Professional Engineer of Geology in 1959.

He has worked with ASARCO Inc., USAEC, Ventures Ltd., and Utah Construction as mine engineer, foreman, small mine manager, geologist, district geologist and chief geologist. Since 1961 he has been a private consultant working for more than 100 companies and governments and managed projects that discovered a number of major deposits, including Kalamazoo and Casa Grande West in Arizona and La Escondida, Zaldivar and San Cristobal in Chile. He is presently conducting mineral exploration in Peru, funded by Arequipa Resources and is associated with Tucson's Mineral Advisory Group. Dave's insight into porphyry copper geology has been universally recognized as having revolutionized mineral exploration practices.

Dave has received AIME's Jackling Award, Society of Economic Geology Silver Medal, the University of Arizona's Distinguished Citizen Award, was CIMM Distinguished Lecturer, and SEG's Thayer Lindsley Lecturer.

PALABRAS DEL

SEÑOR JAMES DAVID LOWELL

EN LA CEREMONIA DE SU DOCTORADO HONORIS CAUSA POR LA UNIVERSIDAD NACIONAL MAYOR DE SAN MARCOS

LIMA, 14 DE AGOSTO DE 1998

GRACIAS DOCTOR MANUEL PAREDES MANRIQUE, RECTOR DE LA UNIVERSIDAD DE SAN MARCO, MIEMBROS DISTINGUIDOS DE LA FACULTAD, ALUMNOS Y AMIGOS.

Me siento muy honrado y aprecio mucho el honor que se me ha conferido el día de hoy. Para mí recibir este título de la Universidad Nacional Mayor de San Marcos que es la más antigua del Nuevo Mundo, con su ilustre historia que se extiende a lo largo de más de 400 años, lo hace aún mayor. Me gustaría también expresar mi gratitud al Ingeniero Teodoro García Blasquez L. Y a Juan Soza Benitez, y Esteban García Corrales, e Ingeniero Fernando G. Perales Calderón quienes han dedicado generosamente su tiempo y energía en planificar y supervisar la construcción de nuevos edificios en la escuela de minas, venciendo muchas dificultades imprevistas, me gustaría también agradecer a todos los profesores y administradores de la escuela académica y profesional de Ingenieros de Minas de la facultad de Geología, Minas y Metalurgia y Ciencias Geográficas.

Esta bello edificio de la Universidad Nacional Mayor de San Marcos es un ejemplo de la arquitectura entre los edificios más antiguos de Lima, que da la sensación de uno estar viendo la evidencia de uno de los centros más importantes de poder en el mundo en la época en que los virreyes de España gobemaban gran parte de Sudamérica desde esta ciudad.

Mis vínculos con el Perú podría decirse que se extiende a tiempos antes de que yo naciera. Mi padre trabajó como Ingeniero de Minas en la Mina Santo Domingo que se encuentra en el flanco oriental de la Cordillera de Los Andes, desde 1919 a 1922 y mi hermana nació en la Ciudad del Cuzco. Mi madre viajaba de la Mina al Cuzco en mula, mi hermana se siente muy orgullosa de tener doble nacionalidad y ha vuelto a visitar Cuzco hace algunos años.

La industria minera y la profesión de Minas se caracterizan por ser muy internacionales. He trabajado en 26 países distintos y tengo amigos mineros en la mayoría de ellos y a menudo no soy capaz de recordar cuales son sus nacionalidades, y esto se debe a que ellos también, se han trasladado de país en país, y son realmente ciudadanos del

mundo. Usualmente ellos tienen una opinión mucho más sofisticada y equilibrada de las políticas internacionales que los periodistas o los diplomáticos profesionales, debido a que ellos han trabajado, o vivido y efectuado negocios con personas de diferentes nacionalidades en diferentes partes del mundo. Uno de esos mineros internacionales, y viejo amigo mío, está aquí hoy día. Alberto Manrique nació en Lima y fue mi compañero de estudios en la Escuela de Graduados en la Universidad de Stanford. Desde que él terminó su educación al igual que yo, ha trabajado en diferentes países . El ha ganado un gran prestigio basado en su distinguida carrera profesional y está nuevamente viviendo en Lima.

Desde el punto de vista de un explorador minero, Perú es ahora una de las áreas más atractivas del mundo para encontrar y desarrollar una nueva mina. Los yacimientos mineros tienden a concentrarse en fajas metalogénicas las cuales están probablemente relacionadas a fracturas de gran escala continental, de emplazamiento profundo en la corteza terrestre. En Sudamérica una franja como la descrita empieza en el Sur de Chile y se extiende al Norte, paralelo al borde del continente, hasta Arica. Entonces ambos, el borde del continente y la franja metalogénica, doblan al noroeste y

desde allí se extiende a lo largo del Perú llegando a ser más débil en Ecuador. El segmento chileno pasa en parte a Argentina y Bolivia, pero los depósitos más importantes, incluyendo la mayoría de los depósitos más grandes de Cobre en el mundo están en Chile y Perú. La franja se desarrolla gradualmente hacia el Norte, y en el Norte del Perú en los últimos años se han encontrado varios depósitos epitermales de oro junto con yacimientos de cobre diseminado previamente conocidos y depósitos polimetálicos.

Un punto importante en relación al Perú es el hecho que hubo un "hiatus" de más de 20 años, durante el período socialista cuando muy poca exploración se hizo y no había fondos disponibles para aplicar algunas de las técnicas más modernas. Y el hecho que gran parte de la superficie de la franja metalogénica esta cubierta por gravas y formaciones volcánicas recientes, aumenta en gran parte las oportunidades de futuros descubrimientos de yacimientos cubiertos. La densidad de yacimientos conocidos en afloramientos de rocas pre-minerales en Perú está entre los más altos del mundo, y estoy seguro que hay muchos más

depósitos importantes cubiertos bajo las superficies de las gravas y rocas volcánicas.

Es muy interesante para mí hacer notar que la importancia económica a nivel mundial del Perú ha figurado repetidamente en la historia del mundo. Es bien sabido que la producción peruana de oro y plata sustentó la economía del imperio español en el siglo 16, y durante el siglo 20 se logró producción a niveles mundiales de métales básicos. Recientemente la producción de oro epitermal y de cobre tipo porfídico han puesto al país a la cabeza de la producción de cobre y oro. Lo que es menos conocido es que 1.500 años atrás la tecnología metalúrgica peruana era en muchos aspectos más avanzada que otras en el mundo. La cultura preincaica había desarrollado una tecnología para usar fundentes en tratamientos de fundición de sulfuros y había desarrollado la técnica para unir metalúrgicamente capas de diferentes métales.

Una parte del aspecto internacional de la minería es la transferencia tecnológica. Hace unas pocas generaciones atrás, la tecnología era transferida de países "avanzados" a países en "desarrollo". Estas distinciones están

desapareciendo. Sesenta años atrás se consideraba que las tecnologías más avanzadas estaban en Europa del Norte y Norteamérica y que había un traspaso de tecnología, por ejemplo, desde los Estados Unidos a Chile. Ahora nuevos centros de desarrollo tecnológico han emergido en Corea del Sur, Japón, Taiwan y Singapur. Rusia sobrepasó por un tiempo en tecnología espacial a nivel mundial. Chile probablemente está exportando ahora más tecnología de la que importa, como es el caso en Brasil. El mundo está cambiando muy rápidamente y las naciones que están teniendo éxito son aquellas que tienen gobiernos estables, un buen sistema de educación, filosofía de libre empresa, objetivos agresivos bien definidos y una planificación futura. En el éxito probablemente el optimismo es más importante que cualquier otra cosa.

Yo he hecho una pequeña contribución en transferencia de educación internacional. En Chile di un curso corto en la Universidad de Chile y dicté conferencias en universidades como también fui coautor de charlas académicas en geología y artículos con Carlos Ruiz Fuller, Director Fundador del Instituto de Investigaciones Geológicas.

Todas estas cosas son útiles, pero además yo creo que los logros reales provienen de dos factores: Trabajos para profesionales en organizaciones extranjeras y títulos académicos en universidades extranjeras. Mis títulos universitarios los obtuve en las Universidades de Arizona y Stanford. En el grupo de hoy hay distinguidos peruanos titulados en ambas instituciones; el Ingeniero Oswaldo Ortiz, Director Escuela de Minas, U.N.M.S.M. como yo es graduado del Colegio de Minas de la Universidad de Arizona. El Ingeniero Alberto Manrique, después de completar su educación de pre-grado en Perú obtuvo un título en la Universidad de Stanford.

La rata de aumento en ciencia y tecnología esta creciendo en progresión geométrica con la suma del conocimiento humano que se duplica cada vez en aún más cortos intervalos. La rapidez y facilidad de transferencia de información también está aumentando rápidamente y el sistema de Internet muchas veces permite una transferencia casi instantánea. Esta explosión de información ha resultado en una ampliación del espacio entre personas moderadamente bien educadas y personas muy bien educadas. Esta diferencia esta representada por sueldos,

standard de vida, status y poder. Esta situación crea un problema enorme para las escuelas y los educadores del mundo, cuyo objetivo es producir una sociedad educada, homogénea y no una polarizada dirigida por una minoría de elite.

Yo soy un miembro del Comité Concejal del Departamento de Geociencias de la Universidad de Arizona. En nuestra última reunión discutimos un proyecto para ofrecer nuevos títulos de Maestría, los cuales en parte serán un paso hacia la creación de una Universidad virtual. Los estudiantes volverían a la Universidad para hacer parte de su trabajo pero mucho se podría hacer fuera de una clase formal usando CD ROOMS que contienen las clases dictadas y quizás algunas de estas clases podrían ser introducidas a través de sistema Internet. La Educación de este tipo se puede impartir a estudiantes del otro lado del mundo y sin límites internacionales, usando el acceso a las mejores bibliotecas del mundo a través de Internet. Una parte del proceso requiere del uso de un lenguaje internacional. Este parece ser el inglés y el conocimiento del inglés está aumentando, llegando hacer muy importante.

La otra cara del problema esta en la organización política mundial. Mientras la tecnología ha avanzado a una velocidad trascendental, la organización política ha avanzado en una atroz lentitud. Es difícil reconocer que haya mucho avance real en la política durante los últimos 200 años. Yo creo que nuestro deber, como líderes y educadores, es tratar de promover en la gente joven del mundo de hoy el espíritu de curiosidad, innovación, flexibilidad, aventura y descubrimiento!

Para mí ha sido una muy buena suerte el haber tenido una oportunidad de contribuir de una manera modesta con el desarrollo de la Escuela de Minas, y devolver a Perú una pequeña retribución de mis logros en el éxito de Arequipa Resources. He conocido muchos de los estudiantes actuales y los he encontrado ansiosos, de mentalidad abierta, gente joven aplicada que esta progresando con métodos modestos. A mí me parece que hay un gran efecto multiplicador entre lo que se está haciendo hoy en la Escuela de Minas, cuando ustedes consideren la cantidad de vidas y carreras que serán positivamente beneficiadas en los estudiantes de hoy, y de los que vendrán en el futuro. El efecto multiplicador a futuro es enorme para el Perú.

Thank you Dr. Manuel Paredes Manrique, Rector de la Universad de San Marcos, Miembros distinguidos de la facultad, y alumnos Amigos.

I am very honored and very appreciative of the honor which has been conferred on me today. For me, receiving this degree from the Universidad Nacional Mayor de San Marcos, the oldest University in the New World with its illustrious history spanning more than four hundred years makes it a much greater honor still. I would also like to express my gratitude to Ing. Teodoro Garcia-Blasques L. and to Juan Sosa Benites and Esteban Garcia Corrales and Ing. Fernando G. Perales Calderon who have devoted selflessly of their time and energy to plan and supervise the construction of the new buildings in the Escuela de Minas against difficult odds. I would also like to thank all of the other professors and administrators of La Escuela Academico Profesional de Ingenieria de Minas de la Facultad de Geologia Minas Metalurgia y Ciencias Geograficas.

This beautiful Univ. Nac. Mayor de San Marcos building is an example of the architecture in the older buildings in Lima which give a sense that you are seeing evidence of one of the important centers of power of the world from the time when the Viceroy of Spain ruled much of South America from this city. One gets the same feeling in Madrid and Toledo and London.

My association with Peru is of long standing and could be said to extend to a time before I was born. My father worked as a mining engineer at the Santo Domingo mine on the East slope of the Cordillera from 1919 to 1922 and my sister was born in the town of Cuzco. My mother rode from the mine to Cuzco by mule. My sister has been very proud to have dual citizenship and returned to see Cuzco a few years ago.

The mining industry and the mining profession are very international in character. I have worked in 26 different countries and I have mining friends from most of these countries and I am often unable to remember what their citizenship is because they, too, have moved from country to country, and they are really citizens of the world and usually have a much more sophisticated and balanced opinion of international politics than the newspaper reporters, or even profession diplomats, because we have worked with, and lived with, and done business with people of different nations and different parts of the world. One of these mining internationalists, and an old friend, is here today. Alberto Manrique was born in Lima and I met him as a classmate in Graduate School at Stanford University. Since completing his education he like me, has worked in many different countries. He enjoys a great deal of prestige on the basis of his distinguished professional career and is again living in Lima.

Seven years ago when I formed Acuarios Minera and Arequipa Resources to do mineral exploration in Peru I considered several different questions:

1) Would the Peruvian post-socialist society be open to foreign investment on terms fair to both sides and would the regulations and peace and order situation permit exploration to be carried out?
2) Would there be available trained and experienced professionals and technicians to carry out my program?
3) Was there good expectation of finding large new undiscovered ore deposits?. and

4) If found was there infrastructure and mining tradition and experience and trained personnel to transform a new orebody into a large, efficient, mining complex? This question revolves around people: miners, equipment operators, technicians, chemists, engineers, metallurgists, geologists, accountants, lawyers and business managers.

The answer to all of these four questions was yes, and I launched my Arequipa Resources Program which was successful four years later when the Pierina gold mine was found.

Pierina is being developed as a large open pit mine which will be in production by December of this year.

From the viewpoint of a mineral explorationist Peru is now one of the most attractive areas in the world to find and develop a new mine. Ore deposits tend to be concentrated in metallogenic belts which are probably related to large continental scale deep seated fractures in the Earth's crust. In South America such a belt begins in southern Chile and extends almost due north parallel to the border of the continent. to Arica. There both the border of the continent and the metallogenic belt turn northwest and the belt then extends the length of Peru becoming weaker in Ecuador. The segment in Chile laps into Argentina and Bolivia, but the large bulk of important ore deposits including most of the largest copper deposits in the world, are in Chile and Peru. The belt evolves northward along its length, and in northern Peru in recent years important epithermal gold deposits have been found together with previously known disseminated copper and polymetallic deposits.

An important consideration regarding Peru is the fact that there was an exploration "hiatus" for more than 20 years during the socialist period when little exploration was done and funds were not available to apply some of the modern techniques. This fact, and the fact that much of the metallogenic belt is masked by surface gravels and recent volcanic formations, greatly increases the opportunities for future discoveries of concealed deposits. The density of known ore deposits in outcrops of premineral rock in Peru is among the highest in the world, and I am certain that there are many important deposits concealed under surface gravels and volcanic rocks.

It is very interesting to me that the global importance of Peru has emerged repeatedly in World history. It is well known that Peruvian gold and silver production underpinned the Spanish empire in the 16th Century, and world class base metal production was achieved in the twentieth century, and porphyry copper and epithermal gold production has more recently put the country in the forefront of world production of copper and gold. What is less well known is that 1500 years ago Peruvian metallurgical technology was in many respects more advanced than in any other part of the world. The Pre Inca culture had developed a technology to use flux materials to smelt sulfide ore and had developed the technique for metallurgically welding layers of different metals together.

A part of the international aspect of mining is "technology transfer". A few generations ago technology was transferred from "advanced countries" to "developing countries". These distinctions are now becoming blurred. Sixty years ago the most advanced technology was considered to be in Northern Europe and North America and there was a flow of technology, for example from the US to Chile. Now new technology

development centers have sprung up in places like South Korea, and Japan, Taiwan and Singapore. Russia surpassed the world for awhile in space technology. Chile is probably now exporting more technology than it is importing, as is Brazil. The world is changing very rapidly and the nations which are succeeding are those which have stable governments, a good system of education, a free enterprise philosophy, and aggressive, clear cut, future planning, and objectives. Optimism that success is possible is probably more important than anything else.

I have made a small contribution to international cross-pollinization of education in Chile. I taught a short course in the University of Chile and gave lectures in Chilean universities and was co-author of achaedemic geology talks and articles in the U.S. and Australia as well as in Chile with Carlos Ruiz Fuller, former director of the Instituto de Investigaciones Geologicos.

All of these things are helpful, but I feel that the real advances come from two things: jobs for professionals in foreign organizations and graduate degrees in foreign universities. My university degrees are from the University of Arizona and from Stanford University. In the group today are distinguished Peruvian graduates of both institutions. Ing. Oswaldo Ortiz, Director, Escuela de Minas, U.N.M.S.M. like me is a graduate of the College of Mines of the University of Arizona. Ing. Alberto Manrique after completing his undergraduate education in Peru obtained a graduate degree at Stanford University.

The rate of increase in science and technology is growing in a geometric progression with the sum of human knowledge doubling in ever shorter intervals. The most recent doubling was in less than ten years. The speed and ease of transfer of information is also increasing rapidly and the Internet sometimes allows almost instant

transfer. This explosion of information has resulted in a widening of the gap between moderately well educated and very well educated people. This gap is represented by salaries and standard of living, and status, and power. This situation creates an enormous problem for the schools and the educators of the world whose objective is to produce a more homogeneous, educated society, not a polarized one directed by an elite minority.

I am a member of the Department of Geosciences Advisory Committee of the University of Arizona. In our last meeting we discussed a plan for offering a new masters degree program which in part will be a step towards the creation of a virtual university. The students would return to the university for part of their work, but much would be done away from the formal class rooms using CD ROMS containing class lectures and perhaps some classes would even be held on the Internet. Education of this sort can occur with students on the other side of the world and across international boundaries while using Internet access to the best libraries in the world. A part of this process requires use of an international language. This happens to be English, and knowing English is increasingly becoming more critical.

The other side of the problem is the world political organization. While technology has advanced at an ever excelling rate, political development has advanced at an excruciatingly slow pace. It's hard to recognize much real advance in the last 200 years, and a cynic might say that the dominant motives of politicians are greed, sloth, and conservatism, whether they represent the political right or the left. I believe it our duty as leaders and as educators to try to foster in the young people of the world today the spirit of curiosity, innovation, flexibility, adventure, and discovery!

For me it is has been very good luck to have an opportunity to help in a small way with the development of the Escuela de Minas, and to return to Peru a small part of my reward from the success of Arequipa Resources. I have met many of the current students and find them eager, open faced, industrious young people who are making do with modest resources. It seems to me that there is a tremendous compounding effect possible on what is being put into the Escuela de Minas now when you consider how many lives and careers will be affected in the current student body and in classes which will attend the school in the future. The compounded future benefit to Peru is enormous.

J. David Lowell

MINING

Thrill

After lucking out with one of the biggest gold finds in North America, Barrick's Peter Munk decided to play it safe. But he soon discovered that investors hated the slow, steady approach. Will betting billions once again make Munk the life of the party?

BY DONALD RUMBALL

seeker

EARLY ON THE MORNING of July 11, two executives from Barrick Gold Corp. of Toronto, the third-largest gold mining company in the world, asked to meet David Lowell and Catherine McLeod, the chairman and president of an infant Vancouver-based gold and copper mining company called Arequipa Resources Ltd. They were turned down. When Barrick's men insisted, Lowell and McLeod agreed to squeeze them into a 20-minute gap between a breakfast meeting and a 9 a.m. presentation. In a cranny of the King Edward Hotel in Toronto, the two West Coast executives found out that Barrick—under the driving leadership of founder and chairman Peter Munk—was mounting a bid to buy their company that day for almost $1 billion.

Less than seven weeks later, the deed was done. But, in between, the takeover raised a lot of eyebrows. First, Barrick's $27-per-share opening bid was considered "generous" for a small company with a new, relatively untested gold find such as Arequipa. Even more important, it reaffirmed the 68-year-old Munk's seriousness when, less than three months earlier, he promised to double Barrick's size and rekindle the market's excitement in its stock. The deal is also notable as the latest stage in Barrick's three-year transformation from conservative North American producer into international exploration and development giant. Wielding a US$1-billion line of credit and stringing together a who's who network of financiers, politicians and geologists, Munk says he won't stop until he's created the world's biggest gold mining company—period.

At the time of the bid (worth US$720 million), mining analysts estimated there were only 3.5 million ounces of gold in Arequipa's Peruvian "Pierina" ore body. That made Barrick's offer equivalent to a cost of US$206 per ounce in the ground. Considering that Barrick has been spending about US$180 to extract each ounce of gold from its existing mines and that the market price of gold was languishing below US$400 an ounce, Barrick's offer seemed to hold little hope of a significant return.

The psychology behind Munk's bid, however, was impeccable. First, Barrick was confident there were more than 3.5 million ounces of gold in the ore body—and Bay Street soon changed its estimate to five million ounces, maybe more. That lowered the projected cost per ounce to about US$144—still expensive, but economically feasible. Second, the offer was all cash—almost unheard of in the gold mining industry, where takeovers are invariably paid for with corporate

paper. (Munk knew that a cash offer would draw stock arbitrageurs into the game, thus ensuring a rational, calculated and predictable bidding process.) Third, everyone knew that Barrick had a US$1-billion line of credit at the bank—enough to pay for the deal—so, with no other gold mining company in as good a position, a bidding war was unlikely.

Barrick's bid was still a huge gamble, however, because no one really knew what Arequipa was worth. Lowell and his team only discovered the Peruvian gold-bearing geological anomaly in October 1995; exploratory drilling began this April. When Barrick made its bid, Arequipa had released results for only nine of its exploratory holes. "We were very surprised," Lowell says. "We thought a bid would come later."

In fact, Munk's charge upset Lowell's careful plans. The latter's clever promotion of Arequipa and its find helped push the company's share price to a high of $35 in April from $2.50 in January. The stock fell back to trade in the $18 to $22 range for most of May and June, but Lowell expected it to rebound as more drilling results were released. Then Munk intervened.

Consensus among insiders now is that Pierina will probably "cap out" at almost 10 million ounces, although there are no guarantees. Based on the deal's eventual purchase price of US$800 million (CDN$30 a share), this will reduce Barrick's acquisition cost to US$80 an ounce. Capital costs for the mine, meanwhile, are expected to be less than US$150 million, while the revenue from the silver also to be mined will reduce extraction costs to between zero and US$100 an ounce. This puts the expected total operating cost per ounce at US$95 to US$195. For Barrick—which posted a pretax profit of US$390 million on revenue of US$1.3 billion last year—that means a chance to at least double its Arequipa investment over the next two decades.

An even greater potential upside lies in the rest of the land package that Lowell assembled for Arequipa. Lowell has been working the Andes for 25 years and discovered the Escondida mine in Chile, the biggest copper mine in the world. So he knows what he is talking about when he says Arequipa has one of the best land packages of any company in Peru. "The election of [President Alberto] Fujimori meant there was hope on the horizon, so in January 1992 I decided the time had come to go back in [to Peru]," says Lowell. "This was well before the major companies made the same decision, so the field was open for claim staking."

ADNAN KHASHOGGI (with Munk, above) was a key ally early in Munk's career. Now Barrick's boss is drawing on a long list of international contacts

As the deadline for acceptance of Barrick's original offer approached, Arequipa tried to bring in other suitors to squeeze out a higher price. But no other bidders could meet Barrick's timetable. Days before the deadline, Munk called Lowell and said he would raise the price to make it a friendly deal. Bob Smith, Barrick's president, and Bill Biggar, senior vice-president of investments and the man in charge of the takeover, then flew to Vancouver offering $30 a share—on the condition that Lowell and his key executives agree to tender their 23% stake to Barrick. Lowell accepted, and Munk was on his way.

IT WAS THE SUMMER OF 1995, AND as Munk looked back over the previous 18 months, he was more than a little annoyed. For Barrick, 1994 had not been a good year on the stock market. Despite a banner year, when the company's earnings and production broke all records, its stock price had drifted erratically downward from its peak 18 months earlier. Admittedly, the market was sliding for everyone, but Barrick's stellar performance should have insulated it from the limp parade of less dynamic companies. It was tough to understand. After several years of exponential growth on the strength of its huge Goldstrike mine in Nevada, Barrick had just swallowed one of its larger competitors, Lac Minerals Ltd., in a US$1.7-billion takeover that vaulted it into the top spot among North American gold mining companies. Barrick had become the third-largest gold mining company in the world—and the most profitable. To have done this was noteworthy. To have done it from scratch, less than 12 years after entering the gold mining business, was exceptional. Yet Barrick's stock could not break out of its dreary pattern, ending the year 22% below its January 1994 high.

Even when stock prices recovered a bit in the first half of 1995, Barrick's insipid recovery trailed the market. It would have been enough to upset anyone coming off

two fabulously successful years, but what infuriated Munk, the company's driving force, was that Barrick had suffered more at the hands of this bear market than the other three first-tier gold companies—Placer Dome Inc., Newmont Mining Corp. and Homestake Mining Co.—all of which had performed worse than Barrick over those two years, according to every available yardstick.

When Munk is infuriated about something, he doesn't stew about it. He gets the issues on the table and in front of his trusted colleagues. Barrick's senior managers sit around their Arthurian round table once a week and Munk joins them whenever he is in town, and so it was inevitable that the sluggish performance of Barrick's stock would surface in the weekly sessions that summer. "Find out why people have bought Placer Dome shares and Newmont shares, but not our shares in the last 18 months," Munk said to his senior managers. "Just find out."

The price of Barrick's shares is at the very heart of Munk's business philosophy, although not in a conventional way. He passionately believes that the goal of a company's managers must be to maximize the benefits flowing to the shareholder—and maximizing shareholder benefits does not mean increasing earnings per share by 10¢ a year. It means doubling the stock price every three or four years. In his 40 years as an entrepreneur (and, latterly, a tycoon), Munk has drummed that message into every single person with whom he has worked, making it a mantra that defines and drives his companies. Every employee in Barrick receives, every day, a one-page sheet with a "market update." On the first few lines of that sheet, in boldface, is Barrick's closing price and volume on the Toronto and New York stock exchanges over the previous week. Then comes the same information for his holding company, Horsham Corp., followed by key statistics about Barrick's major competitors—the Newmonts and Placer Domes whose stock prices had provoked Munk's irritation.

Why then were analysts and investors excited over Placer Dome at the expense of Barrick? The analysts liked Placer Dome, Barrick's managers found out, because it was in a lot of "plays"; Barrick had focused on its handful of mines, investing its time, energy and money in developing them so as to become the most profitable gold mining company in the world. The analysts knew exactly what was in store for Barrick, and decided they preferred the uncertain potential of huge gain from Placer Dome's risky exploration program to Barrick's solid profits.

It's a sensitive issue because up until that year, the foundation of Barrick's success had been Munk's decision to avoid a risky exploration program as the route to growth, choosing instead to grow by acquiring producing properties. Back in 1983, when Munk took his first faltering steps into the gold mining business—after a roller-coaster career of crushing failures such as Clairtone Sound Corp. in the 1960s as well as stunning successes, such as the Travelodge hotel chain of the South Pacific in the 1970s—his vision was crystal clear. The big pension funds and mutual funds in Europe and North America were major investors in gold mining stocks, but they were getting nervous because most of their holdings were in South Africa, a nation that was heading deeper and deeper into political trouble. But there were no other suitable gold mining stocks outside North America to take their place—and the pickings were very slim on this continent. All but a half dozen of the North American gold mining companies were "juniors"—small companies with limited resources owned by promoters or prospectors looking for an "elephant," a huge discovery that would catapult them into the major leagues overnight. Pension funds, however, don't invest in prayers. They want solid, producing companies with a strong cash flow that have some prospect of performing well in their portfolios for many years to come.

To meet that need, Munk decided in 1983 that he would start buying small mines that were in production but not performing to their maximum capability. He would buy them cheaply and wring the last ounce of potential out of them through superior management. Exploration was out. The only drilling he wanted to do was development drilling on properties he already knew held gold in commercial quantities.

As it happened, Munk's was an inspired plan. Four years later, he had bought several producing mines that he was able to improve beyond his wildest dreams. This success, of course, only confirmed the wisdom of staying away from "grassroots" exploration on properties that held no guarantee of success, so his exploration budget languished accordingly. From 1987 to 1993, Munk averaged little more than US$5 million a year on grassroots exploration, a pittance compared to his cash flow, which soared to US$317 million from US$37 million over the same seven years. Placer Dome, by comparison, committed itself to spending about US$70 million every year between 1992 and 1994 on grassroots exploration—more than 25% of its cash flow.

MUNK PASSIONATELY believes that maximizing shareholder benefits means doubling Barrick's stock price every three or four years

This didn't mean Barrick wasn't spending heavily on development. Once Barrick executives realized in 1987 that they were sitting on a genuine elephant in their Goldstrike property in Nevada—acquired that year for a paltry US$62 million from owners who couldn't see its potential—they poured all their energies into its development. During the next eight years, Barrick sank more than US$1.6 billion into its six mines, with Goldstrike alone accounting for more than US$1 billion.

During the heady years, when Goldstrike was emerging from obscurity to become the biggest gold deposit on the continent with its reserves of more than 40 million ounces, there was real excitement in the stock market over the gradual unveiling of Barrick's fabulous treasure house, and investors showed their appreciation by awarding the company a premium on its stock price to reflect its status as a growth company. Now they had taken that premium away. Barrick's very

success had raised the ante in analysts' demand for an encore.

MUNK, IN SOME WAYS, WAS way ahead of the analysts. More than two years previously, in the first half of 1993, he had started wrestling with the dilemma of his success. Back then, he worried about Barrick turning into an institutional bureaucracy. With the US$1-billion development of its Goldstrike mine behind it, Barrick was beginning to feel large and profitable—and the first signs of flabbiness were starting to creep in. The company's staff was still small enough, and its culture still strong enough, that there was no danger of the operation becoming moribund or routine, but the spigots were opening and the cash was flowing. Munk knew that without a jolt from him the sense of urgency that kept Barrick taut and entrepreneurial would begin to fade.

In the winter of 1993, Munk took four months off to ski at his chalet in Klosters, Switzerland. Toronto saw little of him during that time; his colleagues thought he was slowing down. Little did they know he was staying up late into the night, worrying about how he could reinject his entrepreneurial spirit into his fabulous business. Munk knew that if Barrick was to continue growing, it had to switch its attention to exploration now that the development phase had been completed at Goldstrike. Having great reserves is one thing; it's quite another to find enough new mines to replenish those reserves as they are depleted by two million ounces a year. For a company the size of Barrick, moreover, new mines had to be substantial. It couldn't afford to toy with deposits of 100,000 ounces here and 250,000 ounces there. For an ore body to have any impact on Barrick's reserves, it had to contain one million ounces or more—and mines like that are hard to come by.

At the same time, Munk hedged his bets, raising US$700 million to diversify out of gold through his holding company, Horsham Corp., which, in addition to owning US$1.5 billion worth of Barrick shares, owned real estate in Berlin and an oil refining and marketing company in the US Midwest. (The following year, Horsham also bought a 48% stake in fallen real estate giant Trizec Corp. Ltd. for US$484 million.) Munk's next step was to create a senior corporate development group for Barrick. He chaired it and charged it with finding new gold deposits in South America and Asia by whatever means were appropriate. In the space of a few months, Munk wanted Barrick to shed its image of a strictly North American company in pursuit of producing properties that it could manage better than anyone else. Instead, he wanted Barrick to portray the image of an international, aggressive explorer.

Earlier in the year, Munk had brought Brian Mulroney, the recently retired prime minister who was the unhappy lightning rod for the angst of a whole nation, onto his board. Munk was well aware of Canadians' feelings toward his new recruit, but he also knew that Mulroney enjoyed immense prestige outside Canada. After nine years of trotting around the world meeting world leaders, Mulroney had incomparable access to presidents and prime ministers in all the key spots where Munk wanted to take Barrick. Through Mulroney, Munk knew he could get to meet the presidents of Chile and Argentina or the premier of China. With that kind of access and Munk's ability to pitch an irresistible idea,

BRIAN MULRONEY was added to Barrick's board because he had incomparable access in key spots where Munk wanted to take Barrick

Munk knew he could launch Barrick into new mining fields at a speed that would turn heads around the world.

By the spring of 1994 Mulroney was already making friendly calls on the presidents of Chile, Argentina and Peru, among others. On the back of Mulroney's introductions, Munk became more familiar with the key countries of Latin America. He was among the first to see that there was a historic shift under way. Dictatorships that had, for centuries, blighted the prospects of an entire subcontinent were giving way to democracies that were opening up their economies to the power and dynamism of foreign capital. At last, companies such as Barrick could contemplate, with some degree of comfort, investing in the immense mineral deposits of Latin America. Governments there now recognized the benefits that would accrue to their people if they allowed foreigners to take profits home after investing in their countries.

About the same time, Munk set in motion a comprehensive review of Barrick's options in generating its next growth phase. He let everyone know that this was still "his" company and that it was still entrepreneurial. He asked Smith to put together an aggressive plan to acquire new mines, and called a board meeting in the dog days of summer to approve it. His message was simple: we can no longer afford to amble along our growth path, we've got to sprint, and that means an acquisition.

Within weeks, Munk bought Lac Minerals, largely on the strength of its Chilean properties. Its annual production of one million ounces fitted his strategy perfectly, and he grabbed it enthusiastically when it unexpectedly came up for sale. By the end of 1994 Munk felt confident he had set Barrick on a new path. The financial analysts, surely, would sit up and take notice. But they didn't.

THE NEXT SUMMER, WHEN Munk's colleagues came back telling him that the market wanted more "exploration plays," he decided to give the analysts what they craved by more than doubling Barrick's budget for grassroots exploration. The budget for 1995 had been US$30 million, which represented a healthy increase from the previous year's US$20 million (which, in turn, was a big increase over the US$7 million alloted in 1993). Munk's new 1995 exploration budget: US$80 million. About half this money was earmarked for joint ventures with individual prospectors or very small gold companies looking for a partner to do the development drilling and assess the extent of a promising find. The rest was for drilling in existing mines to gauge the extent of their reserves.

Barrick's exploration budget represents a fearsome challenge for its top executives. Alan Hill, Barrick's executive vice-president of corporate development, the man in charge of developing new ore bodies, knows only too well that his neck is on the line: "You know, we're better than anybody else, but there are 150 companies out there looking for the same thing. You've got to kiss a lot of frogs before you find a prince."

Barrick still won't develop any property with less than one million ounces of gold, but it will look seriously at anything any prospector brings to it. To drive the point home about how not to implement this strategy, Barrick suffered a huge disappointment in the fall of 1995 when a small company it had narrowly missed signing up as a partner announced it had made the biggest gold discovery in the world that year. The owners of Calgary-based Bre-X Minerals Ltd. had come to Barrick looking for a partner in late 1993. Barrick's geologists liked the look of its property in Indonesia and the company made an offer: it would buy one million Bre-X shares at $1.25 to $1.50 per share in return for the right to an 80% share of any future Bre-X developments. It was an aggressive, even arrogant, proposal that didn't leave a lot on the table for Bre-X, and negotiations fizzled. A year and a half later Bre-X revealed that reserves on its Indonesian property were at least 15 million ounces and maybe as much as 30 million ounces of gold. Bre-X's shares, then $4, shot up to $59. A few months later, as more details emerged of the immensity of the find, the shares continued their climb, passing $270 in May 1996 ($27 after a 10-for-1 split). At this price the market was guessing that Bre-X's ore body contained more than 50 million ounces of gold.

To make sure the next Bre-X does not fall through Barrick's grasp, Munk has tightened up the process of making deals with junior companies and multiplied the projects that Barrick gets involved in. It was just at the end of last year that Barrick announced it had arranged a revolving credit facility for US$1 billion from Royal Bank of Canada. As the Arequipa

takeover subsequently showed, this credit line, plus Barrick's annual cash flow of US$500 million, will buy a lot of deals—even after the heavy development spending planned for ore bodies in mines the company already owns.

"Five years from now," Munk says, "this is what will give us the windfalls for the next three Goldstrikes." He paces round his office, punching his left palm with his right fist. "I will never be able to put gold in the ground. But to bring an entrepreneurial component into my company when I've got cash flow of $500 million a year—if I can't do that, then I should be shot through the head or be fired."

EVEN WITH THE AREQUIPA success, Barrick now finds itself in a race for time. Having arrived on the international scene many years after its major competitors, it has only just put its exploration strategy in place and must now conduct an effective exploration program for a three- or four-year period of heightened competition. In late 1993 Barrick hired a vice-president of exploration, Alex Davidson. During his first two years at Barrick, Davidson established a comprehensive network among all potential gold sites in the world. By this spring, he had employed about 60 geologists based in 10 offices—two in the US and Canada, five in South America (Chile, Peru, Argentina, Brazil and Bolivia), one in Africa (Mali) and two in Asia (Indonesia/China, and the Philippines). The job of these geologists is to find mines big enough for Barrick—and that means a minimum of one million ounces of gold.

"When a junior [mining company] comes up with something," says Davidson, "we have a team in place that is familiar with the geology, and probably familiar with the junior itself, ready to evaluate that property." If Barrick decides to cut a deal with the prospector (which may be a junior gold company or a lone rockhound equipped with a four-wheel-drive truck), Davidson prefers to do it in "earn-in options," whereby Barrick agrees to spend specified amounts on exploration drilling in order to earn anything from 50% to 90% ownership of any mines that may be developed.

With an annual budget of more than US$50 million, Davidson can afford to complete a lot of these deals; by this spring he had already signed more than 50. He also does joint-venture agreements with juniors, similar to the deal discussed with Bre-X. In addition, Barrick has also embarked on its own grassroots exploration. "We're exploring thousands and thousands of square kilometres," says Davidson. "Our target is another big deposit of 30 million or 60 million ounces."

Munk is elephant hunting again. Typically, the hunt is tightly focused, methodical and comprehensive. He is no longer the man who, in the first half of 1993, pondered the dilemma of his success and concluded that perhaps Barrick had become a mature "commodity play" and that it was, perhaps, time to withdraw gracefully. He has changed his mind dramatically about Barrick. "We are going to do some very exciting things," Munk says. Stay tuned. CB

Adapted from Peter Munk: The Making of a Modern Tycoon, *by Donald Rumball. Published this fall by Stoddart Publishing Co. Ltd.; reprinted by permission.*

MMSA GOLD MEDAL
CANDIDATE INFORMATION

CANDIDATES NAME

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Fax: (520) 281-7019

BRIEF EMPLOYMENT HISTORY

1949-1951: Engineer to Mine Foreman, ASARCO, Santa Eulalia, Mexico

1951-1954: Geologist to District Geol., USAEC, Grand Junction, Colorado

1954-1956: Graduate Student, Stanford University

1956-1959. Chief Geologist, Southwest Ventures, Tucson, Arizona
Mine Manager, Menlove Dalton Mine, 1956-57 Utah

1959-1961: District Geologist, Utah Construction Co., San Francisco and Tucson

1961-1998: Consulting geologist and manager of various contract exploration programs financed by major mining companies and joint ventures with majors. From 1993 to 1996 Chairman of public financed company.

1961-Present: Consulting geologist 100 U.S. and foreign mining and engineering companies and governments. Consultant on geological, mine design, and grade control problems. Participated in 13 major feasibility studies. Managed contract exploration projects which discovered Kalamazoo and Casa Grande West orebodies in the U.S. and La Escondida, Zaldivar, and San Cristobal orebodies in Chile. Member of discovery teams for Vekol Hills, AZ; JA, BC Canada; Dizon and FSE-Lepanto, Philippines; Leonor, Chile; Los Calatos and Prierina Peru. Director, IMDI S.A., operator San Cristobal 10,000 TPD gold mine in Chile. Former Chairman of the Board, Arequipa Resources Ltd., Vancouver, Canada. Principal, Minerals Advisory Group, LLC.

MINING INDUSTRY

Memberships/Registration

Arizona Board of Technical Registration

Registered Geologist	1960
Registered Mining Engineer	1967

Committees

U.S. Committee, Continental Scientific Drilling, 1980

Officerships

Gen. Mgr. Ranwick Inc., Subs Ventures Ltd. of Canada	1955-56
V.P. Southwest Ventures, Subs Ventures Ltd. of Canada	1956-59
Pres. Lowell Mineral Exploration Ltda. de Chile	1990-98
Pres. Exploraciones Mineras Lowell, S.A. de C.V., Mexico	1997-98
Partner Minera del Inca Mining Co., Chile	1984-87
President Acuarios Minera de Peru	1991-96
Chairman Arequipa Resources, Canada	1993-96
President CAP II, LLC, Arizona	1996-98
President LME, LLC, Arizona	1998

Awards

See under Professional Societies

Publications

See attached.

PROFESSIONAL SOCIETIES

Memberships

American Institute of Mining Engineers
Mining and Metallurgical Society of America
Arizona Geological Society
Society of Economic Geologists
Chilean Instituto de Ingenieros de Minas

Committees

MMSA Mining Image Committee
Chairman, A.G.S. Publication Committee Arizona Highway Geol. Map
Planning Committee Society Exploration Geochemists

Officerships

Vice President, Yavapai Sub Section, AIME, 1956
President, Yavapai Sub Station, AIME, 1957
Vice President, Arizona Geol. Society, 1973
President, Arizona Geol. Society, 1974

Awards

1970	AIME, Daniel Jackling Award
1974	CIMM, Distinguished Lecturer
1975-80	SEG, Associate Editor, *Econ. Geology*
1977	SEG, Thayer Lindsley Distinguished Lecturer
1982	SEG, Silver Medal
1994	American Mining Hall of Fame, Medal of Merit

Publications

Attached list of 44 publications

ACADEMIA/EDUCATIONAL

Education

1949 - B.S. Min Engr., University of Arizona
1957 - MS Geology, Stanford University
1959 - E. Geol., University of Arizona

Memberships

Alumni Association - University of Arizona and Stanford University

Committees

U.A. Search Committee, Dean College Earth Sciences
U.A. Search Committee, Head Department of Geosciences
Organizing Committee, New College of Mines, Universidad Mayor de San Marcos

Officerships

Chairman, University of Arizona Fund Raising Committee

Awards

Engineer of Geology, Honorary Professional Degree awarded yearly by University of Arizona College of Mines
University of Arizona Distinguished Citizen Award
Nominated for Doctor Causa Honor Degree by Universidad Mayor de San Marcos, Lima, Peru

Publications

See attached list

CIVIC SOCIETAL

Memberships

Prince of Wales Country Club, Santiago, Chile
Mining Club of the Southwest, Tucson, Arizona

Committees

Officerships

Member of the Board of Directors, Mining Club of the Southwest

Awards

University of Arizona Distinguished Citizen Award

MINING AND METALLURGICAL SOCIETY OF AMERICA

Committees

1998 Mining Image Committee

Officerships

None

Position Papers

None

Two luncheon talks, Tucson Section

MAJOR ACCOMPLISHMENTS

Technical Field

Managed uranium mine in Utah.
Participated in 13 major feasibility studies.
Managed seven exploration programs.
Found or managed exploration projects in nine major ore discoveries including Kalamazoo, Escondida, Zaldivar and Pierina Mines.

Business Field

Vice President, Southwest Ventures, subsidiary Ventures Ltd., Canada
President, Lowell Mineral Exploration LLC, Lowell Mineral Exploration Ltda. (Chile), Exploraciones Mineras Lowell S. A. de C. V. (Mexico). Acuarios Minera (Peru)
Chairman, Arequipa Resources (Canada)

Academic/Educational Field

University of Arizona, member of two faculty search committees; Chairman fund raising committee
Member Geosciences Advisory Committee
Several lectures, Advanced Ore Deposits courses

Civic/Societal Field

Member, U.S. Continental Scientific Drilling Committee
Member of Arizona Cattle Growers Association
Member of Arizona Cattlemen's Protective Society
Talks at Arizona public schools
Republican Party activities

Advocacy of the Mining Industry

Member of MMSA Mining Image Committee
Participated in several University of Arizona talks

OTHER MERITS OR ACCOMPLISHMENTS

Taught Geology Short Course, Universidad de Chile.

Lectures in Canada, U.S., Mexico, Peru, Chile, Australia, Philippines, China, England and France.

Keynote Speaker, AGA/SEG Meeting, 1992

Keynote Speaker, Investing in the Andes, Melbourne, Australia, 1993.

Expert Witness, 11 Court Cases, U.S. and Canada

Keynote Speaker (in Spanish), Chilean National Library ceremony honoring Carlos Ruiz, retiring Director Chilean Instituto de Investigaciones Geologicos.

from The Southern Miner, Fall 1996

Point and counterpoint

Pierina: a billion dollar mountain

On August 16, Arequipa issued a press release recommending that shareholders accept an improved offer by Barrick of C$30 in cash or 0.79 of a Barrick common share plus C$0.50 cash for each Arequipa share. This offer works out to a price of C$1,026 million for Arequipa. Congratulations to the new batch of Arequipa millionaires and particularly to David Lowell on a fine exploration job, and to Catherine McLeod on an outstanding and professional job.

View of the 4000m mountain that hosts Pierina.

By all accounts Barrick's bid is markable. Over a billion dollars anadian) in cash for an unproven gold posit is almost unheard of. However, equipa's share price had previously uched C$35/share and the only way to ake the owners of Arequipa sit up and ke note would be to bid at somewhere ound this level. Catherine McLeod's cellent and highly professional promoon of Arequipa has clearly paid off. Also, significantly lower bid would likely have arked a bidding war.

Barrick has signed a lock-up agreeent with key shareholders and directors Arequipa who together hold 23% of the sued common shares of Arequipa, which mmits them to tender their shares. In the ent of another bid exceeding $31.50/shr hich Barrick does not match, the lock greement would be terminated reak-up fee of C$18 million

payable to Barrick if another bid is successful.

Barrick's initial bid for Arequipa Resources in the first half of July of C$27 per Arequipa share placed a value of C$915 million for the company. This bold and unusual offer was made at a time when Arequipa still had published no reserve data. At that time the drill results for only 9 drillholes and 90 pits had been reported in a gold anomalous area covering 280,000 m².

On August 8 Arequipa reported additional drill results indicating extensions of the ore deposit, including a blind ore deposit to the SE of the main zone, and recommended that shareholders not accept the Barrick offer. It was rumored that a competing offer was pending.

Both Barrick's bid and the Pierina discovery itself will put some real oomph back into Peru's gold exploration. It was time for a new major discovery to follow Newmont's excellent success at Yanacocha. Pierina is sparking something of an area play in Peru and the Barrick offer could set a new standard in valuing gold prospects in the Andes.

'Crazy' bid price?

The price bid by Barrick for Arequipa has been described by experienced members of the mining and exploration industry as "crazy." C$1 billion is comparable with the market capitalization of Cia. de Minas Buenaventura, a Peruvian mining company which owns a large piece of the fabulous Yanacocha gold mine, and a huge portfolio of promising exploration projects throughout some of the most prospective areas of Peru.

Barrick came close to acquiring Bre-X and the bid for Arequipa has been interpreted as a possible over-reaction after missing out there.

Counter-point: Barrick's track record

The offer would be "crazy" if it had been made by anyone other than Barrick.

Barrick Gold has a history of seeking out elephants and paying handsomely for them. Barrick is a master at acquiring properties and projects with elephant potential and then maximizing this potential. But Barrick has also been risk-averse in the past and has had its downside more or less covered. What has Barrick seen in Arequipa that the rest of the industry has missed?

Barrick has a track record of recognizing and pursuing projects with huge upside potential. David Lowell, chairman of Arequipa and discoverer of Escondida, has a proven track record as an elephant hunter. Clearly Barrick sees huge potential in Pierina and other deposits like it in the large property position that Arequipa has assembled.

If Barrick is prepared to pay, for argument's sake, US$100/oz for gold potential, then they must see around at least 7 million oz gold in Arequipa. Barrick is clearly looking beyond the current 280,000 m² area (400m x 700m) tested so far.

Barrick's bidding history

Barrick Gold in 1986 bid US$60 million for the Goldstrike gold property which turned into a "company maker" when deep drilling identified the best gold

deposit in North America. At the time Barrick made its bid, about 600,000 oz gold could be identified in reserves scattered around the property.

Barrick could have recovered most of its $60 million acquisition price by mining the 600,000 oz had deep drilling not been successful at the property. In this sense, Barrick had its downside covered. At the time, industry observers expressed the opinion that $60 million was far too much money to bid for Goldstrike. Neighboring Newmont certainly would not have considered paying even a fraction of this price. It is rumored that Bob Smith was "praying for a 2 million oz deposit at Goldstrike" when they acquired the property.

Next, Barrick bid and paid $1.6 billion for Lac Minerals which owned the El Indio, Nevada and Tambo deposits and mine in the Chilean Andes inland from La Serena, copper-gold deposits in Canada, and several promising exploration properties. Improvements in the mine and plant at El Indio, and discovery of the Pascua deposit nearby, along with a new underground gold deposit at Doyon gold mine in Quebec, have more than justified the price paid for Lac Minerals. Some of the purchase price could be recovered by selling off lesser assets. There was also significant additional exploration potential in the surrounding areas. This price was also originally considered very high, but again Barrick seems to have acquired a huge upside opportunity while having their downside covered by production from reserves that they could already see.

In the case of the C$1,026 million bid for Arequipa, there are a few additional assets that can be sold off to recover a part of this purchase price, but the value of Arequipa's joint venture copper exploration projects with Phelps Dodge and Asarco is unknown, but could possibly be as high as say C$100 million depending on results. Arequipa's interest in the El Ferrol deposit near Cajamarca has been factored in, but recent reports since Barrick made its bid indicate that El Ferrol exploration so far has had disappointing results.

Barrick has not discussed its bid for Arequipa, but it appears that they are mostly interested in the Pierina deposit and exploration potential in both the immediate area and in the huge land position with similar geology that David Lowell has assembled.

Arequipa is drilling

Arequipa clearly has great faith in Pierina to prove up a huge ore deposit, otherwise David Lowell would not have kept on drilling furiously while Barrick's initial bid was pending.

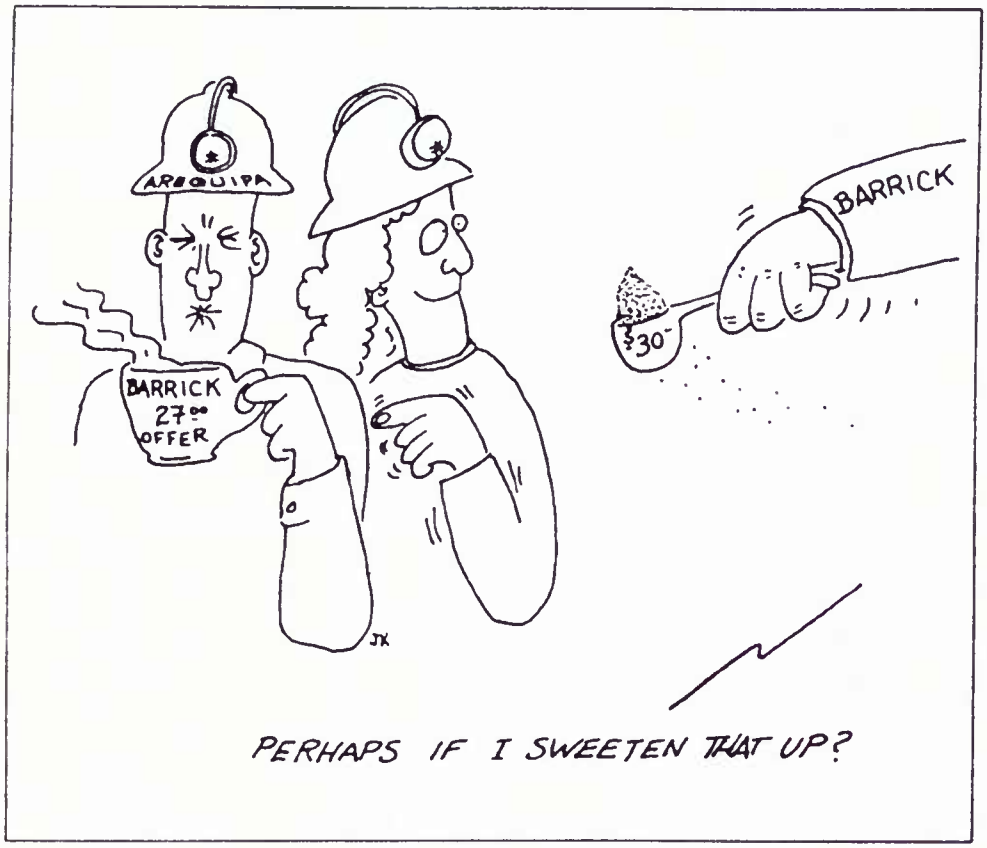
Arequipa has three drills operating night and day at Pierina completing one and a half holes per day down to 200-225 m depth. Each night drill samples are d ven to Lima and prepared for ass Samples are being assayed by three la ratories in Lima with check assay samp being sent to Vancouver. It currently ta about one week to get the assay results

Results of the first nine holes t ninety pits indicate an excellent dep with high gold grades and excellent ad tional silver values. For example, at 0(00E (DDH1) 88m of 6.58 g Au/t and g Ag/t was reported, and at 300S-2((RC-5) 107m of 5.98 g Au/t was repor with additional results still pending fr below this interval.

In fast tracking its drilling program generate a preliminary drill-indica resource on the main Pierina zo Arequipa focussed exploration efforts following the extensions to mineral tions below cover. On August 8 the res of 34 holes on the main zone and south extension and an additional 5 drill h testing the south anomaly area located km from the main Pierina zone w reported.

Some 30 of the 34 holes intercep ore grade mineralization. Tunneling drilling results indicated continuity of main Pierina ore deposit and demonst ed the existence of a still open "blind" zone to the SE that does not outcrop.

from The Northern Miner [n.d.]



From Wall Street Journal, July 12, 1996

Barrick Gold Plans to Make Offer Of $669.5 Million to Buy Arequipa

By Mark Heinzl
Staff Reporter of The Wall Street Journal

TORONTO — Barrick Gold Corp., seeking to bolster its gold reserves, said it will offer 915.3 million Canadian dollars (US$669.5 million) to acquire Arequipa Resources Ltd., which owns a promising gold property in Peru.

Barrick, the world's third-largest gold producer in terms of annual production and North America's biggest, is bidding for Arequipa, based in Vancouver, British Columbia, at an early stage in that company's determination of the size of its Pierina gold deposit in Peru. The offer reflects the increased market values attached to mineral-exploration companies, amid a recent boom in world-wide exploration that has led to some rich mineral discoveries, analysts said.

The offer is "a substantial sum to pay . . . for a project that doesn't have proven and probable reserves yet," said Donaldson Lufkin & Jenrette Securities Corp. mining analyst John Tumazos.

Barrick, which had 36.5 million ounces of proven and probable gold reserves at the start of this year, estimates that Pierina so far contains an unproven "resource" of about five million ounces of gold and so-called gold-equivalent silver, a spokesman said. (Gold-equivalent silver is a way of expressing an amount of silver in terms of gold ounces.)

But Terence Ortslan, a mining analyst with T.S. Ortslan & Associates in Montreal, said that based on the offer, Barrick is probably assuming Pierina has "no less than 10 million ounces in the ground."

Barrick Chief Financial Officer Randall Oliphant said the offer is "generous," but that there's probably more gold to be discovered at Pierina.

Gold companies are constantly under pressure to add new gold reserves while existing reserves are mined out. Barrick's last major acquisition, the 1994 purchase of Lac Minerals Ltd., proved to be a success after recent drilling turned up new gold reserves on acquired properties in Chile.

Barrick said it will offer C$27 for each share of Arequipa, whose shares jumped C$6.60, or 30%, to C$28.60 with 5.8 million shares traded on the Toronto Stock Exchange yesterday. Arequipa's stock traded at just C$2 at the start of the year, before the potential of Pierina was known. Barrick's stock yesterday dropped C$1.40 to C$38.50.

Analysts were split on whether a competing bid is likely. Few other mining companies would be able to top Barrick's all-cash offer, they noted. Arequipa declined to comment on the offer.

From London Financial Times, July 12, 1996

Golden girl

■ Peter Munk's Barrick Gold might be thought to be taking a bit of a gamble with yesterday's hefty US$670m bid for Arequipa Resources of Vancouver. For Arequipa, a mere four years old, has no mines, and its main exploration property in Peru has yet to be fully sampled.

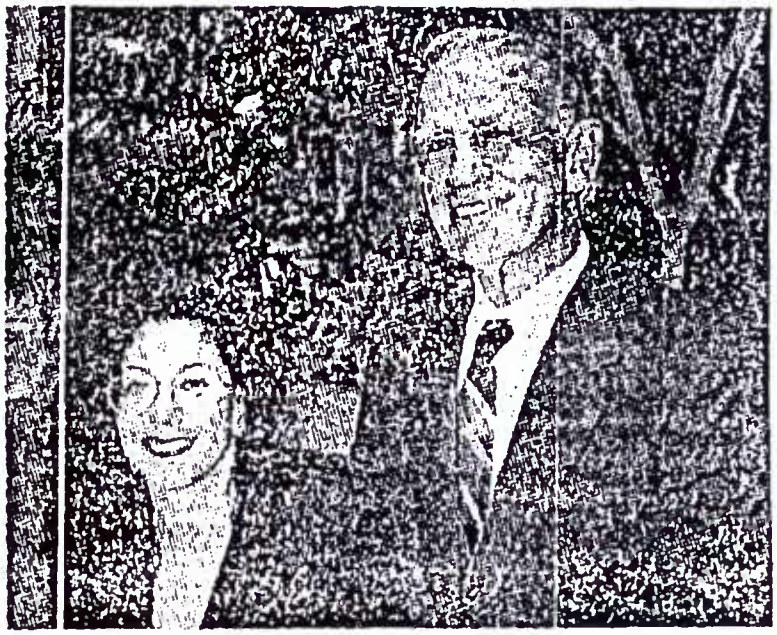
All the same, Munk may turn out to have made a canny choice on where to place his chips. Arequipa's founder and chairman, David Lowell, is something of a legend in the mining industry. Lowell, now in his late 60s and living in Arizona, is credited with the discovery of Chile's Escondida, the world's biggest copper mine. Another Arequipa director is a former president of Placer Dome, another respected name in the gold business.

Arequipa's chief executive, Catherine McLeod, is among only a handful of women in the upper echelons of the mining business. Mining certainly runs in the veins. Her father heads another small Vancouver mining company and her brother is a mining engineer. Instead of spending holidays on the beach, the McLeod family used to head for old mining camps.

McLeod, who is in her late 30s, will do well if Barrick (or someone else) ends up buying Arequipa. The bid values her stake at almost C$9m, not counting several million dollars worth of options. A reasonable reward for those missed sand castles?

David Lowell has sold out to Barrick Gold

Arequipa sale nets founder C$87m



David Lowell and Catherine McLeod: met in South America

David Lowell's achievements as a geologist already have secured him a place in the Mining Hall of Fame. Now they have also made him a very rich man. At the weekend he was celebrating after agreeing to sell the company he set up four years ago to Barrick Gold, North America's biggest gold producer, for more than C$1bn (US$728m) and on terms that value his personal holding at C$87m.

It is for copper rather than gold that Mr Lowell won his place in mining history. In 1970 he wrote a paper about a different way of finding big copper deposits. Since then, many other geologists have successfully employed that theory. He, himself, has collected six "finder's fees" for copper projects, culminating in the 1981 discovery of Escondida in Chile, now the world's biggest copper mine.

The Escondida discovery would have allowed him to retire and live comfortably for the rest of his life. Instead, Mr Lowell, who is now 68, set off to test his theories in Peru.

In South America he met Ms Catherine McLeod, daughter of a Canadian mining entrepreneur and then working for stockbroker Yorkton Securities in Santiago. Previously Mr Lowell had acted as a consultant for other companies. When Ms McLeod realised the potential of the properties he had assembled in Peru, she persuaded him to set up his own company instead. He later appointed her president.

Arequipa was launched on the Vancouver exchange late in 1994 at 78 Canadian cents a share. In January this year the shares were trading at C$2.50. Barrick bid C$27 cash in July but had to lift the offer to C$30 to win the backing of Mr Lowell and Ms McLeod.

Ms McLeod is now 36. Her shares and options are worth about C$17m and several other Arequipa directors and employees are now dollar millionaires.

Arequipa's prime asset is the Pierina gold deposit 400km north of Lima. Arequipa had sunk only nine drill holes into Pierina before the Barrick bid and these suggested there might be 3.5m troy ounces of gold there. Barrick obviously believes there is much more. So do Mr Lowell and Ms McLeod. During the five weeks while the first bid was on the table, Arequipa speeded up drilling on the site and the results were encouraging.

Mr Lowell says the new bid offers Arequipa shareholders the chance to benefit from further discoveries at Pierina or the several other projects the company has been developing in Peru because Barrick is now offering cash or a shares-and-cash alternative.

"I personally will elect to receive a substantial portion of my consideration in Barrick stock," he says.

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