
CONNECTIONS

The EERI Oral History Series

**Egor P.
Popov**

Stanley Scott
Interviewer

CONNECTIONS

The EERI Oral History Series

Egor P. Popov

CONNECTIONS

The EERI Oral History Series

Egor P. Popov

Stanley Scott, Interviewer



Earthquake Engineering Research Institute

Editor: Gail H. Shea, Albany, California

Cover and book design: Laura H. Moger, Moorpark, California

Copyright 2001 by the Earthquake Engineering Research Institute and the Regents of the University of California

All rights reserved. All literary rights in the manuscript, including the right to publish, are reserved to the Earthquake Engineering Research Institute and the Bancroft Library of the University of California at Berkeley. No part may be reproduced, quoted, or transmitted in any form without the written permission of the executive director of the Earthquake Engineering Research Institute or the Director of the Bancroft Library of the University of California at Berkeley. Requests for permission to quote for publication should include identification of the specific passages to be quoted, anticipated use of the passages, and identification of the user.

The opinions expressed in this publication are those of the oral history subject and do not necessarily reflect the opinions or policies of the Earthquake Engineering Research Institute or the University of California.

Published by the Earthquake Engineering Research Institute
499 14th Street, Suite 320
Oakland, CA 94612-1934
Tel: (510) 451-0905 Fax: (510) 451-5411
E-mail: eeri@eeri.org
Web site: <http://www.eeri.org>

EERI Publication Number: OHS-9

ISBN (pbk.): 0-943198-12-7

Library of Congress Cataloging-in-Publication Data

Popov, E. P. (Egor Paul), 1913-

Egor P. Popov / Stanley Scott, editor.

p. cm. -- (Connections: the EERI oral history series ; 9)

Includes index.

ISBN 0-943198-12-7 (alk. paper)

1. Popov, E. P. (Egor Paul), 1913--Interviews. 2. Civil

engineers--California--Interviews. 3. Earthquake engineering--California--History. I.

Scott, Stanley, 1921- II. Earthquake Engineering Research Institute. III. Title. IV. Series.

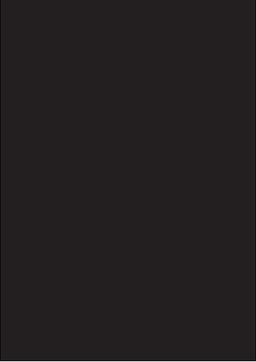
TA 140.P65 A5 2001

624.1'762'092--dc21

2001054499

Printed in the United States of America

1 2 3 4 5 6 7 8 07 06 05 04 03 02 01



Acknowledgments

The help, encouragement, and editorial feedback of EERI Executive Director Susan K. Tubbesing and the EERI Board of Directors were instrumental in both establishing *Connections: The EERI Oral History Series* and in bringing this volume to publication.

EERI also gratefully acknowledges partial funding of this project by the Federal Emergency Management Agency (FEMA).

The editor would also like to acknowledge the invaluable assistance of two people: Gary Varum of Telesis Engineers for his help with all things Russian; and Ms. Jan Ambrosini, Associate Director, Engineering Public Affairs, University of California at Berkeley for her help with historical data and photographs.

Special thanks are also due to the Popov family for sharing family photographs and for their generous contribution toward the publication of this volume.



Table of Contents

| | |
|--|------|
| Acknowledgments | v |
| The EERI Oral History Series | ix |
| Foreword, by Stanley Scott | xi |
| Personal Introduction, by Karl S. Pister | xiii |
| Notes on My Interviews and Life, by Egor P. Popov | xvii |
| Chapter 1 Origins In Russia | 1 |
| Chapter 2 World War I and the Russian Revolution | 9 |
| Chapter 3 Living in Manchuria, 1921-1927 | 13 |
| Chapter 4 Popov Family Settles in San Francisco | 23 |
| Chapter 5 Undergraduate Years at the University of California at Berkeley | 29 |
| Chapter 6 Graduate Studies at MIT and Caltech | 37 |
| Chapter 7 Working as a Practicing Engineer, 1937-1945 | 41 |
| Chapter 8 Early Career at U.C. Berkeley, 1946-1970 | 47 |
| Chapter 9 Thirty Years of Research in Seismic Design, 1970-2000 | 57 |
| Chapter 10 Reflections | 75 |
| Photographs | 77 |
| Appendices | |
| Major Awards and Medals | 89 |
| Other Significant Awards | 90 |
| Books by E.P. Popov and Their Translations | 91 |
| Doctoral Students of Professor Egor P. Popov | 92 |
| Index | 93 |



The EERI Oral History Series

This is the ninth volume in *Connections: The EERI Oral History Series*. The Earthquake Engineering Research Institute initiated this series to preserve the recollections of some of those who have pioneered in earthquake engineering and seismic design. The field of earthquake engineering has undergone significant, even revolutionary, changes since individuals first began thinking about how to design structures that would survive earthquakes.

The engineers who led in making these changes and shaped seismic design theory and practice have fascinating stories. *Connections: The EERI Oral History Series* is a vehicle for transmitting their impressions and experiences, their reflections on the events and individuals that influenced their thinking, their ideas and theories, and their recollections of the ways in which they went about solving problems that advanced the practice of earthquake engineering. These reminiscences are themselves a vital contribution to our understanding of the development of seismic design and earthquake hazards reduction. The Earthquake Engineering Research Institute is proud to have part of that story be told in *Connections*.

The oral history interviews on which *Connections* is based were initiated and are being carried out by Stanley Scott, formerly a research political scientist at the Institute of Governmental Studies at the University of California at Berkeley. Scott has been active in and written on seismic safety policy and earthquake engineering for many years. A member of the Earthquake Engineering Research Institute since 1973, Scott was a commissioner on the California State Seismic Safety Commission for 18 years, from 1975 to 1993. In 1990, Scott received the Alfred E. Alquist Award from the Earthquake Safety Foundation.

Recognizing the historical importance of the work of California's earthquake engineers, Scott began recording oral history interviews with Henry Degenkolb in 1984. Their success let him to consider such interviews with other older engineers. He consulted Willa Baum, Directory of the University of California at Berkeley's Regional Oral History Office, a division of the Bancroft Library. Since its inception in 1954, the Regional Oral History Office has carried out and otherwise promoted oral history interviews on a wide range of major subject areas in science and technology, natural resources and the environment, politics and government, law and jurisprudence, and in many other areas. Scott was encouraged to proceed, and the Regional Oral History Office approved an unfounded interview project on earthquake engineering and seismic safety. All of Scott's subsequent interviews were conducted while he was employed by the Institute of Governmental Studies at U.C.

Berkeley. Following his retirement from the University in 1989, Scott has continued to pursue the oral history project. For a time, some expenses were paid from a small grant from the National Science Foundation, but Scott has done most of the work pro bono.

Scott has attempted to include a selection of senior earthquake engineers who have been active observers of and participants in the earthquake safety effort. In addition, he has included nonengineering professionals in related fields (geology and geophysics) who have made significant contributions to the body of knowledge in earthquake engineering.

The Earthquake Engineering Research Institute learned of Scott’s interview series, and reviewed a number of the early interview transcripts. EERI’s interest in preserving these recollections led to publication of this Oral History Series.

The Earthquake Engineering Research Institute was established in 1949 as a membership organization to encourage research, investigate the effects of destructive earthquakes and the causes of building failures, and bring research scientists and practicing engineers together to solve challenging engineering problems through exchange of information, research results, and theories. In many ways, the development of seismic design is part of the history of EERI.

EERI Oral History Series

| | |
|--|------|
| Henry J. Degenkolb | 1994 |
| John A. Blume | 1994 |
| Michael V. Pregnoff and John E. Rinne | 1996 |
| George W. Housner | 1997 |
| William W. Moore | 1998 |
| Robert E. Wallace | 1999 |
| Nicholas F. Forell | 2000 |
| Henry J. Brunnier and Charles De Maria | 2001 |
| Egor P. Popov | 2001 |

Interviews completed or nearing completion include:

| | | |
|-------------------|-----------------------|---------------------------|
| Clarence R. Allen | John F. (Jack) Meehan | Earl Schwartz |
| L. LeRoy Crandall | Joseph P. Nicoletti | George A. (Art) Sedgewick |
| Roy G. Johnston | Edward O'Connor | James Stratta |
| Ralph S. McLean | Clarkson W. Pinkham | William T. Wheeler |



Foreword

The first two-thirds of Egor Popov's oral history is based on four face-to-face interviews conducted in 1996. After that, however, health problems forced me to stop interviewing, whereupon we dropped the project. Several years later he approached me again, asking for help in completing what he called his autobiography, but doing so without further recorded interviews. We agreed to cast the new material in the dialog format typical of recorded sessions, but in fact we worked separately. That is how the final third of the history was done—Popov would draft sections and send them to me for editorial review. I would edit and ask questions, to which he would respond. A good deal of the material covering his first 24 years on the University of California at Berkeley faculty was prepared or revised that way. All the subsequent portions of the oral history dealing mostly with his last 30 years in Berkeley were initially prepared by Popov, working alone, and then sent to me for editing and raising questions. These compromises in oral history method enabled us to complete his personal history.

Popov's story begins in the violent transition from Czarist Russia to the Soviet Union, and includes a gripping, poignant account of his family's escape to Manchuria in his early youth, their eventual move to the United States, and his life here. His distinguished and productive career as a professor of engineering at U.C. Berkeley ended with his recent death at age 88, while he was still actively engaged in the research that he had pursued so avidly and effectively for so many years: projecting the seismic performance of structural materials and members. I am indeed gratified that I could help bring this work to completion for inclusion in the EERI Oral History Series.

Stanley Scott
Research Associate
Institute of Governmental Studies
University of California, Berkeley
October 2001



Personal Introduction

It was my great privilege and pleasure to know and work with Egor Paul Popov for more than half a century. It is my hope that these remarks, while personal to me in large measure, will strike resonant chords in readers' experiences in knowing and working with this extraordinary individual.

Egor Popov was appointed Assistant Professor of Civil Engineering at the University of California at Berkeley on July 1, 1946. I, recently separated from active duty in the Navy Civil Engineer Corps, entered graduate study in the Division of Civil Engineering and Irrigation, as it was then called, in the fall semester that same year. Almost by accident, I was appointed as a Teaching Assistant and found myself as an assistant to Professor Popov during spring semester. That spring began my lifelong association with the man who became my teacher, mentor, colleague, and friend.

Little did I realize or appreciate then the impact on my own life that appointment would have. I began by grading midterm examinations in Strength of Materials, CE 108A, learning about the subject the many things that I had missed as a student. The following academic year, I was promoted to Lecturer in Civil Engineering, with CE 108A as part of my teaching assignment. The text was woefully out-of-date, particularly for a teacher with the background afforded Egor in studying mechanics with Professor Stephen Timoshenko, coupled with his substantial professional experience. Thanks to the many hours of conversation and discussion of the subject as well as teaching methods with Egor, his offers of help on examinations, and lots of encouragement, I, along with other young colleagues, managed to stay ahead of most of the students in our classes during those early years. Suffice to say his teaching style was inspirational, whether in or out of the classroom.

Egor's influence continued unabated when I, taking advantage of the GI Bill, enrolled in his two graduate courses, CE230A-B, in advanced mechanics of materials. A whole new world opened up for me—the world of applied mechanics. Egor first gave us a grand tour of the history of the subject, drawing on his personal contact with Stephen Timoshenko and Theodore von Karman. Next, he showed us how mathematical language and methodology could be used to describe and comprehend complex physical problems in engineering materials and structures. He painted masterpieces of physical reality using the abstract style of applied mathematics, something I had never seen as an undergraduate. The impact on me, as a newly minted Master of Civil Engineering, was to affect the rest of my life.

Egor inspired me to leave Berkeley for my Ph.D. at the University of Illinois. Before that happened, however, let me interject three unrelated recollections of his class. The first of these is that a fellow student whom I met was Mihran Agbabian, who became a lifelong friend and colleague, in spite of his raising the average on Egor's examinations. Mihran became Egor's first Ph.D. student and Berkeley's first Ph.D. in Structural Engineering. My second remembrance is Egor walking in the door, briefcase in hand, wearing a felt hat. I can't remember when he gave up that habit, but it lasted for some years. Finally, I still recall an entrance to the classroom when he came in with a letter from Timoshenko, laughing about it because Timoshenko was kidding him about octahedral shear stresses—in Russian, of course. Can one ever imagine what that could have been about!

Earlier I noted Egor's disaffection with textbooks on strength of materials. He was intent on writing such a book, but was hesitant because of the book of his mentor, Professor Timoshenko, had written on that subject. Egor took a first step in that direction by agreeing to write a correspondence course version of CE 108A for U.C. Berkeley Extension. He honored me by asking that I assist him in the undertaking, for which, as I recall, we received the sum of one hundred dollars (recall that this was in 1949!). Many of the ideas that later appeared in his first book found their origin in that set of notes.

That first book was a delight for all who used it, beginning a trend in textbook writing that reshaped the teaching and learning of thousands of engineering students around the world—for *Mechanics of Materials* and his following book, *Introduction to Mechanics of Solids*, have been translated into eight languages. But I have jumped ahead with that statement, for *Mechanics of Solids* was not published until 1952.

In the interim, an important book-related event occurred. I returned from Urbana to spend the summer of 1950 in the Bay Area to make plans for my upcoming marriage and to teach in Berkeley's summer session to gain library resources. Egor was diligently working on the book manuscript for *Mechanics of Solids*. What better arrangement could be imagined? I moved in with him, and he sent his wife Irene and the children, Kathy and Alex, to Yosemite.

When not teaching or visiting my wife-to-be in Oakland, we worked on the book. That often entailed sessions at one or two o'clock in the morning, when I returned to his house on Hilgard Avenue to find him sitting in his living room writing away and awaiting my return to try out some new idea or new language on me, who was understandably not in the best state

to offer constructive advice. Yet, he did not give up on me, for he and Irene attended our wedding in that fall. I should also note that while Egor wrote out the manuscript in long-hand, Irene, upstairs in the bedroom, was busy typing the draft. Her efforts can only be called heroic, given old typewriters without the capacity to deal with equations. I cannot leave unspoken my experience in the Popov household at breakfast time. I learned about several quality grades of oatmeal mush—the ordinary variety was “bearsy mush” and the special grade was “bishop’s mush.” I expect that Kathy and Alex ate the bearsy variety more often than not.

A second phase of our relationship began in late 1951 and 1952. Egor planned his first sabbatical leave to be taken in Switzerland and Germany during academic year 1952-53. His absence opened up the need for a replacement in the field of mechanics in the Division of Civil Engineering and Irrigation. Since I was due to complete my Ph.D. in June 1952, I was encouraged to apply for the position, which at the beginning was only temporary. My appointment and the position became permanent, fortunately for me. During Egor’s absence, I had the opportunity to teach his two graduate courses, which gave me a tremendous start. In a sense, it was here that his earlier role as teacher now became that of teacher/mentor, for when he returned, he generously gave me the chance to sit in his courses and informally “co-teach” with him. Nor did it stop there, for with his leadership, a strong program in structural mechanics began to take shape. We co-taught the first course in Theory of Plates and Shells, at the beginning to as few as two students! He offered encouragement and support to me to begin a course in continuum mechanics, which in turn led to my gaining one of the first industry-supported grants in the structural mechanics field. Egor was always there when one needed advice and direction, and he was unflinching in his support of a deserving colleague in the complex academic personnel process of the University.

I cannot fail to mention an incident that even today, almost fifty years later, makes me wonder. I was in the cycle for a merit increase, so it was Egor’s responsibility to sit in on my CE108A class to evaluate the quality of my teaching. The day arrived and he sat quietly in the back of the room. I was explaining a problem that required calculating the shear stress on a circular rivet. I found the correct shear force but, alas, I could not recall the formula for the area of a circle! After class, he gently observed that he thought he should pay a return visit before doing his evaluation. He did and I passed, thankfully.

In 1958 Egor was asked to lead the “structural group” in what is now the Department of Civil Engineering. He not only provided that day-to-day operational effort, but more important, at a time of growth of the faculty he facilitated a number of outstanding appointments. In addition, he led the initiative to create the Division of Structural Engineering and Structural Mechanics in the Department of Civil Engineering—the first of its kind in the United States. Coming at the time of Sputnik, it was a most fortuitous act, for it gave Berkeley a headstart in building and sustaining a nationally acclaimed graduate program in that area.

I have left untouched the superb scope and depth of Egor’s scholarly accomplishments—these are better left to the oral history that follows. Nor have I called attention to his unrelenting commitment to teaching, whether in the classroom, office, or laboratory, for he was a master in each arena. His many national awards attest to the quality of his research, while the Distinguished Teaching Award presented by the Berkeley Division of the Academic Senate attests to the quality of his pedagogy. The positions held by his doctoral students, as well as their independent scholarly and professional contributions add further evidence of the impact he made on both the academic world and the structural engineering profession.

Egor displayed a passion for and devotion to his work seldom seen. Can anyone who knew him recall a chance meeting, after which one had not been thoroughly briefed on the next paper or the next invited lecture to be delivered somewhere in the world? I think not.

Finally, on a personal note—oddly, Egor and I never published a joint paper. We wrote one years ago and it was turned down. This simply adds further proof to a proposition that I learned on the occasion of my own retirement—it is not the things that one does, the papers that one may write that ultimately count in life, but it is the people with whom one is privileged to associate.

Egor entered my life fifty-one years ago like a step function; his impact shaped my life and remains with me today. We who knew him, worked with him, respected him and yes, loved the man, are a privileged band. We are challenged to sustain his legacy.

Karl S. Pister
Chancellor Emeritus, *University of California at Santa Cruz*
Roy W. Carlson Professor of Engineering, Emeritus
University of California at Berkeley
November 1, 2001



Notes on My Interviews and Life

This is the story of my fantastic, turbulent life. I survived by the selfless dedication of my parents. There were several events in which, without their help, the question of survival was at stake. After my marriage, without the kind guidance and extraordinary help from my wife, Irene, I could not have generated the volume of the technical work that is associated with my name. She invariably helped me by editing and typing my papers and books. Generally, this avoided the problem of getting my work ready without the University's help. The University and the profession recognized my efforts, however, especially my work in the area of seismic structural design, and I received numerous awards. This history is dedicated to my parents and to my late wife, Irene.

In developing this manuscript, it is a pleasure to acknowledge Stanley Scott, who has meticulously gone through the text, and to the superb secretarial support provided by Linda Calvin, who with good humor tolerated my endless revisions and, I am sure, also helped to Anglicize my words.

Professor Egor P. Popov
Emeritus Professor of Civil Engineering
University of California at Berkeley
College of Civil Engineering, Davis Hall
November 2000
(ob. April 19, 2001)

CONNECTIONS

The EERI Oral History Series

Egor P. Popov

Origins In Russia

I was born in Kiev on February 6, 1913, according to the old Julian calendar, which Russia was still using then.

Scott: I know you have a very interesting early background. You were born in Russia, escaped the Communist regime, and eventually embarked on your successful career in structural engineering. Why don't you begin with your childhood in Russia?

Popov: Kiev (Kyiv), the capital of Ukraine, is the city of my birth. Located on the high bank of the Dnieper River, with its numerous churches, it is one of the most beautiful cities in Europe. The city carries the name in honor of the oldest of the three brothers and a sister who are considered to be the founders of the city in the fifth century. In consultation with his boyars in 987, Prince Vladimir, with no apparent difficulties, converted the entire population into the Orthodox Christian faith and acquired the title of Saint.

Paternal Ancestors

Popov: My forebears were mostly clergymen, doctors, engineers, and teachers. The Popov roots are evidently in Novgorod, which the Norsemen, or Vikings, earlier called Holmgard or Naugard, meaning that it was a new town. It was the farthest eastern outpost of the Hanseatic League. The Russians had repeated skirmishes with the Swedes, but finally

they prevailed under Ivan III, Prince of Moscow, in the late 1400s.

Novgorod is on Lake Il'men at its outlet to the river Volkhov, which flows north to Lake Ladoga, providing access to the Baltic Sea. In addition, the river Lovat', which originates about 120 kilometers (75 miles) north of a bend in the Dnieper River and flows north, enters the southern side of Lake Il'men. This provides an artery for water transport to the south, toward but not directly into the Dnieper River, which flows by Kiev and on to a outlet on the Black Sea, near Herson.

Scott: So I take it that provides a nearly direct water-transport linkage between the Baltic and Black Seas, except for a divide of higher terrain separating the watershed of the river Lovat' from that of the Dnieper River? You said the Lovat' originates about 120 kilometers north of a bend in the Dnieper?

Popov: That is right. Boats going to or from Novgorod had to be dragged over this hump in order to get from the highest navigable upper reaches of the River Lovat' on across to the Dnieper. That enabled boatmen navigating on the Black Sea to reach Constantinople rather easily.

Scott: They surmounted that higher terrain with portages that carried their boats and goods overland between the two water routes?

Popov: Yes. Kiev, some 550 miles to the south of Novgorod was the largest settlement along the Dnieper River. That is why the Russian state really originated in Kiev and had Norsemen chiefs. The ruling family from Novgorod is ascribed to Rurik, the first visible ruler of the Kievan Rus, who in 860 A.D. led an expedition

against Constantinople. Rurik was followed by Oleg, Igor, Olga, Sviatoslav, Vladimir and Yaroslav, and by 1054 A.D., the Kievan Rus had expanded to the Black Sea on the south, reached the Volga on the north and west, and faced Poland and Lithuania on the east.

Scott: Quite an empire, and at least the early leadership came from Norsemen, of Scandinavian derivation.

Popov: Yes. It shows up in the names. My own name, Igor (or Egor), for example, started off from something like Ingvar, and one of my grandmothers was named Olga, which also has Scandinavian beginnings.

Anyway, in the late 1400s, when Ivan III of Moscow conquered a lot of territory, including Novgorod, he made some big changes. He abolished the city-state charters and marched many people to the Urals, a very long distance away. In that fashion some of my father's ancestors were sent away from Novgorod and marched to the Urals on foot, to a frontier-like country where there were log dwellings and that sort of thing. In the township—Ostroshky—from which my father's mother came, a heavy picket fence surrounded the settlement, just as in the American West. I remember seeing such a picket fence in Poland.

Scott: Something like a stockade, I guess.

Popov: Yes, precisely. Anyway, my Popov ancestors originated in Novgorod, and then in due course moved to Perm, the city in the Urals that in the Communists era was called Molotov—after Vyachaslav Molotov, the Foreign Minister under Stalin, and for whom the “Molotov cocktail” was named. Molotov's fam-

ily had rented one of my paternal grandfather's apartments.

Scott: Why did the Czar march all those people all that long distance out to the Urals? Perm is roughly 1500 kilometers or 900 straight-line miles east of Novgorod, and the route they would have taken on foot was probably a good deal farther.

Popov: He sent them to the Urals because in Novgorod they had a very democratic society, and the city-state of Novgorod operated completely on those principles. Czar Ivan wiped out the leadership of the city-state, marching the leaders out of there. He sent them walking the vast distance from Novgorod to the Urals. Then he put his own people in power.

My grandfather on the Popov side was Rev. Theodore M. Popov. After having been ordained as an Orthodox priest, he moved from his village into Perm, on the Trans-Siberian railroad. He became very prominent in Perm, was in charge of a large church, and managed a large facility for elderly people. In that post he displayed some unusual behavior, such as shaving his facial hair, and was accused of looking like a German pastor rather than like an Orthodox priest. He gave in, and this incident did not last long.

Much more important was his acquisition of the skill of smallpox vaccination by using live vaccinated calves, following the pattern of Western Europe. When this sickness ravaged the countryside, he performed over 100,000 vaccinations, a feat recognized by the government when he was awarded a nonhereditary title equivalent to "Sir" in England, a title very seldom given to clergy. For the benefit of the

whole diocese, he also organized a candle factory of some importance to the church treasury.

His children also did well. One became a captain of a ship on the Volga-Kama, was inducted into the Navy as an officer during World War I, and drowned in the Baltic due to hostile action. Another of his children became a high school teacher, still another became a famous lawyer.

Scott: Those were your uncles.

Popov: Yes. My father, Paul Theodore Popov, became a physician.

Scott: Those Popov siblings did well.

Popov: I also want to mention my grandfather Popov's brother, and especially his son, Alexander, an early-day researcher in the transmission and reception of radio waves. The father, my grandfather's sibling, was also a priest, and settled in a village near Ekaterinburg—Sverdlovsk under the Communists—a city of over one million people on the Trans-Siberian railroad, and the first large city going east from Perm. His son, Alexander Stepanovitch Popov—my father's cousin—graduated from a seminary in Perm and was a frequent visitor at my grandfather's home.

Alexander Popov later became a professor of electrical engineering in St. Petersburg, and was involved in early-day radio transmission. A 1901 item in the Philadelphia newspaper *North American* called it the "world's first apparatus to receive electric signals" and suggested that Alexander Popov's invention preceded Marconi's.¹

1. Italian-born Guglielmo Marconi (1874-1937) shared—with German physicist Karl Braun—the 1907 Nobel Prize in physics for his work in wireless telegraphy.

Scott: Yes, it well documented that Marconi was not the only early-day experimenter with transmission of radio waves. Several experimenters in England and Europe were trying their hand, although here in the United States we did not know much about any Russian work.

Popov: That's right. There is also more information about Alexander Popov—they spelled it "Popoff"—in an item that a friend of mine, Frank Hortig, sent me from the journal *Radio-Electronics*, dated October 1963. Titled "Inventors of Radio: Alexander Stepanovitch Popoff," the item briefly details his experimentation with wireless devices and antennas, development of a thunderstorm detector, and transmission of Morse signals over ever-increasing distances. I'd like to excerpt the item here:

On March 24, 1996, [Popoff]...and his assistant, Rybkine, gave a demonstration at St. Petersburg, transmitting Morse signals between two buildings...and recording them on tape. This radio program—the first in the world...—comprised only two words: Henri Hertz.

In March 1887, he established a station at Kronstadt, and equipped the cruiser *Africa* with his apparatus. As the story of Popoff's record goes, in 1899 wireless communication was established between the battleship *Admiral Aprasin* and the coast, a distance of 45 miles. In 1900, a wireless dispatch from St. Petersburg, using Popoff's apparatus, was flashed to the icebreaker *Ermak*, instructing the crew to rescue a group of fishermen stranded on floating ice in the Gulf of

Finland, possibly the first time wireless was used to save lives at sea....

The article continues:

Undoubtedly Popoff has considerable justification in his claim for firsts in wireless telegraphy as his dates are mostly contemporary with Marconi. But being a basic scientist Popoff is said to have refused to take out patents on his wireless system, contending that the discoveries should benefit the scientific world at large.

The article also notes, however, that Alexander Popov died in St. Petersburg in 1906 at quite a young age, forty-seven, having been born in Perm in 1859.

Scott: That was such an early death. Nevertheless, your father's cousin Alexander was evidently right in there with some of the very early experimenters.² Some of the others, of course, were not only interested in the scientific side, but also worked as promoters and entrepreneurs, and I guess Marconi was among the most active.

2. Editor's note: The Encyclopedia Britannica has a substantial amount of information in its item on Aleksandr Popov, and concludes, "Although it is agreed that Popov's experimental work in connection with Hertzian waves is deserving of recognition, it has not been generally accepted that radio communication was actually invented by him. Popov's description of his receiving apparatus, which he published in January 1896, coincides closely with that described in Marconi's patent claim of June 1896. Popov is credited, however, with being the first to use an antenna in the transmission and reception of radio waves." (From Britannica.com.)

Popov: Yes. Now I will turn to briefly to my grandmother on my father's side, Lubove (Love) Kalashnikova. According to my mother, my paternal grandmother had an unassuming, pleasant personality and was largely concerned with being a mother, as well as busy with parish activities as an aide to her husband, the priest. Her sister was married to a medical doctor named Mislavsky, who did the first thyroid operation in Europe, as well as about 4,000 cataract operations.

Maternal Ancestors

Popov: My mother's father was Mitrofan P. Deryabin, who was born into a doctor's family in Kirov (earlier called Vyatka). He was an extraordinarily good student and graduated from his high school with a gold medal. His father wanted him to be an engineer, the most prestigious profession at that time, but he stubbornly resisted, enrolling in and graduating from a medical military academy in St. Petersburg. A saying about him was passed on to me: "He was the youngest in the class, also the smallest, but was the best student." In that school, traditionally on graduation only the best student was issued a full military regalia, and his name was recorded on a gold board.

It is interesting to note that early in the 1700s, Peter the Great, with his admiration for Western technology, dispatched a man named Deryabin to Germany to learn a better process for casting steel. Steel was badly needed for the repeated wars with Turkey. This Deryabin, who was an engineer, founded a steel and ammunition factory on the river Izh at Izhevsk. His monument, dated 1808, still remains at the factory and to this day some of the best steel in

Russia is produced there. For this work, he was awarded a hereditary title of nobleman. This may have been an additional reason why Mitrofan's father wanted his son to be an engineer.

Scott: Do you think there may be some family connection between your mother's Deryabin people and the steel-making Deryabin?

Popov: Yes, I do, and my mother certainly thought so. I recently verified the story with my brother Nicholas, who fully corroborates my own recollection of my mother talking about our distant Deryabin relative who founded the steel factory.

My maternal grandmother, Olga S. Mirsky, was also an excellent student. She originated somewhere in the area known as Kievan Rus, and in St. Petersburg she graduated from a rigorous, elite, four-year college known as the *Bestujevski* courses. Few women ventured this difficult education, but in later years such a background turned out to be a blessing. When her husband later died from pneumonia, she was able to get a good job very quickly.

These Deryabin great-grandparents of mine were pretty good planners. As Mitrofan, my grandfather, finished his five years at the medical school, Olga, my grandmother, finished her four years of college. They were immediately married in one of the cathedrals in St. Petersburg. My grandfather, being the best student, exercised the privilege of selecting an assignment anywhere in the Empire. He chose Poland, part of which was under Russian control. My mother, Zoe, was born near Warsaw, where there was a small encampment of Russian troops. They relocated elsewhere after my grandfather finished his stint with the Army.

My father was also a very good student, and in his youth I think was also a little cocky. He was sure he was going to be admitted to the top medical school in St. Petersburg, but found otherwise when he showed up there. Our family name Popov is rather common in Russia. My father's name was Paul Theodore Popov, but there was another applicant with the very same three names, and I guess that applicant's record was not very good.

Anyway, when my father arrived, they told him, "You are such a bad student that we threw your application out." It was actually the other guy they were thinking about, but by the time this became clear, it was already too late to enroll for the medical school. Moreover, Russia's 1905 "bloodless revolution" was shaping up. So for one year my father went to the university in Kazan in the middle of Russia, where his uncle was a professor of animal husbandry, and talked him out of following the specialty of animal husbandry.

The next academic year, my father enrolled in the University of Tomsk in Siberia. This was one of the twelve medical schools in all of Russia, presumably all of the same standard. He graduated from the medical school in Tomsk in 1911. While in this school, he was noticed by one of the professors as someone considered promising. When that professor was offered a professorship in Kiev, he took my father along.

While my father was on the way to Kiev, he stopped in Kharkov where his bride-to-be was living with her parents. Kharkov, a major city east of Kiev, had once been the capital of the Ukraine. While my future mother was waiting for her groom, she was attending a dental school

in Kharkov. They were married in a big church ceremony in Kharkov and went off to Kiev.

In Kiev, my father assumed his duties in the medical school of the St. Vladimir University—now Shevchenko University—specializing in obstetrics and gynecology. My mother continued with her study of dentistry. Her old records show her transferring from the Kharkov Dental School to the Kiev Dental School in 1912, and starting in Kiev during the third semester. The Kiev Dental School had been organized and was owned by a Dr. Z. Golovchiner and a Dr. S. Lurie. (The name of "Dr. of Dentistry Z. Golovchiner" also shows on my mother's diploma.) The owners liked my mother very much, and if life had turned out differently, she would have been teaching dentistry in that school.

Scott: So the Kiev Dental School was a privately owned enterprise?

Popov: Yes. At that time, you see, all dental schools in Russia were privately owned, although to obtain a license the graduates had to pass an examination administered by a medical school. My mother, for example, went to Kharkov to take her final exam in the medical school there. Incidentally, much later one of the Kiev Dental School's owners ended up in New York, and my mother made a round-trip on a bus from San Francisco to see her old friend.

Born in Kiev

Popov: I was born in Kiev on February 6, 1913, according to the old Julian calendar, which Russia was still using then.

Scott: Czarist Russia continued with the old Julian calendar, didn't it, whereas much of the

rest of the world had gradually shifted over to our present calendar?

Popov: Yes. Pope Gregory XIII introduced the Gregorian calendar in 1582 and it is now universally used. Russia, however, continued to use the Julian calendar, until the Soviet government adopted the Gregorian calendar. To convert from a Julian calendar date to the equivalent date in the Gregorian calendar, one has to add 13 days to the Julian calendar date. That is why my official papers now show that I was born on February 19, 1913, instead of the old Julian calendar date of February 6, as recorded when I was baptized in the St. Vladimir Orthodox Cathedral in Kiev.

Scott: You mentioned your brother Nicholas as confirming the family memory of a connection with the steel-making Deryabin. When and where was he born?

Popov: My brother's full name is Nicholas Paul Popov, and he is now an M.D. In Russian his first name is Nikolai, and at home we often called him Kolya. In the United States we often called him Nick.

World War I and the Russian Revolution

In a way, we were trapped. We could not go west because the Reds were there.

Likewise, they already were in the Maritime Provinces in the east.

Popov: The rather tranquil life my parents were leading in Kiev when I was born lasted about two years. Then World War I started, and my father was summoned to go to a military gathering center.

Very shortly, orders came through for him to go to the front in Byelorussia—now Belarus. He was there for the duration of Russia’s participation in the war. At the front his life was completely changed, of course—he was no longer a baby doctor, but dealt with wounded soldiers. The doctors’ gathering point was in the city of Penza, where my mother immediately established her dental practice. Once during the war my father was granted a leave, which coincided with seeing his second son, my brother Nicholas, for the first time.

Army Collapse and Revolution

Popov: The front broke soon after my father returned to the combat zone. Army discipline collapsed and the soldiers were

heading home. Fortunately, the soldiers had no quarrel with the medical officers, and in fact helped my father get through a window and into an overcrowded railroad car. About that time, my mother packed us up and arranged to meet father in his parent's home in Perm.

Knowing that the front had broken, they were expecting my father's return home to Perm. When he did show up, to everyone's surprise, my father looked like only a shadow of his former self. They were shocked by his emaciated appearance. Youth has its rewards, however, and he recuperated very quickly. Then he and my mother rented a very nice apartment in the city of Perm, and soon the two of them had established vigorous practices.

It was, however, a period of very difficult living. I remember how in late evenings my mother and I would be dragging a sled to gather hay the army dropped. We needed it for a she-goat that we kept for our subsistence. By then the Revolution was going full blast and my parents realized that something had to be done, so my father negotiated with the railroad's main line for him to take an assignment with them.

Living on the Hospital Train

Popov: The railroad, which was under civilian administration, offered my father the job of being in charge of a hospital train—*Medical Train Number 13*.

Scott: The railroad was operating hospital trains carrying wounded soldiers?

Popov: Yes, my father's task was to help take wounded soldiers, who were anti-Communists, get into safer territory. At first he would not accept this task, but then he added, "I will go,

but I have two sons and a wife. I will go on condition that they stay with me on the train." On this basis an agreement was reached.

Scott: He was trying to keep the family together through all the turmoil of the Revolution and the civil war.

Popov: Yes. It was then either 1918 or 1919. So we stayed together on that train. My father said that at the beginning the train was terrible, bad cars and all. Gradually, little-by-little, however, he was able to improve things. He would inquire at stations, "Don't you have a spare car here? There are wounded soldiers on this train." There were several doctors with him, and he ended up with a fairly good medical complex.

For bathing, they would pull up beside a train "bagne"—the word is from the Italian and bagne is a bath. We would go to our assigned part of the bagne, and I remember the big benches we sat on. We would take hot water and bathe ourselves. We didn't take a bath every day! Also, during all the time we were on the train, the only education I got was from my mother, and I had no organized grade schooling at all. I learned language, verses, composition, and arithmetic from her.

Scott: How long was your family on the train?

Popov: I would estimate that we spent between two and two-and-a-half years living on the train.

Scott: That is a *long* time for a family to be constantly travelling on the train!

Popov: Yes. That is why my mother had to provide me with schooling at home on the train during all that time. Fortunately, she had com-

pleted courses for teaching prior to going into dentistry.

Scott: What was the train's route—where was it traveling from, and what was its destination?

Popov: The train picked up wounded soldiers where the fighting was going on and took them east on the Trans-Siberian railroad to a quieter location. In one instance, we went as far as Vladivostok, where Americans and Canadians were stationed. On that visit, I remember bathing in the pristine waters of the bay at Vladivostok. It used to be a nice summer vacation area, but the waters have become polluted since the Soviet Navy anchored there.

Later, however, the Reds (Communists) took over the Maritime Provinces, and we could no longer go there. At that time, the roughly paralleling Amur railroad to the north did not exist. The shortcut across Manchuria was the Chinese Eastern railroad, built and operated by the Russians, with Harbin as the hub. Many Russians lived along this railroad, which was a boon to the area. (Incidentally, much later, when my parents visited Canada, they found that Siberia had much in common with the terrain of Canada.)

Escape to Manchuria

Scott: What happened next?

Popov: In a way, we were trapped. We could not go west because the Reds were there. Likewise, they already were in the Maritime Provinces in the east. South of Lake Baikal is Mongolia, and in southern Siberia and Mongolia a very active anti-Bolshevik band was operating under the leadership of Baron Ungern von Sternberg. He was a Russian general who

stemmed from a fine family in Livonia (now Latvia).³

His officers were strong anti-communists from Greater Russia and the soldiers were Mongolians. Collectively they were referred to as “wild divisions.” Their leader was simply called “the Baron.” The Mongolian soldiers likened the Baron to God, because during a battle he would gallop before the troops and never be touched by flying bullets. As a result, the troops developed a tremendous rapport with the Baron, whose own personal characteristics were particularly grim. Among other terrible traits, he was *extremely* anti-Jewish, and practically issued orders to shoot Jews on sight, or to inflict other indignities. In the area of southern Siberia where he operated, it was commonly said: “Do not get tangled up with the Baron.”

Then my father heard some highly disturbing news: the Baron had run short of doctors and would commandeer them from our train. So at risk to himself and his small family, he gave the two Jewish doctors on his staff small crosses to wear on little chains around their necks, so they could pass superficial checks by the Baron's men.⁴ Incidentally, cases were also known where his men would chop off ring fingers if they liked the rings on them.

Our train was standing at the station in Manchouli, which technically was in China, but the

3. S. L. Sofronoff, *Short History of Trans-Baikal Cossaks*, 1974, San Francisco. A vivid description in a positive vein can be found in F. Ossendowski, *Beasts, Men and Gods*. E. P. Dutton & Co., New York. 1922.

4. At that time, it was a general practice for Christians to wear such crosses.

railroad was still operated by the Russians. This railroad continued to Harbin, and on through to Pogranichnyy, terminating in Vladivostok, which was then already controlled by the Reds. So my father had to do some quick thinking and went to see the station master, who was a Mr. Donetz. When he saw my father, he exclaimed, "You are from Kiev, where you delivered my two children!"

Then when father told him of our dire predicament, Donetz said, "Go back to the car you live in and stay there. Tonight we will be doing a lot of switching and maneuvering, and tomorrow

you will be in Manchuria, controlled by the Chinese." That night, thanks to the help of Donetz, we got pushed over the nebulous border into Manchuria.

Scott: So while they were switching, the friendly station master had your family's live-in car shifted over to a train being made up to go into Manchuria. Your family just stayed in their car and went across the border that way, with no questions asked?

Popov: Yes. That was quite a triumphant exit from Russia!

Living in Manchuria, 1921-1927

The anti-Soviets would demand the anthem for the Czar, but when it was sung, the pro-Soviets would refuse to stand up. Then there would be some fisticuffs. Usually, this was fairly mild, but the division was getting sharper and sharper.

Popov: In Manchuria, we got off the train in Harbin as poor as church mice. Mother made a suit for my father from a Canadian blanket, and he went looking for work. There were many refugees, and the town was afloat with doctors. So he went directly to the head doctor for the Chinese Eastern railroad, who was an English-educated man, Dr. Wellington Koo. Fortunately for my father, he had with him a business card which stated that he was associated with the medical school of St. Vladimir University in Kiev. Dr. Koo looked over these minimal credentials and said, "You'll have a position shortly." So in a week or so my father was able to start work and we were sent to Hailar, a Manchurian town not far from the Mongolian border. That was a godsend, because we had nothing.

Scott: When was that—you said you were on the train some two years, or maybe more?

Popov: That would have been 1921, when I was about eight years old.

Living in Hailar, Near the Gobi Desert

Popov: Hailar was a nice, small community of people dealing in merchandise, trading mostly with Mongolia. I still remember the caravans with two-humped camels that came in from Mongolia with leather, which was very valuable. A lot of pressed soybeans were also brought in to Hailar, although it was more the Chinese who were bringing that. It was all going to Germany. Even under the Communists, they managed to load the trains, which would go all the way to Germany.

Scott: Tell us a little more about the pressed soybean trade.

Popov: The oil would be squeezed out of the beans, and the compacted solids in the form of soybean disks were then shipped to Germany for use by farmers as cattle feed. They were being sent to Germany in enormous quantities, going by rail all the way, regardless of who held the territory in between.

Fortunately, we had only a very short stay at Hailar, because my mother hated it. Hailar is close to the Gobi Desert, and the sand blows all the time. While we were there, my parents liked to go to Harbin to have a good time going shopping and the like—everything was available there. But I didn't count, so I did not get to go.

There were quite a few Jewish families in Hailar. You no doubt have heard of Samson,

and Samsonite luggage. That was initiated by Samsonowich, who was in Hailar. Also, I remember a man named Braun. And another named Gorb, who ended up in San Rafael. His wife was a medical doctor.

There was a big outbreak of the bubonic plague while we were there. My father identified it for what it was and immediately alerted the authorities. In gratitude, the Chinese presented him with a gold medal. Six months later, the Japanese gave him another gold medal for the same thing. With regard to the plague, the Chinese used two-wheeled carts drawn by horses to pick up the dead, using long tongs to grab bodies and put them on the carts. Presumably they were taken to be burned.

Fortunately for us, the head doctor in Pogranichnyy had misbehaved. As a head doctor he had a railroad car at his disposal to take very serious patients to Harbin, where there were better medical facilities. Instead of using this car for the intended purpose, he was caught smuggling opium. As a result, my father was appointed to replace him.

Life in Pogranichnyy

Popov: Pogranichnyy was on Manchuria's eastern border with the Russian Maritime Provinces, whose end point was at Vladivostok on the Pacific Ocean. These provinces were already in the hands of the Reds. Right next to Pogranichnyy was the Chinese settlement of Suifenho. When we lived in Pogranichnyy, we did not differentiate between the two communities, which were only a stone's throw apart. Since then, however, the boundary has changed and Suifenho is now in China, whereas Pogranichnyy is in Russia.

Scott: So the community you recall living in really comprised two adjacent towns, and at the time both communities were in Manchuria?

Popov: Yes, they were both in Manchuria then, although later Pogradichnyy was on the Russian side of the border. Pogradichnyy was what Russia could have been. It was very cosmopolitan. Although Russian-dominated, surprisingly it had an American consul, British customs (a remnant of the Boxer rebellion), an excellent Orthodox church, etc. In Pogradichnyy my father had several doctors under him. Two were Polish, one was Jewish, and another an Armenian. I can't think of anyone who was "pure" Russian. The biggest drugstore was owned by a Jewish family.

Anyway, my father was very busy with the hospital and some private practice, and my mother immediately developed an extensive dental clientele.

Courtesy of the railroad, we were settled in a large separate house in Pogradichnyy with a garden and separate sheds. After living on a train, the house seemed too large for us. Also, there were refugees who desperately needed a roof over their heads. Therefore, my parents rented one of the rooms to a Jewish scholar, a Mr. Gruenberg—Greenberg in English. He always wore a skull cap and did not interact with us much. Another person in that environment was a Berlin-educated doctor, Mark A. R. Goldberg who had dinner with us almost daily. As a result, my father's philosophy of keeping kids busy led him to make an arrangement with the doctor to teach me German. I must have learned to speak some German with a Berlin accent.

So I spent my early youth in Pogradichnyy, and I went to school for the first time in my life. Judging by the names of the students, 90 to 95 percent were of Ukrainian origin, but we all spoke Russian. Being immersed in this environment, I learned more about the customs of the southern Russians than those of the northern Russians.

We had not stayed in Hailar very long, and I cannot remember any boy or girl that I got to know there. But in Pogradichnyy, it was a ball, and I knew everybody within several blocks. You would go to school with a group of kids, and when you came out of school, in the summer you would either play or go fishing. My friends and I would explore the area and would go everywhere. It was fairly safe within the city limits or a little beyond. The farther out in the country you went, however, the more likely there were to be robbers (Hunghtze). I remember one engineer friend of my father's who loved to fish, and who was killed on one of his outings. (Incidentally, his son flew in the RAF as a pilot during World War II.)

In the winter, with some help, we made places for skating and little hills for sleds. I was too young, however, to join with the older boys in iron sleds doing downhill sledding on steep slopes.

I celebrated my first Easter in Pogradichnyy. After the confessions and the like in a true peasant style on the night before Easter, the women exhibited their goodies on the lawn at the church. These consisted of Easter cakes, colored eggs, cookies and the like, and the priest would walk around and bless the items with holy water. Then the church bells were rung as loudly as possible. This church activity was independent from school. That was a very

pleasant part of my life—few responsibilities, many friends, an eagerness about going to school. But that all was to change when we went to Harbin and its more urban environment.

Battles Between Chinese Warlords

Popov: When we were in Pogradichnyy, it turned out that we were in the eye of a war between two Chinese warlords, Chang Tso-lin and Wu Pei-fu.

Yet the civilian government in the area functioned very well, and the Russians laughed about the warlords and their armies. Having been seasoned by coming through Siberia, the Russians in Hailar laughed about the warlords' fighting. "What kind of battle was that?" they'd say. They were actually very bad fighters, if two or three people were killed, that was a battle—unlike in Russia, where the fighting was horrible.

The opposing Chinese troops were running around and shooting here and there, but they did not bother us. At the same time, they were fighting robbers. In fact, in one case when my friend and I were where we should not have been, we saw a dozen cut-off heads of such people hanging from a bar.

Then one of the warlords got sick, and my father was asked to treat him. Later, the same thing happened with the other warlord. When there was a big battle, my father also helped. In appreciation of these services, one day we saw, against the fresh snowy background, a line of Chinese coming to our house bringing gifts. These gifts were turkey, eggs, sweets, fruit, etc. Which warlord authorized this I do not know. Later I learned that Chang Tso-lin joined Chiang Kai-shek, who, of course, later became

the President of the Republic of China (Taiwan). Fortunately, during all this fighting between warlords, the civilian government in the hands of the railroad functioned well. Also, there was much more freedom than in Russia.

When the war between the warlords subsided, I saw hundreds of Chinese who came in from the south. They overwhelmed the Manchu population. It was hard to know where they vanished to—it always amazed me. Boxcars full of men, women, and children would come and be emptied, but within twenty-four hours they would seem to disappear. All had either been assigned to farms by the Chinese government, or had opportunities to go and farm.

Scott: Those immigrants fresh from the south of China probably found it hard to get used to the Manchurian cold winters.

Popov: Oh, yes, Manchuria is very cold. It was even cold for my parents, who grew up in European Russia.

Scott: Where did those immigrants go? I suppose most were sort of "farmed out" into the agricultural economy of Manchuria.

Popov: As I already mentioned, in Hailar the Germans were buying a lot of skins and disks of pressed soybeans, and the same practice must also have flourished in Pogradichnyy. They were sending skins and soybean disks to Germany in enormous quantities.

The people who immigrated to Pogradichnyy/Suifeng lived outside of Russia proper, and there was a very loose, laissez-faire government. Between the Russians and the Chinese, they sold all the basic necessities for life.

Scott: You refer to a “loose” government, at least in that part of Manchuria. At that time, I presume Manchuria was relatively independent?

Popov: Yes, relatively independent—the Japanese puppet regime called Man-chu-kuo came a little later. At the time we were there, the railroad was all-powerful. Both the police and the utility services were provided by the railroad.

Living in Harbin, 1924-1927

Popov: Rather unexpectedly—at least for my brother and me—my parents declared that we were leaving Pogradichnyy and moving to Harbin. It seems that politically life there in Pogradichnyy in 1924 was becoming more turbulent. The early Russian immigrants were prosperous, while the later refugees struggled.

Scott: So your parents moved to the capital, Harbin, situated in Manchuria’s geographic center?

Popov: Yes. In Harbin, our father entered private practice, and also became the physician for the YMCA. My mother rapidly developed a successful dental practice. When we settled in Harbin in a very nice flat rented from Mr. Kogan, my life drastically changed. Everything became more official, formal—apartment living, city streets, and fewer friends.

Life was so different in Harbin. It was a city. Life became more adult. We went to theaters and operas put on by professionals. I remember on kiosks seeing posters like this: “Hear Jascha Heifetz tonight,” when this famous violinist stopped in Harbin. One could get around the city on privately owned buses, which were remodeled Fords with homemade bodies. My favorite entertainment was American movies. Harbin had a big

department store. The store’s name was originally Russian—Churin—but it had been modified into Chu-Lin to sound Chinese.

In Harbin, I also remember a German place where they made superb sausages. When we lived in Pogradichnyy, my parents would go by train to the big city of Harbin, and when they came back they would bring whole sacks full of various sausages. My German-educated M.D. who taught me German would go to Harbin from Pogradichnyy on Jewish holidays to sing in one of the synagogues. He had a very good voice. He showed me how to sing, and I even tried to do it, but that was a disaster.

Attending School in Harbin

Popov: Harbin was very important in my life. It was a time when I was growing up. You had to learn the things that were being taught to you. I attended a good school that was very strong in mathematics. A traditional Russian gymnasium.

Scott: Talk a little about your schooling in Harbin.

Popov: The school was run by an elected parents committee, in consultation with teachers. As a medic, my father was on one such committee. The administration of the program was in the hands of a principal, who also had to work with the head of the YMCA providing accommodations. The YMCA official was a graduate of Oberlin College in the United States. At one point, the principal decided to go back to Russia to “help” the Soviets and was immediately sent to a concentration camp, where he perished. Similar things happened to others. For example, a friend of my father was a

general. He also went back because he saw no future for his background in civilian life. He met a similar fate.

We had a very good teacher in religion. He was an ex-lawyer and a very well educated man. At your parent's request, or if you were either of Jewish or Mohammedan faith, you were automatically excused from attending. I remember one time two or three Jewish students, as well as one Tartar, triumphantly walking out of the class before the priest came in.

Latin was required, and I took it, but then forgot everything I ever learned. It just evaporated. We took English, which in retrospect was both good and bad. The English grammar that I know started there, where the teacher emphasized the rules of grammar—how you do it, plurals and singulars, past and present. All those rules of English grammar were rehearsed and explained in Russian, so we learned the rules of grammar but did not learn an English vocabulary. In both Latin and English, of course, we also got acquainted with Latin script, having been used to Cyrillic.

Scott: It sounds like an excellent educational system. I presume it was not part of the regular school system in Harbin?

Popov: That I cannot answer. My authority on such issues was the late Professor Boris Bressler, who started and finished at a different Russian gymnasium in Harbin. I never graduated from a Russian gymnasium.

The school I attended was very apolitical. The only problem we ever had was when we played basketball tournaments between the best Chinese schools and the best Russian schools. I learned to avoid those. While they did not get

terribly rough, it was better not to stick your nose in. But basketball was *the* game, a very suitable indoor sport in cold weather. As students, we played in a half-basement. Others would prefer to take light exercises, Swedish style or whatever, or jumping. I specifically remember those activities. When I came to the United States, it became evident that baseball was the main game, but there in Harbin it was basketball.

In Manchuria, they had a very popular ball game called *lapta*, that resembled baseball, but was primitive and different. They used a ball made of cow hair and soap and a stick shaped into a bat. Instead of throwing the ball at a person, another person stands next to you and throws the ball vertically. The rest is similar to baseball. If a person on the other team catches the ball, you are out. If they don't catch the ball, they run after it and throw it, trying to hit the person running either from the bat or returning to the bat. Since the ball is semi-soft, it does not hurt too badly if you get hit. It's an old peasants' game, and we all played it, especially in Pogradichnyy.

Leisure Activities

Scott: What about some of your nonschool leisure activities? What did you do when you were not in school or studying?

Popov: Except for our studies, which were pretty serious, movies are what I especially remember of Harbin. My friends would say, "Let's go to the movies." We knew if it was an American movie, the endings were always, let us say, gracious—things always worked out. We saw every movie of Douglas Fairbanks and Charlie Chaplin. Sometimes we would have to

hunt for the theater where the movie we wanted was being shown, and have to take a rickety bus, pay a few pennies, and maybe end up next to the wharf. That is where I saw Charlie Chaplin in “The Gold Rush,” where he was in Alaska and in one scene he pretended to eat his shoestrings like spaghetti. That was the last movie I saw in Harbin, before my family came to this country.

I was about 12 years old then, and instead of riding sleds down little hills as we had done in Pogradichnyy, I got a big bicycle and rode around the countryside with some friends who also had bicycles. On those rides, we went to places where we were not supposed to go. For example, we paid a visit to a Buddhist monastery. I recall how they behaved and prayed, dressed in their yellow garb. They were either very nice to us, or indifferent.

Scott: Your parents did not know where you went on those trips?

Popov: No, they were unaware of where we went, but we did not abuse our freedom.

We also visited some swampland areas where there were settlements of very poor Chinese, and saw some pretty awful things, such as babies’ bodies practically being chewed up by pigs. Most likely the babies had died of natural causes—it was pretty awful.

When I revisited China in the 1950s with my wife, I continued to repeat, “I see two big changes: Things are much cleaner, and I see no paupers.” We had seen a lot of begging in Harbin when I had been there before. The Chinese would come and plead with housewives endlessly. They could just stand there for twenty

minutes, constantly asking for a handout. They were very poor.

In Harbin, I belonged to something similar to the Boy Scouts called “Brothers of the Campfire.” There were a couple of summer sessions, and our parents sent us. A whole gang of us would go hiking to a little resort town where we went swimming. We also explored the forest next to the camp.

Generally, however, in Harbin we kids lived a little more of an adult life than we had before in Pogradichnyy, where there were children’s parties that we went to, and other memorable occasions, such as parties with Christmas trees and all of that. We saw more kids singing carols in Pogradichnyy than in Harbin, where things were more organized and less interesting.

Scott: While you were in Manchuria did you and your family, and the other Russians, have much communication with the Chinese community?

Popov: There was not much communication with the Chinese in Pogradichnyy and that was also basically true in Harbin. In general, however, life in Harbin was very different from what it was like in Pogradichnyy. We lived in the Russian part of Harbin, where there were a lot of immigrants. But there were many Chinese servants and tradesmen. In Pogradichnyy, my mother had Russian or Polish cooks, but in Harbin they were all Chinese. There was much more evidence of Chinese in Harbin. I remember one of our very nice Chinese cooks who repeatedly warned my parents, “Get out of this country, get out! There is going to be trouble!” That was just before the Japanese took over.

Lack of Prejudice

Popov: There seemed to be a relative lack of prejudice in Manchuria. Things had been different in Russia, where, as you know, Jews could not go beyond certain lines, the exceptions being some professionals. If you were Jewish and an M.D. or an engineer, you could go across the line—known as The Pale of Settlement—and those Jews who were outside the line had much more freedom in many ways, such as practicing medicine or other professions. The line is shown here on one of the maps in this very interesting book of maps.⁵

Scott: The Pale of Settlement was a huge area beyond which Jews were not allowed to go into European Russia?

Popov: Yes. The Pale of Settlement was defined as the area of Byelorussia, Ukraine, and Poland to which Jews were confined. It was in force until 1917, but was applied only in general. University graduates were excluded, which logically encouraged the Jewish young people to enroll for higher learning. But there were also obstacles. In 1911, for example, when the

5. Martin Gilbert, *Atlas of Russian History*, 1972. The map on pages 69-70 shows the area of the Pale of Settlement, where most of the Jews were hemmed in. The Czarist government required the Jews to remain within those territories unless they could get special individual permission to move elsewhere in European Russia. Most Jews, however, continued to live within the Pale, whose area included regions that Russia acquired through the successive partitions of Poland in the late 1700s, which brought in large numbers of Jewish residents who lived in those territories, and was later extended to include areas annexed from Turkey in the 19th century.

government wanted to limit the large Jewish enrollment at the Kiev Polytechnic Institute, Professor Stephen Timoshenko and two other deans resigned from their positions there.

After graduating from such schools, the Jewish students scattered throughout Greater Russia and were not limited in practicing their profession. An alternative route of crossing the Pale was to become a Christian of any denomination. In Harbin, both of my best friends had Jewish mothers. One was the son of a doctor, the other was son of a distinguished refugee engineer.

Scott: Could you say a few words on the relative lack of prejudice you observed in Manchuria, as compared to what you saw in Czarist Russia?

Popov: I was really not personally familiar with the attitudes in Greater Russia toward the Jewish people—I was too young to observe what was going on. In Pogradichnyy, Hailar, and Harbin, however, I did not observe any prejudice at my parents' home, and they had many friends among the Jewish people. In my father's early years in San Francisco, he had a large practice among Russian Jews, and a great many of the immigrant doctors were Jewish.

Divisions in the Refugee Community

Popov: In Harbin, our parents especially had a good social life, although, unfortunately, the divisions in the community got more and more pronounced.

Scott: Are you referring to divisions between pro-Soviet and anti-Soviet factions?

Popov: Yes. The anti-Soviets would demand the anthem for the Czar, but when it was sung, the pro-Soviets would refuse to stand up. Then there would be some fisticuffs. Usually, this was fairly mild, but the division was getting sharper and sharper. Of course, we also saw a lot of military funerals in Harbin. I presume they were mostly officers who had been badly wounded and brought to Harbin to finish their lives there. They would be buried with all the military regalia, with fancy horse-drawn carriages, the band would play very sad, slow marches, and the kids would run out to look.

Immigrating to San Francisco Via Korea and Japan in 1927

Popov: My parents decided that Harbin, with all the political problems, was not the place to bring up their two sons, so they decided to go to America. At that time, it was extremely difficult to get into the United States. People were seriously considering going to Argentina—a lot of Russians went there at that time. America was very select about those it allowed in. You had to have certificates of your health, and enough funds to show that you could sustain yourself and your family for a year.

After we had been in Harbin two years, my parents then had saved enough money to qualify. They had also gone through the formalities required to get into the United States, so were able to come here. In 1927, we left Manchuria and came to the United States. Several of our friends went to Argentina, but my parents did not want to go there, and we lost track of the friends who did.

Scott: Describe the trip to the United States.

Popov: We went through Korea on the train and took a small boat to Kobe, Japan. I remember seeing Koreans with their tall hats working in the fields. They were totally under Japanese direction. While in Kobe, my parents took us to Nara, where there are famous Japanese gardens. There were deer running around, and we had never seen deer before. Then they, in effect, locked us kids up in Kobe, saying, “We want to go see Tokyo—you kids stay here.” So on that day we did not see much, and that was when my brother and I got in trouble over taking baths and not doing it the Japanese way.

As you know, the Japanese practically worship bathing. Anyway, we went to the bath facility in the hotel, soaped up and started to bathe. But then the Japanese started chasing us away, saying something that meant, “You are not supposed to go there!” We were not doing it properly. You are supposed to bathe beforehand and then jump into the big pool. But we had lathered ourselves and jumped in all soaped up.

We stopped in Japan for about two weeks, and, of course, I was overwhelmed with its general appearance and the behavior—things were very different there. While we were in Japan, we were still having the food which we had brought from Harbin. My mother had a lot of those very good sausages that she had bought at the German shop there. Those, of course, eventually spoiled, but the Moscow sausage helped, as it is similar to salami and keeps forever.

Scott: Describe your trip from Japan to the United States.

Popov: We sailed from Yokohama harbor on a Japanese ship called *Korea-Maru*, belonging to Nippon Yusen Kaisha. We went directly

from Yokohama to San Francisco. That ship was later sunk by the Americans during World War II when it was being used to transport either troops or ammunition. We came steerage class, and my mother, who was a very energetic woman, immediately hung curtains all around our area, so we had some privacy. An adjoining area was occupied by a Russian priest and his daughter, who were also coming to San Francisco, where his son was employed. We did not care for the Japanese food on the ship, but the Moscow sausage came to the rescue. On the way, we went through a terrific storm and thought it would be the end of us. We were two or three days late arriving in San Francisco.

On board ship, my brother befriended a man named Morris Walker, who became a big friend of our family, and whom I will mention again later. He liked us, especially my brother. You see, only the nose of the ship was open to steer-

age people, and it was often too crowded.

There were a lot of Filipinos and other Asians going. You could go up the ladder, however, and my younger brother Nick would sit with Mr. Walker in his first-class cabin. I did not get in on that every time, but sometimes he would say "Bring your brother," and I would go too.

I do not know how we communicated, because Mr. Walker did not know much Russian. But he was very proud of having sat with Czar Nicholas when the Czar made a trip to the Orient. I should, but do not, know what Mr. Walker's religious denomination was, although I believe it was Presbyterian. He was a very fine man, and we liked him very much. After we got to San Francisco and were in high school there, we would visit and stay with him up to several weeks in Santa Rosa. Finally, he went back to Scotland to live in their 300-year-old family house.

Popov Family Settles in San Francisco

We had arrived in San Francisco during a very warm season, and loved it. When the cold weather set in, however, to our surprise we discovered that there were no space heaters.

Popov: On arrival in San Francisco, for a couple of weeks we stayed with my mother's high school classmate in the Haight-Ashbury district, and my parents soon rented a flat in the same neighborhood. At that time, the district was largely populated by Irish and Germans. Now, of course, it is entirely different in terms of the occupants.

We had arrived in San Francisco during a very warm season, and loved it. When the cold weather set in, however, to our surprise we discovered that there were no space heaters. Instead, people were using kerosene lamps that were about a foot and a half in diameter, and about two feet high, with a burner underneath that could be lit. Two to four such heaters were employed in an apartment. These heaters had handles so that one could move them wherever needed. There were, however, a lot of fires with those heaters, as people were careless in

carrying them around. Fortunately, gas-fired wall heaters came into general use fairly rapidly.

Almost immediately upon our arrival in San Francisco in 1927, when I was 14, I started attending Polytechnic High School, and graduated at 16. My spoken English was nearly nil when I started school, but a teacher of German, Miss Bodilson, with whom I could converse more readily, suggested that I had better stick with English rather than be confused by German.

Scott: Although you said your English was “nil,” I guess you had gotten enough English in school in Manchuria to be able to manage?

Popov: My English actually was very bad, and at Poly High I had to start at the lowest level. As I noted earlier, however, my knowledge of English grammar started in Harbin, where it was rehearsed in Russian, so we ended up knowing some grammar but with a very limited vocabulary. Even much later, when I was in Berkeley, my failing Subject A (also called “dumbbell English”) where I misspelled a few words, attests to this. Physics at Poly High was given by a vigorous Mr. Jordan, and by a Mr. Stockton, who always looked half-asleep. Both of these teachers were good.

I had chemistry from Miss Brown, who was a playful gal in the way she liked to interact with students and bat at them. She would take up a book, they would throw a piece of chalk at her, and she would bat them. But I never tried that. I had an excellent teacher in mechanical drawing, a Mr. Harris. I forget the name of my first English teacher, but the second one was Mr. Barlow. He was not much of a teacher, but I recall his counting the silver dollars in his

pocket, where he always had several of them, and you could see him jingling and counting them.

In mathematics, I was the star pupil. Miss Kelly was one of my teachers. Others were Miss Wormuth, who was top of the line, and for additional math, there was Mr. Jacobs, who was educated as an engineer. All three of these teachers were very good. Miss Kelly, however, always mispronounced my name, which was being spelled “Egor” and she called me “Edger.” “Edger, go to the board and show them how to do the problem.” My trouble with my name started when I was registering. The registration person insisted on spelling my name “Igor” with an “E”—“Egor.” Thereafter, I just left it that way.

Scott: You have been known as Egor P. Popov ever since.

Popov: Yes.

Living in the Menuhin House

Popov: Because of my father’s desire to get a license to practice medicine in the United States, he virtually locked himself in one of the rooms in the apartment for about a year while he studied English and reviewed medicine. He took the medical exam and passed it in one round, which was pretty good for a foreigner not knowing English well. He understood it, but spoke it very haltingly.

Scott: That was quite a feat.

Popov: Yes. He asked for and received approval to answer in Latin whenever he did not know an English term. He was very proud of passing the exam in one round—very few foreigners manage to pass the first time. He had to go to Los Angeles to take the exam. He

went by boat along with a Japanese fellow with whom he had studied intermittently. So he passed and became a licensed M.D.

Then shortly afterward, we rented a house from the Menuhins, of the famous violinist's family. The father was an Israeli and the mother was a Jewish Russian. The area where the house was located had many Russian and Jewish residents. Soon afterwards, my father decided to buy the whole place. To this day, I am amused that on his own, my father wrote to the Menuhins giving them "Seventeen reasons why they should sell the house to us" and included an offer. They took him up, so we and the Bank of Italy [now Bank of America] became the owners of an historic building in San Francisco. He immediately set up a medical office on the second floor of the building, and lived and practiced out of the building until his death in 1976.

When the violinist Yehudi Menuhin was writing his memoirs, he visited the old place, talked a lot with my mother, and some of his observations are supposedly in his memoirs. Interestingly, I had some coat hangers with the name "Menuhin" written in Cyrillic, and I still have an elegant walking stick with "Menuhin" written in the Latin script. After this visit, for a long time Yehudi kept sending tickets to my parents for his San Francisco concerts. Since my father, who frequently attended concerts, did not like to sit in the first row because too many people jump over your feet, he usually chose the second row. On one occasion they were sitting next to Admiral Chester Nimitz and his wife. Later my mother asked me who were those nice people sitting next to them.

In the ex-Menuhin house there was a large garden in the back where mother worked whenever she had time. There were two huge palm trees in the garden, and repeatedly, before Palm Sunday some people would come from a local Russian Orthodox church and cut some palm leaves. My mother just loved that, as these people cleaned the palm trees and then took some good leaves to the church.

Incidentally, it always bothered me that in the Russian practice, at some services really packed with people, they stand with lighted candles. You see, traditionally only a few benches are available along the walls for the older people. In the Greek church, which is supposedly the same, however, they sit in pews, as in the very nice Greek Orthodox church in Oakland where I have gone a few times.

Scott: A church packed with people standing with lighted candles in their hands sounds like a fire hazard to me.

Boy Scouts

Popov: Responding to our parent's urging, my brother and I joined Boy Scouts with a group which met practically across the street from the rented flat we lived in at first. When we moved to the Menuhin house, it was more cumbersome to attend the meetings, although it cost only 2.5 cents on a street car. My brother and I were most fortunate, however, to start where we did because the adult leadership was superb. One was the manager of the famous Gumps store in the city, another was the principal of Mission High School, and still another was one of the top executives with the phone company. The sons of the latter two people

belonged to the same troop that we did. Because of this association, for two summers my brother and I went to a scout camp located on a small river that flows into the Russian River.

While I was in the scouts, I got whole strings of merit badges and became an Eagle Scout. After your sash is full of merit badges, they have to give you something else, so I was a Palm Scout 1 and a Palm Scout 2. I was then junior assistant scoutmaster. By then, I was already in college, and still kept up with scouting. That's where my Americanization started.

Family Friends in San Francisco

Popov: Both my brother Nicholas and I attended Poly High. Since he liked chess, he and Ed Ginston organized a Chess Club, and the two became very closely acquainted. Ed would visit us, and we would visit him. This lasted through our student days in Berkeley. Several times we went to Yosemite together. Both families, but without my father, who generally was too busy.

For such trips my parents bought a big old Nash, and the Ginston's also bought a Nash. From age 16 on, I had to drive, and always drove the lead car when we traveled together with the Ginstons. I still shudder when remembering one incident when we were headed for Yosemite and were crossing the railroad track ahead of a train. I made it rather well, but saw in the rear view mirror how Ed Ginston was also driving across ahead of the train. He made it across without getting hit, but it was close. I remember that vividly.

Scott: I can understand—that does sound scary! You two drivers were really taking a chance, weren't you?

Popov: I was taking a chance, and he was not really paying attention, but just following me. We generally camped in our tents in Yosemite Valley, for as long as the rules allowed, and had daily campfires. We walked all over the place. During these hikes, often I would be walking along with Ed Ginston's father, Leonard Lee, a fascinating person. In Russia he had been the head sanitary medical director for the whole Soviet Union. He gave me an oral history of the Russian Communist Party. He would tell me about Stalin, Trotsky, Lenin, and others whom he knew personally. He would compare Stalin and Trotsky, and talk about how things developed among the Communists in Russia. In his mind, the original Communists, such as Bucharin, were idealists, and then Stalin did away with them.

Ed Ginston's father sensed that trouble was coming; that's why their family ended up in the Maritime Provinces and later in the United States. We actually became acquainted with the Ginstons through my brother, who had gotten to know Ed in the Chess Club. Our families became quite close, and that lasted through our undergraduate college days. Dr. Ginston graduated from the same medical school in Tomsk, Siberia, as my father.

When we were in high school in San Francisco, we often went to Santa Rosa to visit Mr. Walker, the retired missionary whom we had met on board ship. My brother and I would take the ferry, and then the bus, which would stop and drop us off on a two-lane highway at a place where Walker would meet us. We would

stay with him, and while we were there we followed British customs. That is, we said morning prayers, walked to church every Sunday, and did everything you were expected to do.

Scott: What was Mr. Walker's status or employment when he was in Santa Rosa?

Popov: He seemed to have been an important missionary in China, but was retired by then and was no longer an official in the church. He had three sons, whom I never met. One was in the Australian Navy, one in the New Zealand Navy, and one in the British Navy. Later, his wife developed psychological problems and had to be confined in Napa. After she died, he went back to Scotland. He said to us, "You people come to Scotland." As I noted earlier, he had a house there that was 300 years old. In his view, that was something very good. He kept writing us letters, but in time we lost track of him.

Anyway, we spent part of our summers at the Walkers' place in Santa Rosa. We had fun, but we did not loaf while we were there. I worked for a neighbor picking dry fruit that had fallen on the ground, which was standard practice. We would go around on our hands and knees and pick up the fruit. We were paid 15 cents a box, or something like that, for picking it. That was the first American money I earned. We also befriended some kids in the neighborhood, went for little hikes and things like that.

Scott: Did you and your brother start those visits to Walker immediately after your arrival in San Francisco?

Popov: Yes, immediately.

Scott: So meeting Mr. Walker on the ship proved a very fortunate and helpful thing for you, hadn't it?

Popov: Oh, yes. My parents just adored that guy; they liked him very much. He was a very fine person. He would cook for us when his wife was out of commission, and we would eat modestly, but well. Then the summer would be gone, and school would start again.

At Poly High, I went to the football games and found gym interesting, although I did not have a very formal gym class. I would see some students cheating by cutting across instead of running all the way around the block. Our gym teacher, a Mr. Cox, who was a little goofy, would sit on the floor and beat it with his fists. I was always small, and he told me to box a little Japanese guy. He gave us big boxing gloves and said, "Go at it." We tried, but I banged my opponent a few times, broke his nose and it started bleeding. This event concluded my boxing career forever.

I found education at Poly High not to be difficult. To make a long story short, Poly High had a four-year program, but I made it through in two years. In two years, they told a small group of us, the 1929 graduates, that we qualified to go to either Stanford or the University of California. I had passed English, my chemistry was pretty good, my physics was adequate, and my math was excellent. One of my teachers was a Stanford graduate and tried to talk me into Stanford, but that was hopeless because it was too expensive for me. I had to go to a poor man's school, state-supported U.C. Berkeley.

Undergraduate Years at the University of California at Berkeley

While technically, and in terms of engineering as such, Berkeley might not have been very strong at that time, ... our courses in the material testing laboratory were excellent. With all its faults, I am proud to be a Berkeley graduate.

Scott: You started at U.C. Berkeley in 1929?

Popov: Yes. I entered in 1929 and I graduated in 1933. The first time I visited the campus, I came alone and sat next to the Campanile. Those same benches I sat on that day are still there. As I looked around that day I said to myself, “This is where I will go to school.” The old Civil Engineering building—a three-story, wooden building of typical apartment-like construction of an earlier era—was located where Le Conte Hall (physics) is now. Raymond E. Davis had a little office on the ground floor in the back of the Civil Engineering building. Earl Troxell was near him. It was convenient for Davis and

Troxell since they had common interests, and the laboratory was just across a walkway. Next to this lab was a space occupied by the anatomy department for their work with cadavers. Later, Davis became an important teacher of mine in some basic structures courses, and Troxell was an excellent instructor in the structures laboratory. Also, there was Clement Wiskocil, who later became my advisor. In addition to the course materials I had from him in surveying, Wiskocil digressed in an interesting manner on the practice of engineering.

When registration day came, my father said, “On registration day, you can use our car.” But our tenant said, “No, don’t take that big car, use mine!” When I went downstairs and started to crank his car, however, I did it improperly and broke my arm.

Scott: It backfired, and suddenly turned the crank backward. That was a fairly common occurrence in those days. You needed to hold the crank a special way to protect yourself against that.

Popov: Yes. In those days, in the vernacular, those breaks were called “Ford fractures.” But, actually, the car was a Chevy. So in my first semester of college I went around with my arm in a sling and had to learn to write with my left hand.

U.C. Berkeley’s tuition (or incidental fee as it was called then) was only \$25 a semester. I think we also had to pay a fee of \$10 in chemistry, which gave us access to all laboratory utensils. If you took care and did not break anything, you got your \$10 back at the end. In a surveying course in civil engineering, I broke a surveying tape, and they charged me the cost

of the repair, which was not much. They did not charge us anything in physics. A whole gang of us commuted by ferry and rail transit.

Scott: That was back before the Bay Bridge was built, so you had to take a ferry across the Bay.

Popov: Yes. Then on the East Bay side we were always arguing, “Shall we take the Southern Pacific or the Key System?” The Southern Pacific (SP) had new steel cars and was safer, but you had to walk farther from where they stopped. If you took the Key System, you could get off at Alcatraz, then take the streetcar, which could drop you off at several stops on Bancroft Street. If you took the SP, most of the time you had to walk up from Shattuck Avenue.

A Lesson on the Importance of Grades

Popov: In those early days I never went after grades, as I did not consider high grades that important. I thought a B was just as good as an A. At the beginning of my junior year, however, I had to go to the Dean’s office to get a signature from Miss Meek, a big Irish woman who was domineering in a very pleasant way. I went in and she said, “Do you know that you are an honor student?” I said, “What’s that?” So she explained it to me—if you got better than a B average, you were an honor student. That is when I became more aware of grades, their significance, and the fact that the Dean’s office was watching our grades. Before that, I couldn’t care less about grades, and had been getting mostly Bs. Afterwards, I started to watch my grades a little more.

Campus Hazing

Popov: As freshmen, we were supposed to wear beanies. This rule was imposed and enforced by the sophomores, who wore blue jeans, which no one else could wear. I generally defied this rule, and only in the areas infested by sophomores would I break down. Once, however, I was walking without a beanie near Sather Gate, and got caught by the sophomores. There are two huge masonry vases nearby, one on the right and another on the left. When I was caught, I first got a paddling, and then was put into one of these vases and left there. It was a job to climb out of that vase unaided.

Scott: Did you start wearing your beanie after that?

Popov: No. I am somewhat stubborn.

Reflections on Courses and Lower Division Professors

Scott: I take it that when you came to U.C. Berkeley you had already pretty well made up your mind to study engineering?

Popov: Yes. I had always wanted to be an engineer, although there was some confusion, and my mother thought I was sort of an architect, or architect-engineer. She never understood the division between architecture and engineering, probably because in Russia it was not that prominent.

Anyway, when registering, I signed up for mathematics. I had been advised to take the math course given by Professor Wong, but then I saw all the football players sitting in the back, and on our first test I got a B. I said, “I am smarter than a B. So later I changed to Profes-

sor Buck, a famous top math teacher, a bachelor who lived and died in the Faculty Club. At the end I got one of the few As that he gave. The grading was harder, but you learned more.

To make up my failure at entrance, I also had to take Subject A, an almost worthless course which we called “dumbbell English.” The class was held in the basement of the present Education Building. I did not learn much—I learned more English grammar from the Russian school than I got in that course. In addition, I think the instructor was sweet on one of the girls in the class, and largely answered her questions. I got a passing grade, which is all that was needed. In fairness to the instructor, I should say that I read a book or two in the course, and we had to write several compositions, which were gone over—so it was not all bad.

I took an 8:00 a.m. physics class. In those days, a little man would show up and take attendance by checking off unoccupied seats. He was an assistant to the professor, and we usually paid no attention to him. But I did have some pretty good teachers in physics—Professor Lenzen was one of them.

In the first semester of chemistry, I was not classified near the top, due to my language difficulties. The next semester, I was moved from Room 8 to Room 2, which was pretty good. The professor was Joel Hildebrand, a famous name and a showman. He would pour something into a liquid, and it would turn red. Then he would pour in something else, and it would turn another color. But in his class, we learned chemistry from the teaching assistants.

Scott: Hildebrand was kind of a flamboyant character. Everybody knew who he was, and he

seemed to be around campus forever. I remember seeing him at the Faculty Club when he was in his nineties.

Popov: I wanted to take ROTC, although now I am no longer enthusiastic about the military.

Scott: You wanted to take ROTC, but were not permitted to?

Popov: I could not take it, because I was not yet a citizen. Then they said, “If you buy your own uniform, you can take the course.” But I said, “No, I am not going to buy anything.” So the ROTC option went by the wayside, and as a consequence, I could take some elective courses. I took two more math courses, which turned out to be very profitable.

Professor Ira B. Cross

Popov: I also had Ira B. Cross in a year-long course.

Scott: Ira B. Cross was a well-known and influential labor economist at U.C. Berkeley. I’ve heard a great deal about him over the years. He did work on labor economics, money and banking, the development of socialism, and the like. I recall reading his history of the California labor movement many years ago.⁶

Popov: Frankly, a lot of my social education was from Ira B. Cross. He was a great man, a great lecturer. He would sway the whole audience at Wheeler Auditorium. I was 17 then, and we listened intently when he talked.

6. Cross, Ira B., *A History of the Labor Movement in California*, University of California Press, Berkeley, California. 1935.

Scott: So Ira Cross made a big impression on you?

Popov: Yes. Cross made a big impression. I think a year of Ira Cross was “worth the price of admission.” I did not necessarily agree with him, but that is not the point.

Scott: You did not agree with some of his economic and political views?

Popov: Well, yes, especially considering my parents’ very right-wing views—but I felt that he helped open my eyes to some other things.

Dean Charles Derleth

Popov: Someone else who made a big impression on me was Dean Charles Derleth, Jr., my engineering teacher. Derleth himself was an incredible person. He graduated from Columbia University with his bachelors in letters and science. Then he switched to engineering, took two or three years in civil engineering, and came here. He had a very broad background.

He was a great man, but a poor engineering teacher. Fortunately, we had his assistant, Bruce Jameyson, a much lesser-known person but a solid engineer. Also, Harmer Davis—no relation to R.E. Davis—would come in occasionally. It was from Jameyson and Davis that we learned something about the subject of engineering.

Scott: You thought very highly of Derleth, despite his being a poor teacher of engineering, per se?

Popov: Yes. Derleth was not a good teacher of the things that you could find in the textbook, but we learned other valuable things from him—things about engineering and a lot

more—things that you *couldn't* find in the text. He was a consultant on the Golden Gate Bridge, and told us about that, and how he tangled with the architects. We heard how he defended the southern approach to the Golden Gate Bridge. The architect wanted it one way, and Derleth wanted it another. Derleth prevailed. We got a lot of that kind of thing from him. Incidentally, he also took a year's leave from the University to be chief engineer of the Carquinez Bridge.

I thought he was great. I think the university really missed it by not naming a building in his honor. He was the gatherer, bringing the College of Mining, the College of Mechanics, and the College of Civil Engineering into one school. He never got chemistry to come in, but the other three were organized into one school. Derleth did not, however, get much credit for finally unifying the whole thing. In terms of being an historic figure, I think he was way ahead of Bernard Etcheverry, whom I also respected. During his years here, Derleth was very influential on the campus. I understood that President Robert Gordon Sproul would not do anything major without asking Derleth's opinion.

Derleth was a tough taskmaster who also watched pennies. He required professors to go to the Registrar's Office and check to see that their students had, in fact, paid their fees, and that all who attended classes were legitimate students there. He was quite a disciplinarian. Also interesting was his way of pushing students. In my case, he would seem to praise me in class by saying, "Of course, Popov would know the answer to this problem." Well, I *wouldn't* know the answer, but after class I would certainly go back and bone up on it.

That happened two or three times, and I knew that I was kind of being nudged in class. I remember my friend Preston Schwartz asking me after class, "Did you know the answer to that problem?" And I would say, "No."

Scott: It was his indirect way of saying, "Get cracking."

Popov: Yes.

Professor Bernard Etcheverry

Popov: I did have Bernard Etcheverry, and graduated in irrigation. It was a good place to learn structures. Etcheverry was a very good teacher, but elementary. He covered things down to the size of 2-by-4s and 16-penny nails. In many ways, he was a well-educated carpenter, but from him you learned hydraulics as well.

Scott: At one time, I believe that Etcheverry's irrigation courses were about the only place where the engineering students could learn about wood structures.

Popov: That's right. Etcheverry taught very good structures courses, but the subject was simple. We learned all about designing with 2-by-4 and 2-by-6 planks. It was apprentice-like training, low-level in a way, but very essential. We also had quite a bit of hydraulics—you had to figure out the drop you could allow, and the friction in the flumes.

Scott: At that time, irrigation had an important role in the development of California.

Popov: Yes, that was part of the reason why Etcheverry later got his name on a campus building. He was the top man in the state on irrigation and a great consultant on water systems for the State of California. We students also got

from him some of the kinds of insights we got from Derleth. Some of the other dogmatic teachers were also very good, Clement Wiskocil, for example. He would stand there shaking his finger and telling you how the engineering profession really operates. He was very critical.

Geology Professor's Name Not Remembered

Popov: My geology teacher made absolutely no impression on me. He would stand there in front of the class in Wheeler Auditorium with a copy of his book and read it!

Scott: What a deadly way to present an interesting subject like geology!

Popov: Yes. The subject matter of geology itself had very valuable information that was of lifelong importance to me, and in that sense, it was a useful course. But the way he delivered it was awful. A good friend of mine, Preston Schwartz, and I went to another geology course, also given by lectures based on a book. Preston and I were sitting there toward the back of the room, listening, but not taking notes. "Somebody toward the back isn't taking any notes on my lecture. You have to leave the room." So we got chased out.

Scott: He wanted you to take careful notes on his lecture, even though the material was available in the textbook?

Popov: Yes. He wanted us to do it the following way. He would make a pronouncement, and then everybody would write it down. Then he would make another pronouncement, and again everybody would write it down, and so on. He had a lot to learn about teaching.

Scott: I guess you mostly learned ways *not* to teach from those lectures.

Professor Raymond E. Davis

Popov: Raymond E. Davis had come to Berkeley in the 1920s, I think from the University of Illinois, and entrenched himself in the testing laboratory. He taught some key courses, including a full year of strength of materials, and a course on structures. I took both of them. R.E. Davis was the man who gave me A-pluses, which were not customarily given in those days.

He was the man who developed the low-heat cement aggregates used for Hoover Dam—first called Boulder Dam. That came out of U.C. Berkeley, and there is still a little kiln standing at the Richmond Field Station that was R.E. Davis's kiln. They used it to try different kinds of clinkers in developing a low-heat cement. All concrete heats up when setting, and if too much heat builds up, you get cracking all over the place. They were afraid of that, so they wanted a low-heat cement, and R.E. Davis was a pioneer in that.

Then he made an attempt to broaden our education in his so-called "Spring Lecture." Both Pres Schwartz and I knew about this annual event and chose not to attend. One can find the description of this foul-mouthed event in the oral history by Harmer Davis, who was good at such things himself.

Scott: Yes, I heard Harmer give some excerpts a couple of times. Those lectures were notorious—loaded with slightly disguised ribaldry and double meanings—but in those days, I guess there were no girls in class, and for a time those lectures were part of an accepted

engineering school tradition. When I knew Harmer Davis, he had already become the long-term Director of the Institute of Traffic and Transportation Engineering, now called the Institute of Transportation Studies.

Popov: Yes. When I was a student, Harmer Davis was a testing laboratory and structures man and would substitute for Bruce Jameyson in Derleth's course. Later he became, as you say, the Director of ITTE.

Then Howard D. Eberhart came in. He was a discovery of R.E. Davis's on one of the big dams up north—Grand Coulee, I think. Eberhart was six feet, four inches tall, while R.E. Davis was short, about my height [5'6"]. I think Eberhart played a big role in developing the engineering program here—he was the backbone of it. Henry Degenkolb and other engineers who went through under Eberhart's tutelage had a lot of respect for him. He was a special person and a wonderful teacher. In class, however, he could cut you to bits. I recall one student saying later, "While I was taking his class, I could have killed that guy, Eberhart, but when it was all over, I realized I had learned the most from him."

Scott: I remember Professor Howard Eberhart, and once had lunch with him at the Faculty Club, when I sought advice on my oral history work. I did not know him well, but appreciated how he seemed to take a special interest in me, in part undoubtedly because of my limping gait [Scott had polio in 1937]. He had lost a leg while doing research during World War II, and subsequently did a lot of work on the mechanics of prosthetic devices for disabled persons.⁷

Summer Courses in Civil Engineering

Popov: When I graduated in 1933, I had completed 146 semester units of course work, which is about 220 quarter units. In addition, in Civil Engineering there was a requirement to take two summer courses in surveying field work. After the freshman year, it was given on campus, and after the junior year, it was given in an open area of Fairfax.

The second summer course was very interesting. We lived in tents, three students per tent, and had our meals served in a large dining shed. The tent I ended up in had written right over my head in India ink in bold letters the inscription: "Robert Gordon Sproul, CE '13." Sproul was one of the great presidents of the University of California. Right below his name, I wrote in similar script in ink: "Egor Paul Popov, CE '33." All in all, living in this camp with my classmates was a rewarding, memorable experience.

The course was well-planned from the technical point of view. In parties of three, we laid out hypothetical railroads, and made many topographical surveys, including rapid-fire military reconnaissances, etc. It was a great experience in healthy surroundings that made us fairly good surveyors. Although I did not follow this specialty, as I'll mention later it was useful in one of the major jobs in which I became involved.

7. Howard D. Eberhart, whose left leg was amputated in 1944 due to a freak accident, was co-founder of the U.C. Berkeley Biomechanics Laboratory, set up in part for the study of human locomotion, muscle and joint movement, and the development of designs for artificial lower limbs and braces.

Graduation and MIT Scholarship

Popov: To sum up, I carried a very large program and got through in four years. In contrast to our present standing, engineering was not very strong. Since then, the situation has dramatically changed. Much has happened in the intervening years, and we [the Department of Civil Engineering] now have an enviable international standing.

While technically, and in terms of engineering as such, Berkeley might not have been very strong at that time, we got a broader education than many engineers get now. Also, our courses in the materials testing laboratory were excellent. With all its faults, I am proud to be a Berkeley graduate. I guess having teachers like Ira B. Cross and Charles Derleth certainly contributed to that.

When I was coming toward the end of my studies at Berkeley, the employment situation was dismal. After four years of college, I saw one of my friends, Frank Guisto, get a job pumping gas. Another one was Gallick Pogrebnyak, a Phi Beta Kappa, with a name unpronounceable for an American, and whom I considered my best friend. The best he could do was to find a

niche with the highway department locating property for sale along the proposed roadway, etc. So I thought, “The heck with it, I’ll continue my studies.” I had always had an interest in academic life. I suppose this may be partly due to the fact that my father’s university career was cut short by the war.

Scott: You graduated in the middle of the Depression. Things were tough then.

Popov: Yes. Things were terrible. So I acted on a recommendation by my friend, Professor Sidney Harding, who sat in the same office as Etcheverry. Harding played a key role in my life. When I said I would be looking for a job, he said, “You won’t find any.” But he also said, “If you are interested in teaching, send out applications to many schools for a scholarship. The more hooks you put out, the more likely you are to catch a fish. Apply to every place you can think of.” So I did. Among the places I applied was MIT, and low and behold, I got a scholarship, although it was meager. So I did a year’s work at MIT, and then for the second year I got a much better scholarship at the California Institute of Technology (Caltech).

Graduate Studies at MIT and Caltech

There was an element of going from a farm school to the much more demanding engineering at MIT.

Masters Program at MIT: A Difficult Start

Popov: In 1933, the year I got the scholarship at MIT, I went to Boston by bus, with my parents' help for the fare. I got a masters degree at MIT in 1934, but when I had started at MIT, I had found that I was ill-prepared.

Scott: At Massachusetts Institute of Technology (MIT), you found that your previous work U.C. Berkeley had not prepared you well for the engineering you needed when you entered the MIT program?

Popov: That's right, my preparation was inadequate, and during the year I had a dickens of a time. I really had to work at it. The math I had taken at Berkeley was fine—math was good at Berkeley and also at MIT. But the engineering I had at Berkeley was pretty weak. On the other hand, engineering at MIT was then very strong. John Wilbur, for example, who was my thesis advisor, was very good.

Scott: I can understand how it must have been quite a transition, going into the masters level of comparatively high-pow-

ered engineering at MIT, after getting your bachelors from the more easy-going, perhaps somewhat agriculturally oriented work at Berkeley. You mentioned graduating in irrigation engineering because that was the place to learn about structures at Berkeley.

Popov: Yes. There was an element of going from a farm school to the much more demanding engineering at MIT. Berkeley has now outgrown that background, of course, and in that regard it is notable that many of our more recent staff members did graduate work at either MIT or Columbia. Among these, one can mention Professors Vit Bertero, Ray Clough, Joseph Penzien, Erman Pearson, and Alex Scordelis, all of whom did graduate work at MIT, and Jacob Lubliner, Hugh McNiven, and Jerome Sackman, who did theirs at Columbia. Karl Pister earned his Ph.D. at the University of Illinois at Urbana.

Social Life at MIT

Popov: While I was at MIT, my social life was very limited.

Scott: Limited because you had no time for it, or because you did not know your way around in that new area?

Popov: It is hard to say. Quite a few of the students got married at that stage. You would see girls sitting in a row at some of the churches and in social gatherings. Many of them were Radcliffe College girls. Perhaps they were on the lookout for promising male students. But then I was barely 21, too young to be thinking about marrying.

Each weekend I went with the fellows to restaurants, since no food was served at MIT on

weekends. I played quite a bit of squash, enough to really warm up. On rare occasions, I went to the ocean with a few fellows to take a dip, but generally it was too cold. But all in all, my social life was very limited. My time was spent mostly studying and socializing with my classmates.

Caltech Scholarship

Scott: You were at MIT for one year, got a masters degree, and then went to Caltech to study for your Ph.D., correct?

Popov: Yes. MIT was hard, but had good teachers, and I surmounted it and finished the first year. I wrote my masters thesis on suspension bridges, of all things. By that time, I also saw that I wanted to be in academia. While I really wanted to continue at MIT, I was the second man on the totem pole for the scholarship that I wanted. Meanwhile, remembering Professor Harding's "hooks" theory, I had put out several applications elsewhere. Since MIT was good, I reasoned that Caltech should also be good, so I applied there and got a really good scholarship. That was 1934.

Doctoral Studies at Caltech, 1935-1937

Popov: On the Caltech scholarship, I got full room and board and, in addition, \$15 a month cash. That was quite a bit of money in the Depression times. One could go to a movie for 20 cents, or get a hamburger for 15 cents. I felt rich compared with how I felt at MIT. In return for all these goodies, each quarter I had to teach one section of four or five sections of three consecutive courses in statics, dynamics, and strength of materials.

Relations with Martel

Popov: When I arrived at Caltech, however, I was rather disappointed. In comparison with MIT, it was small. Also, I never hit it off with the French-Canadian structural engineering professor Romeo Raul Martel (R. R. Martel).

Scott: Martel then had a considerable reputation in the structural engineering field, and especially earthquake engineering.

Popov: Very true. He certainly was good in seismic design. My troubles arose due to my own fault. He was trying to persuade me to take his course, but when I looked over the material he showed me, I bluntly said, “I know all that,” which in my mind was certainly true. A similar situation arose again, when I again gave him the same undiplomatic answer. I can note, however, that he was pleased with my design of a gasoline station that he assigned to me. It is still there at Caltech.

So instead of Martel’s courses, I took year-long courses in mathematical physics from Professor William Houston, who later became the president of Rice University, another course from Theodore von Karman on aircraft structures, and still another one from the famous Fritz Zwicky in advanced dynamics. Zwicky was interesting and a good instructor with a special sense of humor, who gave very tough assignments. The choice of such courses further accentuated my rift with R. R. Martel.

An Envious Instructor-in-Charge

Popov: Another minor problem arose in my teaching at Caltech, in the sequence of courses assigned to me. In the first quarter, my section came out at the top in a common final jointly

graded by the instructors involved. One of the instructors was Professor F. W. Heinrich, a West Point graduate who was in charge. It bothered him that one of the underlings was at the top, with his own section placing behind.

Scott: I guess the West Point graduate was affronted by your success. He outranked you, and you were not supposed to outperform him.

Popov: Next quarter he changed the section instructors and gave me another section to teach. Again at the finals, mine came up on top. Apparently he got upset. He told me, “You are driving your students too hard—you can’t do that to them. If you keep this up, we will have to take measures.”

Then in the third quarter with a different group of students again my section was number one, but this time he chose not to talk to me about it any more. I must admit that I drove the students pretty hard, but in later years some of them approached me with kind remarks.

Freelance Work in Materials Testing

Popov: In addition to studies and required teaching, I did freelance work in the materials testing laboratory, which was a natural for me because of the excellent background I had gotten at Berkeley. Professor Fred Converse was in charge of the laboratory. Later, he formed his own large company specializing in soils. Now and then, he would see me and say, “Popov, we have a bunch of welders to qualify. Can you do that over the weekend?” He would have the pieces that they had welded, and wanted them tested. I would say, “What kind of test do you want, the bend or tension?” And he

would tell me what kind. Converse paid me 50 cents an hour. So after the test, he would ask, “How many hours did it take?” “About four,” I would say. “Here’s two dollars.” That was all the bookkeeping there was to it. Through this interaction, he and I became very good friends.

Scott: I take it that somebody else would have observed the welders while they were doing the welding, then you were given the pieces they had welded, so you could test the quality of their work?

Popov: Yes. I was the laboratory man.

Leaving Caltech to Work as a Practicing Engineer

Popov: Anyway, in 1937 the time was ripe to approach Martel regarding my Ph.D. He

started with a pleasant remark, “Oh, you did a really nice report on the plate buckling problem, very clever.” Then we got down to business. I said, “We ought to nail down the matter of my Ph.D.” He replied, “That’s the trouble with you. You will never make a good engineer. You are becoming a mathematician. You ought to go to that Russian at Stanford and get your degree with him.” He was referring to Stephen Timoshenko. I got mad, although I did not show it at the time, but in any event I decided then to quit Caltech.

Scott: Martel felt that it would be a better choice to continue your studies under Timoshenko because he was much more mathematical?

Popov: Yes. Fortunately, I held my temper and it all ended peacefully. So I was at Caltech in 1935, 1936, and 1937.

Working as a Practicing Engineer, 1937-1945

My MIT and Caltech studies helped to resolve [many] problems.

First Professional Job: Fullerton Junior College

Popov: Having made a decision to quit my doctoral studies at Caltech, I needed a job. In view of my excellent relationship with Converse, who had started to call me “Pop” instead of “Popov,” I went to see him. He promptly said, “I’ve got you a job,” and told me to go to Fullerton, saying they needed an engineer there. So I went there, and started working as an engineer. The Fullerton Junior College District had already engaged an architect, Harry Vaughn, and an engineer, Harold Clar. I was to join them in designing buildings for the district.

Scott: I presume they were engaged in a building program, probably with federal funds available under the New Deal. That was going on all over the country about that time.

Popov: Yes. The Fullerton position turned out to be far more interesting and challenging than I expected. It was recognized right off the bat that they would have to use piles and lightweight concrete, because of the soil conditions. Since it was the first job in California in which major school structures were to be built from lightweight concrete, a materials investigation had to be started. The only available lightweight aggre-

gate was Reylite. This involved working with Smith-Emory Testing Laboratory in Los Angeles. The tricky part was to determine the water content in the mix, because if standard procedures were used, the concrete becomes extremely stiff as the water is absorbed by the porous aggregates. Consequently, a special procedure had to be developed for mixing. Working with the many test cylinders that I had to make during casting was like being home in the Berkeley lab.

The second issue arose in the design—the architect did not want any thickness changes in the outside walls. With the relatively long span of the floor beams, however, large bending moments would be applied into the walls, especially under seismic conditions. Further, the two-story Administration building was T-shaped in plan, and special precautions had to be taken between the flange and the stem of the T. The methods of treating such conditions are now well established, but in 1937 one had to be creative. The lateral load analyses were not commonplace then. My MIT and Caltech studies helped to resolve these problems.

The second building in which I was involved had a flat slab on the first floor. What is especially noteworthy is that it was built with federal monies provided by WPA (Work Progress Administration, later renamed Work Projects Administration). The special feature of these money grants was that the workers were to be local people who generally had *no* experience in construction. So I had to show them how to do many things, like bending reinforcing bars and designing small jigs for doing special work.

Then lastly, when the design of both buildings was completed, I was asked by the Fullerton

College administration to be the inspector for both buildings. This again was a most valuable experience.

I learned a good deal by working on the Fullerton job, and I owe much in that regard to the design supervising engineer, Harold Clar. He got his experience in the firm of Purdy and Henderson in New York City, although at times it was almost annoying to hear that everything in New York was superior. He was not bad in analysis for lateral forces, which is so necessary in earthquake design.

Incidentally, while I was working at Fullerton, I had to do something in the evenings. So I took a junior college evening course in welding and machine shop. That was very good background for an engineer to have. I also thought I ought to study singing and started that. I was not very good, but it gave me a nice diversion.

Working for Several Firms in the Southern California Area

Popov: After a brief search, for a short time I worked with the large architectural firm of Parkinson and Parkinson in Los Angeles, with a Caltech graduate, Joe Shieffet (pronounced Shef-FAY), as head engineer. I do not clearly recall to which job I was assigned, but I think it was something for Lockheed in Seattle. For me, that was a rather uneventful position. I was ready to move to the next job.

E.F. Rudolph, Structural Engineer

Popov: The next job I had, run by E. F. Rudolph, Structural Engineer, in Los Angeles, was geographically nearby.⁸ I stayed there several months and found it challenging. Soon, I

was made the head man and got 5 cents per hour for each person I supervised. There were six such people in the office. So I got 30 cents more per hour. Remember, we were still in the depth of the Depression and that was a lot of money at that time.

There was a great variety of projects in this office. We had small school buildings, many markets with front openings practically across the lot, and many other commercial buildings, including a large department store. What was convenient about this job was that it was practically across the street from the Los Angeles building department. Because of the many visits to this facility, I got well acquainted with the chief building inspector, Jake Oberlies, and he always would give me a helping hand. I made another good acquaintance in Harry Bolin, the chief for the Los Angeles area of the State Division of Architecture. For school buildings, he would meticulously go over the plans, calling attention to poor or inadequate details. With him, I certainly developed a student-teacher relationship. Actually, I had three seismic design teachers. Clar was the first, but he was somewhat elementary. Then when I got up to speed, I had Harry Bolin and Jake Oberlies. With Rudolph, the most difficult part of the job was to lay people off, especially when they would break down emotionally because jobs were hard to find.

8. To avoid confusion, some brief engagements are not detailed. For example, after following Harold Clar to the E.F. Rudolph firm, Popov returned to Fullerton to be a building inspector and afterwards rejoined Rudolph. Professor Popov altered slightly the sequence of employment to simplify its recounting.

Martin Pohl, San Bernardino

Popov: It was still the Depression, and my hour of leaving Rudy's office also arrived. But most fortunately, a German educated engineer, Martin Pohl, showed up and wanted me to work for him in San Bernardino. After much hesitation, I agreed and for a few months I worked in San Bernardino. There I was largely responsible for designing several buildings for the Coachella Valley Junior College. Looking back at that job, without any computers, but aided by well-established graphical methods and a slide rule, the work was done and approved by the engineers in the State Division of Architecture. I was very pleased that in the relatively large 1940 El Centro earthquake in their proximity, the Coachella school buildings were undamaged.

After completing the Coachella job, Martin Pohl offered me partnership in his budding firm. I chose, however, to come back to Los Angeles, where I could join Bill Mellema's firm.

Bill Mellema, Los Angeles

Popov: Harold Clar was the head engineer for Bill Mellema's AE (Architect-Engineer) firm, which specialized in engineering seismic design and was bursting at its seams.

The impressive volume of work at Mellema was almost exclusively on school buildings requiring seismic analysis. Essentially, a rather large staff was divided into three groups: one was the draftsmen who did the final ink drawings for the client. The second group was the bulk of the engineers, who did the "gravity load" design. The third was the smallest group, a few lateral load (seismic) designers.

I was in the third and rather elite group of lateral load analysts, and did a number of analyses and designs in the Mellema combine. The work varied in complexity; some was in steel, and some in reinforced concrete. A lot of work was done with a famous architect, Neutra. Incidentally, I can't forget the explosions I heard across the way when the chief designer at Pfisterer, Harold Clar, and Neutra had frequent emotional outbursts over the phone.

Finally, however, Mellema's work dwindled, and only three of us remained—two Whisenand brothers, George and Jim, and myself. We were making the final touches on the last job on a Christmas eve. Then around midnight Bill Mellema walks in carrying three little drinks on a tray. "Well boys, did you finish the job?" Our answer was "Yes." Then continuing he said, "Tomorrow I am closing the office, and here are the checks paying you through today." Then he left the room. There was no bonus, just an accurate sum paying us up through that day.

The reaction from my two colleagues was rather violent. Jim, who was really my best personal and professional friend, said, "This is the end of structural engineering for me." Later he got wings from the Kelly and Randolph fields in Texas, then became a wing commander in the Burma theater of war. The last time I talked with him and his wife, Hazel, in Washington, he was a two-star general and was assigned to the Chief of Staff's Council. It is interesting to remark that Jim and Hazel earlier were witnesses in my citizenship proceedings in Santa Ana, California.

George Whisenand joined FHA, and later, together with others, established perhaps the

leading architectural firm in Hawaii, specializing in the development of large resort complexes all over the Pacific Ocean. Later, Irene and I stayed with his widow in their fine home in Honolulu.

A Whirlwind Romance

Popov: When I again settled in Los Angeles, I decided to continue with my singing lessons. I took these from an Italian diva, whose daughter provided the voice of Snow White in Walt Disney's movie. At this teacher's house where she gave the lessons, I met my future wife's sister, Alena, who on one occasion said to me, "We are getting a small group together—and you should meet my sister Irene." This developed into a whirlwind romance, and later I married Irene.

Southwest Portland Cement Company

Popov: As for myself, with a hope of marrying Irene, I accepted a much more permanent position with the Southwest Portland Cement Company (SWC), headquartered in Los Angeles with a major plant in Victorville, California. This work again turned out to be very interesting. Besides getting acquainted with heavy equipment, and making design changes and additions, two major efforts occupied my time. First, they were negotiating with several dust abatement companies. When one of them was chosen, another young engineer and I had to design the installation of the system. Second, the SWC made a decision to open another quarry for appropriate rock for making cement. They said that as I was a Civil Engineer, I should be able to lay out about a 10-mile-long roadway, together with the electric pole line.

Hence, with a chain-man to help with the surveying, I laid the required systems out in the desert. As I was licensed, somewhere in the archives of the federal system are drawings with my signature. I had never expected this task, but it was fun to lay it out and put to use the summer training in surveying that I had had in Berkeley and Fairfax.

Irene made quite a hit with the SWC and was written up in their Victorville company bulletin. Also in the mid-1940s, while I was working at the SWC, my good wife, Irene, was in charge as a chemist in an allergen manufacturing laboratory, Knap and Knap, in Burbank. In this work, at that time they were permitted to do what Irene called “scratch tests” to detect a person’s susceptibility to various pollens. In this activity, she “scratched” numerous Hollywood stars. All of this happened, as she referred to it, BC—before children. Then, when our first one came along, she resigned her position with Knap and Knap, which shortly thereafter was absorbed by a large pharmaceutical company.

Our first child was born on time, and we moved from Burbank to San Gabriel, where I built our house, as a contractor. As I had a full-time job, I do not know where I found the necessary time. Then when the war came along, our second child was born. The daughter, our first child, later became a fine jewelry designer, and our son is a top clinical psychologist working for the State of Illinois.

World War II began while I was with SWC. Then when the United States entered the war, there was a tremendous rise in patriotism, and many volunteered to join the services. Some of my friends, as graduate engineers, were getting immediate commissions as officers. I felt I

should not be left out, and along with many others went to Griffith Park in Los Angeles, where the enlistment procedure was in full swing. There I indicated that I wanted a commission as a Naval officer. Things went along well, but by the time I had a partial physical—where along the way I was told that my vision was 20/20—someone caught up with me and in no uncertain terms told me that I was not eligible for a commission because I had been naturalized for only about four years.

It would appear that at that time the rule for an officer’s commission was ten years. I understand that later during the war this rule was rescinded. It is interesting to note that my brother was immediately commissioned as a captain in the Army medical corps because he was a derivative citizen. This was due to the fact that he was under 21 years of age, and I was over that age when our parents became citizens.

Later, I went to see my parents in San Francisco, and I tried again to enlist. I went to some tall building on Market Street where the enlistments were held, but the clerks there immediately gave me the same answer I had heard before in Los Angeles. That was the end of my military career.

Working for Goodyear, Aerojet

Popov: As time went on, I made further jumps in employment. For reasons of better pay, I left a very pleasant position with a promising future and excellent relations with the top administration at SWC to accept a job with Goodyear. I did some interesting work there, such as dipping sheets with synthetic rubber into tanks with natural rubber so the sheets would stick during manufacture. Some very

heavy work on large rubber mixers was also rewarding. But upon receiving a call from Aerojet from my Caltech friends, I went there.

Aerojet, which at that time was not large, was located in Pasadena. I was to go work with the double X, which meant a super secret group. The primary work, no longer secret, was on the jet-assisted takeoff unit for military airplanes. Later, when I completed my studies at Stanford, I received a very kind letter from the chief engineer offering me re-employment with Aerojet.

Scott: Jet-assisted takeoff—I believe “JATO” was the acronym they used for it back then.

Returning to School for a Ph.D. at Stanford, 1945-1946

Popov: Before going to Stanford, I had made some preparations, particularly in contacting Professor Stephen Timoshenko, explaining that I wanted to work on my Ph.D. dissertation with him, and he gave me friendly encouragement. Further, I had my graduate work at MIT and Caltech evaluated at Stanford, where it was accepted at par. The two foreign languages required for me at that time were Russian and German. They were accepted in principle, subject to examination. A projection was made that I could complete my Ph.D. in about a year or year and one-half.

On the above basis, I became a Ph.D. candidate at Stanford, and my parents graciously agreed to house my wife and the two small children. Continuing my studies was what they were waiting for. In that way, I could start living in an attic in Palo Alto and study with great enthusiasm.

In my studies, I took every available course from Professor Timoshenko, read solutions of the problems assigned to students in Professor Lydik Jacobsen’s dynamics course, and worked intensely on my dissertation.

Professor Timoshenko was a superb teacher. He delivered his lectures enthusiastically and with great clarity, without the use of any notes. He quickly developed a great rapport with the students, making the experience of attending his classes a pleasure. In addition to the formal studies, it was also always a pleasure to attend his weekly teas over which he presided. At such gatherings with his students, he projected his philosophy on teaching and everything else.

Later, I was greatly honored to be one of the three chosen to say a few words on Timoshenko at his memorial service in the Stanford University chapel. The other two were Vice-President and Provost Emeritus Frederick E. Terman, and Professor Donovan Young, often a collaborator on Timoshenko’s writing.

I successfully completed my dissertation in 1946, with a faculty committee consisting of S. Timoshenko, L. Jacobsen, and D. H. Young. The degree was awarded in Civil Engineering-Applied Mechanics. This was before a separate department of Applied Mechanics was formed. The same summer, I was appointed an Assistant Professor of Civil Engineering at the University of California at Berkeley.

Early Career at U.C. Berkeley, 1946-1970

Where there is life, there is change...

Popov: My early teaching and research started at Berkeley in 1946, essentially right after the war. The teaching staff was small, and a large number of students were eager to continue their education. With no complaints, the staff members had to teach three courses. Some of the large classes had an enrollment of over 100 students. Naturally, I was assigned to teach engineering mechanics courses, and usually also a laboratory course.

Professor Howard Eberhart was in charge of the mechanics courses. I mentioned him earlier when talking about my student days. Eberhart laid down a rule that we all followed—we gave at least three one-hour mid-term examinations. Also, having no assistants, each instructor graded his own exams. As at Caltech, a common final was prepared and graded by the course instructors, each instructor being responsible for grading two or three questions for all of the students in the course.

As instructors, we watched the average grade for our section, which determined the grade point average one could assign to his section. The system was very fair, but tough. We never hesitated to give Ds and Fs to the weak students. At one time, I managed to know the name of every student in my class of a hundred. Nowadays, some of my former students remind me of this feat.

At that time, laboratory courses were taught differently from the way they are now. Unlike present practice, the instructor assigned to a section would be in the laboratory continuously, although we generally had a nonacademic assistant. Usually, either Professor Earl Troxell or Joe Kelly was in charge of the lab courses.

Early Doctoral Candidates

Popov: The teaching of a newly developing course, and the research done in that connection, were left to the instructor. In my case, my first doctoral student was Mihran S. Agbabian. In fact, he was the first student in structures at U.C. Berkeley, and he earned his Ph.D. in 1950. The chairman of the civil engineering department strongly objected, asserting that we did not need any Ph.D.s in civil engineering. Mihran often reminds me how I argued on his behalf with the civil engineering chairman in Berkeley, trying to get approval for his studies toward the advanced degree. After considerable discussion, and using the principal argument, “Isn’t it about time that we should start awarding Ph.D.s?” the Chairman agreed to allow Agbabian to continue his studies. Mihran later completed the work for the degree, and eventually became the chairman of the civil engineering department at the University of Southern California, in Los Angeles.

At the time, the University did not allow a student to be paid for work in the area of his dissertation. So, being unable to get paid for work in the area of his dissertation, Mike Agbabian worked for another professor on the use of incinerators for sanitation purposes.

A number of Ph.D. students with analytic interests were to follow. Among them was Zung-An Lu, who did a very creditable job on computer analysis of shells of revolution. This research appeared to be useful to LTV (Ling-Temko-Vought) in their design of the sphere for the first United States unmanned suborbital flights.

James Goodman studied layered systems with inter-layer slip with reference to wood that he later applied to timber poles. He became nationally known for this work. John Abel pursued studies on static and dynamic structures, which later became a useful approach for beams on elastic foundations. Currently [1996], John is chair of the Department of Civil Engineering at Cornell. M.S. Lin made a contribution recognized by an award from the Society for Experimental Stress Analysis on buckling of spherical sandwich shells. And there were others. As for myself, besides supervising graduate students and teaching undergraduate courses, I continued developing my graduate courses, with a bias toward theoretical issues, and with particular emphasis on shells and nonlinear problems.

Mechanics of Materials Published in 1952

Popov: As I continued my academic career at Berkeley, in six years’ time, I produced a book, *Mechanics of Materials*, published in 1952.⁹ Through teaching, I learned about the defects in the available texts. I deliberately delayed publishing this book, however, being concerned that it might be too close to the work of

9. Popov, Egor P., *Mechanics of Materials*. Prentice-Hall, Englewood Cliffs, New Jersey. 1952.

my master at Stanford, Professor Stephen Timoshenko, although actually, it was quite different. In my Foreword, I cited some remarks that Nathan Newmark, the late head of civil engineering at the University of Illinois in Urbana, made about my book. In my opinion, Newmark was one of the greatest of the United States teacher-researchers in the area of structural and seismic engineering:

Dr. Popov's book is a noteworthy example of an engineering text that blends the best aspects of the practical and the fundamental scientific points of view. This integration is effected logically and simply by building upon elementary mathematics, physics, and mechanics. At the same time, the examples are chosen so as to give the reader an understanding of the practical side of the subject, the limitations of the theories, and the application of the results.

After publication, the book was remarkably successful, being adopted as a text at MIT, Purdue and Stanford, as well as elsewhere. As a couple of examples, a Portuguese translation of my book has been used in Brazil for many years, and at least seven Iranian-version printings of it are available in Iran, which does not recognize American copyright law. In developing the book, I owe much to my late wife, Irene, for her help in editing and typing the entire manuscript.

Work on Shell Structures

Popov: As a result of my interest in shells, I became active in the International Association for Shell Structures (IASS), which was founded

by a famous Spaniard, Eduardo Torroja. This association provided an opportunity to organize the World Conference on Shell Structures under the auspices of IASS in 1962 and over which I presided, aided by colleagues Alex Scordelis and a former doctoral student, Steve Medwadowski. Apparently, the theme and timing of this conference was very fortunate as we were supported by the presence of the U.C. Chancellor, Edward Strong; the Acting Mayor Harold S. Dobbs of San Francisco; Richard H. Tatlow III, National Academy of Sciences-National Research Council; and A. M. Haas, President, IASS. A two-and-one-half day technical meeting in San Francisco attracted over a thousand people to the concurrent technical sessions, with speakers from many parts of the world.

Chairing the Structures Group

Popov: Dean Murrough P. O'Brien had wanted to sort of organize the structures group to bring the lab and theory together, but the first man he brought in to do that really did not work out. So in 1956, Dean O'Brien appointed a triumvirate—Eberhart, Troxell, and myself—to administer the structures group in the Department of Civil Engineering.

Scott: How did the triumvirate work out?

Popov: It was terrible. Nothing changed, everybody went his own way. It still needed one person to do the job.

Asked to Chair: Negotiations with the Dean

Popov: So in 1959, after one year, Dean O'Brien asked me to take over the structures

group. Further, he said that R.E. Davis would stay in the office where he was, which was the logical location for the structures lab and the division office. To that I replied, "If I am the head of the structures group, then the main office should be mine." To counter that, O'Brien promised to rearrange the rooms in the building and make an attractive office for me. "We can make arrangements for you by cutting a door through the wall to give you access." I did not accept this, however, and as strong a man as O'Brien was, he backed down and R.E. Davis had to move.

Scott: So you chaired the group for what period? Also, what was its formal name?

Popov: I chaired from 1958 to 1960. During my tenure in office as chairman of the group, we named it the Division of Structural Engineering and Structural Mechanics (SESM). Furthermore, this group had a *separate* budget within the department of Civil Engineering and the group was in full charge of the structures laboratory. With the next Chairmen, these advantageous arrangements were lost.

Building Davis Hall

Popov: The SESM group initiated the building of the new Davis Hall. Professors Bouwkamp and Scordelis, as chairmen, provided the drive that was necessary to implement this development and promoted the idea of the new building among Berkeley colleagues and the U.C. Berkeley administration.

This operation ran very smoothly, except at the last meeting when the architect presented the final version of the design. I was the only one who objected to having at the most a few small

windows. I lost on that motion. They kept saying, "It is a laboratory building, you don't need windows." They had an alternate design with glass all around, which was going too far in the other direction, and the faculty rejected that.

Scott: So they went ahead with the small-window design.

Popov: Yes. When they were building the structure, in my opinion it looked very bad. It was referred to as "The Castle," and for a long time afterwards I called it "Fort Davis." Only after the Engineering Library was designed by a Nisei architect and the bare wall facing the Campanile was covered did the complex have a good outside appearance.

Recruiting New Instructors

Popov: Under my tenure in office as SESM Chairman, large numbers of new staff were added to the department. It was my privilege to help direct the choice of several staff members. Fortunately, by this time in my career, I had developed a wide acquaintance with chairmen in leading universities in my field, and I could approach them on a personal basis for recommendations of outstanding individuals. My experience showed this method of recruiting staff, together with University procedures, to be very effective.

Scott: Say a little more about how you went about recruiting.

Popov: I got on an airplane and made lots of stops. I had been active in the American Society of Civil Engineers and the American Society of Engineering Education. That had given me broad exposure and I knew a lot of people. So I asked "Where are the good schools?" and

went about visiting them, looking for new staff members.

Scott: With whom did you confer at each of the schools?

Popov: The departmental chairmen. First, I went to the University of Washington, then to Chicago, then the University of Illinois. After that I went to MIT, which was a very important stop. As luck would have it, the department's executive officer, Chuck Norris, said: "We have a fellow here whose English is not very good, but he himself is very good. If I were you, I would take a chance on him. He is probably the best man we have now." That was Vitelmo Bertero, who was from Argentina. After MIT, I went on to Columbia and talked to Professor Jewell Garrelts, Chairman of Civil Engineering and Mechanics. As a result of my conversations at Columbia, three showed up—Jacob Lubliner, Hugh McNiven, and Jerome Sackman, although they didn't all show up at the same time.

Scott: That was a net catch of four from your trip—Bertero, Lubliner, McNiven, and Sackman.

Popov: Yes. About the same time, however, in collaboration with Howard Eberhart I had strong influence in appointing Ray Clough and Jim Kelly. Alex Scordelis and Ed Wilson were native sons who returned to Berkeley on their own accord—the first, after completing his graduate studies at MIT, and the second, after some very successful engagement in professional practice. So with Vitelmo Bertero, Ray Clough, Jim Kelly, Jerome Lubliner, Joseph Penzien, Karl Pister, Alex Scordelis, Jerome

Sackman, Ed Wilson, and some others, we had built up a powerhouse of a group.

Scott: The department had grown pretty rapidly during the 1950s, hadn't it, and began building a reputation?

Popov: Yes, our reputation had gotten to be very good, and we were sought after for lectures.

Scott: Was much of this work related to earthquake engineering, or did that mostly come later?

Popov: Most of that came later after my sabbatical leave (1952-1953). By that time, the real strength of that department was in the three—Clough, Penzien, and Bertero.

Scott: Ray Clough was focusing much of his attention on developing the finite element method of analysis, wasn't he?

Popov: Yes. He had worked on that at Boeing in Seattle in 1953-53 as part of their research on stresses in aircraft with triangular shaped wings. He continued his finite element work here in Berkeley, but it was not specifically seismic-related research—that work came later. In 1971 Vit Bertero and I did a couple of papers on "Testing Facility For Frame Subassemblages"—to be used in earthquake studies—and we were the first ones in the new testing lab (now Davis Hall). It was for this work that we got National Science Foundation funds for earthquake studies. Serious work on earthquake studies at U.C. Berkeley started just about then, and quite a few papers appeared in 1975, and important work with Ma and Bertero was published in 1976.^{10, 11}

Sabbatical Leave In Europe

Popov: After a short stint in my administrative capacity, and having simultaneously taught three courses each semester, I took a sabbatical leave and spent a year—1952-53—divided between Switzerland and Germany. Partly due to Timoshenko’s tutelage, I developed great respect for the scholarship in both of those two countries. I also found the experience living abroad rewarding. Even my children, once we cast anchor for the winter in Zurich, and after driving through devastated Germany, said Zurich was “just like Berkeley.”

At that time, Germany was a total wreck. In the spring, however, it was tolerable, and we spent the second half of the year in Germany.

While I was in Europe, our dean of engineering, John Whinnery, wrote to me suggesting I should come back and assume the leadership of SESM. To that I essentially firmly replied that “There is no such thing as an irreplaceable man.” On my return to Berkeley, I resumed vigorous activities, which I will now describe.

-
10. Ma, Shao-yeh M., Vitelmo V. Bertero, and Egor P. Popov, *Experimental and Analytical Studies on Hysteretic Behavior of Reinforced Concrete Rectangular and T-Beams*. Earthquake Engineering Research Center, University of California at Berkeley. Report no. UCB/EERC 76-02, May 1976.
 11. Ma, Shao-yeh M., Egor P. Popov, and Vitelmo V. Bertero, “Cyclic Shear Behavior of Reinforced Concrete Plastic Hinges,” *Dynamic Response of Structures: Instrumentation, Testing Methods and System Identification*. University of California at Los Angeles. 1976.

Vacuum Chamber Consultation: Johnson Space Center

Popov: Then, apparently because of some reputation that I had acquired in the area of shell analysis and design, in 1964, I received a call from a former student, Don (H.D.) Yorston, who was working for the Bechtel Corporation. He told me that they were in trouble with the huge vacuum chamber for simulating some aspects of landing on the moon, and Bechtel had reserved for me a first class flight to Houston, Texas, as they needed my help. I said that I had another class on that day and two classes the next day, and only after that could I schedule a brief trip to Texas. He had to accept my decision, and I flew “first class” the day after I completed my classes that week.

After an uneventful flight to the then-small airport at Houston, I went to what is now called the Johnson Space Center. After going through some elaborate clearances, I was at the huge damaged cylindrical vacuum chamber, which was about 120 feet tall and about 60 feet wide, and had a 40-foot diameter circular door. It was very fortunate that the technicians stopped the air evacuation before more extensive damage due to implosion could develop.

Scott: An implosion. So basically the walls had caved in?

Popov: Yes. To do an inspection I needed to be able to climb freely over this test monster, and as this was some 35 years ago, I was younger and could do it. Some of the climbing was rather hazardous, especially along the outside cap with its sloping edges. To me, the inside of this vacuum chamber looked beautiful—church-like. Except for the banks of GE

lights simulating the sun, everything was painted black—the floor, the walls, the cryogenic panels for cooling the space, etc. There was a rotating circular platform on which they placed the “bird”—in which the astronauts arrive on the moon—together with the last rocket booster. Platform, “bird,” and rocket booster could all be maneuvered through the 40-foot diameter door. All of this was very complex, and was a tribute to man’s genius.

After studying the problem in Berkeley, I came to the conclusion that there were no ready-made solutions. Nowadays, it could be done using finite elements for curved surfaces. In 1964-65, however, when I was doing the work, no such solution was available for curved surfaces, although it could already be done for a flat surface. Therefore, I hypothetically rolled out the cylinder into a flat surface, with ribs, and applied the end edge boundary forces.

For our work on this project, Jerry Raphael used a fully implemented finite element program for flat surfaces that had been developed by Ray Clough to obtain the needed solution for a flat plate with ribs. After that, I rolled this flat sheet with ribs back into the original cylindrical shape. From such data, the force vectors normal to the cylinder and along the ribs could be calculated. Anyway, the cylinder ribs were reinforced as needed, and the suggested repair worked. When a paper along these lines was written, intended for publication, and I asked Bechtel to release the paper, I got a firm negative response, because everyone was suing everybody. I tried to explain that at the University, a professor’s paper is more valuable than money, but my argument did not work.

There had been several tense meetings in the period before the fix was achieved, although on my subsequent trips to the Space Center, I was most cordially received. On one of those tense occasions, we had gathered to meet with Colonel F. P. Koisch, who ran the project for NASA. All of the contractors—there were several of them—sat on one side of the table, and I was included in this group. There was a lot of nervous apprehension on our side, as everyone feared the Colonel, who was considered to be businesslike and very strict. Then he entered the room with his retinue. After he came in, he glanced over at me and promptly proceeded to shake my hand, saying, “You may remember a group of West Pointers in your class. I was one of them.” I answered affirmatively, and the ice was broken. At that meeting, addressing me, he said, “This is a national problem, and I can immediately order anything we need to fix this chamber.” After that, the meeting was conducted in a reasonably relaxed manner.

The next day, our Bechtel team was seated on a large stage, and one person at a time was called out to testify, after the customary procedure of being sworn in. I was selected among others to go to the stage center, swear in and answer questions. To this day, I have saved three tomes of the proceedings of this session, and now I see what I had said in Houston at the Johnson Space Center. The whole event was quite an experience!

This was not the end of my relationship with Houston. Some time later, while I was sitting at my desk at the University, three men walked in and discharged on my table what I could refer to as a lot of pieces of junk. They explained to me that they were developing a centrifuge, at the end of which was to be a sphere for three

astronauts sitting in a vacuum. This centrifuge could be spun very fast to check the subjects' ultimate endurance. I came back with similar questions to those I had asked the Bechtel people about the vacuum chamber. "Tell me the material you use and the speed at which you spin the centrifuge, and by all means provide me with detailed drawings of your design." They carried out this request, and I found that their door attachments on the module were poor. They fabricated another module, it tested out well, and when I visited Houston again I was offered a ride on this contraption. To that I replied, "Forget it!"

Work on Nonlinear Analysis

Popov: About the time I completed my tasks with Houston's problems, I had the privilege of working with a stellar constellation of brilliant students and co-workers. The three that first come to my mind are: Said Yaghmai from Iran, Hans Petersson from Sweden, and Miguel Ortiz from Spain. Collectively, they helped to significantly advance the solution methods for nonlinear problems in mechanics of solids. **[Dr. Pister: Do you know what year this would be?]**

Said Yaghmai

Popov: It appears that earlier than anybody else, Said formulated a solution methodology for such problems using the finite element approach. In principle, this made a pronounced improvement in the solution of such problems. Said's work on this development had an interesting history. After completing his dissertation, he expressed to me his wish to get some American production experience in prestressing rein-

forced concrete. Apparently, that was needed in his family's business. At that time, I knew of a good concrete casting yard in Visalia, California, where they were routinely doing prestressing, and I arranged for his job there. Everything was then going well, until in reviewing Said's dissertation, I found an error in formulation. I immediately called him and explained the problem. On hearing of this problem on his dissertation, he immediately resigned his work at the yard and came back to Berkeley to spend about a month and a half eradicating the error, at no cost to the NASA project. Said's behavior in the matter impressed me very much, and my esteem for him grew immensely.

While he was still in Berkeley, Said showed the new development to the late Professor Paul Naghdi, a superb, internationally recognized theoretician in the mechanics of continua, who initially was also from Iran. Apparently, he was very impressed by this development. Unfortunately for us, however, this work had to "die on the vine," since severe political problems developed very shortly after Said's return to Tehran, so our dream of doing some papers on the subject could not be realized. I have noted, however, that in the development of nonlinear analysis with finite elements, even some of the illustrations in current papers resemble the ones we had used.

Hans Petersson

Popov: Partly because of his personality and thinking approach, it was great fun to work with Dr. Hans Petersson, a Fulbright scholar from Sweden, another star I attracted to work with me. The only difficulty with him was his habit of working through the night, and you

could not call him before 11:00 in the morning. On that, my wife would jokingly say to me, “Again you are working with one of those mushroom people.” Dr. Petersson’s work with me on “Constitutive Relations for Generalized Loading,” in the *Journal of Engineering Mechanics* of ASCE in 1977,¹² and “Cyclic Metal Plasticity: Experiments and Theory,” in that same journal in 1978 are exemplary.¹³

Miguel Ortiz

Popov: The last name among the three names noted earlier is Miguel Ortiz, who originally was from Madrid. He came here on the highest recommendation from one of his well-known professors whom I saw at IASS [International Association for Shell and Spatial Structures] meetings. The prognosis for his success was obvious. Now he is Professor of Aeronautical Engineering at Caltech. His prowess is to capture analytically the inelastic cyclic behavior of materials. In this area, he has attained an enviable reputation. Our joint papers, such as “A Physical Model for the Inelasticity of Concrete”¹⁴ and “Distortional Hardening Rules for Metal Plasticity”¹⁵ are well known. I was asked by one of the Stanford professors for copies of one of these papers for distributing in class.

After Miguel, others followed from Spain. It would appear that in Spain, mathematics is taught well and at a high level.

Other Excellent Doctoral Students

Popov: After the above analysts, I had the good fortune of having other excellent doctoral students. Among them, I would like to mention the following: Yanis Dafalias from Athens, Per Larsen from Norway, S. Nagarajan from India, and Parviz Sharifi from Iran. Each one of them made important contributions. All of these were excellent students.¹⁶

Then quite unexpectedly, and after receiving an “all-OK” from my doctor a couple of days earlier, I had a heart attack on August 13, 1970. So it was then my number one job to get well. My exciting activity had to stop for awhile. After a rest and losing 30 pounds, on October 28, 1970 I cautiously began to resume my previous activity.

For other reasons, however, and not only due to my health problems, my activity in some areas slackened. About two or three days before my eventful day [heart attack], NASA indicated that the last two other researchers and I were

12. Petersson, Hans and Egor P. Popov, “Constitutive Relations for Generalized Loadings,” *Journal of the Engineering Mechanics Division*. ASCE, Reston, Virginia. Vol. 103, no.EM4, August 1977.
13. Popov, Egor P. and Hans Petersson, “Cyclic Metal Plasticity: Experiments and Theory,” *Journal of the Engineering Mechanics Division*. ASCE, Reston, Virginia. Vol. 104, no.EM6, December 1978.

14. Ortiz, Miguel and Egor P. Popov, “A Physical Model for the Inelasticity of Concrete,” *Proceedings of the Royal Society of London Series A: Mathematical and Physical Sciences*. Vol. 383, no.1784, September 1982.
15. Ortiz, Miguel and Egor P. Popov, “Distortional Hardening Rules for Metal Plasticity,” *Journal of Engineering Mechanics*. Vol. 109, no.4, August 1983.
16. A complete list of Professor Popov’s publications can be found on his web page, at <http://www.ce.berkeley.edu/~epp/>.

being terminated in the program from which my research was funded. In fact, the manager of that program was leaving NASA himself. But where there is life, there is change, and from my modest effort on seismic resistant construction earlier, now there were great opportunities

to go in that direction. Hence, my research effort was redirected toward the work I did at Fullerton, Los Angeles, and San Bernardino, as well as earlier at Berkeley. Strong earthquakes in California as well as abroad provided excellent background for this activity.

Thirty Years of Research in Seismic Design, 1970-2000

*Almost immediately after our tests,
EBFs were incorporated in designs for
four different buildings...*

Scott: What would you characterize as your most important work during the past thirty years?

Popov: Yes, my last thirty years at Berkeley [1970-2000]. First, however, let me give you a bit of background. Back in 1676 an English scientist, Robert Hooke, promulgated his famous law—Hooke’s Law. Phrased in modern terms, his law stated that stress is linearly proportional to strain.

For three hundred years, Hooke’s Law held sway in all later developments in solid mechanics. It is applicable both in tension and compression. For small deformations and for thousands of cycles, it remains useful in many applications, especially in mechanical engineering. The law does not hold, however, for large displacements when the material yields in attaining its maximum capacity.

The success of my first book on *Mechanics of Materials*¹⁷ can be largely attributed to a clear recognition of this phenomenon.

But this is only the first step. In seismic design, we seek not only an instantaneous first maximum load, but also to understand how the material degrades during repeated and reversed loading conditions. Little was known on this subject, which is extremely important in seismic engineering. I undertook an extensive exploration of this difficult problem, which I have pursued during the past 30 years.

First Phase of Reinforced Concrete Work

Scott: Could you give the highlights of your most important work during the period 1970-2000? Emphasize what you see as the principal significance of your findings, using non-technical language that lay readers will be able to follow.

Popov: During my last 30 years at Berkeley, my research was largely devoted to the study of simulated seismic (cyclic) behavior of structural elements—their connections and systems. The discussion presented here is not in chronological order, but rather is based on the logic of the final developments. Having already been steeped in reinforced concrete work, the first phase of my seismic research focused on studies in reinforced concrete.

The first project was with a graduate student, R. Alamo-Neidhart, from Mexico, and the work was done in 1969. We studied the cyclic behavior of a reinforced concrete cantilever beam with large-size longitudinal reinforce-

ment. John Blume gave us \$500 to help with the project. This work elicited very favorable comments from industry, reaching wrong conclusions favoring reinforced concrete. Then I joined Professor Bertero in further research on reinforced concrete. Together we completed several NSF-funded projects with some success.

One of the important reinforced concrete projects was with Sutipoul Viwathanatepa from Thailand.¹⁸ On this project, we studied bond deterioration of reinforcing bar strength capacity during cyclic loads. This study consisted of using large reinforced concrete blocks into which, for each test, a large reinforcing bar with protruding ends was inserted prior to concrete pouring. By applying cyclic forces on the protruding ends, the varying bond stress, strain, and slip were determined.

This work was followed by an exhaustive study by Shao-Yeh M. Ma which included both experimental and analytical studies of the hysteretic behavior of the longitudinal reinforcing bars in concrete rectangular beams, and T-beams.¹⁹ In the series of tests, nine cantilever beams, representing moment-resisting

17. Popov, Egor P., *Mechanics of Materials*. Prentice-Hall, Englewood Cliffs, New Jersey. First edition, 1952.

18. Viwathanatepa, S., Vitelmo V. Bertero, and Egor P. Popov, *Effects of Generalized Loadings on Bond of Reinforcing Bars Embedded in Confined Concrete Blocks*. Earthquake Engineering Research Center, University of California at Berkeley. Report no. UCB/EERC 79-22, 1979.

19. Ma, Shao-yeh M., Vitelmo V. Bertero, and Egor P. Popov, *Experimental and Analytical Studies of the Hysteretic Behavior of Reinforced Concrete Rectangular and T-Beams*. Earthquake Engineering Research Center, University of California at Berkeley. Report no. UCB/EERC 76-2, 1976.

reinforced concrete beams sized according to the current seismic code, were tested. In the T-beam tests, the relative amounts of the longitudinal reinforcement were varied at the top and bottom. The report discusses the significance of these experimental results in detail.

Photogrammetric measurements of the beam's critical region as it was subjected to repeated and reversed loading proved to be useful for interpreting beam cracking behavior. On this project, analytical studies also were carried out to gain a better understanding of the interrelationship between flexure, shear, and bond resisting mechanisms in the reinforced concrete critical regions subjected to inelastic load reversals.

Elaborate fundamental studies were extended still further, including the effect of the compressive force applied to concrete simultaneously with cyclic loading on the reinforcing bars. This work was meticulously carried out by a visiting German scholar, Rolph Eligehausen,²⁰ with encouragement by Professor F. C. Filippou.²¹

In 1975 Professor Bertero and a graduate student, T. Y. Wang, had completed an NSF project on the hysteretic behavior of a reinforced concrete framed wall.²² Then in 1979 a graduate student, Brian Forzani, successfully studied hysteretic behavior of lightweight reinforced concrete beam-column subassemblages.²³ Forzani's project employed a half-scale wall model for the bottom three stories of a nine-story building, and the top of the model was subjected to cyclic force.

These reports were rather extensive, and there were others. After the above projects were completed, however, for lack of time I largely abandoned my work on reinforced concrete and transferred my energies to research on steel.

President, Northern California Structural Engineers

Popov: Despite my involvement with students and research projects, I expended considerable effort with the Structural Engineers Association of Northern California (SEAONC). I was elected as SEAONC President for the 1983-84 term, my license as a structural engineer having been an essential "union card" that

-
20. Eligehausen, R., E. P. Popov, and V. V. Bertero, *Local Bond Stress-Slip Relationships of Deformed Bars Under Generalized Excitations: Experimental Results and Analytical Model*. University of California at Berkeley, Earthquake Engineering Research Center. Report no. UCB/EERC 83-23, 1983.
21. Filippou, Filip C., Egor P. Popov, and Vitelmo V. Bertero, *Effect of Bond Deterioration on Hysteretic Behavior of Reinforced Concrete Joints*. Earthquake Engineering Research Center, University of California at Berkeley. Report no. UCB/EERC 83-19, 1983.

-
22. Wang, T. Y., V. V. Bertero, and E. P. Popov, *Hysteretic Behavior of Reinforced Concrete Framed Walls*. Earthquake Engineering Research Center, University of California at Berkeley. Report no. UCB/EERC 75-23, 1975.
23. Forzani, Brian, Egor P. Popov, and Vitelmo V. Bertero, *Hysteretic Behavior of Lightweight Reinforced Concrete Beam-Column Subassemblages*. Earthquake Engineering Research Center. Report no. UCB/EERC 79-01, 1979.

made me eligible for the office. In addition to the one-year presidency, the commitment also meant serving two years as a Board member before and one year after the year as President.

Scott: Relatively few of the academic people teaching or doing research in structural engineering are themselves licensed structural engineers, are they?

Popov: That's right. To this day, the only other person on the staff of civil engineering at U.C. Berkeley who has had such a license is Professor T. Y. Lin. Because of my activity with SEAONC, I became well acquainted with several leading engineers. Among these, Navin Amin, Henry Degenkolb, Nick Forell, Clarkson Pinkham, and Mark Saunders continuously played a role in my subsequent research.

Of this group of distinguished engineers, I probably interacted professionally with Navin Amin—of the San Francisco office of SOM (Skidmore, Owings and Merrill)—more than with any of the others. He has great erudition, and on several occasions he and I discussed his imaginative plans for future or hypothetical buildings. I also was asked to be a consultant on SOM's 47-story building at 345 California Street in San Francisco, which resulted in a *Spectra* paper that discussed some interesting cyclic experiments on steel components and connections.²⁴

24. Popov, Egor P., Navin R. Amin, Jason J.C. Louie, and Roy M. Stephen, "Cyclic Behavior of Large Beam-Column Assemblies," *Earthquake Spectra*. Earthquake Engineering Research Institute, Oakland, California. Vol. 1, no.2. February 1985.

Henry Degenkolb became my social and professional friend. Our contacts occurred in his office and during his visits to our structures laboratories. This provided an opportunity to discuss our ongoing work on eccentrically braced frames (EBFs). I was impressed with his general knowledge of structural design, with particular emphasis on timber because of his experience with many wooden structures on Treasure Island, site of the 1939 World Fair.

Because Henry was so knowledgeable, in my capacity as the Chairman of Structural Engineering and Structural Mechanics, I helped him get a temporary appointment in teaching timber structures to a regular class at UCB. That had been a rather neglected area in our teaching. Forever afterwards, Henry was very proud of this engagement. There was further interaction with Henry because both of us were on the NSF team on the U.S./Japan project, chaired by Bob Hanson from Michigan.²⁵ This challenging activity—conducted in Tsukuba, Japan—related to a full-size, three-story steel building, rectangular in plan, using different bracing schemes, among them EBFs.

Nick Forell, a meticulous and imaginative designer, acquainted me with much of the Forell-Elsesser philosophy in structural design. I also provided some help in the difficult design of their San Francisco Museum of Modern Art,

25. Hanson, Robert D., "U.S./Japan Coordinated Earthquake Research Program," *Proceedings of the Sessions at Structures Congress '87 Related to Buildings*. Report of the U.S./Japan Cooperative Research Program on Earthquake Engineering Utilizing Large-Scale Test Facilities. ASCE, Reston, Virginia. 1987.

which employs very heavy EBFs. At Berkeley, we also did cyclic tests for some other Forell-Elsesser projects. During the tests, technical discussions with Nick were rewarding.

My lasting relationship with Clarkson (Pinky) Pinkham arose from his appointment as the Technical Secretary to the AISC Committee on Seismic Provisions for Structural Steel Buildings, which I was asked to chair. This connection resulted in endless phone calls between Berkeley and [Pinkham's office in] Los Angeles regarding the [American Institute of Steel Construction] AISC seismic code. Pinky is a tireless worker who is unusually competent in the area of seismic design.

Mark Saunders, being exceptionally well qualified in seismic design and immersed daily in intricate details, provided me a good sounding board on a variety of issues that came up in our research. He was someone with whom I could always discuss our designs, and I also found attending his SEAONC subcommittee meetings to be very valuable.

Ron Hamburger of EQE is another distinguished engineer whom I should mention, and who made an impact on my knowledge of seismic design. It was a pleasure to attend the technical committee meetings he chaired in 1990-1991, to serve as one of his consultants on the seismic evaluation and upgrading of the 23-story Chevron Building at 225 Bush Street in San Francisco.

Structural Steel Research

Popov: Continuing with my story, my early significant work on structural steel was done with R.B. (Bruce) Pinkney, a Canadian from

Winnipeg. The work was supported by the American Iron and Steel Institute, and reported in their Bulletins Number 13 and 14 in November 1968.²⁶ We did a very large number of cyclic tests on beams attached to column stubs. The types of attachments of the beam to the columns included many welded and bolted types. The reported experimental data in Bulletin Number 14 occupied some 324 pages. Many of the recently reported tests by others are very similar, except for increasing the cyclic displacements.

In retrospect, it is clear that our data on the experimental project were strongly skewed by having a great many small hysteretic loops, and did not explore the effects of large displacements. Thirty years ago when we were doing the research, there was a great deal we did not know about seismic behavior.

Scott: You had been focusing on the small displacements?

Popov: Yes. At that time, our ignorance of seismic behavior was great. Basically, our cyclic studies had involved only small displacements, and hence did not explore the effects of large displacements.

26. Popov, Egor P. and R.B. Pinkney, *Behavior of Steel Building Connections Subjected to Repeated Inelastic Strain Reversals: Experimental Data*. Structures and Materials Research Report series. Earthquake Engineering Research Center, University of California at Berkeley. Report no. UCB/EERC 67-31. Prepared under the sponsorship of the American Iron and Steel Institute. AISI Project no.120, Earthquake Performance of Steel Members and Connections. 1967

During one of these tests, Dr. Ted Higgins, the founder of the American Institute of Steel Construction (AISC), was visiting our laboratory at Berkeley. On seeing what we were doing, he asked me, “Why are you doing these tests? In building work, we are concerned only with static loads.” Building design was essentially based on elastic static analysis, so on that basis, his remark was true. The building code was formulated on the basis of the allowable elastic stress, the so-called ASD [allowable stress design]—except, that is, for fatigue loads.

Scott: I take it that, back then, there was much less awareness of the importance of deformation and inelastic behavior in strong seismic shaking?

Popov: Yes, but things changed fairly soon. Thus, a few years later, in 1980, at an AISC meeting in Oconomowoc, Michigan, Dr. Higgins created a Task Committee on Seismic Provisions within the AISC Committee on Specifications and made me the chairman. Jim Malley at Degenkolb Engineers is now the chairman of this committee, while I continue to participate as a courtesy vice-chairman. So the code *continuously* changes as new advances occur.

Column Splices

Popov: The next item of concern was column splices, an essential in steel construction. This is important, since in all buildings more than two stories tall, the columns are made up of vertical pieces joined together, or spliced, by welding or bolting. The Los Angeles Building Department asked us to do this work, and in 1976, under the auspices of AISI and with some help from NSF, we carried out a number of

such tests on W14 x 320 shapes of ASTM A570-70A Grade 50 steel, due to its common use in buildings. Roy M. Stephen, our Principal Development Engineer, supervised the tests. Quoting directly from the reports:²⁷

The results of these tests indicate that from the strength point of view, welded splices in large column sections perform very satisfactorily even with minimum welds. The fact that the splice has undergone severe cyclic loading seems to have little or no effect on the ultimate tensile strength. However, the designer must recognize that *partial penetration welded connections exhibit very little ductility*. [emphasis added].

When any one of these specimens failed in the testing machine, we must have awakened the neighborhood with the big bang. The applied forces were on the order of 2 million pounds. In July 1970, we published a report entitled “Cyclic Loading of Full-Size Steel Connections”—I was an author, and had the assistance of Roy Stephen. The report was first published in 1971 as University of California EERC Report Number 71-7, then it was republished by AISI as their Bulletin Number 21, dated February 1972, and the work received a great deal of attention.

The cantilever test beams were of two sizes, W18 x 50 and W24 x 76, and had clear lengths

27. Popov, Egor P. and Roy M. Stephen, *Tensile Capacity of Partial Penetration Welds (for columns)*. Earthquake Engineering Research Center, University of California at Berkeley. Report no. UCB/EERC76-28, October 1976.

of seven feet. All specimens were of 36 ksi grade steel, and A325 bolts were used where needed. AWS specifications were strictly followed using flux cored wire E70-T4 (Lincoln Electric Innershield designation: NS-3M). Robert Preece of Testing Engineers provided exceptionally thorough ultrasonic inspection of welds on all specimens. AISI appointed a blue ribbon committee to oversee the tests. My reason for giving some details on the test specimens is the pivotal role these tests played in investigations after the 1994 Northridge earthquake.

Shortly before the tests on these connections, my wife and I were walking in San Francisco. When I noticed a steel building going up, I told her that the next day I would have to break one of these connections where the beams looked like they were 24 inches deep. Her retort was “So large!” If I were answering her now, I would say, “That is not big enough!”

Scott: Testing should be done on much larger specimens?

Popov: Yes. We continue to test small specimens and project the results to very large members. We need to test larger or full-scale specimens. Later I’ll discuss a couple of our June 2000 tests where I’ll try to develop this point further.

Beam-to-Column Assemblages

Popov: In 1971, fundamental studies were initiated on inelastic behavior of steel beam-to-column subassemblages. An interior panel of a multi-story building was considered, with the columns terminating above and below their mid-heights. The beams were rigidly attached to the column at the center and terminated in

pinned supports at the outer supports. Four specimens, two each of identical shape, were investigated experimentally under combined vertical and horizontal loading. The specimens were half scale, being 27 feet long between end pin supports. The columns between the end pins were 6 feet, 8 inches long. The prototype for this model was a 20-story, 4-bay office building. Two of the model types were for the 17th floor, the other two for the 5th floor.

AISI supported the project, and again an excellent oversight committee was appointed. The work was a part of a study by Helmut Krawinkler, with supervisory leadership provided by Professor Bertero, and with my support. The research completed on this project is of lasting importance.²⁸

Most of the seismic structural research is conducted for simplicity on individual members or connections. Unlike such work, this study is concerned with an investigation of an axial force acting on a column with loads on beams on each side of the column. Such a system of members is referred to as a subassemblage. This more complete structural system is then cyclically loaded horizontally, simulating an earthquake, and the data thus obtained more accurately corresponds to the behavior of a structure during an actual earthquake.

28. Krawinkler, Helmut, Vitelmo V. Bertero, and Egor P. Popov, *Further Studies on Seismic Behavior of Steel Beam-Column Subassemblages*. Earthquake Engineering Research Center, University of California at Berkeley. Report no. UCB/EERC 73-27, December 1973.

Eccentrically Braced Frames

Popov: Next, I want to discuss work on eccentrically braced frames (EBFs), which became a major effort of mine.

Scott: Yes. You have already mentioned eccentrically braced frames a number of times, and it would be good if you could cover that subject in some detail. I think it would help if you first put the topic in its historical context by giving a little background on eccentric braced frame design. First, however, it would be very helpful to provide a brief definition or description of an eccentric braced frame, using nontechnical language.

Popov: Bob Reitherman recently prepared a highly compressed historical overview of seismic design for the Year 2000 CUREe calendar. Bob's full identification is Robert Reitherman, Director of CUREe (California Universities for Research in Earthquake Engineering). We can excerpt portions of his overview here:

Concentrically braced frames of K, V or inverted V (chevron), X, or single diagonal configuration have been used for centuries in timber, later in iron, and finally steel, in nonseismic regions. Again, these braced frame layouts were appropriated for seismic use and gradually modified.

None of these three basic types of vertical structural elements that resist horizontal seismic forces—walls, braces, frames—was invented because of earthquakes, and all three have had to be modified by earthquake engineers to take into account inelastic behavior and other seismic

factors. Starting with a “blank piece of paper” and devising a new structural element specifically with earthquakes in mind as was done with the eccentric braced frames is thus unusual.

In the continuing work of Professor Popov and others, especially as applied to steel frames in the SAC Steel Project or by individuals or firms inventing new steel moment-resisting connections, innovations have been tested that utilize mechanisms to provide controlled frictional slip, to reduce beam sections to more positively control where inelasticity occurs, or other details, which, while quite different from the bracing configuration of the EBF, continue the same concept of attempting to dissipate energy rather than meet it head on with strength.

Frames with moment-resisting joints advantageously respond to earthquakes in a flexible, load-reducing manner and have the potential for high ductility, while braced frames have greater stiffness and reduced drift-induced nonstructural damage. The eccentric braced frame (EBF) offers some of the virtues of both.

The development of this new structural system with earthquakes specifically in mind is an example of the continuing trend toward energy dissipation devices and strategies. H. Fujimoto tested braced K braces in 1972, and the EBF in its current

form can be dated to 1977 with the experimental work by Popov and Roeder.” [Additional paragraphing was introduced to help emphasize key points.]

EBFs For Wind Bracing: An Elastic Design

Scott: Basically, the use of eccentric braced framing for seismic design is rather recent, isn't it?

Popov: That is true of its use in *seismic* design, which is rather recent. But I do not share the general belief that eccentric bracing was itself invented only recently, because I do not believe that is true. Actually, EBFs have existed for many years. I learned from my first professional teacher, Harold Clar, who earlier had been associated with the firm of Purdy and Henderson in New York, that they regularly used such systems at doors and windows of tall buildings. Also, Henry V. Spurr of that same firm wrote a definitive book on wind bracing, in which he explains how such systems should be implemented for static loads.²⁹ Spurr was Clar's senior in the Purdy and Henderson firm, and Clar, in turn, was my chief in Fullerton and also later at Bill Mellema's firm in Los Angeles, where he was chief engineer.

Scott: So eccentric braced framing was already being used for wind bracing, and only later was adapted for use in seismic design?

Popov: That is right. Wind bracing, where at least one brace end terminates at a short segment

of a floor beam, provides an excellent prototype of what became known as an EBF in earthquake-resistant design. Wind bracing, however, is designed on an *elastic* basis. In seismic design, in order to prevent brace buckling, it is essential that the links be able to deform *inelastically* when subjected to cyclic forces. In our research, we were also to learn that during extreme cyclic excursions, short links perform best.

Inelastic Design For Seismic Performance

Popov: I have already mentioned Robert Hooke's famous 1676 Law, which asserted that stress is linearly proportional to strain. That idea is still in general use in structural design, and is the basis of building codes worldwide. Hooke's relationship does not hold for large displacements, where inelastic design is called for to permit some degree of deformation.

Only very gradually, however, is allowable stress design (ASD)—which is based on the Hookian concepts—giving way to load and resistance factor design (LRFD)—which is based on inelastic design concepts.

Scott: Where did LRFD specifications come from, and when?

Popov: AISC issued the LRFD specifications in September 1986, after intensive work by a 46-member committee. Clarkson Pinkham and I were the only committee members from California. As of now, either ASD or LRFD can be used in the design of buildings. Most computer programs are written for ASD, however, and some engineers find it easier to use. So ASD is still generally favored, although the situation is gradually changing, as it is recognized that the

29. Spurr, Henry V., *Wind Bracing: the Importance of Rigidity in High Towers*. McGraw-Hill, New York. 1930.

LRFD approach is much more accurate for seismic design.

Initial Research on Seismic EBFs

Scott: What about research on the seismic use of EBFs?

Popov: The genesis of our research with EBFs can be traced to the Spurr approach [to wind bracing]. Prior to 1976, Charles Roeder was looking for a dissertation topic. During his search, I must have suggested examining the inelastic cyclic behavior of braces and links under seismic conditions. On accepting this challenge, Roeder began work in 1977, and was shortly joined by Koichi Takanashi from Tokyo, who provided us with some information on the limited similar work in Japan.³⁰ This fitted into our plans nicely, and resulted in a comprehensive report.³¹

While there was still further research on the topic that could and should be pursued, that had to wait for three years until the necessary funds became available to continue the work. This resulted in the work of Keith Hjelmstad and Jim Malley. After that, another three years elapsed before we obtained new funds, where-

30. Popov, Egor P., Koichi Takanashi, and Charles W. Roeder, *Structural Steel Bracing Systems: Behavior Under Cyclic Loading*. Earthquake Engineering Research Center, University of California at Berkeley. Report no. UCB/EERC 76-17. June 1976.

31. Roeder, C.W., and Egor P. Popov, *Inelastic Behavior of Eccentrically Braced Steel Frames Under Cyclic Loading*. Earthquake Engineering Research Center, University of California at Berkeley. Report no. UCB/EERC 77-18, June 1976.

upon Kazuhiko Kasai and Michael Engelhardt followed, three years apart, with new ideas and money to resolve the problems encountered. Finally, in 1989, Jim Rickles completed the extensive cycle of EBF study. Completion of research on a complex problem, if at all possible, is difficult to achieve, and it takes time. Note that only now is 1676 Hooke's law [stress is linearly proportional to strain] looked at in proper perspective.

In tackling an extensive study of EBFs at Berkeley, we did not deal with the static problem, but instead were concerned with their cyclic behavior in the inelastic range, including the need for web stiffeners in the links in the advanced stages of strong cyclic loading. A host of NSF-sponsored advanced students worked on their theses on this problem. Listing them chronologically, those who were involved included: Charles Roeder 1977, Keith Hjelmstad 1983, Jim Malley 1983, Kazuhiko Kasai 1986, Michael Engelhardt 1989, and Jim Rickles 1994. Each one of these people made a contribution to the general understanding of the behavior of EBFs.

Use of EBFs in Practice Prior to Research

Scott: You refer to "an extensive study of EBFs." In giving some history of the research program, could you say a few words about where the ideas for the program came from, and how the program was structured?

Popov: First, before starting to talk about EBF research, I should mention three cases of EBF use in the United States *prior to any research on their seismic behavior*. One case was in Texas, and the other two on the west coast. The

Texas example is the Hyatt-Regency Hotel in Dallas, in a nonseismic region, designed in 1978 by Richard G. Troy, Welton Beckett Associates. Its variable-height towers made extensive use of steel shear walls, while the lower two or three floors used bracing, inverted concentric V-braces and inverted split Vs. Eccentric V-braces were extensively used along the corridors in other parts of the building.

The West Coast examples are both, of course, in seismic regions. First, is the People's Bank Building in Seattle, Washington—currently the U.S. Bank of Washington, designed by the TRA architectural firm and completed in 1974. Its central core uses inverted eccentric V-braces encased in concrete. The other West Coast example of an early seismic EBF design is one for a building that was never built, a projected 30-story Nob Hill Hyatt Hotel. It was designed by John Portman & Associates, Architects, and Henry J. Degenkolb Associates, engineers. The proposed building would have had an unusually narrow floor plan and a 28-story atrium. Concentric and eccentric inverted V-braces were employed to resolve the difficult framing problem. The drawings were completed in the early 1970s, but the project never materialized.³²

It is clear that prior to 1986 all EBF projects were based on legally acceptable ASD codes, and that inelastic cyclic behavior of braces and links was not considered. The alternative approach of doing verification tests, which is now mandatory for public school work, was not

followed. Fortunately, the EBF system is intrinsically good, and should perform reasonably well, at least in a moderately strong earthquake.

Early Research on Seismic Use of EBFs

Scott: What about the earliest research on seismic use of EBFs—when was that started?

Popov: The earliest attempt at studying EBFs appears to have been done in Japan by M. Fujimoto, et al., and published in 1972 in the *Transactions of the Architectural Institute of Japan*.³³ The shape of the experimental specimens employed in Fujimoto's work resembled the shape of some designs used in the Spurr approach for wind bracing. In addition, T. Hisatoku, et al. soon investigated another type of EBF with the shape of an inverted Y. Their report was published in 1974 in the *Takenaka Technical Institute as Report Number 12*.³⁴ These Japanese references may be found in the 1976 EERC Report Number 76-17, which I co-authored with Koichi Takanashi and Charles Roeder.³⁵

In 1976 and 1977, Roeder and I conducted the first United States experiments on an EBF design with the help of a large advisory committee nominated by the American Iron and

32. Private communication between Egor P. Popov and Loring Wyllie, Principal, H.J. Degenkolb Associates, 1992.

33. Fujimoto, M., T. Aoyagi, K. Ukai, A. Wada, and K. Saito, "Structural Characteristics of Eccentric K-Braced Frames," *Transactions of the Architectural Institute of Japan*. Report no.195, May 1972.

34. Hisatoku, T. et al., *Experimental Study on the Static Behavior of the Y-typed Bracings*. Takenaka Technical Institute, Japan. Report no. 12. August 1974.

Steel Institute (AIS). We used a one-third scale model of one side of a 20-story building's planar bracing. Maximum drift in either direction was just under 4 percent, and the EBF behavior was considered excellent.³⁶

EBF Testing Results Incorporated into Practice

Popov: Almost immediately after our tests, EBFs were incorporated in designs for four different buildings, and I was a consultant on three of them. The first EBF use was in the 49-story Embarcadero 4, which was designed in the mid-1970s by architects John Portman & Associates and reviewed by engineering consultants URS/Blume. I was a consultant on the project. Although the building complied with the San Francisco building code, which then had no lateral drift provision, it was concluded that strong wind or severe earthquake forces could cause excessive lateral deflection. Under the leadership of Joseph Nicoletti of URS/Blume, the building was in effect retrofitted using EBFs—opposing single diagonal braces in two different bays in the narrow direction. Data recorded in the heavily instrumented

building during the 1989 Loma Prieta earthquake showed very good behavior, and good projections for a larger quake, except for the three top stories, which may experience minor damage during a severe earthquake.

The second use of EBFs was in a large lowrise building designed and built in 1980—the Fireman's Fund Building in Lucas Valley in Marin County. It was designed by architects Page, Cloudsley & Baleix, and Degenkolb Associates were engineers. Eccentric V-bracing was adopted for several bays along the perimeters to gain lateral resistance where moment resisting bracing would have been too costly. I was not a consultant on the project.

The third building of note using EBFs was the five-story O'Connor Hospital in San Jose, designed by architects Stone, Marraccini & Patterson, with engineering by Rutherford & Chekene, and on which I was a consultant. The building has single diagonal braces, and, being a hospital, was reviewed by engineers at the Structural Safety Section of the Office of the State Architect. It was designed in 1978-1979, and built in 1980.

The fourth building in the early use of EBFs was the 19-story Bank of America's Regional Office and Branch Building in San Diego, designed by San Diego architectural firm of Tucker, Sadler & Associates, and engineers James R. Libby & Associates. In an unusual feature, the three lower floors are contained within the two outside EBF end cores, with 26-foot-wide EBFs in the north-south direction and 20-foot-wide EBFs in the east-west direction.

35. Popov, Egor P., Koichi Takanashi, and Charles W. Roeder, *Structural Steel Bracing Systems: Behavior Under Cyclic Loading*. Earthquake Engineering Research Center, University of California at Berkeley. Report no. UCB/EERC 76-17, June 1976.

36. Roeder, Charles W. and Egor P. Popov, *Inelastic Behavior of Eccentrically Braced Steel Frames Under Cyclic Loadings*. Earthquake Engineering Research Center, University of California at Berkeley. Report no. UCB/EERC 77-18, August 1977.

The Berkeley research on EBFs was further advanced by the time this design was done around 1981, so the project was able to take advantage of the findings and stiffened the links with stiffener and laterally brace the links at both ends. The City of San Diego accepted the design as meeting the requirements for ductile frames.

Scott: I take it you were a consultant on this building?

Popov: Yes, I was.

Testing EBFs at One-Third Scale

Popov: I would like to discuss other Berkeley seismic EBF research that followed on immediately when D. N. Manheim used one-third scale models of a portion of the bottom three floors of a 20-story eccentrically braced frame prototype in testing two new EBF types with different framing configurations, and also tested ways of making effective beam-to-column connections. As the behavior of many of these was inadequate, and because of the importance of the problem, an extensive research program on beam-to-column links was undertaken,³⁷ eventually developing formulas for stiffener spacing and related matters that were adopted by SEAOC in 1988.

Full-Scale Experiment at Tsukuba Reveals Possible Design Flaws

Popov: About the time this beam-to-column link research had reached a definitive stage, we received a request to select brace sizes and detail the links for a full-scale experiment at Tsukuba—the Japanese “science city”—for a joint U.S./Japan effort sponsored by the U.S. National Science Foundation and the Ministry of Construc-

tion in Japan. The agreement to enter into the cooperative program was reached in 1981, and work on the project started almost immediately.

The model was a full-size, six-story structure with a 15-meter (49.2 feet) square plan having two 7.5-meter (24.6 feet) bays in each direction. The structure was 22.4 meters (73.4 feet) high to the top of the roof girders. The test structure had three parallel frames in the loading direction and three perpendicular frames. The EBF bracing in the central, transversely-loaded bay had a short link at the top with braces terminating at the bottom at the intersection of the floor beam with the column.³⁸ The bracing pattern was similar to that motivated by the Spurr approach. The method of

37. Manheim, D.N., “On The Design of Eccentrically Braced Frames,” Ph.D. thesis (Dr. of Engineering). University of California, Berkeley, 1982.

Hjelmstad, K.D. and Egor P. Popov, *Seismic Behavior of Active Beam Links in Eccentrically Braced Frames*. Earthquake Engineering Research Center, University of California at Berkeley. Report no. UCB/EERC 83-15, 1983.

Malley, James O. and Egor P. Popov, *Design Considerations for Shear Links in Eccentrically Braced Frames*. Earthquake Engineering Research Center, University of California at Berkeley. Report no. UCB/EERC 83-24, 1983.

Kasai, Kazuhiko and Egor P. Popov, “General Behavior of WF Steel Shear Link Beams,” *Journal of Structural Engineering*. ASCE, Reston, Virginia. Vol.112, no.2, February 1986.

Kasai, Kazuhiko and Egor P. Popov, “Cyclic Web Buckling Control for Shear Link Beams,” *Journal of Structural Engineering*. ASCE, Reston, Virginia. Vol. 112, no.3, March 1986.

attaching the braces at the floor level was conventional and presented no special problems. The attachment of the brace to the beam, however, has several different possibilities and can lead to difficulties.

Scott: What kind of difficulties were found by the Tsukuba model testing?

Popov: I can summarize the results at Tsukuba. You see, there are at least two methods of attaching an eccentric brace to the beam in general use. There appears to be no special problem if the brace is a wide-flange member with its web parallel to the web of a beam, and the brace flanges welded directly to the flange of the beam. A serious problem may arise, however, from using an attachment that is simpler to fabricate and is applicable to several types of braces, such as double angles. In this kind of brace attachment, a piece of T-section is ordinarily welded to the flange of the beam, which permits welding a brace to the web of the T. Unfortunately, however, the vertical dimension of the T web can be large, and when this detail is subjected to a compressive force, the web of the T can buckle. This is exactly what happened in the Tsukuba test.

After I saw that detail in the model at Tsukuba, I lost sleep over the matter for a couple of nights. Nevertheless, I recommended that Roeder, a resident engineer for the United States team, proceed with the test, whereupon the inevitable happened and it failed.

Scott: I presume you recommended a go-ahead because everything was set up for the test, and there was merit in having a real-life demonstration that the detail was in adequate?

Popov: Yes. A test failure would dramatically demonstrate that the detail being employed was poor.

Scott: So they ran the test and the detail failed.

Popov: Yes, and after witnessing the failure, on my return home from Japan on a Christmas eve, I wrote up this development. By mail, I alerted a number of California engineers to the problem. Also, in several of my talks, I called attention to this bad design. Unfortunately, not everyone took note of the difficulty with this detail, and it was frustrating to see EBFs continue to be done incorrectly. Fortunately, due notice is finally being taken—the correct detail is shown in the AISC “Seismic Provisions for Structural Steel Buildings,” dated April 15, 1997. This welcome change was accomplished under the stewardship of Jim Malley, who was the AISC chairman of the Task Committee on Seismic Design.

In addition to the lines of research I have been describing, Berkeley research on EBFs pursued two other issues: links with concrete floors, and the behavior of long links—the latter is particularly important in some functional layouts.^{39, 40}

38. Roeder, C.W., D.A. Foutch, and S.C. Goel, “Seismic Testing of Full-Scale Steel Buildings,” Part II, *Journal of Structural Engineering*, ASCE, Reston, Virginia. Vol. 113, no.11, 1987.

39. Ricles, James M. and Egor P. Popov, *Dynamic Analyses of Seismically Resistant Eccentrically Braced Frames*. Report no. UCB/EERC 87-07, 1987.

Richmond-San Rafael Bridge Retrofit

Popov: Another major application of EBFs is in progress for the seismic retrofit of the Richmond-San Rafael bridge, on which I was consulted. Because of the need for unusually long shear links in the middle of the bridge's symmetric towers, the webs of the links had to be very thin, and this aspect of the problem required a special investigation.

For conventional EBFs, with a variety of rolled sections generally available, it is possible to choose an appropriate *W*-section so that the moment capacity and the shear strength of the member are compatible—the bending capacity and shear strengths are matched. As a link becomes very long, however, the shear capacity of the available rolled members exceeds the moment capacity for the applied load. Unfortunately, there was this kind of imbalance on the Richmond-San Rafael Bridge, which required a long link in the middle of the supporting frame to achieve proper clearances for large trucks.

When the bridge was retrofitted, this problem was resolved by fabricating beams having thin webs, and fillet welding them to substantial

flanges. A large number of vertical stiffeners had to be employed, as the web of the manufactured *W*-section was rather thin. Before the retrofitting was done, there were cyclic tests of the manufactured beams to ensure that the design was appropriate. I witnessed the tests, made in Nevada, and believe that we have properly resolved the problem. This may, in fact, be a first in resolving the problem of very long links.

Braced Steel Tubular Offshore Structures

Popov: Cyclic inelastic behavior of braced steel tubular offshore structures was done at the request and support of the American Petroleum Institute (API), resulting in a co-authored report by Victor Zayas, Stephen Mahin, and myself. This massive project played a major role in formulating the code for offshore towers. This report also formed the basis for the dissertation of Victor Zayas. Hysteretic behavior under repeated reversing loads was of particular interest and importance.

Alaska Pipeline

Popov: Another project of great importance dealing with the development of petroleum oil resources dealt with the Alyeska (Alaska) Pipeline. Quite unexpectedly, I received a call from the engineers concerned with building an oil pipeline across Alaska, and they indicated a need for some critical experiments on the large pipes for this project. The chief engineer for this project made many visits from Houston to the then-new facility at the Richmond Field Station, where our 4,000,000 lb. Universal Testing Machine was moved from Berkeley.

-
40. Engelhardt, Michael D. and Egor P. Popov, *Behavior of Long Links in Eccentrically Braced Frames*. Earthquake Engineering Research Center, University of California at Berkeley. Report no. UCB/EERC 89-01, 1989.

Engelhardt, Michael D. and Egor P. Popov, "Experimental Performance of Long Links in Eccentrically Braced Frames," *Journal of Structural Engineering*. ASCE, Reston, Virginia. Vol. 118, no.11, 1992.

This machine, together with auxiliary equipment, was used in the investigation. This consisted of taking 31-foot lengths of the instrumented 48-inch diameter pipe, filling them with pressurized water, and applying large axial forces and, for some cases, also simultaneously applying horizontal pull at the middle of the specimen. The latter was a simulation of the pipe behavior at occasional supports. At about this point, I gave out because of my heart condition, and Professor Jack Bouwkamp competently took over the project and completed the experimental program with success.

An extensive report titled *Full-Scale Studies on the Structural Behavior of Large Diameter Pipes Under Combined Loading* was prepared by Jack Bouwkamp and Roy Stephen and published by the Structures and Materials group in the Department of Civil Engineering as Report Number UC-SESM 74-1.

After a gap in my “services” as a result of my health problem, I returned to this fascinating project and completed analytical buckling studies and suggested design criteria for pipe thicknesses. Analytical studies were also done as to what would happen to the pipeline under surges in pressure. At that time the chief engineer, who paid us frequent visits in Richmond, was killed in Houston in an accident with a truck that jack-knifed. The pipeline was his life. But for me, the story with the Alyeska project did not end there.

Later, completely unexpectedly, I received a letter from a Los Angeles attorney indicating that I may be summoned to court because of failures that occurred on the pipeline. There were a number of questions which I was asked to answer. With due care and expenditure of

my time, I dutifully replied. In about two or three months time, I received another letter on the same issue stating that I was exonerated.

Important Milestone Projects

Popov: The next two projects that come to my mind is the work in 1986 and 1988 of Keh-Chyuan (K.C.) Tsai. In the first one of these reports, beam web-to-column connections are considered, and the advantages of the use of ribs on flanges is explored. The second report is a compendium of test results on many types of beam-to-column connections under large cyclic pulses. In this study, among others, there are connections with end plates, all-welded connections without auxiliary plates, bolted connections for resisting the applied bending moments, etc. What is interesting is that K. C. Tsai continued with similar work in his native Taiwan and had an important responsibility in helping to organize an excellent modern laboratory for research on seismic problems.

Another important contribution to deeper understanding of seismic structural behavior of connections is recorded in the 1995 doctoral dissertation of Tzong-Shuoh Yang. In this work, perhaps for the first time, a 3D inelastic finite element analysis of a beam-to-column connection of a beam directly welded to a column is given. The usual attempts to use 2D inelastic finite element analyses are inaccurate, and misleading results are obtained in the regions of high stress. Interesting results of the maximum stress intensity factors for the top and bottom cover plates versus the end loads are also exhibited. Analytical and experimental results of connections with reduced beam cross-section by means of perforation are also

given. The design of frames with slotted bolt holes as energy dissipaters are discussed following the work of Carl Grigorian. Seismic input energy mesh diagrams for 24 different earthquakes are compiled as reference material.

The last item of significant accomplishment by my former graduate students to be mentioned is the work of Carl Grigorian. His 1994 dissertation titled *Energy Dissipation with Slotted Bolted Connections* was a success. During some of the test runs on a shaking table of his, heavily loaded, three-story steel frames, there was a remarkably large attendance of interested spectators during announced tests. It was demonstrated that the use of slotted holes is an excellent means of dissipating energy. However, a rapid development of base isolation systems and the Japanese development of braces with a slipping joint decreased the potential for the use of this device, although some applications of this system on major projects are of record. I will bring up something further on the slotted bolted connection later.

The completed research on steel members and connections is also useful for bridge applications. Thus, it was possible to adapt the friction devices studied by Grigorian to prevent excessive lateral displacements of the arches at the south end of the Golden Gate bridge.

Another major application of EBFs for seismic retrofit of the Richmond-San Rafael bridge is in progress. On this project, because of the need of long shear links in the middle of symmetric towers, the webs of such links had to be very thin. This aspect of the problem required a special investigation. The study was successfully carried out both analytically and experimentally. It was determined that narrower

spacing between stiffeners than specified in the building code is essential. We were consulted on both of the above two projects.

Two Projects Not Completed

Popov: Along with the preceding discussion it seems appropriate to comment on two uncompleted projects.

One project was done at the request of Nabih Youssef, the principal of a Los Angeles firm of structural engineers, who encountered a retrofit problem with a four-story library building on the Riverside campus of the University of California. In this building, lightweight reinforced concrete exterior wall panels were damaged by a recent earthquake. Having in mind Grigorian's work, Youssef turned to us for appraising his design, improving it if possible, and performing cyclic experiments on a full-size panel with slotted bolted connections. This work was done at Berkeley.⁴¹ The behavior of the panels under cyclic loads with improved details was very good.

The second project dealt with steel beam-to-column connections. In spite of the huge NSF-sponsored research program, I remain skeptical about the achieved recommended details.

Going back to the fundamentals, I continue to believe that in the interest of savings, we continue to test specimens that are too small. For example, an all-bolted connection can be easily

41. Sasani, Mehrdad and Egor P. Popov, *Experimental and Analytical Studies on the Seismic Behavior of Lightweight Concrete Panels with Friction Energy Dissipators*. Earthquake Engineering Research Center, University of California at Berkeley. Report no. UCB/EERC 97-17, 1997.

devised. However, for large connections, the number of bolts in the beam flanges becomes excessive. Another problem appears to be endemic to the welds of flanges and cover plates to column flanges. In our experience, I saw many such welds fail in a brittle manner, ending with a bang. The quality of field welds is more suspect. On the other hand, shop fillet welds are generally excellent, and they can be easily controlled and inspected.

We have developed a connection which makes use of bolts in tension and down-hand shop fillet welds in shear. Two such specimens for W36x150 beams attached to W14x257 columns, using WT20x132 Ts with eight 1¼ inch A490 bolts in each Tee have been fabricated and tested with promising results. It would appear that the design can be used for larger beams.

Reflections

...we have seen great progress in our understanding of seismic phenomena.

Scott: We are nearing the end of this history of your life and work. As you reflect on your long career, do you have any closing observations that you would like to make?

Popov: My main graduate education was in Civil Engineering and Applied Mechanics, as was my Stanford diploma for the doctoral degree status. Before going to Stanford, I had already acquired some background in this at Caltech, and continued such studies when at Stanford, where the degree was awarded just before a separate Department of Applied Mechanics was formed.

My early teaching at Berkeley—including what I consider my most important early teaching—was also in mechanics courses in the Department of Civil Engineering. My research was also in mechanics. All my subsequent work was strongly influenced by this background, and as opportunities arose in seismic engineering, I fitted into that niche.

The “mechanics attitude” is reflected in my understanding of the need to refine Hooke’s linearly elastic theory and take *inelastic* cyclic behavior into account. In writing my book, *Mechanics of Materials*,⁴² and rewriting successive editions,

42. Popov, Egor P., *Mechanics of Materials*. Prentice-Hall, Englewood Cliffs, New York. 1952.

I tried to illustrate some of the issues encountered when studying repetitive cyclic loading, and I found seismic design and analysis to be an interesting and extremely rewarding field for research. My students and I have focused a good deal of our work on use of EBFs in seismic design because of, first of all, need, and second, because of the availability of federal research funds for that purpose. You might say we followed the path of least resistance and went where the money was.

In addition to working on EBFs, however, I was also deeply involved in the subject of reinforced concrete, usually working with Professor Vitelmo Bertero. I also did what I consider important work on the framing of tubular steel towers for oil derricks under nonlinear cyclic loads—that research was being supported by a consortium of oil companies.

Scott: Do you have any further concluding comments?

Popov: In the years that I have been associated with seismic research and consultation, we have seen great progress in our understanding of seismic phenomena. This has resulted in continuing improvements in seismic design and construction. Looking back over my own career, I note that my first involvement in studying the behavior of steel building connec-

tions subjected to repeated inelastic strain reversals—work done in 1968 with Canadian student Bruce Pinkney—appears to have been the first such study in the United States. It was a precursor for much similar work that followed, and studies of cyclic behavior soon became standard procedure. After the 1994 Northridge earthquake, NSF generously supported a flood of such work. This has led to continuing improvement in our understanding of earthquake problems and the means of abating them.

Wider and more sophisticated use of such innovations as base isolation and friction devices should greatly aid future developments. Further improvements in seismic design can be anticipated, as we see the advent of vastly improved analytical procedures, as well as a more meaningful collaboration between structural engineers and seismologists.

Scott: The growth of communication between engineers and academic researchers is very important.

Popov: Yes it is. In fact I want my final observation to emphasize how very important to my work has been my own close relationship with the practicing profession of structural engineering.

Photographs



This photo was taken on the occasion of Popov's father's only visit home from the war front during World War I. Egor is standing at his mother's right, and his brother Nicholas is in front. Penza, Russia, 1916.



Popov's parents, Paul Theodore Popov and Zoe Deryabin Popov, at the time of their wedding in 1911.



Clipping from a Philadelphia newspaper regarding father's cousin, Alexander Popov, inventor of wireless communication. Year unknown.



Nicholas (left) and Egor ready for Manchurian cold.



Egor and brother Nicholas in Pogradichnyy. The family donkey is pulling a sled made by young Egor.



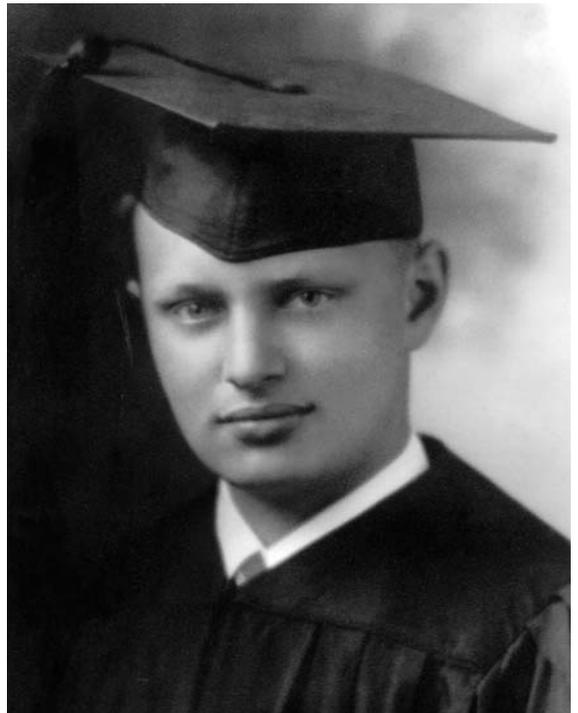
A children's birthday party in Harbin, Manchuria. The Popov brothers are standing in the back row. Nicholas is third from the left and Egor is next to him on the right. Year unknown, but it would have been about 1925 or 1926.



Popov and his brother Nicholas (left) upon leaving Harbin.



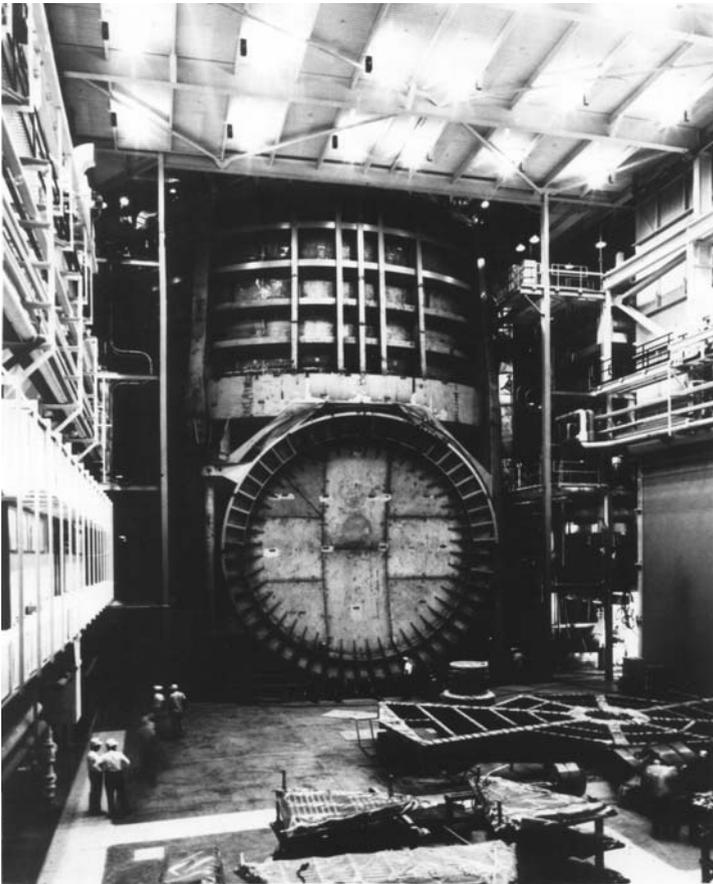
Transit work in Fairfax during summer surveying and engineering course for the University of California at Berkeley, summer 1932.



Egor (Igor) Paul Popov in 1933, graduating as an honor student from the University of California at Berkeley. (photo: Bossum, San Francisco)



Popov's field office on the Fullerton Junior College project, 1937.



120-foot high vacuum chamber for testing the Apollo moon-bound spacecraft, 1964. (photo: NASA)



Egor Popov, his wife, Irene, and children, Kathy and Alex, before they left for Popov's sabbatical year in Europe in 1952.





Left: Test specimen of braced steel frame for offshore applications.

Below: A segment of the braced steel frame after test.





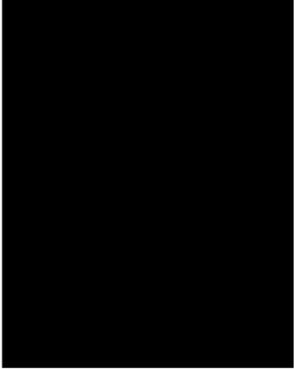
Professor Popov in the early 1970s.



Popov receives the 1983 Berkeley Citation. (photo: Bruce Cook)



A dinner meeting instigated primarily by Professor Popov's former doctoral students in celebration of his 87th birthday. Professor Popov is seated in the center of the group. February 27, 2000, Monaco Hotel in San Francisco.



Appendices

Major Awards and Medals

1976 Elected to the National Academy of Engineering of the United States of America for contributions in the mechanics of solids and the inelastic cyclic behavior of structural systems.

1976 Ernest E. Howard Medal, American Society of Civil Engineers. Presented to a Member of ASCE in recognition of significant contributions to the advancement of Structural Engineering.

1977 Distinguished Teaching Award, conferred by the Committee on Teaching of the Division of the Academic Senate, University of California at Berkeley.

1979 J. James R. Croes Medal, American Society of Civil Engineers (co-recipient with Charles W. Roeder) for the paper "Eccentrically Braced Steel Frames for Earthquakes."⁴³

1981 Nathan M. Newmark Medal, American Society of Civil Engineers for outstanding contributions to shell theory and the inelastic analysis of structures that span both the fields of structural mechanics and engineering mechanics in a way that emphasizes the interaction of the disciplines.

1982 J. James R. Croes Medal, American Society of Civil Engineers for the paper "Seismic Behavior of Structural Sub-assemblages."⁴⁴

43. Roeder, Charles W. and Egor P. Popov, "Eccentrically Braced Steel Frames for Earthquakes," *Journal of the Structural Division*. ASCE, Reston, Virginia. Vol.104, no.ST3, March 1978.

1983 The Berkeley Citation, University of California at Berkeley for distinguished achievement and notable service to the University.

1985 Distinguished Engineering Alumnus elected by Engineering Alumni, University of California at Berkeley.

1986 Honorary Member, American Society of Civil Engineers.

1986 William M. Murray Lecturer, Society for Experimental Mechanics. In recognition of outstanding contributions in the field of seismic analysis.

1987 Norman Medal, American Society of Civil Engineers (co-recipient with S. A. Mahin and R. W. Clough) in recognition of the paper "Inelastic Response of Tubular Steel Offshore Towers."⁴⁵

1989 Theodore von Karman Medal, American Society of Civil Engineers, for contributions to structural mechanics covering a broad range of subject areas, including plasticity theory, shell theory, and inelastic analysis of frames and shells.

1993 Distinguished Lecturer, Earthquake Engineering Research Institute.

1999 George W. Housner Medal, Earthquake Engineering Research Institute, for lasting contributions to earthquake engineering

44. E. P. Popov, "Seismic Behavior of Structural Subassemblages," *Journal of the Structural Division*. ASCE, Reston, Virginia. Vol.106, no.ST7. July 1980.

45. Popov, E.P., S.A. Mahin, and R.W. Clough, "Inelastic Response of Tubular Steel Offshore Towers," *Journal of the Structural Division*. ASCE, Reston, Virginia. Vol.111, no.1, October 1985.

through a distinguished career as an inspiring educator and pioneering researcher on innovative concepts for design of new earthquake-resistant structures and retrofit of existing structures.

Other Significant Awards

1965 Honorary Member, International Association for Shell and Spatial Structures.

1968-69 Miller Research Professor for basic research in science, University of California at Berkeley.

1968 M. Hetenyi Award for outstanding paper on "Buckling of Spherical Sandwich Shells" by Society for Experimental Stress Analysis (now Society for Experimental Mechanics). Co-recipient with M.S. Lin.⁴⁶

1972 Theodore R. Higgins Lectureship Award, American Institute of Steel Construction (AISC), for contributions to engineering knowledge of fabricated steel as principal author of a report on cyclic yield reversal (with R. B. Pinkney).⁴⁷

1977 Western Electric Fund Award for Excellence in Instruction of Engineering Students, by Pacific Southwest Society of the American Society of Engineering Education.

46. Lin, M.S., and E.P. Popov, "Buckling of Spherical Sandwich Shells," *Experimental Mechanics*. Society for Experimental Stress Analysis (now Society for Experimental Mechanics).

47. Popov, E.P. and R.B. Pinkney, *Reliability of Steel Beam-to-Column Connections Under Cyclic Loading*. Earthquake Engineering Research Center, University of California at Berkeley. Report no. UCB/EERC 69-1, 1969.

- 1977 Symposium Honoring Professor Popov on Structural Engineering and Structural Mechanics organized by his colleagues with support of NSF, and resulting in a book edited by Professor Karl S. Pister.⁴⁸
- 1979 Archie Higdon Distinguished Educator Award presented by the Mechanics Engineering Division of the American Society of Engineering Education for Outstanding Service for the Engineering Mechanics Division.
- 1979 Citation in "Those Who Made Marks in 1979," in *Engineering News Record*.
- 1984 ASCE Committee on Research Award for many contributions to the understanding of structural behavior and to improvements in building design through research.
- 1986 Raymond C. Reese Research Prize for an ASCE paper on EBFs (co-recipient with James O. Malley).⁴⁹
- 1988 Honorary Member, Structural Engineers Association of Northern California (SEAONC).
- 1991 Fellow, American Association for the Advancement of Science (AAAS).
- 1999 Lifetime Achievement Award, American Institute of Steel Construction (AISC).
- 2000 Elevated to the Berkeley Chapter as Honorary Member by students of Chi Epsilon.

48. Pister, Karl S. ed., *Structural Engineering and Structural Mechanics: A Volume Honoring Egor P. Popov*. Prentice-Hall, Englewood Cliffs, New Jersey. 1980.

49. Malley, James O. and Egor P. Popov, "Shear Links in Eccentrically Braced Frames," *Journal of Structural Engineering*. ASCE, Reston, Virginia. Vol. 110, no.9. September 1984.

Listed on numerous citations by Lincoln Arc Welding Foundation for supervision of students winning awards.

Listed in:

Who's Who in America

Who's Who in the West

Men of Achievement

Who's Who in Engineering

McGraw-Hill Modern Scientists and Engineers

Engineers of Distinction

(Engineering Joint Council)

Who's Who in Frontier of Science and Technology.

Books by E.P. Popov and Their Translations

Mechanics of Materials. Prentice-Hall, Englewood Cliffs, New Jersey. First edition, 1952, 500 pages.

Problems and Solutions for Mechanics of Materials, translated into Hebrew by E. Steg. 1969, 370 pages plus tables.

Introduction to Mechanics of Solids, Prentice-Hall, Englewood Cliffs, New Jersey. 1968, 571 pages.

Introduction to Mechanics of Solids: in MKS units, Prentice-Hall of India, Eastern Economy Edition. 1973, 572 pages.

Introduction to Mechanics of Solids, Prentice-Hall, in Japanese, Baifudan Co., Tokyo. 1975, 2 volumes: 345 and 320 pages.

Introduccion a la Mecanica de Solidos. Prentice-Hall: Editorial Limusa, Mexico, D.F. In Spanish. 1976, 652 pages.

Mechanics of Materials, 2nd Edition, SI Version. Text in collaboration with S. Nagarajan; problems with assistance of Z.A. Lu. Prentice-Hall, Englewood Cliffs, New Jersey. 1978, 590 pages.

Mukavemet Kati Cisimlerin Mekanigine Giris, Caglayan Kitabevi. In Turkish. 1976, 655 pages.

Introducao a Mecanica dos Solidos. Blucher. In Portuguese. 1979, 534 pages.

Introduction to Mechanics of Solids. In Iranian. 767 pages.

Mecanica de Materiales, Prentice-Hall: Editorial Limusa, Mexico, D.F. SI Version, 2nd Edition. In Spanish. 1978, 676 pages.

Mekanika Teknik, Penerbit Erlangga, in Indonesian. 1985, 629 pages.

Engineering Mechanics of Solids, Prentice-Hall, Englewood Cliffs, New Jersey. 1990, 727 pages.

Engineering Mechanics of Solids, Prentice-Hall International, Inc., in Korean, 1992, 725 pages.

Engineering Mechanics of Solids, Prentice-Hall, Englewood Cliffs, New Jersey. 2nd Edition, 1999, 864 pages.

Mekanika de Solidos, in Spanish. Pearson Education. Segunda Edicion, 2000, 888 pages.

Technical Reports and Publications

Egor P. Popov authored or co-authored 58 technical reports and 240 technical papers, many of which can be found on the Internet. Also see Professor Popov's web site at <http://www.ce.berkeley.edu/~epp/>.

Doctoral Students of Professor Egor P. Popov

in chronological order

Mirhan S. Agbabian

Bayard S. Wilson

John Brotchie

Zung-An Lu

James Goodman

Mohammed Khojasteh-Bakht

John Abel

M.K.S. Rajan

J. Vasquez

M.S. Lin

S. Yaghmai

P. Sharifi

Helmut Krawinkler*

Per Larsen

James O. Malley**

S. Nagarajan

O. K. Kiciman

Y. F. Dafalias

Ma, Shao-yeh M. *

T. Y. Wang*

C.W. Roeder

J. Vallenat*

S. Viwathanatepa*

D. Soleimani*

V. Zayas

D. Manheim

M. Ortiz

K. Hjelmstad

K. Kasai

F. Filippou*

J. Ricles

K. C. Tsai

M. D. Engelhardt

C. E. Grigorian

T. S. Yang

*denotes co-supervisor

**denotes an M. Eng. student

A

- Abel, John, 48, 92
- Aerojet, Pasadena, California, 46
- Aerospace work, 46
- Agbabian, Mihran S., 48, 92
- AISC Committee on Seismic Provisions for Structural Steel Buildings, Technical Secretary for, 61
- AISC Committee on Specifications, Task Committee on Seismic Provisions, 62
- Alamo-Neidhart, R., 58
- Alaska Pipeline, 71–72
- Allowable stress design (ASD), 62, 65
- American Institute of Steel Construction (AISC), Lifetime Achievement Award, 91
- American Iron and Steel Institute (AISI), 61–62, 67
- American Petroleum Institute (API), 71
- American Society of Civil Engineers (ASCE), 50
Popov Honorary Member of, 90
- American Society of Engineering Education (ASEE), 50
- Amin, Navin R., 60
- Aoyagi, T., 67
- Awards and medals, 89–91
- Axial force, 63, 72

B

- Bank of America's Regional Office and Branch Building, San Diego, California, 68
- Beams
- beam-column assemblages, 63
 - beam-to-column connections, 61–63, 69
 - cantilever, 58, 62
 - concrete rectangular, 58
 - concrete stubs, attached to, 61
 - cracking, 59
 - cross-section, reduced, 72
 - cyclic tests on, 71
 - elastic foundations, 48
 - flanges, 42, 70, 74
 - floor, long-span, 42
 - loads on, 63
 - T-beams, 58
 - testing, 61
 - webs, thin, 71
 - web-to-column connections, 72
- Bechtel Corporation, San Francisco, California, 53
- Bending moments, 42, 72
- Berkeley Citation, University of California at Berkeley, 86, 90
- Bertero, Vitelmo V., 38, 51–52, 58–59, 63, 76
- Blume, John A., 58
- Boeing, 51
- Bolin, Harry, 43
- Books authored by Egor P. Popov, 91–92
- Bouwkamp, Jack, 50, 72
- Boy Scouts of America, Popov member of, 26
- Braun, Karl, 3
- Bressler, Boris, 18
- Bridges
- Carquinez, California, 33
 - Golden Gate Bridge, San Francisco, California, 33
 - Richmond-San Rafael, California, 71, 73
 - suspension, MIT masters thesis on, 38

- Brotchie, John, 92
- Bubonic plague, outbreak of in Hailar, Manchuria identified by Popov's father, 14
- Building codes, compliance with, 68
- Building inspection
Fullerton Junior College, 42
- Buildings
Bank of America's Regional Office and Branch Building, San Diego, California, 68
Chevron Building, San Francisco, California, 61
Embarcadero 4, San Francisco, California, 68
O'Connor Hospital, San Jose, California, 68
U.S. Bank of Washington (formerly People's Bank Building), Seattle, Washington, 67
-
- C**
- California Institute of Technology (Caltech), Pasadena, California, 47
graduate studies, 38–40
materials testing, freelance work during graduate studies, 39
- California Office of the State Architect, Structural Safety Section, 68
- California Universities for Research in Earthquake Engineering (CUREE), 64
- Campanile, U.C. Berkeley, 29
- Carquinez Bridge, California, 33
- Cement, low-heat, 34
- Centrifuge, 53
- Chevron Building, 225 Bush Street, San Francisco, California, 61
- Chi Epsilon, Berkeley Chapter Honorary Member, 91
- Citizenship, 45
- Clar, Harold, 41–44, 65
- Clinkers, 34
- Clough, Ray W., 38, 51
- Coachella Valley Junior College buildings, 43
- Columns
flanges, 74
loading, 63
splices, 62–63
testing of, 63
- Concentric braced frames, 64
- Concrete
beams, rectangular, 58
lightweight used at Fullerton Junior College, 41
reinforced, 44
Southwest Portland Cement Company (SWC), 44
- Converse, Fred, 39, 41
- Croes, J. James R. Medal, 89
- Cross, Ira B., 32, 36
- Cyclic loads. *See* Loads, cyclic
-
- D**
- Dafalias, Yanis, 55
- Davis Hall, U.C. Berkeley, 50
- Davis, Harmer, 32, 34
- Davis, Raymond E., 29, 32, 34, 50
- Degenkolb Engineers, San Francisco, California, 62, 67–68
- Degenkolb, Henry J., 35, 60

- Dental schools in Russia, Popov's mother attends, 6
- Depression, work during, 43
- Derleth, Charles H. Jr., 32–33, 36
- Deryabin family, Popov's ancestors, 5
- Deryabin, Mitrofan P. (maternal grandfather), 5
- Deryabin, Olga (maternal grandmother), 5
- Distinguished Engineering Alumnus, University of California at Berkeley, 90
- Distinguished Lecturer, Earthquake Engineering Research Institute, 90
- Division of Architecture, State of California, 43
- Division of Structural Engineering and Structural Mechanics, Department of Civil Engineering, University of California at Berkeley, Chairman of, 49–51
- Dobbs, Harold S., 49
- Doctoral students of Prof. Popov, 48, 54–56, 92
- Dust abatement, 44
-
- E**
- Earthquake Engineering Research Institute
Distinguished Lecturer, 90
Housner Medal, 90
- Earthquakes
El Centro, California (1940), 43
Loma Prieta, California (1989), 68
Northridge, California (1994), 63, 76
- Eberhart, Howard D., 35, 47, 49, 51
- Eccentric braced frames (EBFs), 64–70
early research, 67–68
engineering practice, use in prior to research, 66–67
first U.S. tests, 67
practice, test results incorporated into, 68–69
- Education
Caltech, graduate studies, 38–40
Massachusetts Institute of Technology, Masters degree, 37–38
Polytechnic High School, San Francisco, California, 23–24, 26
Stanford University, Ph.D. degree, 46, 75
U.C. Berkeley, summer field work, 35
U.C. Berkeley, undergraduate years, 29
- El Centro, California earthquake (1940), 43
- Eligehausen, Ralph, 59
- Embarcadero 4, San Francisco, California, 68
- Emigration to U.S., 21–22
- Energy dissipation, 73
- Engelhardt, Michael D., 66, 71, 92
- Engineer, work as practicing, 41–46
- Engineering Mechanics of Solids* by Egor P. Popov, 92
- Engineering practice, use of EBFs in prior to research, 66–67
- Engineers, practicing, Popov's close relations with, 76
- Etcheverry, Bernard A., 33–34, 36
- Examinations, grading, 47
-
- F**
- Filippou, Filip C., 59, 92
- Finite element approach, 54
- Fireman's Fund, Novato, California, 68
- Flanges, 42, 70, 74
- Flat slab buildings, 42
- Forell, Nicholas F., 60

Forzani, Brian, 59
 Foutch, Douglas A., 70
 Framing systems, 64, 69–70
 Fujimoto, M., 67
 Fullerton Junior College District, work for as engineer, 41–42, 83

G

Garrelts, Jewell, 51
 Ginston, Ed, 26
 Goel, S.C., 70
 Golden Gate Bridge, San Francisco, California, 33
 Golovchine, Dr. Z., 6
 Goodman, James, 48, 92
 Goodyear, 45
 Grand Coulee Dam, 35
 Gregorian calendar, Popov's birthdate according to, 7
 Griffith Park, Los Angeles, California, 45
 Grigorian, Carl E., 73, 92
 Guisto, Frank, 36

H

Haas, A.M., 49
 Hailar, Manchuria, living in after escape from Russia, 13–14
 Hamburger, Ronald O., 61
 Hanson, Robert D., 60
 Harbin, Manchuria
 living in (1924–1927), 17–18
 Popov family arrives in immediately following escape from Russia (1921), 13

Harding, Sidney, 36, 38
 Heinrich, F.W., 39
 Hetenyi Award, 90
 Higdon, Archie Distinguished Educator Award, Mechanics Engineering Division of the American Society of Engineering Education, 91
 Higgins, Theodore R., 62
 Higgins, Theodore R. Lectureship Award, American Institute of Steel Construction (AISC), 90
 Hisatoku, T., 67
 Hjelmstad, Keith D., 66, 69, 92
 Hooke, Robert, 57, 65, 75
 Hooke's Law, 57, 66
 Hoover Dam, 34
 Hortig, Frank, 4
 Housner, George W. Medal, Earthquake Engineering Research Institute, 90
 Houston, William, 39
 Howard, Ernest E. Medal, 89
 Hysteretic behavior
 beam-column subassemblages, 59
 load reversal, repeated, 71
 loops, 61
 reinforced concrete wall, 59
 reinforcing bars, 58

I

Implosion, 52
 Incinerators, 48
 Inelastic finite element analyses, early inaccurate and misleading results in regions of high stress, 72

Inspection, building, Fullerton Junior College, 42

Institute of Traffic and Transportation Engineering (now Institute of Transportation Studies), 35

International Association for Shell and Spatial Structures (IASS), 49, 55

Introduction to Mechanics of Solids by Egor P. Popov, 91

Irrigation, undergraduate course work in, 33–34

J

Jacobsen, Lydik S., 46

James R. Libby & Associates, Engineers, 68

Japan Ministry of Construction, 69

Japan, Popov visits enroute to U.S. as a child, 21

Jet-assisted takeoff (JATO), 46

Jigs for special work, 42

Jobs

Aerojet, Pasadena, California, 46

Coachella Valley Junior College, 43

Fullerton Junior College District, 41–42, 83

Goodyear, 45

Lockheed, 42

Mellema, William, Architects-Engineers, Los Angeles, California, 43–44

Parkinson and Parkinson, Architects, Los Angeles, California, 42

Pohl, Martin, in San Bernardino, 43

road in California desert, surveying, design, and construction of, 44

Rudolph, E.F., Structural Engineer, Los Angeles, California, 42

Southwest Portland Cement Company (SWC), 44

vacuum chamber, Johnson Space Center, 52–54, 83

John Portman & Associates, Architects, 68

Johnson Space Center, vacuum chamber, 52–54, 83

Julian calendar, Popov's birthdate according to, 1, 6

K

Kasai, Kazuhiko, 66, 69, 92

Kelly, James, 51

Kelly, Joseph, 48

Kharkov Dental School, Karkov, Russia, 6

Khojasteh-Bakht, Mohammed, 92

Kiciman, O.K., 92

Kiev, Russia

Dental School, 6

Popov born in, 1

Popov's parents move to, 6

St. Vladimir Orthodox Cathedral, 7

Knap and Knap, allergen manufacturing firm, 45

Koisch, Col. F. P., 53

Koo, Dr. Wellington, 13

Korea-Maru, Popov sails to U.S. on, 21

Krawinkler, Helmut, 63, 92

L

Larsen, Per, 55, 92

Lateral load analyses not commonplace in early days, 42

Le Conte Hall, U.C. Berkeley, 29

Lin, M.S., 48, 90, 92
 Lin, T.Y., 60
 Lincoln Arc Welding Foundation, 91
 Loads, 69
 on beams, 63
 combined, 63
 cyclic, 58–59, 61–74
 beams, 71
 braces and links, 66–67
 column splices, 62
 inelastic, 59, 75
 nonlinear, in oil derricks, 76
 repetitive
 research. *See* Research, cyclic tests, 73
 short links, 65
 test results compendium, 72
 tests for Forell/Elsesser, 61
 wall panels, behavior of, 73
 web stiffeners, 66
 end, 72
 exceeding capacity, 71
 first maximum, 58
 gravity, 43
 lateral analysis not commonplace in early days, 42
 reversals of, 59, 71
 static, 62, 65
 Lockheed, job for, 42
 Loma Prieta earthquake (1989), 68
 Los Angeles Building Department, research for, 62
 Lubliner, Jacob, 38, 51
 Luc, Zung-An, 48, 92
 Lurie, S., 6

M

Ma, Shao-yeh M., 52, 58, 92
 Mahin, Stephen A., 71
 Malley, James O., 62, 66, 69–70, 92
 Manchuria
 escape to from Russia, 13–22
 Hailar, 13–14
 Harbin, living in, 17–21
 Pogranichnyy/Suifehno, living in during Russian Revolution, 14–17
 warlords, battles between, 16
 Manheim, D.N., 69, 92
 Marconi, Guglielmo, 4
 Martel, Raul Romeo (R.R.), 39–40
 Massachusetts Institute of Technology (MIT), Masters degree from, 37–38
 Materials
 degradation of during cyclic loading, 58
 inelastic cyclic behavior, 55
 steel beam-to-column subassemblages, 63
 testing while at Caltech, 39
 McNiven, Hugh, 38, 51
Mechanics of Materials by Egor P. Popov, 48, 57, 75, 91–92
 Medals and awards, 89–91
 Medwadowski, Steve, 49
 Mellema, William, 43–44
 Mellema, William, Architects-Engineers, Los Angeles, California, 43–44
 Menuhin family, Popovs rent from in San Francisco, 25
 Menuhin, Yehudi, 25
 Military service, trying to enlist during World War II, 45

Miller Research Professor, University of California at Berkeley, 90
 Mirsky, Olga S. (maternal grandmother), 5
 Molotov, Vyachaslav, 2
 Moments, bending, 42, 72
 Murray, William M. Lecturer, Society for Experimental Mechanics, 90

N

Nagarajan, S., 55, 92
 Naghdi, Paul, 54
 National Academy of Engineering, elected to, 89
 National Aeronautics and Space Administration (NASA), 54–55
 National Science Foundation, 51, 62, 69, 73
 Newmark, Nathan M., 49
 Newmark, Nathan M. Medal, 89
 Nicoletti, Joseph P., 68
 Nonlinear analysis, 54
 Nonlinear problems in shell structures, 48
 Norman Medal, American Society of Civil Engineers, 90
 Norris, Charles, 51
 Northridge, California earthquake (1994), 63, 76

O

O'Brien, Murrough P., 49
 O'Connor Hospital, San Jose, California, 68
 Oberlies, Jack, 43
 Offshore structures, braced steel tubular, 71, 76
 Ortiz, Miguel, 54–55, 92

P

Page, Cloudsley & Baleix, 68
 Parkinson and Parkinson, Architects, Los Angeles, California, 42
 Pearson, Erman, 38
 Pei-fu, Wu, 16
 Penzien, Joseph, 38, 51
 People's Bank Building, Seattle, Washington (now U.S. Bank of Washington), 67
 Petersson, Hans, 54–55
 Pinkham, Clarkson (Pinky), 60–61, 65
 Pinkney, R. Bruce, 61, 76, 90
 Pipe thickness, design criteria, 72
 Pister, Karl S., xiii-xvi, 38, 51, 91
 Pogranichnyy/Suifehno, Manchuria
 living in during Russian Revolution, 14–17
 Pogrebnyak, Gallick, 36
 Pohl, Martin, 43
 Polytechnic High School, San Francisco, California, 23–24, 26–27
 Popov family
 Kiev, living in, 6
 Manchuria, living in following escape from Russia, 13–22
 Russian Revolution, life during, 9–12
 San Francisco, settling in, 23–27
 Popov, Alexander (father's cousin), 3–4, 79
 Popov, Alexander (son) xiv-xv, 84
 Popov, Egor P., 75
 awards and medals, 89–91
 baptized at St. Vladimir Orthodox Cathedral, Kiev, Russia, 7
 books authored by, 91–92
 Caltech, graduate studies, 38–40

- Chairman of Division of Structural Engineering and Structural Mechanics, Department of Civil Engineering, 49–51
- committee memberships, 61–62
- doctoral students of, 48, 54–56, 92
- Eagle Scout, 26
- emigration to U.S., 21–22
- fruit picking during summer vacations, 27
- heart condition, 72
- hospital train, living on during Russian Revolution, 10–12
- Japan, visit to enroute to U.S. as a child, 21
- Manchuria, living in following escape from Russia, 13–22
- Masters degree from MIT, 37–38
- Polytechnic High School, San Francisco, California, 23–24, 26
- practicing engineer, working as, 41–46
- practicing engineers, close relations with, 76
- reflections, 75
- Russia, childhood in, 1–12
- Russia, escape from during World War I, 12
- sabbatical leave (1952–1953), 51–52
- SEAONC president, 59–60
- Stanford University, doctorate from, 46
- undergraduate years at U.C. Berkeley, 29
- Popov, Irene (wife), 44, 49, 84
- Popov, Katherine (daughter), xiv–xv, 84
- Popov, Nicholas Paul (brother), 7, 77, 80–81
- Popov, Paul Theodore (father), 3, 6, 77–78
- Bubonic plague, outbreak of in Hailar, Manchuria identified by, 14
- hospital train, service on as medical officer, 10–12
- Russian military service during World War I, 9
- Popov, Rev. Theodore M. (paternal grandfather), 3
- Popov, Zoe Deryabin (mother), 5–6, 77–78
- Portman & Associates, Architects, 67
- Problems and Solutions for Mechanics of Materials* by Egor P. Popov, 91
- Publications, 89–92
- See also* individual footnotes
- Purdy and Henderson, New York, 65
-
- ## R
- Radio waves, early transmission and reception of by Alexander Popov, 3–4
- Rajan, M.K.S., 92
- Raphael, Jerry, 53
- Recruiting new staff as Chairman of Department of Civil Engineering, Division of Structural Engineering and Structural Mechanics, University of California at Berkeley, 50
- Reese, Raymond C. Research Prize, 91
- Reflections, 75
- Reinforced concrete, 54, 58–59
- beams attached to concrete stubs, 61
- hysteretic behavior of wall, 59
- mechanisms, interrelationship between, 59
- wall panels, 73
- Reinforcing bars, 42, 59
- bond deterioration during cyclic loads, 58
- longitudinal, hysteretic behavior of, 58
- Reitherman, Robert K., 64

Research

- beam-to-column connections, 61–63, 69
- bridge, 71, 73
- cyclic tests, 71
 - beams, 61
 - Forell/Elsesser, 61
 - research compendium, 72
 - wall panel, full-size, 73
- early on seismic use of eccentric braced frames (EBFs), 67–68
- eccentrically braced frames (EBFs), 64–70
- focus, change of, 55
- long links, 71
- for Los Angeles Building Department, 62
- one-third scale, 69
- reinforced concrete, 58–59
 - beams attached to concrete stubs, 61
 - mechanisms, interrelationship between, 59
- specimens, size of, 63, 68–69, 73
- steel, 61–74
- wrong conclusion, 58
- Reylite, lightweight aggregate, 42
- Richmond Field Station, U.C. Berkeley, 34
- Richmond-San Rafael Bridge, California, 71, 73
- Ricles, James M., 66, 70, 92
- Road in California desert, surveying, design, and construction of, 44
- Roeder, Charles W., 66–68, 70, 92
- Rudolph, E.F., Structural Engineer, Los Angeles, California, 42
- Russia
 - ancestors in, 1–7
 - childhood in, 1–12

- Dnieper River, transportation on, 2
- escape from, 12
- Kiev, history of, 2–3
- Novgorod, 2
- Russian Revolution, 9–12
- Rutherford & Chekene, San Francisco, California, 68

S

- Sabbatical leave (1952–1953), 51–52
- Sackman, Jerome, 38, 51
- Saito, K., 67
- Samsonite luggage, 14
- Sasani, Mehrdad, 73
- Saunders, Mark, 60–61
- School buildings, designing, 41–43
- Schwartz, Preston, 33–34
- Scordelis, Alexander, 38, 49–51
- Seismic design, 57–74
 - Fullerton Junior College, 42
 - inelastic, 65
 - Mellema firm, working for as practicing engineer, 43
 - reflections on improvements in, 76
 - reinforced concrete, 58–59
 - steel, 61–74
 - taught to Popov, 43
- Sharifi, Parviz, 55, 92
- Shell structures, 49, 52
- Shieffet, Joe, 42
- Singing lessons, 44
- Smallpox, use of vaccination during outbreak of in Russia by Popov's grandfather, 3

- Smith-Emory Testing Laboratory, Los Angeles, California, 42
- Society for Experimental Stress Analysis, 48
- Sofronoff, S.L., 11
- Soleimani, D., 92
- Southwest Portland Cement Company (SWC), 44
- Soybeans, trade in in Manchuria, 16
- Sproul, Robert Gordon, 35
- Spurr, Henry V., 65–67, 69
- St. Vladimir Orthodox Cathedral, Kiev, Russia, Popov baptized at, 7
- St. Vladimir University, Kiev, Russia, Popov's father associated with, 13
- Stanford University Chapel, memorial service for Timoshenko, 46
- Stanford University, Palo Alto, California, doctorate from, 46, 75
- Steel, 61
 - beam-to-column subassemblages, 63
 - braced tubular offshore structures, 71, 76
 - bridges, 71, 73
 - column splices, 62
 - connections, 61, 76
 - EBFs. *See* Eccentric braced frames
 - frame testing, 73
 - research. *See* Research
 - shear walls, 67
- Stephen, Roy M., 62
- Stone, Marraccini & Patterson, Architects, 68
- Strong, Edward, 49
- Structural Engineers Association of Northern California (SEAONC)
 - Honorary Member of, 91
 - president of, 59–60
- Subassemblages, 51
 - beam-to-column, 59, 63
- Suborbital flights, unmanned, 48
- Summer field work in land surveying, 35
- Symposium Honoring Prof. Popov on Structural Engineering and Structural Mechanics, 91
-
- T**
- Takanashi, Koichi, 66–68
- Tatlow, Richard H. III, 49
- Terman, Frederick E., 46
- Timoshenko, Stephen, 40, 46, 49
 - Popov speaks at memorial service for, 46
- Torroja, Eduardo, 49
- TRA Architects, 67
- Troxell, George Earl, 29, 48–49
- Troy, Richard G., 67
- Tsai, Keh-Chyuan (K.C.), 72, 92
- Tso-lin, Chang, 16
-
- U**
- U.S. Bank of Washington (formerly People's Bank Building), Seattle, Washington, 67
- Ukai, K., 67
- University of California at Berkeley, 86, 90
 - 1970–2000, 58–59, 61–74
 - Chairman of Division of Structural Engineering and Structural Mechanics, Dept. of Civil Engineering, 49–51
 - Distinguished Engineering Alumnus, 90
 - early teaching and research career, 47–56
 - examinations, grading, 47

- Miller Research Professor, 90
 summer field surveying as an undergraduate, 35
 teaching career, reflections on, 75
 teaching load, 47
 undergraduate years, 29
 undergraduate course work in irrigation, 33–34
 University of California at Riverside, library building, 73
 University of Southern California, Los Angeles, California, 48
 University of Tomsk, Siberia, Popov's father's medical school, 6
 URS/Blume, San Francisco, California, 68
-
- V**
 Vacuum chamber, Johnson Space Center, 52–54, 83
 Vallenas, J., 92
 Vasquez, J., 92
 Vaughn, Harry, 41
 V-braced frames, 67–68
 Viwathanatepa, Sutipoul, 58, 92
 Vladimir, Prince of Russia, 1
 von Karman, Theodore, 39
 von Karman, Theodore Medal, American Society of Civil Engineers, 90
-
- W**
 Wada, A., 67
 Walker, Morris, 22, 26–27
 Wall panels
 full-size with slotted bolted connections, 73
 reinforced concrete, 73
 Walls, outside, thickness of, 42
 Wang, T.Y., 59, 92
 Warlords in Manchuria, 16
 Welded connections, 61, 70, 72
 column splices, 62–63
 failure of, 74
 webs, 71
 Welding
 Popov work at testing laboratory during college, 39
 Welding and machine shop course at night, 42
 Welton Beckett Associates, 67
 Western Electric Fund Award for Excellence in Instruction of Engineering Students, 90
 Wheeler Auditorium, U.C. Berkeley, 32, 34
 Whisenand, George, 44
 Whisenand, Hazel, 44
 Whisenand, James, 44
 Wilbur, John, 37
 Wilson, Bayard S., 92
 Wilson, Edward L., 51
 Wind bracing, 65
 Wiskocil, Clement, 30, 34
 Works Progress Administration (later the Work Projects Administration), 42
 World Conference on Shell Structures (1962), 49
 World War I, 9–12
 Wyllie, Loring A. Jr., 67
-
- Y**
 Yaghmai, Said, 54, 92
 Yang, Tzong-Shuoh, 72, 92

Yorston, Donald (H.D.), 52

Young, Donovan H., 46

Youssef, Nabih, 73

Z

Zayas, Victor, 71, 92

Zwicky, Fritz, 39

