reasoning that these experts would attract research contracts as well as quality junior faculty and promising graduate students. Under Terman's leadership, Stanford's reputation flourished and the university was sometimes referred to as "Terman Tech" because of his shaping influence. Terman envisioned universities as more than a place for learning, seeing them also as major economic influences in the nation's industrial life. Calling the idea of creating an industrial park on plentiful Stanford land "our secret weapon," he shaped the venture into a high-technology center. Klystron tube producers Varian Associates became the first tenant in 1951. By the late 1960s, 90 businesses would employ 26,000 workers at the Stanford Industrial Park.

In 1955, Terman was named provost at Stanford; in 1959, he took on additional duties as the school's vice president. Five years later, he helped organize the National Academy of Engineering, of which he became a founding member. His career achievements were commemorated in 1977 when Stanford University dedicated the $9.2-million Frederick Emmons Terman Engineering Center.

While at Harvard, Terman had written his famous *Radio Engineer's Handbook,* the fifth of his eight books. Not counting foreign publications in at least eight languages, his books had sold over 600,000 copies by the time he retired in 1965. His texts were readable, thorough, and practical; furthermore, Terman diligently updated each new edition to reflect current developments. Results of his personal research are documented in more than 50 articles he wrote for technical journals. In 1952, he summarized his vision of modern technology, as quoted by Blakeslee: "Through its ability to control, to amplify, and to convert between light, sound, and electricity, electronics provides a nervous system for our machine-age civilization."

Terman died in his sleep of cardiac arrest at his Stanford campus home on December 19, 1982.

SELECTED WRITINGS BY TERMAN:

Books

Radio Engineer's Handbook, McGraw-Hill, 1943.

Electronic and Radio Engineering, McGraw-Hill, 1955.

SOURCES:

Periodicals

Blakeslee, Sandra, "Stanford to Honor Fred Terman at Engineering Center Oct. 6," Stanford News Service, October 5, 1977.

Palo Alto Times, December 12, 1945.

San Jose Business Journal, February 15, 1988, p. 19.

Other

Bloom, William, L. Kenneth Wilson, and Jane Morgan, *Audio Tapes of Interviews on the Occasion of the Silver Anniversary of Palo Alto,* Palo Alto, CA, 1969.

—*Sketch by Sandra Katzman*

Karl Terzaghi
1883-1963
Austrian-born American engineer

Karl Terzaghi bridged the gap between geology and civil engineering by creating the field of soil mechanics. He developed the fundamental methods and tools used to investigate the nature and behavior of soils that are still employed by soil engineers today. His theories have greatly expanded how an understanding of the behavior of soils can be used in construction projects, and designs for the foundations of most major structures now depend on his work.

Terzaghi was born in Prague, Austria-Hungary (now Czechoslovakia), on October 2, 1883, to Anton Terzaghi von Pontenuovo and Amalia Eberle Terzaghi. His father, who died while Terzaghi was a boy, was an infantry commander. Terzaghi attended military school and then the technical high school in Prague. In 1900, he entered the Technische Hochschule, a university in Graz, Austria, where he studied mechanical engineering. He also discovered an interest in geology and was once encouraged to become a professional writer by a professor who had read some of his essays. Terzaghi served a year in the army after graduating from the Technische Hochschule, during which time he translated *Outlines of Field Geology* by Scottish geologist Archibald Geikei. His interest in geology increased; he agreed to serve as a geologist on a Greenland expedition in 1906, but a mountaineering accident forced him to back out.

Terzaghi's first job was as superintendent of construction at an engineering firm in Vienna. In 1908, he moved to Croatia on the Adriatic coast, where he remained until 1910, surveying the geology of the site for a proposed hydroelectric power facility. It was here that Terzaghi became interested in applying geology to engineering problems. After the project he addressed the subject in a paper he wrote on the origin of land forms and the underground conditions of the region. During this period, he began working in Russia, helping to complete a St. Petersburg construction project that had been halted due to structural hazards. In January, 1912, he was awarded a doctorate of technical sciences from the Technische Hochschule with a thesis based on the unique design of one of his Russian construction projects.

Begins Work in Soil Mechanics

By 1912, Terzaghi had begun his search for a rational approach to foundation engineering and spent 1911 through 1913 in the United States traveling to dam sites, researching geological studies and looking for connections between them and his own construction experience. When World War I began in 1913, he returned to Austria to join the army, transferring to the newly formed Austrian air force and serving until 1916. In that year, he married Olga Byloff, with whom he would have one daughter. They were separated in 1922 and divorced in 1926.

After leaving the air force, Terzaghi accepted a position at the Imperial School of Engineers in Istanbul, Turkey, where he built his first soil mechanics laboratory. He used tools from the physics department and kitchen utensils to create a program for investigating the physical composition of clay soils. After World War I ended, Terzaghi accepted a teaching position at Roberts College, an American school in Istanbul. He developed his second soils laboratory there, remaining until 1925. Terzaghi's theories about soil mechanics advanced considerably during this period as he invented more tools and techniques for studying the behavior of soils. An example is Terzaghi's discovery that weight supported by clay soils is first carried by the liquid in the microscopic pores of the clay and then transferred over time into the clay itself. Terzaghi published a compilation of his works in 1925, which led to a visiting lectureship at the Massachusetts Institute of Technology (MIT).

During his four years at MIT, Terzaghi developed a program for teaching soil mechanics, improved his testing methods, and expanded his work to include investigations of pavement design and earth dams. Up until this time, Terzaghi had worked only in temperate climates. Curious about the effects of different climates on structures, he asked the United Fruit Company for the opportunity to study soil behavior at their Latin American locations. In 1928, he traveled to United Fruit facilities in Costa Rica, Panama, Spanish Honduras, and Guatemala, studying, among other things, the stability of sloped embankments and the flow of water through soils. After his return from Latin America, Terzaghi received a telephone inquiry about his work from Ruth Doggett, a doctoral student studying geology at Radcliffe College in Cambridge, Massachusetts. Their conversation led to courtship and then marriage in the summer of 1930. They would have a son and a daughter. The Terzaghis cooperated on several projects throughout their careers.

By 1930, Terzaghi had returned to Vienna to teach at the Technical University, which became, under his influence, the focal point of earthworks studies. For nine years, Terzaghi lectured and taught his laboratory techniques to engineers and students from as far away as Australia. He concentrated his research on developing new ways to measure the reactions of sand and clay to stresses such as the weight of buildings. During this period, the role of soil mechanics in engineering was becoming more widely understood by professionals; Terzaghi's role in the development of this field was recognized in 1936 when he returned to Boston, Massachusetts, for a special ceremony at Harvard University. There he was named the first president of the International Conference of Soil Mechanics and Foundation Engineering. He would remain the society's active president for twenty-one years and honorary president for several more.

Terzaghi lectured in many European cities, as well as North Africa and Central Asia. He was known for consulting on construction projects that had been interrupted by unexpected structural failures. An afternoon phone call to a place where he was staying in France once brought him to London that same evening to study a failure at an earthen dam project. This began a fruitful relationship with British engineers, and in 1939 he was invited to deliver the James Forrest Lecture to the Institution of Civil Engineers. Terzaghi was only the second non-British engineer to receive this honor since the institution was founded in 1890.

In 1938, Terzaghi accepted a visiting lectureship at Harvard University. He moved his family to the United States and settled in Winchester, Massachusetts. This developed into a very productive period of Terzaghi's career, during which he taught, consulted on a worldwide basis, and wrote two important books and almost one hundred papers. In 1946, Harvard made him Professor of the Practice of Civil Engineering. Terzaghi included adventure in his work as often as possible, such as studying the Sasumua dam site in Kenya in 1953 near the warring Mau Mau tribe. He also worked on famous projects and was chair of the Board of Consultants for the controversial High Aswan Dam in Egypt.

Terzaghi maintained a rigorous professional schedule and continued his teaching, consulting, and researching well into his seventies. His health remained excellent and he regularly out-paced much younger geologists on field investigations. Terzaghi retired from the Harvard faculty in 1956 at age seventy-three, but he still worked, and in the spring before his seventy-fifth birthday he traveled to fifteen cities throughout the United States and Europe. Over the next several years he wrote a textbook and worked with several leading engineering schools as a lecturer and research consultant. By the end of his career he had received six honorary doctoral degrees, the Norman Medal from the American Society of Civil Engineers three times, and the Frank B. Brown Medal of the Franklin Institute of Philadelphia. Terzaghi died on October 25, 1963, at his home in Winchester, Massachusetts.

SELECTED WRITINGS BY TERZAGHI:

Books

Erdbaumechanik auf bodenphysikalischer Grundlage, Deuticke (Vienna), 1925.

Principles of Soil Mechanics, McGraw-Hill, 1926.

Theoretical Soil Mechanics, Wiley, 1943.

(With Ralph Peck) *Soil Mechanics in Engineering Practice,* Wiley, 1948.

From Theory to Practice in Soil Mechanics: Selections from the Writings of Karl Terzaghi, with bibliography and contributions by L. Bjerrum, A. Casagrande, R. B. Peck, and A. W. Skempton, Wiley, 1960.

Periodicals

"Large Retaining-Wall Tests I-V," *Engineering News Record,* February 1, 1934, pp. 136–140; February 22, 1934, pp. 259–262; March 8, 1934, pp. 316–318; March 29, 1934, pp. 403–406; April 19, 1934, pp. 503–508.

"Stability of Slopes of Natural Clay," *Proceedings of the International Conference on Soil Mechanics and Foundation Engineering,* Volume 1, 1936, pp. 161–165.

"Undisturbed Clay Samples and Undisturbed Clays," *Boston Society of Civil Engineers,* Volume 28, 1941, pp. 211–231.

"Permafrost," *Journal of the Boston Society of Civil Engineers,* Volume 39, 1953, pp. 1–50.

"Egypt's Aswan High Dam," *Proceedings of the Canadian Soil Mechanics Conference,* Volume 46, 1956, pp. 47–51.

"Soil Mechanics in Action," *Civil Engineering,* Volume 29, 1959, pp. 69–70.

—Sketch by David N. Ford

Nikola Tesla
1856-1943
Serbian American inventor and electrical engineer

The first person to prove and perfect the efficient use of alternating-current electricity, Nikola Tesla saw his polyphase system become the standard for power transmission throughout the world. He also pioneered research in such areas as artificial lightning, high-frequency and high-tension currents, and radio telegraphy. Before his death in 1943, Tesla had acquired more than one hundred patents for high-frequency generators, adjustable condensers, thermomagnetic motors, transformers, his famous Tesla coil, and other inventions that were to become integral elements in modern technology. Tesla was born on July 10, 1856, the son of Serbian parents in the Croatian village of Smiljan. The settlement was located near the town of Gospić in what was then a part of the Austro-Hungarian empire, an area that later became Yugoslavia. Tesla's father and mother, Milutin Tesla and Djuka Mandić, had expected their son to follow in his father's footsteps as a Greek Orthodox clergyman. But during his early school years in Smiljan and then in nearby Gospić, where his parents moved when he was six or seven years old, he excelled in math and science. Gradually it became clear that the young and independent-minded Tesla was no candidate for the seminary.

Early Achievements in Europe

In 1871, when Tesla was fifteen, he attended the higher secondary school at Karlovac, Croatia. After four years, Tesla moved to Graz, Austria, to attend the higher technical school or polytechnic institute in 1875. As before, he excelled in math and science, seemed to have a prodigious memory (he was reputed to have memorized Johann Wolfgang von Goethe's epic drama *Faust*), and showed particular interest in electrical engineering. While attending the technical school in Graz, Tesla commented on the unnecessary (and potentially dangerous) sparks that were emitted by a Gramme dynamo, a direct-current induction motor that was being demonstrated in the classroom. The sparks emerged from where the brushes came into contact with the commutator, and Tesla commented that these sparks could be eliminated by creating a motor without a commutator. The professor was skeptical of the young scientist's theory, and at that time nothing came of the idea. Over the coming years, however, Tesla would continue to work to overcome the problems of direct-current motors.

NOTABLE TWENTIETH-CENTURY SCIENTISTS

VOLUME 4 S-Z/INDEXES

Emily J. McMurray, Editor

Jane Kelly Kosek and Roger M. Valade III, Associate Editors

Gale Research Inc.

An International Thomson Publishing Company

I(T)P

NEW YORK • LONDON • BONN • BOSTON • DETROIT • MADRID
MELBOURNE • MEXICO CITY • PARIS • SINGAPORE • TOKYO
TORONTO • WASHINGTON • ALBANY NY • BELMONT CA • CINCINNATI OH