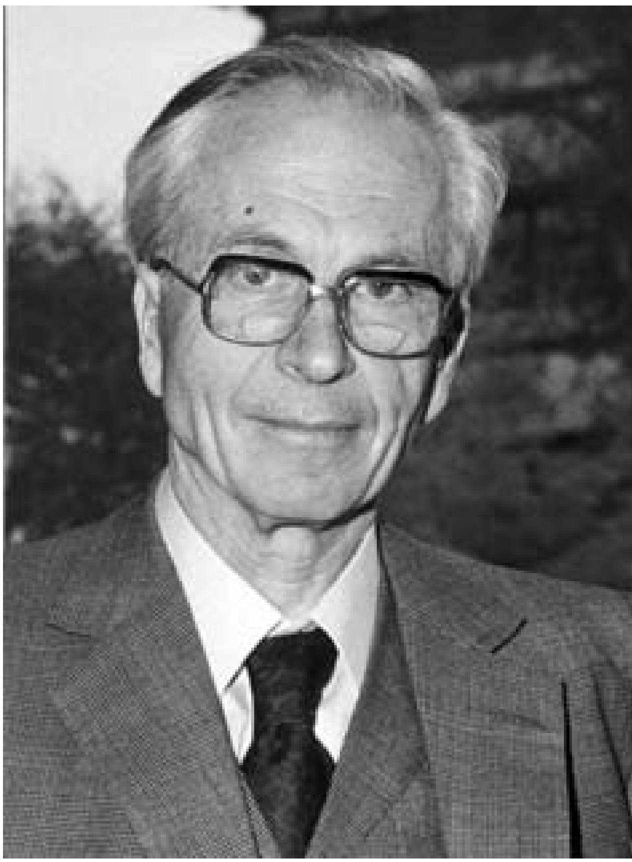

JOHN H. ARGYRIS

1913-2004

Elected in 1986

"For outstanding pioneering and continuing contributions in computer mechanics over a period of more than 30 years."

BY THOMAS J. R. HUGHES, J. TINSELY ODEN,
AND MANOLIS PAPADRAKAKIS
SUBMITTED BY THE NAE HOME SECRETARY

JOHN H. ARGYRIS was a person with great vision, class, and persuasion, who dramatically influenced computational engineering and Science and who will be long remembered as one of the great pioneers of the discipline in its formative years. He passed away quietly on April 2, 2004 after respiratory complications. John rests in peace in Sankt Jorgens Cemetery in the city of Varberg, 60 km south of Goteborg, Sweden, near Argyris's summer house.

John was born on August 19, 1913, in the city of Volos, 300 km north of Athens, Greece, into a Greek Orthodox family. His father was a direct descendant of a Greek Independence War hero, while his mother came from an old Byzantine family of politicians, poets, and scientists, which included the famous mathematician Constantine Karatheodori, professor at the University of Munich.

Volos, as it was during his childhood, remained very much alive in his memory, especially the house he grew up in. He vividly remembered, until the end, details of the room where, at the age 2, he almost died from typhoid fever.

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In 1919 his family moved to Athens, where he received his initial education at a classical gymnasium in Athens. After studying civil engineering for four years at the National Technical University of Athens, he continued his studies at the Technical University of Munich, where he obtained his engineering diploma in 1936. Just after graduation he was employed by a private consulting organization working on the leading-edge technical design of highly complex structures. One of these early engineering accomplishments was that of designing a 320m high radio transmitter mast with a heavy mass concentrated at the top.

With the outbreak of World War II, John was in Berlin continuing his studies at the Technical University. Just after the German invasion of Greece, John was arrested and led to a concentration camp, on the accusation of transferring research secrets to the Allies. His savior turned out to be the eminent German Admiral Kanaris, of Greek descent, who arranged his escape by informing the guards that the prisoner would be executed outside the camp. In 1944, Kanaris himself was tragically executed as one of the leaders of the assassination attempt against Hitler. Following his escape from prison, John managed to leave Germany soon thereafter in a very dramatic manner. He swam across the Rhine River during a midnight air raid, holding his passport in his teeth. He managed to reach Switzerland, where he completed his doctoral degree at ETH Zurich in 1942 in aeronautics. In 1943 he moved to England and worked as a technical officer at the Engineering Department of the Royal Aeronautical Society of London.

John could never derive any pleasure in ordinary day-to-day work and was only attracted to problems that seemed unsolvable. Even when working in industry, his directors soon realized that the best policy toward John Argyris was to entrust him with intractable problems. At the same time he was fascinated by the properties of triangular and tetrahedral components that appeared to him as ideal elements to build up an engineering system. He could never sympathize with Cartesian analytical geometry that he found most inelegant. During the war, he wrote three classic papers in *Reports and*

Memoranda of the then Aeronautical Research Council. These were concerned with the diffusion of loads into stringer-reinforced stressed skin structures of wings and fuselages. He developed a theory using his intuition that combined differential equations and finite difference calculus that was immediately successful and later confirmed by experiments and applied with great success to British fighter and bomber aircraft during the war. However, the real breakthrough in his way of thinking and approach to technical problems of solid mechanics was achieved when the first electromechanical computing devices emerged in 1944 in Britain at the National Physical Laboratory and in the United States at Harvard University.

In those days aeronautical engineers were trying to build the first combat jet aircraft whose speed required swept-back wings. One such example was the flawed German fighter ME262, proof of its designers' failure to develop a reliable method of analyzing the nonorthogonal geometry of wings. In August of 1943 John spent three whole days and nights in a bold attempt to solve that particular problem. His only help was a rudimentary computing device capable of solving a system of up to 64 unknowns. It took one sudden moment of clarity, on the third evening of his brainstorming session for him to realize that the answer could be the application of triangular elements. Here his dislike of orthogonal Cartesian geometry found an ideal field. Astonishingly enough the deviation from preceding experimental test results proved less than 8 percent. This was the birth of the matrix force and displacement methods, the finite element method, as later named. Immediately, all publications on this method were declared secret. Within the triangular element philosophy, John did not use Cartesian direct and shear stresses and strains, but a novel definition of stresses, expressed in terms of these direct stresses and strains, measured parallel to the three sides of each triangle. This new definition of stresses and strains led to the formulation of the Natural Approach, which possessed great computational advantages and allowed a simple and elegant generalization to large displacements.

In 1949 John joined the Imperial College of the University of London as a senior lecturer and in 1955 became a full professor and director of the Sub-department of Aeronautical Studies until 1975. After becoming an emeritus professor he continued his collaboration with Imperial College as a visiting professor until 1980. In 1959 he accepted an offer from the University of Stuttgart and became director of the Institute for Statics and Dynamics of Aerospace Structures. He created the Aeronautical and Astronautical Campus of the University of Stuttgart, a focal point for applications of digital computers and electronics. After becoming an emeritus professor at the University of Stuttgart, he continued to work until the age of 88 with the same vigor, writing books and scientific papers with a compelling vitality and creative thinking.

In 1956 John addressed the problem of stress analysis of aircraft fuselages with many cut-outs, openings, and severe irregularities. Computers then were not capable of enabling a global application of the finite element method. John, again following his intuition, realized that the problem could be solved by a new physical device involving the application of initial stresses and strains and an extension of matrix methods to a higher level. This was presented at the International Union of Theoretical and Applied Mechanics (IUTAM) Congress in Brussels in 1956 and created a great upheaval, because the whole derivation involved only 20 lines of physical argument and four lines of advanced matrix algebra. Most experts in the United States and Europe said that the theory must be wrong on the grounds of its simple derivation, and they did not even accept the evidence of the computational results obtained by John that proved the correctness of this derivation. Somewhat later, however, a Ph.D. thesis from Sydney, Australia, was sent to John in which the candidate proved in 124 pages of close mathematical argument that the formula of John Argyris was indeed correct. This approach was also extensively applied to the design of the Boeing 747 as early as 1960. In the 1960s and 1970s John had applied the finite element method with great success in aerodynamics, optimization, combustion problems, nonlinear mechanics and other fields of research and industrial interest, among them the suspension roof of the Munich Olympic Stadium in the late 1960s. Around that period the National Aeronautics and Space Administration (NASA) sought his knowledge on the thermal shielding of the Apollo spacecraft. He suggested covering the fuselage with specially formulated substances that, upon reentry into the atmosphere, would evaporate and cool its surface. In 1976 John was concerned with the theory of chaos and introduced these theories in studying the turbulence flow around the European space vehicle *Hermis*.

It is difficult to summarize the impressive accomplishments of John Argyris. Among his writings were over 10 books, including three important textbooks: *Introduction to the Finite Element Method,* Vols. I, II and III, (1986–88); *Dynamics of Structures* (1991), *An Explanation of Chaos* (1994). The latter was printed in English and German and in Germany alone was published three times in one year, a rare achievement for a scientific publication of this kind. In addition to these writings, he published over 500 extended scientific articles in major international journals and lectured extensively both within Europe and abroad. His textbooks and extensive journal publications are essential reading material for students, practicing engineers, and researchers around the world and have become benchmarks for later treatises on computational mechanics.

One of his most important contributions in the engineering community was the founding and editorship of the journal *Computer Methods in Applied Mechanics and Engineering,* a publication that has provided much of the lifeblood of computational methods in applied mechanics and engineering for more than three decades. John Argyris took great interest and pride in this venture and insisted on running the journal meticulously and diligently, thus succeeding in making it one of the leading journals in computational mechanics available today.

John received many honors including 18 doctorate degrees, “Honoris Causa,” three honorary professorships and six academy memberships from universities and academies all over the world, and more than 25 other awards and distinctions, among them the Gauss–Newton Award from the International Association for Computational Mechanics (IACM), the von Karman Medal from the American Society of Civil Engineers (ASCE), the Timoshenko Medal from ASME, the Laskowitz Gold Medal from the Academy of Science of New York for "the invention of the Finite Element Method," the Prince Philip Gold Medal of the Royal Academy of Engineering, the Grand Cross of Merit of the Federal Republic of Germany, and the Einstein Award from the Einstein Foundation for his "momentous work on the Finite Element Method and Chaos Theory." He was also a fellow of the Royal Society of London, honorary member of the Executive Council of IACM, and honorary president of GACM.

John was blessed with many talents, making him a true modern Renaissance man; he was a scholar, a thinker, a teacher, a visionary, an orator, an elegant writer, a linguist. Deeply cultivated, a man with rare principles and a passionate patriot, he was also unique in blending his Mediterranean temperament with Western European rationalism.

In the paper that coined the name "Finite Element Method," published in 1960, the world-renowned author Ray Clough refers to the finite element method as "the Argyris Method." Von Karman's prophetic statement that Argyris's invention of the finite element method entailed one of the greatest discoveries in engineering mechanics and revolutionized our thinking processes more than 50 years ago was proven to be absolutely true. Indeed, the finite element method, based on John Argyris's fundamental and far-reaching contribution, has truly revolutionized today's engineering and scientific environments. He had the vision and intellectual capacity to develop the basic steps of the finite element method and to make numerous contributions in the development of the method. His early work "Energy Theorems of Structural Analysis," published in 1954, is considered to be the most important series of papers ever published in the field of structural mechanics.

During the early years at Imperial College he met his wife Inga-Lisa, who provided him with unshakable support throughout all the difficult moments of his life. John was also fortunate to see his son Holger follow a successful career in engineering and bring into the world, with his wife Carina, two adorable grandchildren who brightened his final years.

John, in accordance with Herakleitos's aphorism of "everything flows," has joined the pantheon of those enlightening personalities who, with their revolutionary ideas and contributions, changed the scientific world in the 20th century. His geometrical spirit, the elegance of his writings, his deep appreciation and understanding of classical ideas, his creativity, and his epochal vision of the future initiated and defined the modern era of engineering analysis and set us all on life's path of discovery. Our computational mechanics community has lost the most eminent member and for many of us a devoted friend. He will be deeply missed, but his legacy will empower generations.