

**PRESENTED AT 5th GRACM INTERN. CONGRESS COMP. MECH.
Limassol, Cyprus June 29-July 1, 2005**

Published by POLYDYNAMICS INC, DUNDAS, ON., CANADA

JOHN H. ARGYRIS ENGINEERING PIONEER, INNOVATOR AND VISIONARY (1913-2004)

by John Vlachopoulos

"Conceptualist and pioneer of the finite element method" and "the creator of the first computer design software" was the headline in the June-October 2004 issue of Scientific Discovery [1] announcing the passing of the Founding Chairman of the World Innovation Foundation (W.I.F.), John H. Argyris. W.I.F. is an international organization dedicated to "a holistic scientific vision of the future world" with membership of over 1000 mostly university professors, including several dozens of Nobel laureates. Huebner in his book [2] on the finite element method (FEM) states that "the first efforts to use piecewise continuous functions defined over triangular domains appear in the applied mathematics literature with the work of Courant [3] in 1943. Motivated by Euler's paper [4], Courant used an assemblage of triangular elements.....". After citing several other publications Huebner further states " There followed a 10-year spell of inactivity, which was broken in 1954 when Argyris and his collaborators began to publish a series of papers extensively covering linear structural analysis and efficient solution techniques well suited to automatic digital computation". Felippa [5] considers Matrix Structural Analysis (MSA) the 'ancestor' of the Finite Element Method (FEM) and highlights "major contributions of Collar and Duncan, Argyris, and Turner, which shaped this evolution". This is what Clough [6] said about the series of papers by Argyris [7] written as a book " In my opinion this monograph certainly is the most important work ever written on the theory of structural analysis". John Argyris in an interview with the Thessalia Newspaper [8] in 1996 said: "My methods were used for the first time, for the design of British fighter planes in 1944..... I hated Cartesian geometry and wanted to find another method applicable to problems in aeronautical structures where you do not have rectangular geometries. I spent three days and nights brain storming and suddenly I thought of triangles and the finite element method. Nobody believed me. They said Argyris is crazy. The chief structure engineers said that all this is nonsense. These are dangerous things. They should be banned. I made trials, although the [electromechanical] computers of that time could not handle more than 64 unknowns, the deviation from previous experiments was less than 8%".

I remember, way back in 1972, after I had started my search for a mathematical tool to solve non-Newtonian flow problems in complex geometries, I asked one of my McMaster U. colleagues from the Civil Engineering department, about who invented the FEM, that was by then used widely in structural

mechanics problems. I was given a very terse answer: "Argyris, John, don't you know, and in fact he is Greek". My colleague spoke so matter-of-factly that I did not dare utter any of the other names that I had associated with the finite element method. Well, I did know much about John Argyris work, as I did not know that we shared the same birthplace, Volos.

The controversy on who originated the finite element method is likely to continue. However, the seminal contributions of J. H. Argyris, R. W. Clough and O. C. Zienkiewicz are the most frequently mentioned, in that order, as having had the greatest impact in establishing the FEM on sound scientific basis and in helping expand its applicability to numerous engineering problems. Actually, R.W. Clough, who coined the term 'finite elements' in 1960, is known to have referred to FEM, as the Argyris' method. Nowadays, with powerful number crunching machines that can handle millions of unknowns the finite element method is a well established analytical tool that is used in all branches of engineering from the design of space vehicles, aircraft, skyscrapers and bridges, to the analysis of air and water flows in the environment, simulation of seismic and tsunami phenomena, simulation of blood flow through the human circulatory system and much more. Whether it was for the design of the giant twin Petronas Towers in Malaysia, the jet engines and fuselage for Europe's Airbus or automotive plastic parts in Detroit, it is safe to bet that the finite element method was used. The FEM is the most powerful mathematical tool for the solution of engineering problems. John Argyris received numerous awards and distinctions, for his outstanding contributions in co-inventing FEM and making it an engineering reality, including the Von Karman Medal of ASCE, the Timoshenko Medal of ASME, the Einstein Award (USA), Verdienstmedaille des Landes Baden-Wuerttemberg (Germany), Fellow of Royal Society (Gold Medal, UK), The Prince Philip Gold Medal of the Royal Academy of Engineering (UK) presented by HRH Prince Philip personally, the CBE (UK) and many more.

Actually there is much more to John Argyris life and accomplishments than finite elements. He was born in Volos, Greece on August 19, 1913. His name at birth was Ioannis Hatziargyris son of Nikolaos. He changed his name to Argyris "for simplicity and because I did not like the non-Greek origin of Hatzi"[8,9] . The name Argyris is derived from 'argyros' (silver), latin 'argentum', which has origins in ancient Greek mythology, 'Argus' (bright). The Hatziargyris family was a prominent family of wealthy landowners in the plains of Thessaly (Tsiflikades in modern vernacular Greek). Hatziargyris Street that runs through the center of Volos, from the seashore towards Mount Pelion was named after a close relative who was mayor of the city, Ioannis Hatziargyris (1831-1908).He had reportedly [10] negotiated a truce between the Greek fleet that was patrolling Pagasitikos Bay and the Ottoman troops that had reoccupied Volos in 1897.The Turks had threatened to burn down the entire city in the event that the Greek fleet would bomb their positions. John Argyris mother was Loukia Karatheodoris. Her father

Kostakis Karatheodoris (1840-1922) was an engineer, diplomat and served as the Prince of Samos before the union of the island with Greece. Another relative, Alexandros Karatheodoris Pasha was a diplomat and ambassador of the Ottoman Empire, had served as Prince of Samos and briefly as Governor of Crete. The Karatheodoris were Greek elite from Constantinople and held important positions in the Ottoman Empire. Loukia was fluent in 7 or 8 languages [8] and developed considerable social activities in her life. After divorcing John's father Nikolaos she married (no children) Themistoklis Sofoulis (1930) who was born in Samos and later became Prime Minister of Greece. German born Constantin Caratheodory [11], one the 20th Century's greatest Mathematician's, was John's great uncle. John's brother Costas Hatzargyris(1914-1986) was a prominent journalist and noted author in politics and economy, a tireless member of the Greek Communist Party (KKE in Greek), known also for trying unravel the suspicious role of foreign government agents in the infamous and still unsolved George Polk affair [12]. John's first wife was Elmina Rangavi daughter of the Greek ambassador to Germany. His second wife of nearly 60 years was Ingalisa Johansson from Sweden with whom he had one son Holger Nikolaos Argyris [13].

John respected the intellectual strength, but disagreed with his brother's political persuasion and philosophy [9] and blamed the path that his brother took to the negative influence of his domineering paternal grandmother and the suffocating atmosphere that she had created within his family [8].He was very admiring of his mother's rare personality, spirit and intellect and the influence and culture of the Karatheodoris family. In an interview with Isadora Papadrakakis[14], John said that his famous Mathematician uncle Constantin Caratheodory had difficulties understanding him. They had different ways of viewing things. "His rationalism clashed with my madness, my intuitive approach". According to Despina Rodopoulou, Caratheodory's daughter and godmother of Holger Nikolaos "John was handsome, lively, all smiles and my father was worried about us flirting. He used to say to me: He will achieve absolutely nothing in his life" [14].

John Argyris left Volos at the age of six when the family moved to Athens. He was educated at home till the age of thirteen at the insistence of his authoritarian father. He studied Civil Engineering at the National Technical University of Athens (E.M.Polytechneion) but he had to interrupt his studies apparently due to malicious targeting but one of his professors [8]. Professor Protopapadakis hated John and his family because they were pro-Venizelos and held them responsible for the execution of his father by the Venizelos government after the Asia Minor disaster. "He asked me, before the entire auditorium, about lighting of railways. I answered 'electricity and gas', 'You fool, you forgot candlelight. You will be an absolute failure in life' " [14]. John went to Munich, Germany and completed his Dipl.Ing. degree at T.H. Muenchen in 1936 with general passing average of 9.95, the maximum being an unprecedented 10

[1]. He was employed by a private consulting company (Firma Gollnow in Stettin) when he designed a 320 meter high radio transmission tower, at the time an extremely difficult problem due to the heavy mass concentration at the top. John's expressly strong dislike of the Nazis and his outspokenness resulted in his imprisonment at concentration camps for several weeks. After escaping and with special papers and a visa provided by Admiral Wilhelm Franz Canaris the head of military intelligence, he headed south. He risked his life to visit Caratheodory in Munich in order to inform him about his experience of Nazi brutality [14] and according to Despina Caratheodory it was the only time that Constantin gave his undivided attention to John. After swimming the icy cold waters of Rhein, he ended up in Switzerland. Admiral Canaris, who believed that his family was related to Greek 1821 freedom fighter and (later) prime minister Konstantinos Kanaris (but never documented by anyone [19]), was executed as one of the leaders of the abortive assassination attempt against Hitler. About Admiral Canaris, John said " He was the person who helped me more than anyone in my life. He forged papers for me, he offered me the means to find my way out of Germany at a time when I was completely helpless. In my eyes he behaved superhumanly" [14].

In Switzerland, John studied for his Doctor of Science Degree at the Technical University of Zurich (ETH), and after the completion of his studies he went to Spain, was arrested by Franco's fascists and eventually escaped via Portugal to England. It took three days of intense interrogations before the British were convinced that he was not a German spy [1]. In Britain, he started working for the Royal Aeronautical Society (R.Ae.S) and applied several innovative techniques in solving some extremely difficult problems and that is where he conceived and executed his first ideas and developments on the FEM. After the war and at the invitation of Sir Arnold Hall, Professor of Aeronautical Structures he became Senior Lecturer (1949) and in a couple of months Reader at Imperial College [1]. He did a lot of work at Imperial College reinforcing his FEM with mathematical rigor and extraordinary technical sophistication. In 1955 he was appointed Professor and continued his numerous research and industrial consulting projects with great vigor and dedication.

John Argyris became Professor at the T.H. Stuttgart (now University of Stuttgart) and founded the Institut fuer Statik und Dynamik der Luft – und Raumfahrtkonstruktionen (ISD) in 1959. He continued his pioneering research work in both Stuttgart and London for many years. "I have 140 research coworkers in Stuttgart and 40 in London" told me during my visit to his office and discussion in 1975 [9], "I fly to London once a week and I am really getting tired of so much traveling". He was 62 at the time, but he continued his frenetic pace of work beyond his mandatory retirement and well in to his eighties as Director of the Institut fuer Computer Anwendungen in Stuttgart from 1984. In the 1996 interview with Thessalia [8] he said: "I am over eighty years old and I

work 100 hours per week. I am used to it and I enjoy working". He had published more than 500 papers. John was physically very well fit. Until the age of 83 he was downhill skiing and until the age of 85 he was walking 1-2 hours everyday [13].

When he was asked by the Thessalia [8] reporter which one of his projects he considered the most "revolutionary", he said: "My work on the thermal protection of [NASA] spacecraft by ablation". This is a rather surprising choice to me. I would have guessed that he would have cited one of his trail blazing energy theorems and structural analysis papers [7]. But, John was an engineer at the very core of his heart and from his vantage point he was proud of the solution of engineering problems, this time for avoiding the burning of the NASA spacecraft during re-entry in to the earth's atmosphere. John was a problem solver, but also a people person. In the early years at the Stuttgart Institute, he knew the first names of all of his numerous coworkers and employees, about their families and even most of their birthdays.

From 1976 he started working on Chaos theory and published an 800 page book in 1994 in both English and German [15], which received universal acceptance and praise. He told Thessalia [8] that "the greatest achievements of the 20th Century were Einstein's Relativity, Heisenberg and Dirac's Quantum Mechanics and then the Theory of Chaos. I am sure his choice of chaos will find many of my fellow chemical engineers fully in agreement, as they frequently face challenging everyday problems of chaotic mixing of chemicals and polymers. Well, there was more work for John Argyris beyond finite elements and [infinite] chaos. In a 1997 paper [16] he proposed some new experiments on the physics of gravitation and defined a new concept: the gravitational superconductor. He received an honorable mention from the Gravity Research Foundation for this paper. His book on gravitation and the universe appeared in 2002 [17].

John Argyris never lost his Greekness throughout his life despite his long absence from his fatherland. According to his wife Ingalisa "Science is a great love of his, but it comes second to his love for Greece" [14]. He was planning to return to Greece, to work, even at an advanced age. In 1975, the then Prime Minister of Greece Konstantinos Karamanlis had asked him to return to Greece to start up a center of advanced technology and innovation [9]. Unfortunately, Karamanlis had more pressing matters to attend to, those turbulent years after the downfall of the military junta, and nothing happened. There were also other proposals later, by the E.M. Polytechnion and the University of Ioannina, but again nothing materialized. Perhaps the University of Thessaly, which awarded (1996) him a Doctorate honoris causa may take up the challenge in the future, to create a center of technology and innovation in memory of this great innovator and visionary, in Volos, the birthplace of John Argyris. The Thessalia reporter [8] asked him in 1996 why Greeks are more creative abroad than in

their own country. He blamed it on slow changing old habits and lifestyle, lack of discipline and excessive late night entertainment in Greece. But, things will definitely change, he said. However, he was not all that happy with the more disciplined German lifestyle either. There was this lingering wish to return home some day, like Ulysses. He never did, except for few brief visits, he died in Stuttgart on April 2, 2004 and was buried in the cemetery of Varberg in Sweden in the presence of close family and a representative of the Greek government.

In the words of German Bundestag's member Ute Kumpf [18] John Argyris was "a European and citizen of the world". He was born in Volos and studied in Athens, Munich and Zurich. He worked and taught in the U.K. and Germany and visited numerous Universities throughout the world in his lifetime and received many distinctions and awards from several countries. He spoke Greek, English, German, French and Swedish. He was a man "of intellect, wit, zest for life and culture, a man of strong personality and radiance". And according to the Scientific Discovery [1] article: John Argyris- Engineer Extraordinaire.

REFERENCES

1. Anon., Scientific Discovery, June-October 2004-page 3. Available at www.thewif.org.uk
2. Huebner, K.H. "The Finite Element Method for Engineers" Wiley (1975)
3. R. Courant , Bull. Am. Math. Soc. , Vol. 49, 1943.
4. L. Euler, " Methods Inveniendi Lineas Curvas Maximi Minimine Proprietate Gaudentes" M. Bousquet ,Lausanne and Geneva (1974).
5. C.A. Felippa, Computers & Structures, 79(14),1313-1324 (2001).
6. R.W.Clough, Intern. J. Num Meth. Eng., 60(10),283-287(2004).
7. J. Argyris "Energy Theorems and Structural Analysis" Aircraft Engineering, 1954 and 1955. In 1960 these papers were consolidated in a book by Butterworths.
8. Newspaper THESSALIA, Diadromes, "John Argyris enas megalos Voliotis efyge" Sunday ,March 23,2004 (includes a 1996 interview),Volos, Greece.
9. Private discussion with John Argyris, Stuttgart, Germany(1975).

10. Y. Kordatos "Istoria tou Volou kai tis Agias" 20os Aionas, Athens (1960).
11. R. Burlirch and M. Hardt "Constantin Caratheodory: Life and Work" available at: www-m2.ma.tum.de/Veroeffentlichungen. See also www.mlahanas.de/Greeks and www-history.mcs.st-andrews.ac.uk/
12. E. Vlantou "Who killed George Polk", Temple Univ. Press, Philadelphia (1996).
13. Holger Nikolaos Argyris, private communication (2005).
14. Isadora Papadrakakis, Interview published in Athens Newspaper TO VIMA (April 2001).
15. J. Argyris, G. Faust and M. Haase "An Exploration of Chaos" North Holland Publishing (1994). Originally published in German as "Die Erforschung des Chaos" Vieweg Verlagsgesellschaft (1997).
16. J. Argyris and C. Ciubotariu, Mod. Phys. Lett. A ,12(40), 3105-3119 (1997).
17. J. Argyris "Physics of Gravitation and the Universe" Editura Technica (2002).
18. MdB Ute Kumpf "Worte zum Gedenken an Prof. Dr. multi Dr. h.c. John Argyris" available at www.uni-stuttgart.de
19. There is some evidence that Admiral Kanaris enjoyed very much the idea of somehow being related to the Greek hero of independence Konstantinos Kanaris. As a young sailor he had visited Greece and after somebody suggested to him the possible connection, he met with the King of Hellenes, but no proof of a relation with Konstantinos Kanaris was ever produced. Actually the Kanaris family has its origins in Northern Italy and any Greek connections cannot be totally excluded.

John Vlachopoulos
 Professor and Director,
 CAPPA-D
 Chemical Engineering
 McMaster University, Hamilton, Ontario, CANADA L8S 4L7
 Email: vlachopj@mcmaster.ca