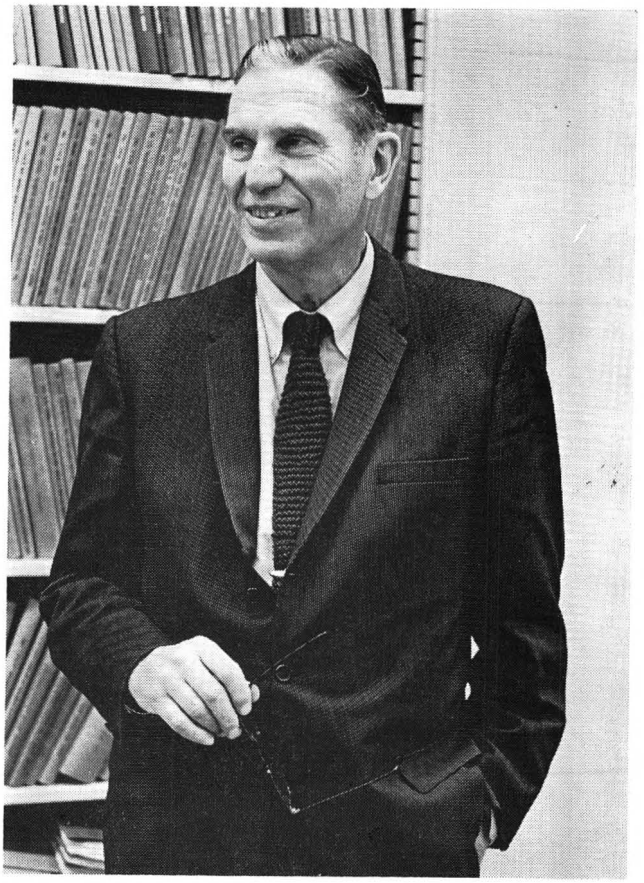
ChE educator

JOHN HAPPEL OF NYU*



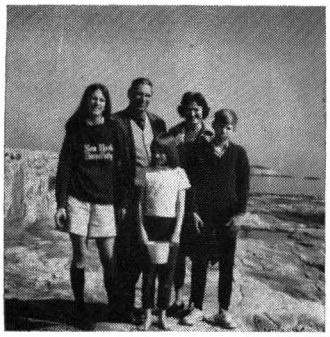
"Be sure it isn't a case of the Greener Grass Law" advised Ken Watson as John Happel decided to leave his industrial career for teaching. His first position after leaving M.I.T. began at the laboratories of the Standard Oil Company of New York in Brooklyn. There after ten years he had become a supervisor in charge of a section of fifty scientific personnel engaged in a variety of activities from design of refining equipment to running a fleet of test cars. During World War II, he was one of a technical committee charged with the design and initial operation of the world's largest butadiene plant for production of synthetic rubber. Following the war he worked with several major chemical companies on petrochemical projects, obtained his doctorate at Polytechnic Institute of Brooklyn and after seventeen years in the oil industry accepted a position at New York University in 1948.

He regards his second career, as a professor, as being particularly rewarding, especially as he was fortunate in meeting Dorothy Merriam. She became his wife soon after he started teaching at New York University and along with his academic activities he launched on the project of being the father of three children, Jill, George and Ruth now 17, 15 and 13 years old. Shortly after joining New York University, Happel became chairman of the chemical engineering department, a position which he holds at the present time. His teaching duties involved the initiation of a plant design course based on economic process principles learned in industry, which form the basis of his textbook, "Chemical Process Economics". His research and teaching interests have centered in the field of fluid dynamics and more recently in chemical kinetics and catalysis. He has co-authored a book on "Low Reynolds Number Hydrodynamics" and translated part of a Russian book on "Catalysis by Non-metals" in addition to publishing a hundred papers and patents in these fields.

Happel's career with Socony, the first of a number of metamorphoses of the organization now called Mobil, began with trips to the numerous refineries of the company located throughout the United States. Low temperature analytical fractionation of gases had recently been developed and it proved very attractive economically to modernize the gas recovery facilities of many of these refineries to incorporate light ends into gasoline which were formerly being wasted as fuel gas.

Soon a more exciting prospect developed. Eugene Houdry, the father of modern catalytic cracking, had been "discovered" in France by Harold Sheets a director of the Vacuum Oil Company, which had just merged with Socony. Houdry, the son of a wealthy steel magnate and a racing car enthcsiast, had found that a French druggist could make a very superior grade of gasoline by contacting oil fractions with clay as a catalyst. He and his entire organization had been imported to the United States together with a small pilot plant for catalytic cracking of petroleum. Happel and two other scientists at

Prepared by Professors Kapfer, Treybal, and Parker of Chemical Engineering Department of New York University.



The Happel family at Madison, Conn., showing, left to right, Jill, John, Ruth, Dotty, and George.

Socony were given the assignment of evaluating his process. They lived with Houdry and worked with his group at the Paulsboro refinery of Vacuum Oil Company for a number of months. It was demonstrated that the process was truly catalytic. Though the process was not yet ripe for immediate commercialization, Sun Oil Company and Socony-Vacuum continued to work with Houdry developing it from an engineering standpoint. It, together with alkylation formed the basis for the production of high octane number aviation gasoline, of such great importance several years later.

During the years following, the petroleum refining industry developed considerably in the technology of producing "tailor made" molecules whether for use as liquefied petroleum gas, special solvents, fuels and lubricants or as feedstocks for the chemical industry as ethylene and butylene fractions. Happel was succeessful in convincing the technical management of the Company that the formation of a chemical engineering group to make designs, cost estimates and plant tests would be a useful asset. This group served many of the Company domestic refineries as well as producing and refining operations in Europe and other foreign countries. Projects included asphalt blowing stills in Australia, stabilizers for hydrogen sulfide removal in Iraq, crude rerunning stills in Austria. Happel was also responsible for an automotive laboratory consisting of engines for gasoline and lubricating oil evaluation as well as a small fleet of test cars used for road testing of gasoline on Long Island.

With the beginning of World War II, Happel was assigned to the Petroleum Industry War Council, an organization formed by the U.S. Government and charged with the development of strategic military requirements for petroleum products. Development of sources of aviation alkylate, catalytic gasoline blending stock and toluene were important goals. At about that time the Manhattan project was getting under way

Happel's philosophy of education, shared by his colleagues at NYU, is that in addition to theoretical training a young engineer should have some substantive experience early in his career.

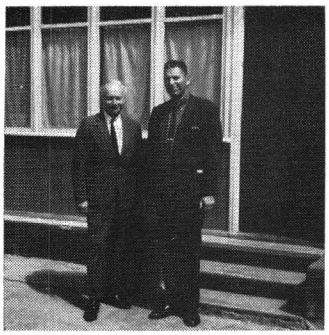
---

and Happel was about to be assigned to it, when Pearl Harbor changed military priorities abruptly.

The United States was cut off from Malay rubber and only a limited stockpile was available. It was critically necessary to develop a source of butadiene for the manufacture of synthetic rubber to replace the natural product in automobile, tank and aeroplane tires. A technical team composed of one representative from each of five major oil companies in the Beaumont, Texas area was charged with the responsibility of selecting, designing and putting into initial operation a plant to make 100,000 T/yr. of butadiene, the world's largest plant capable of handling 20% of the total United States rubber demand. This plant was also to be the prototype of others built for the U.S. Government by the oil industry. Happel was designated as the Socony-Vacuum Oil Company representative of this team. They took to the road, visited all major companies doing research in this area and designed a plant which was erected by the Lummus Company. The plant

John and George mountain climbing in the high peaks region of the Adirondacks looking toward Saddleback Mountain.

which cost $60,000,000 went on stream as planned, and produced at a rate well in excess of design capacity. There were more than a few anxious moments. One well remembered incident was the occasion of formal celebration of the opening of the plant by Bradley Dewey, the Rubber Director. In the course of his speech in which prepared notes were thrown away, he congratulated all involved,—though the plant had not yet started and indeed there were serious problems in initial running of the solvent extraction towers. Together with other rubber facilities, this plant was turned back to private industry ten years later and is still operating economically today.



At Novosibirsk in Russia, John with Prof. G. K. Boreskov, Director of the Catalysis Institute at the Staff club house.

Happel believes that a scientist or engineer should endeavor to be acquainted with intellectual developments outside of his own field of specialization.

For this work along with the other members of the Technical Advisory Committee, Happel was awarded the Navy's Certificate of Achievement.

After the war, Happel was engaged in several surveys with major chemical companies looking toward a possible joint petrochemical venture. It was not until a number of years later that Mobil ventured into the petrochemical business based on ethylene. At this time Happel completed his requirements for the doctorate at Polytechnic Institute of Brooklyn under the direction of Donald F. Othmer. Soon after, he accepted a position in the chemical engineering department at New York University and became Chairman in 1949.

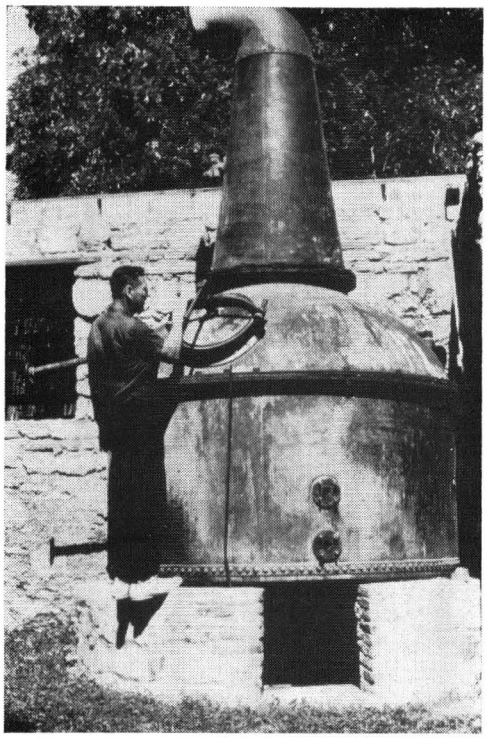
He teaches an undergraduate course in plant design and a graduate course in chemical engineering kinetics. In teaching, Happel feels that his industrial experience enables him to make a special contribution in the design course which integrates academic knowledge learned by lower classmen and applies it to industrial situations. The student gains confidence in the use of technical knowledge guided by economics as a tool for decision. Happell believes that economics and cost estimation are still too often neglected subjects among engineers. To arrive at an economic optimum in the design of any plant both economic and technical factors must be combined. Graduate teaching has been intimately concerned with his researches in the field of hydrodynamics and catalysis undertaken in most cases with advanced students as well as colleagues.

Happel feels that hydrodynamics as a field is attractive in that it is accessible to a completely rigorous methematical approach, which at the same time can be verified experimentally and serves as the foundation for motion of fluids relative to particulate systems. These systems are encountered in fluidization, sedimentation and flow through porous media. In chemical engineering the creeping motion equations can serve as a basis for modeling systems involving simultaneous transport processes and chemical reactions. The researches of Happel and his brilliant student and later colleague, Howard Brenner, resulted in the publication of a book in this area.

The main thrust of Happel's researches throughout his career and especially in recent years has been in the area of kinetics and catalysis. Following his work on petrochemicals in industry, he has studied similar hydrocarbon systems to a considerable extent. One area of continuing interest has been the development of techniques for high temperature pyrolysis for production of acetylene. Production of acetylene from carbide seems to be basically cumbersome and presents a continuing challenge for production directly from hydrocarbons. Some of his recent researches promise to develop a process for making very cheap acetylene which could compete with ethylene, the present major petrochemical building block.

In the field of heterogeneous catalysis, he and his colleagues have developed new theories and techniques for the study of complex reactions by means of isotopic tracers. These researches have been sponsored by such organizations as the National Science Foundation and the National Air Pollution Control Administration. Systems studies have included hydrocarbon hydrogenation and dehydrogenation, the conversion of sulfur dioxide to alleviate atmospheric pollution, and the mechanism of the water gas shift reaction.

In connection with his studies he has made a number of trips abroad to assess development in catalysis. A several month trip to Japan sponsored by the National Science Foundation has resulted in the chemical engineering department being host to a number of visiting scientists from Japan. On the occasion of the IV International Congress on Catalysis, he presented a paper in Moscow and made an extended trip to Russia sponsored by the Soviet and U.S. Academics of Science. More recently under sponsorship of NATO he visited Germany and has instituted a cooperative research program on catalysis with Professor Jochen Block of the Fritz-Haber Institute in West Berlin. Many foreign scientists



At St. Croix, Whim estate, remains of an old rum still.

will contribute to a conference on tracer applications to catalysis being organized by his colleague, Professor M. A. Hnatow and himself next summer under the sponsorship of the New York Academy of Sciences.

Happel has been active in many organizations. He has served on both the Admissions Committee and the Program Committee of the AIChE. He has also served on Committees of the Combustion Institute, the American Rocket Society, the Board of Directors of the Petroleum Research Foundation of the ACS. He is a past president of the New York-New Jersey Catalysis Club and is currently serving as vice-chairman of the Catalysis Section of the New York Academy of Sciences. He was also a member of the Senate of New York University, elected as a faculty representative of the School of Engineering and Science.

Happel believes that a scientist or engineer should endeavor to be acquainted with intellectual developments outside his own field of specialization. In his own case doing this has not presented any problems for his wife is an accomplished concert violinist, at present concert master of the Greenwich Philharmonia. Through her he has become acquainted with much of what happens in the musical world and met many musicians. He feels that the two culture distinction of C. P. Snow is largely overdrawn. The main distinction between engineers and artists is that the latter work for less compensation in many cases.

For many years Happel's relaxation has varied among various athletic sports including skiing and skating in the winter, tennis and swimming in the summer. He has spent many summers in the Adirondack mountains of New York hiking and mountain climbing. A few years ago he became a 46er, one of a group which has climbed all 46 peaks 4000 ft. in altitude or higher. These peaks including a number without trails offer a unique opportunity for exploring one of the few remaining areas of unspoiled virgin forest in the East. Lately he has built a small greenhouse to extend his gardening season. Foods flavored by a variety of fresh homegrown herbs are a useful by-product.

Happel's philosophy of education, shared by his colleagues at New York University, is that in addition to theoretical training a young engineer should have some substantive experience early in his career. This may be making decisions which really are put into practice, in plant operation or best of all some direct contact with experimental work either at school or in industry. He recalls how during his own undergraduate days, he was interested in the ideas of professors who had been out practicing the kind of engineering he was still studying in theory.

What is it that has made his academic life such a satisfying career? Happel cites advantages such as variety of occupation, independence of thought and action, and time for leisure. Perhaps more than all of these he feels that the organization he has been associated with and the pleasure of working with intelligent and cooperative colleagues at all levels has been a lasting source of satisfaction. Of course, one of the greatest challenges and joys in the academic life is the students. Many of these have found careers in both industry and teaching. Among the latter are Robert Pfeffer at the City University of New York; Jack Famularo, Chairman of Chemical Engineering at Manhattan; Howard Brenner at Carnegie-Mellon; Dean W. H. Kapfer at New York University; Norman Epstein at Vancouver. "My own children are growing up, so I can see that I'm getting older," says Happel, "but each year my students in the senior plant design course are the same age with their ever renewed problems and questions. Here is a real fountain of youth!" □