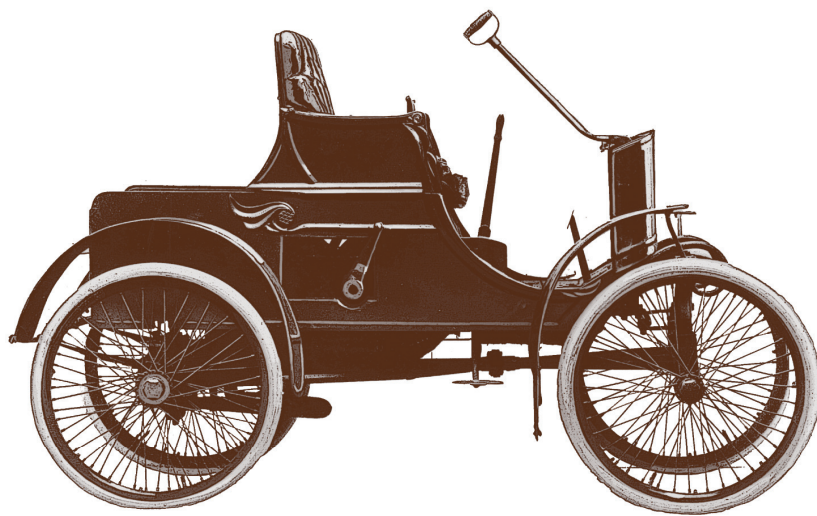


A 150-YEAR  
HISTORY  
OF MECHANICAL  
ENGINEERING  
AT LEHIGH



Compiled by Stanley H. Johnson, Emeritus Professor

## A 150-YEAR HISTORY OF MECHANICAL ENGINEERING AT LEHIGH

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There was mechanical engineering education at Lehigh from the very beginning, but it has taken various forms over the first 150 years, as will be seen. This compilation was undertaken at the urging of Chairman Gary Harlow. Several faculty were kind enough to contribute reminiscences to the recent history, extending the material available from the “Brown and White” and Lehigh catalogs. There is no claim of comprehensive thoroughness. Whatever the sources offered that seemed interesting and contributed to a feeling of the flavor of life in the department was included. The arrangement is approximately chronological and the content tends toward gossip at times. I hope readers are kept interested and gain an appreciation of the significant role our department has played on campus from the very beginning, 150 years ago.

The story divided naturally into four sections plus a brief history of mechanics prior to merger

1. The history of mechanical engineering education at Lehigh from the first full year of classes, 1866, until 1914, the beginning of World War I. Joe Klein became the first professor of mechanical engineering in 1881. Tau Beta Pi was founded at Lehigh in 1885.
2. The tumultuous interwar years, 1918-1941, brought rapid changes and financial uncertainty. The early faculty consisted of two professors of ME and one professor of machine design. James Ward Packard gave \$1,000,000 for the purpose of erecting the laboratory that became Packard Lab.
3. WWII disrupted campus life, but Army and Navy Specialized Training Programs maintained the student population. In 1946 there were 3,427 students enrolled, including 591 married students and 577 veterans. The Librascope General Precision computer arrived on campus.
4. Mechanics education began in 1945 as part of civil engineering and grew to become a prominent department under Ferdinand Beer in 1957.
5. The Mechanical Engineering and Mechanics departments merged. The national unrest over the Vietnam War impacted campus. Centers/institutes were established, “engineers” became “mountain hawks”, and the department expanded and diversified.

## Early Years of the Mechanical Engineering Department, 1866-1914<sup>1</sup>

Lehigh University was formally opened on Saturday, September 1, 1866, in the presence of the Trustees, the Faculty, the Students of the First Class, and invited guests. This opening was due to the determination of the Trustees to begin with two classes only, which would find ample accommodations in Christmas Hall, the building already erected on the park. (1) The entering First Classmen of 1867 included a future president of Lehigh, Henry S. Drinker. (2) Packer Hall (the present day UC) was to be ready for the reception of students on the first of September, 1868. (3)

In their first two years, students were called *First* and *Second Classmen* and followed a common program before selecting one of five schools of technical coursework: General Literature; Civil Engineering; Mechanical Engineering; Mining and Metallurgy; and Analytical Chemistry. Those in the schools were called *Junior* and *Senior Schoolmen*. (4)

According to the register (modern day course catalog), during study hours, students were required to be in their rooms unless they had received permission of absence from the president. There were 45 *RULES FOR THE GOVERNMENT OF STUDENTS*. The 45<sup>th</sup> rule said that no student shall enter any restaurant or place where intoxicating liquors are sold without the permission of the President. (5) The officers of the University were a president, professors, instructors, librarian, and janitor. (6)

On September 1, 1867 there were 20 Junior and Senior Schoolmen. (7)

The first University Day exercises were held on June 22, 1871. (8) Through the generosity of the Founder, the Hon. Asa Packer of Mauch Chunk, Pa., and by resolution of the Trustees, passed in July 1871, tuition was declared to be *free* in all branches and classes. (9) Entering tuition in 1867 had been \$45 per term (10) increasing to \$62.50 in 1869 and decreasing to \$50 in 1870. (11)

In February 1872, Chas. Mc Millan, C.E., was appointed professor of civil and mechanical engineering. (12)

In 1873, The Engineering Society of The Lehigh University was established and organized under the auspices of the professor of engineering for the benefit of students of civil, mechanical, and mining engineering. (13)

For 1875-76, Augustus Jay Dubois, C.E., Ph.D., professor of civil and mechanical engineering, (14) joined the faculty. The register of that academic year pointed out that the problems that the civil engineer would be called upon to solve are mainly statical problems involving the idea of rest or equilibrium, and the ends to be obtained in his constructions are stiffness, rigidity, and immobility. (15) The object of the mechanical, or more properly, dynamical engineer is not to avoid or prevent, but to produce motion. Thus the new names: School of Civil (Statical) Engineering; and School of Mechanical (Dynamical) Engineering. (16)

Since the founding of the university, a limited number of graduates who desired to pursue their studies under the direction of the faculty were allowed to use the library and attend lectures during a term of three years, free of expense. (17)

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<sup>1</sup> Almost all of the information herein came from the Brown and White archives or the Lehigh course catalog archives.

In 1877, it was announced that graduates of the School of Mechanical (Dynamical) Engineering, by remaining an additional year and pursuing the appropriate course of study, could receive the degree of Civil Engineer (C.E.). (18) A similar offer was made to graduates of the School of Civil (Static) Engineering. (18 p. 19) By remaining an additional year they could receive the degree of Mechanical Engineer (M.E.). The School of Mining and Metallurgy offered a fifth-year undergraduate program. (18 p. 26)

The same year, the register first announced and published the requirements for post graduate degrees. (18 pp. 8-9)



Joseph F. Klein, D.E., first professor of mechanical engineering at Lehigh

*“The Faculty will recommend for the Degree of Master of Arts, candidates otherwise properly qualified, who after taking at this University the degree of Bachelor of Arts, shall pursue for at least two years, at the University, a course of liberal study approved by the Faculty, pass a thorough examination on the same, and present satisfactory theses.*

*The Faculty will recommend for the Degree of Doctor of Philosophy, candidates otherwise properly qualified, who after taking at this University either of the Degrees of Civil, Mechanical or Mining Engineer, or Analytical Chemist, shall pursue, for two years, at the University, a course of advanced Scientific study in the line of their profession, pass through a thorough examination in the same, and present satisfactory theses.*

*The Faculty will recommend for the Degree of Doctor of Science, candidates otherwise properly qualified, who after taking at this University the Degree of Bachelor of Science, shall pursue, for at least two years, at the University, a course of Scientific study, embracing two subjects approved by the Faculty, pass through a thorough examination, showing in one of these subjects special attainments, and shall present satisfactory theses in the one of the subjects, based upon original scientific investigation.”*

In 1877, S.R. Crumbaugh, M.A., LL.D., professor of civil and mechanical engineering, replaced Professor Dubois. (18 p. 4) The following year Mansfield Merriman, C.E., Ph.D., professor of civil and mechanical engineering, replaced Professor Crumbaugh. (19) In the register for 1878-79 the names “School of Civil Engineering” and “School of Mechanical Engineering” regained their previous forms. (19 pp. 18,21)

In 1881, Professor Merriman became professor of civil engineering and Joseph F. Klein, D.E., joined the faculty as the first professor of mechanical engineering. (20)

The School of Technology was formed by including: the Course in Civil Engineering; the Course in Mechanical Engineering; the Course in Mining and Metallurgy; and the Course in Chemistry. The degrees offered after four years of study were C.E.; M.E.; B.M., Bachelor of Metallurgy; and A.C., Analytical Chemist. The degree of E.M., Engineer of Mines, required a fifth year. (21) The graduate degrees offered were M.A., Ph.D., and D.Sc. (21 p. 42)

In 1883-1884, the post graduate degrees offered were M.A., M.S., and Ph.D. (22) The Advanced Course in Electricity was established. Instead of an extended department of Electrical Engineering, it was thought best to offer a course occupying not more than one year and presenting very fully the purely electrical portion of an Electrical Engineering course. (22 p. 53)

In 1888, the Course in Electrical Engineering and Physics replaced the one-year Advanced Course in Electricity. The degree of Electrical Engineer (E.E.) would be given to graduates of this course. (23)

In 1889, the Course in Architecture was added. (24) The School of Technology included six distinct courses: civil engineering, mechanical engineering, mining and metallurgy, Electrical engineering, chemistry and architecture. (24 p. 58)

From 1883 to 1892, the Course in Mechanical Engineering had an average enrollment of 69 undergraduates.

Beginning in January 1892, tuition was re-imposed at the rate of \$100 per collegiate year. (25)

The Tau Beta Pi Association, national engineering honor society, was founded at Lehigh in 1885 by Dr. Edward Higginson Williams, Jr., professor of mining engineering and geology. (26) The Tau Beta Pi society inaugurated their campus lecture course with a lecture by Professor Williams on “Glaciation and its Results in Eastern Pennsylvania.” (27)

The first use of the term “Department of Mechanical Engineering” appeared in the register (catalog) for 1896/97. (28) The first appearance in the Brown and White was January 30, 1894. (29)

In 1897 and thereafter, the examination for admission to the Freshman Class in the School of Technology included Solid Geometry. Arithmetic was omitted from the requirements for admission. (30) In 1898, and thereafter, one year’s work in German was included in the requirements for admission to the Technical Courses. (31)

In 1899, Lehigh began offering a mechanical engineering optional course in marine engineering involving some 400 hours of work. In its main features, it was an extension of the principles of steam engineering to the marine field and of the principles of hydraulics to shipbuilding problems. It was directed by Professor Klein. (32)

At the turn of the century, mechanical engineering had three instructors, in addition to Professor Klein, 126 undergraduates and two graduate students. (33)

On April 6, 1900, the Physical Laboratory was destroyed by fire. The fire department of South Bethlehem responded but could not save the building. The most valuable apparatus in the building were in the dynamo room. That room contained about ten dynamos of various sizes and the engine that furnished power. All the moveable machines were saved. (34)

The Physical Laboratory was rebuilt as the New Laboratory of Physics and Electrical Engineering. (35) The eastern half of the basement was reserved for the experimental work of the mechanical engineering department. Mr. Warren A. Wilbur, of South Bethlehem, gave \$5000 for equipment for a mechanical engineering laboratory to be installed in the new space. The main purposes to be realized by the laboratory were to be

- a. The training of the student in the experimental work that he may be called upon to perform as a mechanical engineer.
- b. The furnishing of the facilities and opportunities for doing original, experimental work. (36)

The Physical Laboratory was the home of the Department of Physics and Electricity and evolved into the building now known as Lewis Laboratory.

The Senior Mechanicals spent the week before the Christmas holidays on a visit of inspection to prominent Philadelphia manufacturing firms, including Baldwin Locomotive Works, Southwark Foundry and Machine Company, and Cramp's Ship Yards. (37)

In 1901, the following thesis subjects were chosen by the members of the Mechanics Section of the senior class: (38)

Design of a tugboat for the Amazon,  
 The adoption of jigs in machine shops as a labor saving device,  
 The design of an electric automobile,  
 Plans and estimate for construction and equipment of a 1000 KW railway power station  
 Design of an air compressor plant for the foundry and machine shop of Monongahela Manufacturing Co.,  
 Piecework system,  
 Design of a 600 ton coaling station for L.V.C.R.R. at South Easton,  
 Modern methods for the utilization of waste gases,  
 Design of a rotary cement kiln,  
 Test of the manufacturing plant of A.L. Laubeinstein, Ashland, Pa,  
 Comparative cost and efficiency of compressed air as motive power,  
 Design of a bevel gear planar,  
 Rock drills,  
 Duty test of the Marden Creek Pumping Plant, Berkley, Pa.,  
 Tool Steel,  
 Design and discussion of a tower condenser, capacity 550 pounds of steam per minute.

As noted above, Mr. W.A. Wilbur's \$5000 gift was to be used to equip space in the new physics building for the use of the M.E. department. That gift was followed by offers of so much valuable machinery that the space allowed was found inadequate, and it was determined to erect a new structure. The new building would be a 40 by 72 feet annex to the Boiler House. The total space available for the new apparatus will be, in square feet: Boiler House Shop, 1330; New annex, 2880; New Annex Sub-story, 1440; and space in the Physics Building, 2160. In the space set aside in the Physics Building will be located the Internal Combustion Engine together with such other apparatus. The Laboratory was to open in the fall of 1901. (39)

In 1903, Williams Hall was ready for occupancy. One half of the building was devoted to geology, biology, and mining engineering, and the other half to the department of mechanical engineering. (40)

For 1903-04, there were 174 mechanical engineering students (41) and Assistant Professor of Mechanical Engineering Robert C.H. Heck, M.E., was added to the faculty. (41 p. 7)

For 1907-08, Professor Klein had risen to be the senior member of the faculty and was joined in the mechanical engineering department by Professor of Experimental Engineering Robert Heck and Professor of Machine Design Paul Bernard de Schweinitz. (42)

For 1908-09, Professor Heck departed and was replaced by Assistant Professor of Mechanical Engineering Arthur Warner Klein, the son of Joseph Klein. (43)

In 1910-11, Joseph F. Klein became Dean of the Faculty. Paul Bernard de Schweinitz, was appointed professor of mechanical engineering. Also Arthur Warner Klein was appointed the first associate professor of mechanical engineering. Assistant Professor Edward L. Jones, was added to the mechanical engineering faculty. (44)

The following was reprinted in the Brown and White of 1 March 1910:

“quite as notable as the broadening sweep of business at the steel works [Bethlehem Steel] is a more quiet undertaking on the part of John Fritz, the great mechanical engineer, who is building and donating to Lehigh University a civil engineering laboratory after his own design. This laboratory built of steel and cement will be a capacious shop filled with fixtures whereby mechanical engineering may be brought home to the learner as the blacksmith drills his apprentice to make a horseshoe.” (45)

At the monthly meeting of the Mechanical Society, C.A. Schulz, '11, gave a complete description of the Grey Mill of the Bethlehem Steel Co. He showed by the aid of sketches, the construction of the rolls, methods of rolling and varying the dimensions of the I beams and H shapes which are being turned out by this invention of recent years which has so revolutionized the manufacture of structural steel. (46)

Prof. J. F. Klein's book on “The Physical Significance of Entropy and of the Second Law” was published and described as an exhaustive, clear and concise exposition of this important subject, which has puzzled the engineering world for decades. (47)

At the regular meeting of the M.E. Society, it was the unanimous decision of those present to affiliate with the American Society of Mechanical Engineers. (48)

The average monthly wage of the mechanical Engineering graduate starting in the practice of his profession has been as follows: 1901, \$55; 1902, \$60; 1903, \$65; 1904, \$57; 1905, \$67; 1906, \$69.33; 1907, \$73; 1908, \$66.64; 1909, \$72.90; 1910, \$75.40; 1911, \$76.20. In the ten years, then, the university graduate's wages as a mechanical engineer have increased from those of a mine laborer to about the minimum earned by a full-fledged miner. That is an important gain; and the inducement of being qualified to begin earning a pretty good living the day after graduation is one of the strong attractions to the applied science courses. The engineers outstrip the doctors and the lawyers in this respect, although the outlook for eminence and prosperity later on is certainly no better [from The Syracuse Post Standard]. (49)

The Mechanical Engineering Society meetings were frequently held at the residence of Dr. and Mrs. Drinker, until being more often held in Williams Hall after 1912. (50)

The following magazines were presented for the coming year to the Department of Mechanical Engineering by the mechanical engineers of the Class of 1895: “Iron Age,” “Power,” “Engineering

Magazine,” “Engineering and Mining Journal,” “Engineering News,” “Gas Engine,” “Iron Trade review,” “Mining and Scientific Press,” and “American Machinist.” (51)

Fred V. Larkin, B.S., G.E., was appointed instructor of mechanical engineering. (52)

Prof. A.W. Klein spoke to the monthly meeting of the Mechanical Society on “The German Trip of the American Society of Mechanical Engineers.” The party sailed on the 10<sup>th</sup> of June [1913] from Hoboken on the Hamburg American ship “Victoria Louise” and the German reception committee came on the ship at Plymouth. They landed on June 19<sup>th</sup> at Hamburg where they remained for three days, visiting shops, the harbor, Tier Park, and various places of interest. The members were also entertained at various dinners. They next went to Leipzig where they remained for three days. There the members attended an international convention of engineers. Several large shops and plants were visited and several musicals, followed by dances were held for them. The King of Saxony attended one of their conventions. (53)

World War I began 28 July, 1914, when Austria-Hungary declared war on Serbia. (54)

Major General Leonard Wood, chief of staff of the War Department, announced the government’s intention to continue the experiment of military camps of instruction for students of educational institutions that were held the previous July at Gettysburg and at Monterrey, Cal. The camps were praised and the good they do toward fitting the average student for emergency military life was told by the major general. (55)

The 1914 Register showed a total of 705 students, one of the largest enrollments in the history of Lehigh. There are 145 students in Mechanical Engineering, 135 taking Civil Engineering, and 92 in the Electrical Engineering Course. (56)

To an entering class of 247 men, Dr. Drinker addressed his remarks at the forty-ninth annual opening exercises of the University. The president outlined to the men what they had come to college for and gave a complete discussion of the great European War and its resultant effects. (57)

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## The Mechanical Engineering Department between WWI and WWII<sup>1</sup>

In August, 1914, Germany declared war on Russia and France and invaded Belgium. The United Kingdom declared war on Germany and sent a British Expeditionary Force to France. The United States declared neutrality. (1) The University offered the following four-year courses of study: Arts and Science; Civil Engineering; Mechanical Engineering; Metallurgical Engineering; Electrometallurgy; Mining Engineering; Electrical Engineering; Chemistry and Chemical Engineering. (2) The mechanical engineering faculty consisted of professors Joseph F. Klein, professor of mechanical engineering and dean of the faculty, Arthur Warner Klein, his son and professor of mechanical engineering, and Paul Bernard de Schweinitz, professor of machine design. (2 pp. 6-7)

Mrs. Dr. Drinker, wife of President Drinker and their two daughters were in England when England declared war. Professor of Latin Language and Literature Robert Blake and his wife were in Belgium when the army was mobilized. Professor of Metallurgy Joseph Richards and his wife were in Germany during mobilization. Mrs. Miller, wife of Professor of Geology Benjamin Miller, and their two children left Germany the day war broke out. They fled to Paris through Switzerland and crossed the English Channel on the U.S. Battleship Tennessee, later reaching home via Montreal. (3) Students and faculty including J.F. Klein and F.V. Larkin, assistant professor of mechanical engineering, donated \$1,283.86 to relief of Belgian sufferers. (4)

Ninety four members of the Class of 1915 graduated, including sixteen bachelors of mechanical engineering and one master of science in mechanical engineering (5) and department heads secured positions for most of them. (6) Fall 1916 saw the largest enrollment since the university was founded. Student registration was 775 plus 285 extension students in evening school and Saturday classes. There were 136 mechanical engineering registrants. (7)

A regular meeting of the Mechanical Engineering Society was held at the residence of President Drinker. The subject of the first speaker, Lieutenant E.P. Finney of the United States Navy, was "The Organization of the Battleship." (8) The Class of 1917, the "War Class," voted to invest its surplus funds in a war bond. Dean Klein urged the graduates to "acquit yourselves like men. Be not found wanting. Be a credit to your Alma Mater, to your country and do your duty as citizens of the world." (9)

Professor Joseph Frederick Klein, dean of the faculty and head of the department of mechanical engineering, died suddenly at his residence at 357 East Market Street. He was born in Paris in 1849 and was 68 years old. Professor Klein was the oldest member of the faculty in point of service, having been professor of mechanical engineering since 1881. (10) Thomas Edward Butterfield was promoted to associate professor of mechanical engineering. (11)

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<sup>1</sup> Almost all of the information herein came from the Brown and White archives or the Lehigh course catalog archives.

At opening exercises in 1919, Secretary of War Newton Baker spoke of the service which college men had rendered in the war and described the reinstatement of the Reserve Officers' Training Corps. President Drinker then announced the appointment of Fred V. Larkin to be professor of mechanical engineering and placed in charge of the department. He pointed out that Professor Larkin had been an instructor in mechanical engineering at Lehigh from 1912 to 1913, assistant professor from 1913 to 1915, and engaged



Frederick Viall Larkin mechanical engineering department head 1919-1948

in war industries since. (12) Charles R. Richards was announced as the new president. He was educated as a mechanical engineer at Purdue and Cornell and taught mechanical engineering at the Colorado Agricultural College, the University of Nebraska and the University of Illinois, rising to the position of dean of the College of Engineering and director of the Engineering Experiment Station. (13)

In a reversal of prior enrollment totals, in 1923 the mechanical engineering department ranked fourth behind the departments of business administration, arts and science and electrical engineering. (14) Data representing the distribution of the 2,987 men graduated from the mechanical engineering course up to and including the Class of 1922 showed 27% unaccounted for, and of the remaining, 92.6% were engaged in engineering, 3.9% became attorneys, bankers

and physicians and 3.5% made other choices. (15).

In October 1923, the Alumni War Memorial Building was approaching completion as a memorial to all who served. (16) In June 1925, Lehigh graduated the largest class in its history. (17) Professor de Schweinitz departed. Fall 1925 Lehigh enrollment was the highest in the history of the institution. (18) Thomas Edward Butterfield was promoted to professor of heat power engineering. (19) James Alexander Mease was appointed associate professor of machine design. (20) Professor Mease died in December, 1925. (21)

The curriculum in industrial engineering was added to the college of engineering in 1925, completing the separation of mechanical engineering and industrial engineering. On completion of the four-year curriculum, the degree Bachelor of Science in Industrial Engineering would be awarded. (22) Milton Caleb Stuart was appointed professor of experimental engineering in the department of mechanical engineering. (23) Professor Larkin gave a reception at his home at 135 Wall Street for the seniors of the M.E. Society with smokes and eats. It was decided that the industrial engineers, who had no society of their own, be admitted to membership. (24) Instead, Mr. L.W. Wallace, past president of the ASIE was present at an organizational meeting to help Professors Larkin and Carothers get an Industrial Engineering Society of Lehigh University started. (25)

President Richards declared "nowhere in the university are the needs for additional room and equipment greater than in the departments of electrical engineering and mechanical engineering." Accordingly, the architects of the recently completed Alumni War Memorial Building proposed a building of width of 225

feet and depth of 184 feet. It was estimated that the cost of erecting the proposed Electrical and Mechanical Engineering Hall would be \$750,000 and an endowment of \$300,000 would be required to maintain it. (26) In January 1927, James Ward Packard, Lehigh '84, gave \$1,000,000 for the purpose of erecting the proposed building. (27) The Alumni Banquet of 1927 honored James Ward Packard, whose generosity made the Packard Engineering Laboratory possible. Unfortunately, Mr. Packard was ill and was represented at the banquet by Alvan Macauley, president of the Packard Motor Car Co. (28)

Organization at Lehigh of Theta Chapter of Pi Tau Sigma was completed in 1927. Lehigh President C.R. Richards, while at the University of Illinois, had founded the national Mechanical Engineering Honorary Society in 1914. (29) Professor Stuart arranged a technical magazine seminar for the staff of the mechanical engineering department, the purpose of which was to keep members abreast of latest developments in their subjects. (30)

James Ward Packer died on May 20, 1928, just as work was beginning on the new laboratory which he had made possible. (31)

President C.R. Richards and W.R. Okeson, treasurer of the university, attended the funeral of James Ward



**Completed Packard Laboratory in 1929 with Bethlehem Steel in the background**

Packard in Warren, Ohio. (32) Lehigh would receive one-third of the \$4,000,000 estate of James Ward Packard at the death of Mrs. Packard. An endowment fund of \$20,000 was willed to the university as an immediate gift. (33)

Every week Lehigh students sent home, on the average, 553 suit cases of laundry for which the Bethlehem post office collected about \$102.56 in fees. (34)

James Ward Packard Laboratory was completed and The Packard Motor Car Co. sent the first Packard to Lehigh. (35) The president of the Oakland Motor Car company, A.R. Glancy, M.E '03, secured for

the mechanical engineering department the following automobile engines for the new Packard Laboratory: Buick; Packard; Willys Knight; Oakland; Pontiac; Cadillac; Viking; Chrysler and a General Motors truck engine. (36)

Lehigh engineers, by action of the faculty, would be permitted to graduate with either a regular engineering degree or a bachelor of science degree in their appropriate courses, depending on their choice. Men already graduated would likewise be allowed the opportunity to exchange their diplomas for a B.S. in their respective schools. (37)

Fred Larkin gave the third in a series of College Lectures, "Man's Conquest of Nature" with the assistance of a robot named "Televox" that was built by Westinghouse Electric and Manufacturing Company. Televox could fix furnace drafts, turn light switches, open doors and read electric gauges. (38) Professor Larkin was the originator of the probationary observation circuit used by Bethlehem Steel

Company and known as the “loop course.” He taught the course in the summer of 1930 as had been his custom for the eight prior years since its establishment. (39)

Worldwide GDP fell by 15% from 1929 to 1932. In the 21st century, the Great Depression is commonly used as an example of how far the world's economy can decline. The depression originated in the United States, after the fall in stock prices that began around September 4, 1929 and became worldwide news with the stock market crash of October 29, 1929 (known as Black Tuesday). (40)

On October 15, 1930, noted educators and prominent industrial leaders joined Lehigh in dedicating the James Ward Packard Laboratory of mechanical and electrical engineering. The dedicatory address was made by Charles M. Schwab, chairman of the board of directors of the Bethlehem Steel Corporation and a member of the board of trustees of Lehigh University. (41) The very first Packard, designed and built by James Ward Packard, was driven from President Richard's front yard to Packard Laboratory by President Richards. (42) Model A-1 had been built in the electric lamp factory of J.W. and W.D. Packard at Warren, Ohio. J.W. Packard believed he could build a better automobile than any available for purchase. The first car was such a success that friends insisted on duplicates and the Packard Motor Car Company resulted. (43)

Department heads announced that industrial demand for the Class of 1932 was exceedingly poor. Professor Larkin said that although they had an excess of men because the business year did not come up to expectations, men placed the previous year were retained and wages were maintained. (44)

The Mechanical Engineering Society and the Electrical Engineering Society met together to view “Dynamic America” an all-talking motion picture called by Professor Larkin the finest industrial film ever made. (45) Professor Larkin, accompanied by Mrs. Larkin embarked on a round-the-world sabbatical trip for pleasure and to study technical points of power and industry in foreign countries. (46)

Lehigh University felt highly fortunate in comparison with many of her sister institutions during the period of depression. Nevertheless, the budget for 1932-1933 anticipated a reduction in income of \$82,719 or 8.6%. The biggest reduction came from the earnings of the James Ward Packard estate. (47)

Alcohol consumption had not been illegal under federal law. But nationwide prohibition began in the United States in January 1920, when the Eighteenth Amendment to the U.S. Constitution went into effect, and was repealed in 1933, with the ratification of the Twenty-first Amendment. (48) When asked what stand the administration would take on the free use of 3.2 alcoholic beverage which was about to become available, President Richards said the introduction of legal beer will have no effect on the present policy at Lehigh. “We will not allow the sale of liquor of any sort on the campus.” (49)

Permanent or temporary jobs were found by 167 members of the Class of 1933, 35 were taking graduate work and 59 were unemployed. Twenty-one did not answer a questionnaire. (50) Associate Professor of Machine Design Alexander Walker Luce joined the department. (51) John A. Broadhead, head of the placement bureau, said chances for employment were improved for the Class of 1934. (52) One hundred thirty one men started work at jobs provided by the various departments of the university and paid for by money appropriated by the Federal Emergency Relief Administration at an average pay rate of \$15 per month. (53)

The Ford Motor Company sent as a gift to Lehigh a new Ford V-8 motor due to the efforts of Professor Larkin. The Ford Company was the only firm that had not sent a motor upon the first request of the university. (54) Burgess Hill Jennings was promoted to associate professor of mechanical engineering. (55) An advertisement for a Keufel & Esser Co. Log Log Trig slide rule appeared in the Brown and White in 1935. (56) President Richards, the first mechanical engineer to be president of Lehigh, resigned. He had not fully recovered from a recent heart attack. An editorial gave him credit for having made Lehigh University a nationally recognized institution of the highest caliber. (57) He was replaced by Clement C. Williams who had been dean of the college of engineering at the University of Iowa, head of the civil engineering department and professor of railroad engineering at the University of Kansas. (58)

Stephen Timoshenko, then professor of engineering mechanics at the University of Michigan, was awarded an honorary Doctor of Science degree at Lehigh commencement in 1936. (59)

Milton C. Stuart announced that the department of mechanical engineering would celebrate the 200<sup>th</sup> anniversary of the birth of James Watt, the inventor of the steam engine. "The only statue of James Watt in this country," said Professor Stuart, "is the one over the entrance to Packard laboratory." The 200<sup>th</sup> anniversary was celebrated from January 19 to January 21 at Lehigh and at the Franklin Institute, Philadelphia. (60) The only scale replica of a Watt walking beam engine was handmade in its entirety by W.S. Clewell, mechanic and laboratory assistant in the mechanical engineering department. (61)

After a lapse of 42 years, graduate work was resumed at the doctoral level by action of the board of trustees. "In the extension of the graduate program at Lehigh, the primary aim is advanced study rather than merely awarding Ph.D. degrees. Emphasis will be placed upon substance rather than upon labels." In 1877-78 provision had been made for the granting of Ph.D. and Sc. D. degrees. In 1883-84 the Sc.D. degree was dropped and in 1894-95 the Ph.D. degree was withdrawn. (62) Each of the university's three colleges was reorganized under the supervision of a dean. Bradley Stoughton assumed the duties of the dean of the College of Engineering. (63)

At the end of 1936-1937, 70 per cent of seniors had already been placed, including 82 per cent placement in the engineering curricula. Starting salaries were 10 per cent higher than the previous year. (64) By September, in seven out of nine engineering curricula, including mechanical engineering, every man had been placed. (65) Total undergraduate enrollment reached a new high of 1738, including 109 in mechanical engineering. (66)

A two-place observation-bomber was given to the university by the U.S. Army. It was arranged as an exhibit along the north wall on the third floor of Packard Lab. The department announced plans to build a wind-tunnel. (67) The director of placement announced that 212 of the 278 graduates of the class of 1938 were placed, including 14 of 17 mechanical engineers. (68)

Milton C. Stuart, professor of mechanical engineering delivered an address on the life and character of Asa Packer to the American branch of the Newcomen Society of England at a dinner held in honor of Lehigh by the society in New York City. (69) President Williams appointed a committee to discuss problems arising from the new Flight Theory of Aviation course. The committee included Professors Larkin and Butterfield. (70) An engine for testing the antiknock properties of gasoline and diesel fuels was installed in Packard Lab. Exhaustive research by the Cooperative Fuel Research Commission had resulted in the evolution of the machine of the type purchased. (71)

In most countries of the world, recovery from the Great Depression began in 1933. In the U.S. recovery began in early 1933, but the U.S. did not return to 1929 GDP for over a decade and still had an unemployment rate of about 15% in 1940, albeit down from the high of 25% in 1933. (72)

Thirty-three sophomores were denied permission to continue in engineering as a result of the Sophomore Comprehensives, including seven mechanical engineers. Study of past results showed that not more than one percent of those in the lowest 20 per cent and having averages below 1.5 ever graduated as engineers and none with their class. (73)

President Williams announced 90 staff changes including the appointment of James Van Deusen Eppes as instructor in mechanical engineering. (74) Two members of the mechanical engineering department, Burgess H. Jennings, associate professor of mechanical engineering, and Alexander W. Luce, associate professor of machine design, have resigned from the faculty after long service to assume positions respectively as professor of mechanical engineering at Northwestern Technological Institute, and head of the department of mechanical engineering at the University of Connecticut. (75)

Fifty Lehigh engineers applied for Naval Reserve Officer commissions following a speech by Admiral Harry E. Yarnell, U.S.N. retired. No men will be called before graduation. (76) A navy ensign and member of the Board of Naval Aviation Cadet Selection and Naval Training described the training offered college graduates and seniors. (77)

The charter of Lehigh University had been granted on February 9, 1866. The trustees of the proposed university had met for the purpose of organization in the Sun Inn July 27, 1865. Lehigh was the first "polytechnic" school in Pennsylvania and one of the first in the country. On the 75<sup>th</sup> anniversary of the founding date, the original charter was resurrected from the archives by the university auditor. (78)

Graduating members of R.O.T.C. units were told to expect to be called to one year of service unless granted a deferment. (79). Dean Congdon sent letters to 694 students, 21 years and over, to clarify procedures for any student registered for Selective Service, who might desire to seek deferment of his induction into service. (80)

World War II is generally said to have begun on 1 September 1939 with the invasion of Poland by Germany and subsequent declarations of war on Germany by France and the United Kingdom. In December 1941, Japan attacked the United States and European territories. The United States declared war on Japan on 8 December 1941. (81)



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## The Mechanical Engineering Department from 1943 to the Merger in 1969<sup>1</sup>

At the outbreak of World War II, Lehigh was a school of about 1,781 undergraduates. (1) Some left school to join the fighting, some were reservists (2) who were called up, and some were drafted. With the drainage of men into the armed forces and the diminution of the entering classes, the enrollment of the school fell to 339 in fall 1944. (3) In the five years of war, 3,300 Lehigh men served in the armed forces and 66 lost their lives. (4)

During World War II, Lehigh participated in the Army Specialized Training Program (participants were known on campus as ASTRP or ASTP students) and the Navy V-12 College Training Program. The 3309<sup>th</sup> Service Unit of the Army Specialized Training Division of the Army Service Forces, War Department, was established at Lehigh in June, 1943. (5)

Thirty V-5 naval aviation cadets arrived at the campus in February 1943 to enter the Civilian Pilot Training Program at Lehigh. Assistant Professor of Mechanical Engineering Thomas Jackson was the head of the program. (6) An Army Air Corps Training Program brought 158 Air Corps reservists to campus in July 1943. Courses given reservists were similar to those given the ASTP unit. (7) In November, 1943, the registrar announced there were 457 civilian students, 1323 AST cadets and 97 ROTC men registered. (8)

The university offered an accelerated program allowing students to complete a degree program in 32 months. Each semester was 16 weeks in length, as were conventional semesters at the time. Acceleration was accomplished by eliminating all vacations except one week at Christmas and an interval of one week between each of the semesters, in this manner, three semesters were provided each year. Freshmen could enter in February, June or October. A full program of work for entering freshmen was offered each semester, with corresponding second-semester courses the following semester. Two semesters of basic engineering curriculum was a normal stay for ASTP reservists on campus. (9)

The war took a toll on the faculty. In April 1943, James Eppes, instructor in mechanical engineering, left to become an ASTP instructor at MIT. (10) In May 1944, nine mechanical engineering instructors left campus to work in the war industry. (11) Dean Palmer put out a list showing a decrease in the faculty from 175 to 71 members. (12)

As listed in the 1943-1944 university catalog, the mechanical engineering department faculty consisted of Fred Larkin, professor of mechanical engineering, head of the department of mechanical engineering, director of the curricula in mechanical engineering and industrial engineering; Arthur Klein, professor of mechanical engineering; Milton Stuart, professor of mechanical engineering; and Thomas Jackson, assistant professor of mechanical engineering. They taught 15 lower-division mechanical engineering courses, 14 upper-division courses, nine graduate-level courses and 10 industrial engineering courses. The registrar reported that 18 women and 15 men had registered for graduate instruction. More were expected. (13)

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<sup>1</sup> Almost all of the information herein came from the Brown and White archives or the Lehigh course catalog archives.

On University Day, May 24, 1943, Lehigh granted 18 B.S. degrees in industrial engineering, 32 B.S. degrees in mechanical engineering, one M.S. degree in mechanical engineering, and 87 certificates of candidacy for commissions in the Officers Reserve Corps. On Founder's day, October 18, 1943, one M.S. degree in mechanical engineering, 12 B.S. degrees in mechanical engineering, three B.S. degrees in industrial engineering, and nine certificates were granted. At midyear commencement, February 20, 1944, 20 B.S. degrees in mechanical engineering, one B.S. degree in industrial engineering, 16 certificates for ASTP students, and one certificate for a 2<sup>nd</sup> lieutenant in the U.S. Marine Corps Reserve. (14) By University Day, June 18, 1944, there were no more certificates granted. One M.S. in mechanical engineering, seven B.S. degrees in mechanical engineering, and three degrees in industrial engineering were granted. (15)

In 1944, with the G.I. Bill of Rights as a nucleus, the Lehigh administration and the alumni developed a blueprint of Lehigh's future, not only for Lehigh's returning sons, but also for all other ambitious veterans who would take advantage of the golden opportunity to complete or further interrupted studies. (16) In March 1945, the university registrar announced that 289 undergraduates enrolled at Lehigh and there were 38 discharged veterans studying at the university. (17)

In 1941, prior to Pearl Harbor, the mechanical engineering and industrial engineering department faculty consisted of Professors of Mechanical Engineering Fred Larkin, Arthur Klein, Thomas Butterfield and Milton Stuart; Associate Professor of Industrial Engineering John Connelly, Assistant Professor of Mechanical Engineering Arthur Bates and nine instructors, including Thomas Jackson and James Eppes. (18) In 1945, the M.E. faculty consisted of Professors Larkin and Klein; Assistant Professors Jackson and Bela Erdoss; and Instructor James Hartman. (19)

In January, 1945, Lehigh's ASTRP unit departed. They received a very high rank in the national Achievement Tests given to all ASTRP units. (20)

In August 1945, the university faculty decided the university would close the day after President Truman's announcement of Japan's surrender. There would be services in Packer Chapel on V-J (victory over Japan) Day, (21) which was September 2, 1945, when the signing of the surrender document occurred, officially ended World War II. (22)

F.V. Larkin, head of the mechanical engineering department said, "I look forward for the freshman class to be filled to overflowing in September 1946. I expect most of the upperclassmen to return to fill our upper classes by that time." (23)

In spring semester 1946, eleven members of the university faculty returned from wartime leaves, including Thomas Holme. (24) Four M.E. faculty received the Army Commendation Medal for their technical contributions to the war effort:

Professors Larkin and Stuart for their work on the history of rocket development. Each received personal commendations from Lt. Gen. Campbell, chief of ordnance, for their excellent work in compiling the history of rocket development. Professor Stuart was also director of research at Franklin Institute and involved in the thermodynamics of the recoilless gun; Associate Professor Holme for directing research at Springfield Armory. He was decorated with the Legion of Merit by Gen. Eisenhower for his contributions to the development of illuminated night sighting

equipment for small arms; Mr. R. Williams, instructor, for meritorious service as chief of technical administration, branch of arms and ammunition at Aberdeen Research Center, Aberdeen, Maryland. (25)

A new laboratory was established at Lehigh, a part of the Philadelphia District Ordnance Gauge Laboratory. This M.E. – I.E. lab was under the direction of Associate Professor T.T. Holme, returned to Lehigh after four and a half years stationed at the Springfield Armory. (26)

Assistant Professors of Mechanical Engineering Erdoss and Jackson were promoted. (27) Joel Furness Bailey was named assistant professor of mechanical engineering. (28) In the summer of 1946, 2111 undergraduates (1838), graduate students and adult education students was an all-time high total. Only 335 did not see service in the armed forces in World War II. (29) By fall there were 3427 students enrolled, including 81 former students readmitted after service in the armed forces and 545 new students. There were 591 married students and 577 of those were veterans. There were 1818 undergraduates registered in the nine departments of the college of engineering. The largest group of engineers was majoring in mechanical engineering. (30)

Professor Fred V. Larkin, head of the mechanical engineering department, was honored by Pi Tau Sigma, the national mechanical engineering society, at the 20<sup>th</sup> anniversary banquet of the Lehigh Theta Chapter on May 1, 1948, held in anticipation of his retirement on June 30 after 36 years of service. For the previous 20 years Professor Larkin had served as executive vice president of the national council of Pi Tau Sigma. (31) Dr. Raymond Walters, president of the University of Cincinnati, spoke at the dinner. He paid tribute to Professor Larkin as the epitome of successful educators, very interested in students and their problems, yet able to uphold the reputation for which Lehigh was famous. The climax of the evening came when a large portrait of Professor Larkin was unveiled. (32) That painting still hangs in the office of the chair of the department. In July 1948, Professor Larkin received the honorary degree of doctor of engineering at the Stevens Institute of Technology. (33)

At the May 1948 meeting of the board of trustees, President Martin Whitaker announced 16 faculty promotions. Both Ferdinand P. Beer in mechanics and James B. Hartman in mechanical engineering were promoted from assistant professor to associate professor. Arthur Gould was elevated to the rank of assistant professor of mechanical engineering. (32) Dr. James B. Hartman was installed as chairman of the Delaware Valley Section of the Society for Experimental Stress Analysis for the year 1949-1950. (34)

The 1949 national convention of Pi Tau Sigma was held at Lehigh. Fred Larkin, professor emeritus, served as toastmaster for the banquet. He had helped found the local chapter of Pi Tau Sigma at Lehigh. Burgess H. Jennings, national president, attended the convention. Jennings had been a member of the Lehigh mechanical engineering faculty. Milton Stuart, head of the department of mechanical engineering, delivered the opening remarks. (35) At the 1949 formal initiation banquet of Pi Tau Sigma, Arthur C. Bates, professor of mechanical engineering and director of research, was initiated into the fraternity as an honorary member. (36)

In January 1950, President Whitaker announced the adoption by the faculty of two new five-year educational programs. The first offered the degree bachelor of science in mechanical engineering at the end of four years and that of Bachelor of Science in electrical engineering at the end of the fifth year. The

second program, in the same way, offered degrees in industrial engineering and business administration. (37)

Professor T. E. Jackson's ME104 class operated the world's first successful engine as part of its study of the history of engines of that type. Built in 1876 by Dr. Otto, the engine produced one-half horsepower and used city gas as fuel. (38)

The Korean War impacted the university less than had World War II, but in 1952 the Korean GI Bill granted benefits to those who saw active service for at least 90 days after June 26, 1950. Each vet was entitled to benefits for one and a half times the duration of his active service, up to a maximum of 36 months. (39)

In June 1952, Arthur W. Klein retired after 48 years of service to the department. He was a member of the Lehigh Class of 1899 and had



James Buss Hartman, head of mechanical engineering from 1952 to 1961

worked as an engineer with the Essex and Hudson Gas Company, Newark, N.J. and the Atlanta Gas and Light Company, Atlanta, Ga. He also taught at Grove City College, Grove City, Pa. before joining the Lehigh faculty in 1904 as an instructor. (40) At that time his father, Joe F. Klein, was head of the department. Arthur Klein wrote a book on the kinematics of machinery in 1917 and later prepared notes on impulse turbines for General Electric and reaction turbines for Allis-Chalmers. He sang with the Bach Choir for 35 years. (41)

After 1948-1949, the department of mechanical and industrial engineering was separated into two departments. Initially, there were 291 industrial engineering students and 376 mechanical engineering students. (42) In May 1952, James B. Hartman and Arthur F. Gould were appointed heads of the departments of mechanical engineering and industrial engineering, respectively. They succeeded Professor Milton Stuart, who had asked to be

relieved of administrative duties. Stuart had been head of the department of mechanical engineering and acting head of the industrial engineering department. (43)

Department students attended three-week summer machine shop courses at the Bethlehem Technical High School. There the men spent eight hours a day working on various projects that included machine tools, hand tools, shapers, lathe work, bench work, and gas and electric welding, according to Professor Hartman, head of mechanical engineering. L.B. Kehler, a Lehigh graduate, was the staff director at the Technical School and Instructor T.S. Eichelberger was the Lehigh representative. (44)



In 1951 there were 2651 registered students compared to 2799 the previous year. The decrease was attributed to the then current period of industrial mobilization, Selective Service, and the effects of the post-depression birthrate drop. Graduate school saw an increase of 20 students compared to fall semester 1950. (45) In 1963, Lehigh's adult education program was well underway, presenting a number of short, noncredit courses to area adults. A mechanical engineering refresher course, consisting of 15 sessions, was taught by Professor Tom Jackson. The classes met in the Packard Laboratory lounge. (46)

In May 1954, Emeritus Professor Fred Larkin passed away at the age of 71. Dr. Larkin, who was head of the department of mechanical engineering from 1919 to his retirement in 1936, graduated from the University of Wisconsin in 1906 with the degree of Bachelor of Science in general engineering. He was awarded the degree master of science in mechanical engineering by Lehigh in 1915. (47)

Professor Hartman coauthored the 3<sup>rd</sup> edition of *Machine Design*. (48) Professor Hartman and Russell E. Benner, instructor in mechanical engineering, wrote on stress analysis in design for *Machine Design Magazine* and professor Stuart coauthored a 2<sup>nd</sup> edition of *Principles of Engineering Thermodynamics*. (49) In the fall of 1954, foreign enrollment at Lehigh set a record with 85 students from 30 foreign countries. The largest number of foreign students came from Burma. Civil engineering attracted 17 foreign students and 13 enrolled in mechanical engineering. (50)

In January 1955, the *Brown and White* reported that Assistant Professor of Mechanical Engineering Frank Kreith's 1951 Chevrolet convertible had been stolen by two boys aged 13 and 15, who had escaped from Allentown State Hospital. Within one hour of reporting his car stolen, he was notified by police that the car had been recovered in Trenton, N.J. Professor Kreith pressed no charges against the boys since they were already being held for auto thefts and burglary. (51)

After 29 years of service to the department, Milton S. Stuart, professor of mechanical engineering, retired in June 1955. He was a graduate of the University of Pennsylvania. (52) Dr. Stuart was head of the department of mechanical engineering from 1950 to 1951, and head of mechanical engineering and acting head of industrial engineering from 1951 to 1952.

From 1912 to 1915, Stuart worked with Bethlehem Steel as a steam engineer and was also an instructor at Rensselaer Polytechnic Institute. From 1915 to 1920, he was a mechanical engineer at the United States Naval Engineering Experimental Station at Annapolis and from 1920 to 1926 he was a professor of mechanical and marine engineering at the U.S. Naval Academy. He joined the Lehigh faculty in 1926. During World War II, Professor Stuart went overseas with the Army Educational Service. After retirement he served as a consultant to the U.S. Army Frankfort Arsenal. (53) He was affectionately profiled in the February 21, 1950 issue of the *Brown and White*. (54)

McGraw-Hill published Professor Hartman's *Dynamics of Machinery* as part of their series of mechanical engineering texts. (55)

Spring 1956 undergraduate enrollment was 2562. More than half of the university's students were enrolled in the college of engineering, and the mechanical engineering department led all departments with 338 undergraduates enrolled. (56) Fall undergraduate enrollment was 2681 with 1561 enrolled in engineering departments. (57) Record high number of foreign students was enrolled. (58) Undergraduate enrollment reached 2673 with 560 students registered in the graduate school. (59) Director of Placement

Everett Teal reported that the average monthly starting salary accepted by Class of '56 engineering graduates was \$418. (60)

Associate Professor Frank Kreith's 549 page book, *Principles of Heat Transfer* was published in 1958. He resigned from the department soon after. (61) A portion of the \$3000 grant from the Committee on Educational Aid of E.I. DuPont de Nemours & Co. supported Assistant Professor Fazil Erdogan in the study of the use of transform calculus in conjunction with variational principles to obtain approximate solutions for boundary and initial-value problems. (62)

In 1959, Packard Lab housed the Librascope General Precision computer. Primarily the machine was used in courses in programming with applications in math, physics, industrial, mechanical and electrical engineering. Input was via perforated tape. To quote the B&W, "The speed with which computations are made defies time. Operations with 50 numbers of up to 9 digits are completed within two seconds." Visitors on tour of campus were often taken through the computer lab where the LGP computer created a highly favorable impression. (63)

One third of James Ward Packard's estate was left to Lehigh when he died in March 1928, with provision that it be held in trust until Mrs. Packard's death. During Mrs. Packard's lifetime, one quarter of the income from the entire estate, after a \$25,000 deduction, came to Lehigh. Packard, a mechanical engineering graduate, founded the Packard Motor Car Company and the Packard Electrical Company. In 1927, Packard donated \$1,200,000 for the construction and equipping of the James Ward Packard Electrical and Mechanical Engineering Laboratory. The laboratory, considered one of the finest of its kind when built, was completed in 1929. (64)

In 1960, Jerzy Owczarek came to Lehigh from the General Electric Company. He was appointed as an Associate Professor, promoted five years later to the rank of Professor, and during his research at Lehigh, he discovered an important phenomenon of reflecting pressure pulses between turbomachinery blades.

Assistant Professors Fazil Erdogan and David M. Parke were promoted to associate professor of mechanical engineering. (65)

On Sunday, May 7, 1961, James B. Hartman, professor and head of the mechanical engineering department, died of a heart attack. He would have been 51 on May 23. He was a noted authority on machine design and applied mechanics phases of mechanical engineering. Professor Hartman graduated from Lehigh in 1931 with a Bachelor of Science degree in mechanical engineering and one year later received his master's degree. For twelve years after leaving college, Hartman worked as an engineer for the Ingersoll-Rand Company. He started as a test engineer and advanced to be supervisor of the Diesel Development Programs. In 1945 he returned to Lehigh as an instructor in mechanical engineering. A year later he was appointed a DuPont research fellow and completed his Ph.D. thesis. In 1947, he was appointed as assistant professor and one year later earned the rank of associate professor of mechanical engineering. In 1951, he was made a full professor of mechanical engineering. During the following year, Dr. Hartman became head of the mechanical engineering department and director of the curriculum. In 1960, Dr. Hartman received the R.R. and E.C. Hillman Award for advancing the interests of the university. (66)

Associate Professor James V. Eppes was named acting head of the mechanical engineering department. (67) Dr. Russell Benner assumed teaching duties in the mechanical engineering department at the rank of associate professor. Richard C. Progelhof was promoted from research fellow to assistant professor of mechanical engineering and awarded an NSF Cooperative Fellowship in mechanical engineering. (68)

The industrial engineering department faculty defeated the mechanical engineering department faculty 21-6 in a football game and then held the football championship of Packard lab. (69)

The annual university report for 1961-1962 stated that the university was attracting more than enough engineering candidates and increasing enrollment, despite a national decrease for the fifth consecutive year. (70)

Dr. Ralph Long, educator, engineering consultant, and a program director of the National Science Foundation, Washington, D.C., was named head of the department of mechanical engineering. Before joining the NSF, he taught at Yale, the University of Maryland, and the Illinois Institute of Technology. He succeeded James B. Hartman, who headed the department for nine years. (71)

In 1962, the university completed installation of a General Electric solid-state computer in the computer laboratory that was located in the James Ward Packard Engineering Laboratory. A broad range of new and revised courses assured every engineering sophomore of coursework in computing techniques and application. (72) Theodore Terry was promoted from instructor to assistant professor of mechanical engineering. (73)

In 1964, the most extensive Packard Laboratory renovations in the lab's 34 year history were nearing completion. Ralph Long, head of the mechanical engineering department, pointed out many of the changes made in lab and office space throughout the building. (74)

Jerzy Owczarek completed his textbook *Fundamentals of Gas Dynamics* in 1964. This contribution was followed by his book *Fundamentals of Fluid Mechanics* in 1968.

Dr. Alan Stenning was appointed full professor of mechanical engineering by University President W. Deming Lewis. (75)

At a faculty meeting of the college of engineering, it was announced that a combined curriculum for the departments of mechanics and mechanical engineering would go into effect for the Class of 1969. A proposal to combine the two departments had been made in the spring of 1968. According to John J. Karakash, dean of the college of engineering, the change in curriculum was made "to give the broadest possible education in the first three years of the course, and to give seniors maximal freedom in choosing their study program." In reference to the merger proposed by the two departments, Alan H. Stenning, acting chairman of the mechanical engineering department, said that the combination is "almost a certainty" pending approval by University President W. Deming Lewis and Provost Glenn Christensen. (76)

Thomas E. Jackson, associate professor of mechanical engineering, took the Model A-1 Packard automobile, which is normally on display in Packard Engineering Laboratory, out of the glass case for closer inspection by visiting members of the Pierce Arrow Society of the Delaware Valley Region.

Jackson had recently driven the car in the Bethlehem Chamber of Commerce parade for the opening of the spur route into Bethlehem. (77)

Speaking at the monthly meeting of Omicron Delta Kappa, the national leadership honorary fraternity, University President W. Deming Lewis pointed to two main reasons for expansion of the graduate school: to attract top faculty members and to provide more spaces for undergraduates who wish to pursue their education. For these reasons it was decided to triple the number of doctorates and double the number of students in the graduate school. (78)

First Lt. Robert E. Coates, Jr. died of wounds he received in combat while under hostile attack in Vietnam. He had graduated in 1966 with a degree in mechanical engineering, entered the army a month after graduation and had been in Vietnam since October 1967. (79) In a survey conducted by the Brown and White and answered by 150 faculty members, 44 percent said they would be opposed to fighting in the war as a soldier. (80)

Dr. Russell E. Benner, department of mechanical engineering, was advanced from associate professor to full professor effective September 1, 1968 (81) and the Mart Science and Engineering Library was nearing completion. (82)

A poll conducted and released by the local chapter of the American Association of University Professors, in conjunction with the social relations department of the university, indicated that an overwhelming majority of the faculty approved of making Lehigh coeducational. The college of engineering showed a response of 51 (72.9%) for, 17 (24.3%) against and two undecided. (83)

On May 29, 1967, Dean John J. Karakash had proposed that the undergraduate curricula of the departments of mechanical engineering and mechanics be consolidated, and the departments be joined, the joint department to be known as the Department of Mechanical Engineering and Mechanics. By combining forces, it was expected that both undergraduate and graduate programs would gain in strength, since students would benefit from the resources of both departments and some of the then present duplication would be eliminated. (84) A study committee was formed, composed of four representatives from each department, and the following represents the recommendations of the committee.

#### Objective

*The main objective of the merger is to obtain more effective education for the student at both the undergraduate and the graduate level, while preserving the emphasis on engineering which characterizes the program presently followed by the majority of undergraduates.*

#### Department Title

*The suggested name "Department of Mechanical Engineering and Mechanics" meets with general approval. A possible but less popular alternative is "Department of Mechanical and Aerospace Engineering." Some of us feel that the objective "Aerospace," while desirable, would require a considerable investment in staff and facilities by the university before it could be justified. Others are reluctant to give up "Mechanics."*

#### Department Organization

*Initially, the combined department will have a faculty of almost thirty, and output of approximately seventy B.S. degrees each year, and a graduate enrollment of close to one hundred students. In addition, it will be responsible for a large service load of undergraduate courses.*

*In a department of this size, it will be necessary for the chairman to delegate some administrative functions to other faculty members. One possible arrangement would comprise a Curriculum Director for the undergraduate program and a graduate committee under a Graduate Director to handle admissions, recommendations for financial aid and graduate advising and registration.*

*However, it is felt that the final organizational structure should be decided by the chairman and the members of the joint faculty.*

*The educational responsibilities of the joint department can be divided up into roughly four areas. These are a) Design, b) Dynamics, c) Solid Mechanics, d) Thermo-fluid Sciences. It is suggested that a professor-in-charge be named for each of these areas, to take responsibility for the organization of courses and for coordination with the Curriculum Director. These professors might also serve as the graduate committee.*

#### *Undergraduate Program*

*It is proposed that a joint curriculum be created, to be administered by a single Curriculum Director. This joint curriculum will consist of common freshman, sophomore and junior years, and of a senior year offering a wide selection of courses. Depending upon the program he chooses during his senior year, each student will be graduated with either a B.S. in Mechanical Engineering, or a B.S. in Engineering Mechanics. Students satisfying the requirements for both degrees will indicate to the Curriculum Director the field in which he wishes to graduate.*

#### *Graduate Program*

*There are marked differences between the graduate programs in Mechanics and Mechanical Engineering, especially at the doctoral level. In consequence, it is proposed that M.S. and Ph.D. degrees be offered in both Mechanics and Mechanical Engineering as at present with separate qualifying and general Ph.D. examinations, although students in both programs will take many of the same courses. It is desirable to consolidate the graduate courses of the two departments so as to eliminate duplication and permit a greater variety of courses to be offered.*

*Graduate admissions standards will be the same for both programs, and it is recommended that admissions and applications for financial aid should be handled by a joint committee representing both Mechanics and Mechanical Engineering.*

#### *Faculty*

*It is expected that the faculty will continue to hold appointments in either Mechanics or Mechanical Engineering, and that new appointments may be made under either title.*

#### *Initiation of New Program*

*It is recommended that the new program become effective with the Class of J'70. An initial step would be to request immediate changes in course offerings, as well as changes in the existing, separate M.E. and Mech. curricula. The revised sophomore and junior schedules would become effective in the fall of 1968 and the revised senior schedule in the fall of 1969.*

Such were the recommendations made September 22, 1967 by the committee consisting of: R.E. Benner; F. Erdogan; J.A. Owczarek; P.C. Paris; G.C. Sih; T.A. Terry; A. H. Stenning, chairman, Merger Study Committee; F.P. Beer, Secretary.

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## A Brief History of Engineering Mechanics at Lehigh<sup>1</sup>



Ferdinand Beer, head of the mechanics department, 1957–1969

There was no explicit mention of mechanics in the Lehigh course catalogs until 1945-1946 when a subsection of the civil engineering course list was labeled “Mechanics” and contained Mech 1, Statics; Mech 2, Dynamics; and Mech 3, a condensation of Mech 1 and Mech 2. (1) This was the case when Professor Ferdinand Beer<sup>2</sup>, pictured here, joined the Civil Engineering Department as an assistant professor of mechanics in 1947. (2)

In 1950, the name of the Civil Engineering Department was expanded to “Department of Civil Engineering and Mechanics”, (3) and Professor Beer became associate professor of mechanics in the Civil Engineering and Mechanics Department and professor of mechanics in 1952. (4)

In academic year 1955-56, the Civil Engineering and Mechanics Department faculty consisted of William Joseph Eney, professor of civil engineering and head of the department of civil engineering and mechanics; Professors Beer and C.D. Jensen; Associate Professors M.B. McPherson, R.E. Kolm, R.H. Snyder, and L.S. Beedle, and Assistant Professors E. Russell Johnston Jr., Albert W. de Neufville, H.S. Strausser, Jr., W.B. Clement, E.K. Muhlhausen, B. Thurlimann, C.E. Ekberg, Jr., A. Smislova, A. Sami, and K-S. Wan. (5)

President Whitaker announced the appointment of Joseph C. Osborn, assistant professor of mechanics, and Paul C. Paris, instructor in mechanics. (6)

In February 1957, in his report to the board of trustees for the 1955-56 fiscal year, President Martin D. Whitaker reported on the growth of Lehigh’s assets, progress made in curriculum advancement, and the establishment of a Division of Mechanics. (7)

*As another step in coordinating engineering instruction, a division of mechanics was established last year and operated under the direct supervision of the dean of engineering. Courses in this subject, previously offered in several departments and involving some duplication, are now all concentrated in this division which has its own staff of instructors. (8)*

Quoting the Brown and White (9)

*Dean Bewley pointed out that the new curriculum in engineering mechanics will be a highly scientific one. It conforms well to the recommendations of the American Society of Engineering Education for more basic and fundamental approaches in engineering.*

Initially the faculty of the Division of Mechanics consisted of Professor of Mechanics Beer and Assistant Professors of Mechanics Johnston, de Neufville and Osborn. (10) They offered the following courses to

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<sup>1</sup> Almost all of the information herein came from the Brown and White archives or the Lehigh course catalog archives.

<sup>2</sup> Ferdinand Pierre Beer, B.S., Geneva (Switzerland), 1933; M.A., 1935; Ph.D., 1937; M.A., Paris (France), 1938.

undergraduates: Mech 1, Statics; Mech 11, Mechanics of Materials; Mech 13, Materials Testing laboratory; and Mech 102, Dynamics.

Advance undergraduates and graduate students were offered: Mech 301, Advanced Mechanics of Materials; Mech 302, Advanced Dynamics; Mech 303, Mechanics of Continua I; Mech 304, Mechanics of Continua II; Mech 325, Aerodynamics; and Mech 326, Aerodynamics.

At the graduate level, Mech 402, Advanced Analytical Mechanics; Mech 404, Advanced Vibrations Analysis; Mech 411, Theory of Elasticity; Mech 412, Theory of Elasticity and Plasticity; Mech 415, Structural Mechanics and Elastic Stability; Mech 416, Theory of Plates and Shells; Mech 421, Hydrodynamics; and Mech 422, Advanced Mechanics of Compressible Fluids, were offered. (11)

Dr. Harvey A. Neville, university provost and vice president, announced that Dr. Ferdinand P. Beer would be the first head of the newly formed Department of Mechanics with the appointment to be effective July 1, 1957. (12) The department started with 19 undergraduate students in the fall of 1957. (13)

*The engineering mechanics major, the 10<sup>th</sup> in the College of Engineering, is headed by Dr. Ferdinand P. Beer. It is a highly scientific curriculum, especially designed for high-grade analytical work in aircraft, automotive and similar industries. Twice as much mathematics is required as in any other engineering curriculum.* (14)

In the fall of 1958, there were 25 undergraduates enrolled in the Department of Mechanics. (15)

For academic year 1959-60, the staff was expanded to include Assistant Professors D.M. Parke and G.F. Smith and Instructors in Mechanics Bahar, Sih, Bede, Engel, Kaplan, Karna, McGrattan, and Sturm. (16) Professor E.R. Johnston Jr. departed for Worcester Polytechnic Institute, but not before he and Professor Beer published their widely used texts "Mechanics for Engineers: Statics" and "Mechanics for Engineers: Dynamics". (17) Also in 1959/60, George Sih, instructor in mechanics, and Marie Smith, graduate student in mechanics, were initiated by Sigma Xi. (18)

*Enrollments in the departments of the college of engineering were as follows: chemical engineering, 102; chemistry, 26; civil engineering, 87; electrical engineering, 197; engineering mechanics, 30; engineering physics, 69; industrial engineering, 123; mechanical engineering, 175; metallurgical engineering, 71; and mining engineering, 27.* (19) Mechanics majors John W. Hutchinson and Pearn Niller were named recipients of Woodrow Wilson fellowships -- Hutchinson to study mathematics at Harvard and Niller to study engineering mechanics at Brown. (20) Niller was awarded a Fullbright Scholarship for study abroad and would work for an advanced degree at ... Cambridge. (21)

For academic year 1961-62, Joe Osborn was promoted to associate professor and George Sih was promoted to assistant professor in mechanics. (22) Phi Beta Kappa member Jim Rice was awarded an NSF Cooperative Fellowship. (23)

The Annual University Report for 1961-62 included a statement by President Harvey A. Neville on engineering enrollment at Lehigh as compared with a national decline in engineering enrollment. Neville said in the report:

*Lehigh is the only college among the 10 institutions in Pennsylvania offering engineering curricula and is one of the few universities in the nation that showed an increase in freshmen enrolling in engineering in 1961. Lehigh's experience for 1962 shows a further increase from 433 freshmen engineers in 1961 to 454 this year. (24)*

In academic year 1962-63, the National Science Foundation authorized the initiation of a research program, "Stress Analysis in Materials Containing Cracks With Applications to Fracture Mechanics." (25) Paul Paris was promoted to the dual posts of assistant director of the Institute of Research and assistant professor of mechanics. (26)

Dr. George R. Irwin, superintendent of the mechanics division of the U.S. Naval Research Laboratory spoke on "Crack Toughness and Resistance to Crack Extension." At the time, Dr. Irwin was considered the foremost authority on this subject in the world. (27)

Professor Gerald Smith, engineering science department, Yale University, spoke on "Constructive [B&W probably meant constitutive] Equations for Anisotropic Media" at a Mechanics Colloquium. (28) NSF Cooperative Fellowships were awarded to undergraduate Ronald J. Hartranft and graduate student James R. Rice. (29) George C.M. Sih and Paul C. Paris were promoted to associate professors of mechanics. (30)

In academic year 1963-64, new instructors William C. Lennox and Nicholas J. Pagano were appointed to the mechanics faculty. (31) Robert G. Sarubbi was advanced from instructor to assistant professor of mechanics. (32)

In the fall of 1963, Dr. Harvey A. Neville, university president, discussed the development of the campus and the expansion of operations within the university. In response to a question about Packard Lab, he answered:

*You think of Packard Laboratory—you get the impression of a big building and lots of room and so on. That building was built in 1928. At that time there were two departments: mechanical engineering, which had a staff of 10, and included industrial engineering, which was merely an option; and electrical engineering, which had a staff of eight.*

*At that time, the total engineering undergraduate enrollment at Lehigh was 852, and the total graduate student population was 67, with very few in that building.*

*Now the present situation is that the mechanical engineering staff is 11; electrical engineering staff, 16; industrial engineering, 10; engineering mechanics, 13; and the dean of engineering and the associate dean of engineering are housed there, and the computer laboratory, which utilizes several rooms, has been put in.*

*The undergraduate engineering enrollment is 1,319, and the graduate enrollment, as compared with 67, is 1,148, including 166 graduate students who have their major activities in that building. (33)*

He went on to say that consideration was being given to more efficient utilization to make classrooms and laboratories.

In the spring, Dr. Alan S. Faust, dean of engineering, announced plans to rearrange laboratory space to better accommodate the graduate students in Packard Lab and to make room for an undergraduate laboratory for seniors in mechanics. (34)

NASA hosted a two-day symposium at Langley Field, VA, devoted to “Winds Aloft and Their Application to Launch-Vehicle Design.” Professor Beer and Instructor in Mechanics William C. Lennox intended to “devise a more reliable method to predict, from statistical data collected on wind velocities of the atmosphere, maximum loads that would occur during launching.” Working on the study of air and spacecraft fatigue were Professor Paul Paris, Grad Student James Rice and Dr. Beer. Grants under which other members of the Lehigh Mechanics Department were working included the studies of impact points of unguided missiles for the U.S. Army Signal Corps, stresses on materials containing flaws for the Office of Naval Research, and stress analysis of cracked bodies for the National Science Foundation. (35)

According to Everett A. Teal, director of the placement office, chemical engineers and mechanics majors commanded top salaries in 1964, with a median salary of \$615 per month. This represented a salary increase of 5.1 percent for chemical engineers and a rise of 9.8 percent for the mechanics majors, the latter rise being the largest in any field. (36) In academic year 1964-65, Robert J. Ravera was named instructor in mechanics. (37) Dr. Paul C. Paris, associate professor of mechanics, was



Professors Erdogan, Sih and Wei (l-r)

granted a one-year leave of absence to work with the National Science Foundation. He served as director of the Undergraduate Instructional Scientific Equipment Program. (38)

Dr. Ferdinand Beer, head of the department of mechanics; Dr. Fazil Erdogan, professor of mechanics; and Dr. George Sih, associate professor of mechanics, presented papers at the annual meeting of the American Society

of Mechanical Engineers. (39) Dr. Makoto Isida, head of the Second Airframe Division, National Aerospace Laboratory, Japan,

served as visiting professor until January 1966. (40) Paul Paris and George Sih were advanced to full professor rank. (41)

The effect of wind forces on rockets and missiles was studied in two research projects under the direction of Professor Beer. One research project, sponsored by the Army Electronics Material Agency, was concerned with theoretical and experimental methods of predicting the response of unguided rockets to wind. The National Aeronautics and Space Administration sponsored a project to predict the extent of structural damage to spacecraft as a result of varying wind velocities encountered as the vehicles rise through the atmosphere. (42)

In academic year 1965-66, Lehigh was granted \$720,000 in federal funds to conduct fundamental research on the mechanisms of corrosion of materials. Dr. Paul Paris was to direct the Lehigh phase of the \$3.9 million contract granted to the U.S. Naval Research Laboratory. (43)

In academic year 1966-67, Dr. Arturs Kalnins was advanced from associate professor to full professor of mechanics in the department of mechanics. (44) A National Aeronautics and Space Administration grant generated a search for a refined method of calculating the stress on atmospheric re-entry vehicles. (45)

In academic year 1967-68, Robert J. Ravera was promoted to assistant professor of mechanics from instructor in the College of Engineering (46) and Dr. Vahram Biricikoglu to assistant professor of mechanics. (47)

Dr. Albert C. Zettlemoyer, vice president of research, announced the appointment of Dr. George C. Irwin as Boeing University Professor. Irwin's appointment was the culmination of a close relationship between Boeing Aircraft Corp. and Lehigh that began in 1960. At that time Boeing supported research that initiated a continuing study of fracture mechanics at Lehigh. (48)

In May 1967, Dean of Engineering Karakash proposed that the undergraduate curricula of the departments of mechanical engineering and mechanics be consolidated, and that the departments be joined, and that the joint department be known as the "Department of Mechanical Engineering and Mechanics." A study committee was formed and the process began.

It was expected that the faculty would continue to hold appointments in either mechanics or mechanical engineering and that new appointments would be made under either title. It was proposed that a joint undergraduate curriculum be created, consisting of common freshman, sophomore, and junior years and of a senior year offering a wide selection of courses. Depending upon the program he chooses during his senior year, each student would be graduated with either the B.S. in mechanical engineering or the B.S. in engineering mechanics. It was proposed that M.S. and Ph.D. degrees be offered in both mechanics and mechanical engineering with separate qualifying and general Ph.D. examinations.

In July 1968, the separate departments of mechanics and mechanical engineering were merged. (49)

The mechanics department trained many noteworthy graduates. Following is a list of Ph.D. students who graduated and stayed at Lehigh for post-doctoral studies. They were subsequently considered for tenure-track positions in the department, and their advisors are also noted: (50)

Jacob Kazakia (Professors Rivlin and Varley) joined the faculty in 1972 as assistant professor, Center for the Application of mathematics,

Herman Nied (Professor Erdogan) returned from industry to join the faculty in 1995 as professor and chairman of mechanical engineering and mechanics,

George Sih (Professor Smith) joined the faculty in 1961 as assistant professor of mechanics,

Robert Sarubbi (Professor Beer) joined the department in 1968 as assistant professor of mechanical engineering and mechanics and served as associate chairman under Professor Beer,

Robert Ravera (Professor Beer) joined the department in 1968 as assistant professor of mechanics,

Ted Terry (Professor Erdogan) joined the faculty in 1955 as assistant professor of mechanical Engineering,

Robert Lucas (Professor Erdogan) joined the faculty in 1964 as assistant professor of mechanical engineering and served as associate chairman under Professor Harlow,

Richard Roberts (Professor Erdogan) joined the faculty in 1964 as assistant professor of mechanical engineering,

Ronald Hartranft (Professor Sih) joined the faculty in 1966 as assistant professor of mechanical engineering.

In June 1969, two short courses in fracture mechanics were offered as a two-week sequence for a complete grounding in fracture mechanics methods. Dr. Paul Paris, professor of mechanics, served as course leader of “fundamentals of fracture mechanics.” Professors George R. Irwin and George C. Sih served as course leaders of “advanced analytical methods of fracture mechanics.” (51)

Dr. George R. Irwin, Boeing university professor of mechanics, was named a winner of the Alumni Honor Award by the University of Illinois, College of Engineering. Irwin’s analytical work on the stability of cracks, known as the “Griffith-Irwin theory,” formed the basis of fracture theory. (52)

The 1966/67 course catalog listed 25 mechanics courses, including 11 courses at the graduate level. (53) After the merger of the mechanics department and the mechanical engineering department, the 1969/70 course catalog listed 23 mechanics courses. (54) Missing were Mech 10, Problem Computation Laboratory; Mech 104, Fluid Dynamics; Mech 302, Advanced Mechanics of Materials; Mech 305, System Dynamics; Mech 306, Experimental Methods in Mechanics; and Mech 404, Advanced Vibrations Analysis. Two new mechanics courses appeared in the catalog: Mech 424, Unsteady Fluid Flows, and Mech 407, Wave Propagation in Solids.

The decision to merge the mechanics and mechanical engineering departments came 10 years after the announcement establishing the division of mechanics.

Source: Lehigh course catalogs							
1957/58	prof	Beer					
	assoc	Johnston					
	asst	de Neufville	Osborn	Parke			
1958/59	Prof	Beer					
	assoc	de Neufville					
	asst	Osborn	Parke				
1959/60	prof	Beer					
	assoc	de Neufville					
	asst	Osborn	Parke	Smith			
1960/61	prof	Beer					
	assoc	de Neufville					
	asst	Sih	Taylor	Warnock			
1961/62	prof	Beer					
	assoc	de Neufville	Sih				
	asst	Osborn	Taylor	Warnock			
1663/64	prof	Beer					
	assoc	de Neufville	Osborn				
	asst	Paris	Sih	Taylor	Warnock		
1964/65	prof	Beer					
	assoc	de Neufville	Osborn	Paris	Sih		
	asst	Sarubbi	Taylor	Warnock			
1965/66	prof	Beer	Erdogan				
	assoc	de Neufville	Osborn	Paris	Sih		
	asst	Taylor	Warnock				
1966/67	prof	Beer	Erdogan	Paris	Sih	Smith	
	assoc	de Neufville	Kalnins	Osborn			
	asst	Perlman	Updike	Warnock			
1967/68	prof	Beer	Erdogan	Paris	Sih	Smith	
	assoc	Kalnins	Osborn	Wei			
	asst	Hartranft	Karna	Perlman	Updike		
1968/69	prof	Beer	Erdogan	Irwin	Kalnins	Paris	Rivlin
	prof	Sih	Smith	Varley			
	assoc	Osborn	Wei				
	asst	Hartranft	Lennox	Ravera	Salathe	Updike	
	senior	junior	sophomore	freshman	total		
Fall 1957	1	7	10	1	19		
Spring 1958	1	6	10	2	19		
Fall 1958	7	9	9	0	25		
Spring 1959	7	7	7	0	21		
Fall 1959	7	10	13	2	32		
Spring 1960	6	11	13	0	30		
Fall 1960	12	11	4	0	27		
Spring 1961	13	9	4	0	26		
Fall 1961	11	7	10	0	28		
Spring 1962	10	9	11	0	30		
Fall 1962	7	12	6	0	25		
Spring 1963	9	11	4	0	24		
Fall 1963	13	6	13	1	33		
Spring 1964	13	5	10	0	28		
Fall 1964	6	9	10	1	26		
Spring 1965	8	8	7	0	23		
Fall 1965	10	10	14	0	34		
Spring 1966	12	11	11	1	35		
Fall 1966	10	8	13	0	31		
Spring 1967	8	11	7	0	26		
Fall 1967	8	9	4	0	21		
Spring 1968	8	8	3	0	19		
Fall 1968	9	2	4	0	15		

Mechanics Department faculty members and undergraduate enrollment: 1957-1968



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28. "Campus News Brief". *Brown and White*, 12 March 1963. Vol. 74, 36, p. 5.

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## The Mechanical Engineering and Mechanics Department<sup>1</sup>

In 1969-1970, the new department of mechanical engineering and mechanics had two university professors: Professors Irwin and Rivlin, ten professors of mechanics or mechanical engineering: Professors Beer; Benner; Erdogan; Kalnins; Owczarek; Paris; Sih; Smith; Stenning and Varley, six associate professors of mechanical engineering or mechanics: Associate Professors Eppes; Jackson; Osborn; Sarubbi; Terry and Wei, Associate Professor of Physics Blythe, Adjunct Associate Professor Nevis, eight assistant professors: Assistant Professors Biricikoglu; Hartranft; Levy; Lucas; Ries; Roberts; Salathe and Updike, two instructors, 11 teaching assistants, and 16 research assistants. (1) It was the largest department on campus. Professor Beer was the department head.

The mechanical engineering and mechanics department received a three-year grant for \$670,000 from the National Science Foundation and a two-year grant for \$400,000 for research in fluidics and fluid control systems using fluidic devices from the Department of Defense. (2) The Atomic Energy Commission sponsored continuing research titled “Influence of Temperature on Fatigue-Crack Growth” directed by Professor Wei. NASA sponsored continuing research titled “Elastic and Plastic Analyses of Fracture Theories and Crack Problems” directed by Professor Sih. (3) But department news virtually disappeared from the Brown and White during the latter years of the Vietnam War.

Periodically, war affected the university, as it did the nation. During WWI and WWII students joined the armed forces or were drafted, faculty left to bolster the war efforts, finances were strained. The effects of the Korean War were similar but less disruptive. The effects of the Vietnam War were altogether different. By 1970, there was widespread opposition to the government’s prosecution of the war. On campuses across the country demonstrations against the war were suppressed by police, sheriff’s deputies, highway patrolmen and National Guard troops. Demonstrators were tear-gassed, jailed, beaten and, at Kent State University in 1970, four were killed and nine wounded by Ohio National Guard troops.

There was a significant national response to the shootings: hundreds of universities, colleges, and high schools closed throughout the United States due to a [student strike](#) of four million students, and the event further affected public opinion—at an already socially contentious time—over the [role of the United States in the Vietnam War](#). (4)

Scientists on as many as 30 campuses across the nation paused to discuss the implications of their work. A national movement to temporarily suspend scientific research began at MIT where 1200 researchers and students discussed the possibilities of re-orienting research toward areas of social progress. (5) Lehigh Professor James McIntosh, instructor of sociology, suspended his regular class instruction “as a gesture of support and in sympathy with those striking.” (5)

In July 2015, Professor McIntosh recalled his early days at Lehigh:

*“I arrived to an all-male campus and very conservative place in fall, 1966. I had committed civil disobedience in Syracuse as a CORE member and again in Selma. I was astonished at the lack of student and faculty activity in protesting the war, never mind encouraging the civil rights movement. There was*

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<sup>1</sup> Almost all of the information herein came from the Brown and White archives or the Lehigh course catalog archives.

*hardly any anti-war movement until the total elimination of the 2S deferment and the lottery system was introduced in 1969. A couple of flash points from 1970 that I recall: the Kent state killings produced a solemn candle light march controlled by the Chaplin and deans of students. The nationwide student strike that followed was received in mixed fashion at LU. I went to my class and they were all there but on strike. They wanted to talk about Kent State so I made them go outside.*

*It was a hit or miss proposition. There were protests about ROTC being on campus and the Dow Chemical recruitment team was picketed. Campus governance became an issue as the student body began to catch up to their nation-wide peers. However, they seemed more opposed to local issues than national politics. The first sit-in of the President's office was a demand for more professors to be hired in the Social Relations Department. Caps were not allowed on class size by the registrar and I had a seminar of over 50 students! The general feeling was students were flexing their muscles as they complained about various rules they were to follow. Eventually, the student government called the Arcadia voted itself out of existence. I do recall an evening rally in Grace Hall where President Lewis spoke after a meeting with the trustees in New York earlier in the day. He scolded a few students who tried to interrupt him with guerrilla theater and threatened to walk out. The majority of the student body supported him and booed their radical peers. I believe Lewis announced something along the line as we feel your pain and will do something about it. The Forum was created as a combination faculty & student governing body. Year was 1970. I do not recall when it expired as a governing body but I do recall faculty refusing to participate because of the endless meetings!"<sup>2</sup>*

The Vietnam Moratorium Committee, a national organization to bring pressure on the government to end the war in Vietnam through national student strikes, held an organizational meeting on campus. It was attended by a small group of students and faculty member Charles Vihon. (6) Professor Joe Osborn of the mechanical engineering and mechanics department was a counselor on affairs related to the draft and conscientious objector status. (7)

University administrations generally opposed the antiwar movements and suffered the same loss of confidence that the national government experienced. University governance systems were examined. Lehigh had an organization called "Arcadia" through which students had a voice on campus. Debates over the war, disputes over which speakers could or should come to campus, led to discussions of restructuring the university's governance system. (8)

At a mass meeting, students overwhelmingly supported a resolution calling for the establishment of a Student-Faculty Forum with the power to legislate and review all University policy. (9) Over 750 people attended an engineering college meeting to present, consider and discuss the proposals of the various departments regarding a forum. Student participants from the mechanical engineering and mechanics department thought the forum should consist of 20 students and 20 faculty. Department faculty suggested a forum of 30 students, 30 faculty and 5 administrators to be elected each fall, beginning in 1970. (10)

In April 1970, the university faculty overwhelmingly ratified a constitution for the University Forum. The constitution defined the forum's functions as having the legislative authority to set policy with respect to extra-curricular activities, academic environment, and the academic program and planning. (11) The University Board of Trustees unanimously approved creation of a joint student-faculty-administration forum and accepted its constitution. (12) Professor Ferdinand Beer, chairman of the mechanical

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<sup>2</sup> Reminiscence generously provided by James McIntosh, professor of sociology and anthropology, fall 2015.

engineering and mechanics department was elected the first forum chairman. (13) Arcadia suspended operations and organized a group of six students to make recommendations to Arcadia and the Forum on what should become of Arcadia. (14)

In September, 2015, Professor Rockwell, M.S. in Mechanical Engineering, Lehigh, 1965; Ph.D., 1968, appointed to the faculty in 1970, recalled departmental life during the Vietnam war years.

*As of 1970, the merger of the Department of Mechanical Engineering and the Department of Mechanics had been completed. Enhancement of the Department through appointment of senior faculty was made possible by a major grant from the National Science Foundation coordinated by Ferdinand Beer. That initiative brought Forbes Brown and John Chen to us.*

*In the spring of 1970, the Kent State tragedy markedly affected our students and faculty, and Ferdinand Beer, Chair of our Department, emerged as a campus leader amid student unrest at meetings that filled Grace Hall. He led the newly formed University Forum, with the aim of enhanced dialogue between faculty and students.*

*Within the Department, the educational process soon returned to its normal, rigorous state. The atmosphere was collegial and supportive among faculty colleagues, but could be quite spirited. Defense of doctoral dissertations sometimes involved contentious interactions between faculty having different perspectives. Internal seminars given in the Department by leading Lehigh researchers in the area of solid mechanics were strongly attended by faculty colleagues, who enjoyed learning the consequences of theoretical approaches of counterparts at other universities and new directions of thinking at Lehigh.*

*Undergraduates benefited greatly from high-caliber textbooks written by faculty in our Department. Ferdinand Beer (and his colleague Russell Johnston) dedicated great care to optimize the quality of their books on statics and dynamics, which had large international impact. Jerzy Owczarek had just completed his textbooks on fundamentals of fluid mechanics and gas dynamics. The level of sophistication of these works, using vector calculus approaches, is well above what is typically taught these days in most undergraduate fluid mechanics courses. Those who went on to graduate work at other universities remarked that they were extremely well prepared. During a later era of the Department, Forbes Brown completed his book on engineering system dynamics, which introduced our students to a unique and effective approach using bond graphs. The influence of this approach extends beyond mechanical engineering to nearly all other engineering disciplines.*

*This era also marked the onset of larger-scale, long-term programs and funding in fluid mechanics and flow-structure interaction, as a complement to ongoing research in these areas. Jerzy Owczarek directed project THEMIS, a DoD program that engaged a team of faculty and focused on fluidics and flow control. Funding from an international foundation was introduced to the University in the form of long-term grants from the Volkswagen Foundation of Germany on flow-structure interaction, which I secured following a sabbatical as a von Humboldt Fellow. I was fortunate that this research theme served as the basis for decades-long funding from the National Science Foundation, the Air Force Office of Scientific Research (AFOSR), and the Office of Naval Research (ONR), as well as grants from NASA. These research programs led to invitations from AFOSR and ONR to organize international workshops, held at Lehigh, in order to identify critical unresolved issues and provide guidance on flow-structure interactions to university researchers and national laboratories. A physical understanding of turbulence and*

*turbulent boundary layers was advanced by the productive collaboration of Charles Smith and David Walker, who came to Lehigh with Douglas Abbott, and received continuous funding for many years from AFOSR. Charles Smith became the pre-eminent authority on bubble flow visualization of turbulence and turbulent boundary layers, and David Walker pioneered a deep understanding of these flows through theory and computations, which won international acclaim, including his receiving the Senior Scientist Award of the von Humboldt Foundation of Germany.*

*Meetings of Department faculty were consistently cordial, well attended occasions held in the conference room next to the Dean's office. Close quarters promoted an awareness of the cigarette and cigar smokers among us. Written communication within the Department was printed on a mimeograph machine, then distributed to mailboxes. Changes or corrections immediately prior to printing were, of course, not encouraged. Faculty mail was collected from sliding metal drawers located behind the counter at the entrance to the main office- no worries about hacking of those inboxes. Jacket and tie was the expected attire within the Department, and especially in the faculty dining room located in the University Center, where it was often difficult to secure a table if one was a few minutes late. One hour lunches, often with colleagues from other Departments and Colleges at Lehigh, involved debates and discussions of major issues of the day, ranging from local politics to international issues and finance, typically resulting in well informed faculty, but no defined course of action. These informative lunches were complemented by daily meetings of the Fifth Floor Coffee Club in Packard Lab, which was actually open to all of our Department. The annual faculty awards dinner, usually held in Grace Hall, was preceded by gathering of smaller groups of faculty from our Department at a local establishment. The dinner itself was very festive, and the MC for the evening did not hold back in poking fun at both administration and faculty colleagues.<sup>3</sup>*

Professor Beer was replaced as chairman of the Forum by Professor of Chemical Engineering Curtis Clump, keeping the leadership position of the Forum in engineering hands. (15) Finally, in a look back at a decade of student political activity on campus, for the purpose of acquainting incoming students with the Forum and the issues with which it deals, the catalyst for the formation of the Forum was said to have been the firing of a popular social relations professor without consultation with that department. No mention was made of antiwar sentiment. (16) Congress gave President Richard Nixon what he asked for: a two-year continuation of the draft; authority to end student deferments; and no significant limits on his war or defense policy. (17)

In 1970-1971, Thomas Jackson was promoted to full professor, Robert Lucas and Richard Roberts were promoted to associate professor and Forbes Brown and Vedanth Kadambi joined the department as associate professors. Kemal Aren and Peter Hilton joined the department as assistant professors. (18) Associate Professor of Mechanical Engineering and Mechanics Ted Terry was a member of a team of Lehigh ocean engineers that reported the first successful use of a nuclear densitometer attached to a submersible vessel. (19)

Emeritus Professor Terry, M.S. Lehigh, '51, Ph.D., '63, member of the department 1951-1995, recalled the dives he experienced.

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<sup>3</sup> Reminiscences of the Vietnam War years from Professor Rockwell, September 2015

*Following a trip on the research vessel USS Alimos (sponsored by Lehigh's Center for Marine and Environment Center in 1969) Professor Terry developed an interest in obtaining more accurate strength measurements than those obtained by conventional coring sampling. As a member of the Marine Geotechnical Laboratory, he participated in a dive in the Alvin submersible in the Hudson Canyon using a nuclear densitometer. This was activated using the Alvin's mechanical arm at a depth of 2650 feet. Later he and students designed a probe tower to be operated from a research submersible. This was attached to the Lockheed Deep Quest Submarine and with members of the Marine Geotechnical Laboratory made a series of dives in the San Diego Trench, to a depth of 4050 feet. Shear strength readings were made to a soil depth of 10.5 feet in the bottom sediments. In addition, measurements of density were made using the bident containing a nuclear source in one leg and a detector in the second leg. He also designed a laboratory bench detector that could be used to rapidly scan drilling cores for density variations. With Professor Adrian Richards, director of the Marine Geotechnical Laboratory at Lehigh, this was tested on the Glomar Conception drilling ship off the coast of Florida.*<sup>4</sup>

In 1971-1972, John Chen joined the department as full professor of mechanical engineering and mechanics, Forbes Brown was promoted to full professor of mechanical engineering and Robert Wei was promoted to full professor of mechanics. Gerald Smith joined the Center for the Application of Mathematics, Alistair MacPherson joined the department as associate professor of mechanical engineering and mechanics. (20) Professor James Eppes was promoted to full professor and Assistant Professors Ronald Hartranft, Edward Levy, Donald Rockwell, and Dean Updike were advanced to the rank of associate professor. (21) Professors Beer and Eppes completed 25 years of service. (22)

*...Lehigh admitted women to the University in 1971. I transferred into Lehigh's Mechanical Engineering program as a junior that year and was proud to become its first female to graduate with a B.S. in Mechanical Engineering in 1973.*<sup>5</sup>

Dr. Alan Stenning, a member of the mechanical engineering department from 1965 to 1972 and acting chairman from 1966 to 1972, was found dead in his home in Pittsburgh. (23) Professor Joseph Osborn was seriously injured when his bicycle was hit by a car. He was found lying unconscious on the roadway, his mangled bicycle beside him. (24)

Dr. Andrew Dimarogonas was named associate professor of mechanical engineering (25) but 2 years later Professor Dimarogonas resigned his position and left the United States for France following a civil suit lodged against him by his former employer General Electric alleging he tried to publish papers containing "proprietary information." Dimarogonas said he hoped to return to the United States some time to teach in a place "where there are no pressures." (26)

Professors Edward Levy, Donald Rockwell and Robert Sarubbi were promoted to rank of full professor, Stanley Johnson was promoted to the rank of associate professor of mechanical engineering and mechanics. (27) Professor Ronald Hartranft was promoted to full professor. (28) The department received a gift of two large air compressors from Ingersoll-Rand, aided by a contract from the Energy Research and Development Administration and several contributors. (29) Peter Hilton, associate professor of mechanical engineering and mechanics joined two other faculty in a task group conducting a science and

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<sup>4</sup> Contributed by Emeritus Professor of Mechanical Engineering and Mechanics Tedeodore Terry, November, 2015.

<sup>5</sup> An excerpt from an email from Patricia Teller Beading, LU '73.



technology exchange between the United States and the Soviet Union. (30) Thomas Jackson, professor of mechanical engineering and mechanics and a full-time faculty member since 1937 retired. (31)

*Tom came to Lehigh in 1935, having studied at Carnegie in Pittsburgh. Milton Stuart hired him and supervised him in his studies in thermodynamics. His Masters thesis topic was combustion indication in multi-cylinder diesel engines.*

*Tom supervised the Mechanical Engineering laboratory sessions. He also supervised the ME Machine Shop. He re-organized the Shop in 1965 and was a troubleshooter in the ME labs and shop which were part of the Packard Lab major renovation occurring near his retirement in 1977. Tom continued teaching thermodynamics, notably the Engines and the Jets courses, as an adjunct professor until his final retirement in 1981. His classroom teaching featured true recitation with students working problems at the blackboard. His personal consultations were even more effective, beginning with a brief assessment of the student's status, then proceeding with paper and pencil and conversation to the desired level of clarity.*

*The following is a brief and incomplete listing of Tom Jackson's extracurricular activities:*

*Member of the Board of Governors for the ABE airport*

*Caretaker of the Japanese garden near the Bethlehem Public Library*

*Contributor to the Kemmerer Museum of Bethlehem*

*Practitioner and collector of the Japanese art of Bonsai*

*Elder of the Church of Christ in Bethlehem*

*Expert courtroom witness*

*Author of one unpublished thermodynamics book*

*Curator of the Packard automobile until his death in 1998, including:*

*Driver in the opening of Route 378 and the Packard 75<sup>th</sup> anniversary celebration*

*Inventor of slide rule improvements*

*Advisor to Phi Sigma Kappa fraternity<sup>6</sup>*

The university established a new interdisciplinary research center, the Energy Research Center, under the direction of Edward Levy, professor of mechanical engineering and mechanics. (32)

*Originally founded in 1972 as the Task Force for Energy Research, the Energy Research Center (ERC) was converted into a multidisciplinary research center in 1978. Research within the Center, supported by contracts and grants from government and industry, focused on fuels and energy resources, electric power generation technologies, energy conservation and the environment. Participants in the Center included faculty and students from Mechanical Engineering and Mechanics, Materials Science and Engineering, Chemical Engineering, Industrial and Systems Engineering, Civil and Environmental*

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<sup>6</sup> Communication from Richard Towne, LU '72 and Laboratory Operations Supervisor, November 2015.

*Engineering, Electrical Energy, Earth and Environmental Sciences, Physics and Chemistry and a professional research staff supported by the ERC.*

*From its inception in the 1970's to 2015, the Center has received more than \$60 million in research funding from external sources. Funding for the Center came from grants and contracts obtained from U.S. government agencies such as the National Science Foundation, Department of Energy, Environmental Protection Agency, and the Department of Defense. Other sponsors included private sector companies in the electric power generation industry, research institutes such as the Electric Power Research Institute, and companies and research institutes in other countries involved in electric power generation technologies. From its inception in the 1970's to 2015, the Center received more than \$60 million in funding from external sources.*

*The Energy Research Center has also been active in education of Lehigh students through its research programs. Over 200 MS and Ph.D. students participated in energy research projects for their theses and dissertations through 2015, and undergraduate students participated in energy research projects as Summer Research Interns or as students enrolled in undergraduate project courses.*

*Professor Levy served as Center Director from 1978 until his retirement in 2013. Dr. Carlos Romero, a Principal Research Scientist in the Center, was appointed Center Director in 2013.<sup>7</sup>*

The university established another new interdisciplinary research organization, the Institute of Thermofluid Engineering and Science, headed by John Chen, professor of mechanical engineering and mechanics. (33)

Ronald Rivlin, centennial university professor of mechanical engineering and mechanics and director of the Center for the Application of Mathematics had the highest salary on campus, exceeding even that of University President Deming Lewis. He had published “well over 200 articles,” 56 of which were cited in 1978 alone. Eleven other Ph.D.’s work for CAM as researchers or teachers. Together they “pull in quite a bit of research money from the outside,” Rivlin said. “We are considerably involved with the mechanical engineering department,” Rivlin added. (34)

In 1981, Douglas Abbott, professor and chairman of mechanical engineering and mechanics and director of the CAD/CAM educational program said “We have the best integrated CAD/CAM two-department program in the country.” The program was developed in the mechanical engineering and mechanics and industrial engineering departments. Twenty-three industrial partners contributed funds totaling \$3.3 million. Assistant Professor of Mechanical Engineering John Ochs said that the 23 companies supporting the CAD/CAM program asked for between two and five summer hires having computer-aided design and computer-aided manufacturing experience. (35) Donald Bolle, dean of the college of engineering and physical sciences announced that the university had begun drawing up a proposal to the state of Pennsylvania for a “Ben Franklin Technology Center,” of which CAD/CAM will be a major part. John Ochs, professor of mechanical engineering and mechanics, was director of the CAD lab and Emory Zimmers, professor was director of the CAM lab. (36) Douglas Abbott was appointed vice provost for computing and information services by Provost Arthur Humphery. Abbott would be responsible for the

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<sup>7</sup> Brief history of the Energy Research Center by Professor Edward Levy, September 2015.

management of the university libraries the university computing center, the institution-wide interactive facilities and communication systems. (37)

*“In my opinion the department leadership was the driving force in the growth of the department in Design and Laboratory development. Design morphed from classical engineering design to Technical Entrepreneurship following a national trend that was captured by Lee Iacocca (Lehigh IE '54) who said “Innovate, Automate, Emigrate or Evaporate.” During this 36 year time span we witnessed the demise of Bethlehem Steel going from 16,000 plus employees in Bethlehem to bankruptcy. However, this was accompanied by the start of the Ben Franklin Technology Centers with Bethlehem having one industrial park in 1983 to today when we now have Lehigh Valley Industrial Park #7 with 440 companies and 22,000 employees.*

*The evolution of the department followed a natural sequence of engineering design, design in a broad context, computer-aided design, computer-aided manufacturing, manufacturing automation, robotics, mechatronics, Integrated Product Development (IPD) and Technical Entrepreneurship (TE). This was accomplished while maintaining the rigor of engineering mechanics and the fundamental principles of mechanical engineering. Under Chairman Douglas Abbott's leadership Lehigh University CAD/CAM program became nationally and internationally known with the MEM department offering the first CAD/CAM courses in the undergraduate curriculum in the USA. Over \$5M was raised from Lehigh Alumni and Industry sponsors with support from industrial leaders as Lee Iacocca (Chrysler), Bill Hittinger (RCA), Dexter Baker (Air Products), Harold Mohler (Hershey Foods). Companies such as AT&T, Bell Labs, Johnson & Johnson, General Motors and several aircraft companies were coming to Lehigh to learn CAD/CAM and later computer-aided engineering using new numerical techniques such as Finite Element Modeling and kinematic and dynamic system modeling.*

*In 1983 with leadership from Doug and others at Lehigh and across the Commonwealth of Pennsylvania, the Ben Franklin Partnerships were established in Pittsburgh, Philadelphia, Harrisburg/Penn State, and at Lehigh representing the northeast tier of the state. Under this proposal, technical entrepreneurship became the economic engine that it is today.*

*Fazil Erdogan - 1986 to 1990. Fazil continued the support and growth of the programs started under Abbott's leadership adding manufacturing and automation faculty and labs. It was said that before the 1980's, MEM graduates never had to actually make anything. Under Fazil's Leadership this changed. MEM students had to design and produce real-world products and these were made in new MEM shops.*

*Robert Wei – 1990 to 1996. In 1992 Bob convened a two-day industry workshop with a focus on MEM graduates: what is working and what needs improvement. The general consensus was that our student were technically sound but had no idea about the business context of their work and were ignorant of the look, style, aesthetics or ergonomics of their designs. The conclusion of the workshop was the formation of Lehigh's nationally recognized and award winning Integrated Product Development (IPD) program where students from engineering, business and industrial design work on industry sponsored projects. Industry sponsors supply the projects and domain expertise and the Lehigh faculty act as guides on the side mentoring student teams to create new products. In 1996 the pilot had 3 teams of three students. The pilot won the first ASME curriculum innovation award and today the program has grown to 235 students from 8 majors working in 33 teams on 25 sponsored projects. In 2012 the National Academy of*

*Engineering recognized Lehigh's IPD program as one of the top senior design programs in the country providing our student with real world experience so they can hit the ground running at their first job.*

*Charles Smith - 1996 to 2002 As the IPD program grew, in many cases entrepreneurially-oriented students wanted to work on their own ideas, rather than one from a company. The on-campus presence of the Ben Franklin Partners encouraged graduate students and faculty to commercialize university funded R&D and offered space and business assistance to local entrepreneurs. During Chuck Smith's tenure as MEM department's leader and with the opening of the New Rauch Business Center and the Zoellner Arts Center, the MEM department became the driving force behind the development of the first campus wide Maker space in the Wilbur Powerhouse. In its 17,000 sq ft undergraduates could work in a space where "design and entrepreneurship meets." Started in 2000 with a \$5M funding raising effort, the building opened in 2002 providing IPD and design students a place to develop and commercialize their ideas.*

*Herman Nied - 2002 to 2008 During Herman's tenure the department led the effort to grow interdisciplinary degrees such as Integrated Business and Engineering (IBE). Grants from the US Department of Labor, Commerce and Education grew the IPD, IBE and entrepreneurship programs. With a new president and her new vision, the entrepreneurship initiatives became central to the department, college and university's strategic plan. Graduate courses in IPD and interdisciplinary courses from business and arts saw the numbers of students and faculty engaged in entrepreneurial startups grow.*

*During Herman's tenure with support from the NSF, the college launched a bio-engineering undergraduate major with the graduate degree following in 2012. These new programs are having profoundly positive impact on MEM and other majors with new MEM faculty having research and development impact in the areas of bio-mechanics, cell and tissue and bio medical devices.*

*Gary Harlow - 2008 to present. In 2010 with a grant from the Dexter F and Dorothy H Baker Foundation, Lehigh's Baker Institute for Entrepreneurship, Creativity and Innovation was launched to be the umbrella for campus wide entrepreneurial activities. The IPD program and MEM department were substantial underwriters of this effort with shared staffing and financial support. In 2012 with support from the Baker Institute, the MEM department's Master of Engineering in Technical Entrepreneurship was launched. In this award winning masters enrolled students have dedicated faculty working in a dedicated space in the Powerhouse offering a curriculum dedicated to student entrepreneurs who must design a new product or service and launch it in one year.*

*In the past 7 years Gary has shepherded in the next generation of MEM faculty, many of whom have the entrepreneurial mindset and are very hands-on. Through the past decade the number and quality of labs has continued to grow as shown in the list below. In the next 7 years the number of new faculty will*

*continue to grow and will invigorate research and development as well as continuing the entrepreneurial efforts that started back in the 1980's”<sup>8</sup>*

Promoted to the rank of full professor of mechanical engineering and mechanics were Charles Smith and J. David Walker. Sudhakar Neti and John Ochs were promoted to associate professor of mechanical engineering and mechanics. (38)

In 1982, Fazil Erdogan was the first recipient on the Libsch Research Award, a university wide recognition, for excellence in research and scholarship. Subsequently, Donald Rockwell and David Walker received the Libsch Award in 1989 and 1991 respectively. (39) Eugenio Schuster won the Early Career Libsch Award in 2011. (40) In 1982, Assistant Professor Kyra Stephanoff became the first female member of the department.

*The Center for the Application of Mathematics (CAM) was formed in Fall, 1965. Everett Pitcher (Mathematics) served as the acting Director in 1966. The initial policy committee consisted of:*

*Deming Lewis (University President)*

*Ferdinand Beer (Mechanics)*

*Arthur Brody (Psychology)*

*Donald Hillman (Philosophy)*

*Jerzy Owczarek (Mechanical Engineering)*

*Sutton Monro (Industrial Engineering)*

*In 1967 Ferdinand Beer followed Pitcher as the acting Director. Ronald Rivlin arrived as the permanent Director in the Fall of 1967, and served in that capacity until 1981 when Gerald Smith became acting Director. Smith served as the full-time director until CAM was dissolved in 1990. Rivlin continued as an Adjunct Professor at Lehigh. Over the period 1982-83, members of CAM were given standard academic appointments in Mechanical Engineering & Mechanics (MEM), Mathematics, and Chemical Engineering. Those joining MEM on a permanent basis were:*

*Philip Blythe*

*Jacob Kazakia*

*Kenneth Sawyers*

*Gerald Smith*

*Eric Varley*

*A Division of Engineering Mathematics was created within MEM in 1983. The Division consisted of the members of CAM listed above together with (at various stages)*

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<sup>8</sup> Communication from Professor John Ochs, director of the Integrated Product Development program, August, 2015.

*Terry Delph*

*Fazil Erdogan*

*Gary Harlow*

*Stanley Johnson*

*Arturs Kalnins*

*Antonios Liakopoulos*

*Alistair MacPherson*

*Herman Nied*

*Alparslan Öztekin*

*David Walker*

*Blythe served as head of the Division from 1983-1999. A graduate program in Applied Mathematics, developed jointly with the Mathematics Department, was introduced in 1981. Within MEM, the latter program was replaced in 1998 by a new graduate degree program in Computational & Engineering.<sup>9</sup>*

In fall 1983, Fazil Erdogan, chairman of the department of mechanical engineering and mechanics, received the prestigious Alexander Von Humbolt Senior U.S. Scientist award. He was granted a leave of absence to conduct research at the Ernst-Mach Institute of Applied Mechanics at Freiburg, West Germany. (41)

*In 1998, Lehigh held a symposium honoring Fazil Erdogan, expert in fracture mechanics, professor emeritus of mechanical engineering and mechanics and former dean of engineering. Forty researchers from around the world, many of them Erdogan's former students, presented papers.<sup>10</sup>*

The Zenith Z-100 and the International Business Machines PC were offered to students at a discount according to Mark Lang, assistant professor of mechanical engineering and mechanics and director of the microcomputer evaluation project sponsored by the Ben Franklin Partnership. (42)

Kyra Stephanoff, assistant professor of mechanical engineering, was among the first to receive the new national Presidential Young Investigator Award. (43)

Ferdinand Beer, University Distinguished Professor of mechanical engineering and mechanics retired in 1984. (44)

In 1985, several Lehigh professors joined a nationwide movement criticizing the Strategic Defense Initiative (SDI) commonly known as "Star Wars," as "ill-conceived and dangerous" and signed a petition objecting to university research for the project. Lehigh's official policy was to treat SDI just like any

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<sup>9</sup> Communication from Emeritus Professor Philip Blythe on the history of the Center for the Application of Mathematics, November 2015.

<sup>10</sup> Extracted from Lehigh document "Countdown to 150."

other research money the university may receive. The only restriction on contracts is that findings must be publishable, not classified or secret. There were no SDI funded projects at Lehigh. (45) University policy required professors who own private corporations that could undertake funded research to report these businesses and their earnings to the university each year. (46)

742 acres and five of eight buildings on Bethlehem Steel Corp's Homer Research Laboratories property were purchased by Lehigh. Building H would house the Engineering Research Center for Advanced Technology for Large Structural Systems (ATLSS). (47)

Arkady Voloshin was granted tenure at the rank of associate professor of mechanical engineering and mechanics. (48) Ronald Rivlin, professor emeritus and adjunct professor of mechanical engineering received the Timoshenko Medal of the American Society of Mechanical Engineers for pioneering research of fundamental importance in solid and fluid mechanics. (49) John Ochs, associate professor of mechanical engineering and mechanics was appointed to the board of directors of the National Computer Graphics Association. (50)

The highest average yearly starting salary reported by Lehigh's Class of 1987 in the engineering college was \$30,600 for engineering physics. The next highest average was for chemical engineering at \$30,024. Computer science-electrical engineering was next highest at \$29,244, followed by material science and engineering at \$28,452, mechanical engineering at \$27,996, industrial engineering at \$27,672 and civil engineering at \$23,616. (51)

In 1988, three faculty were appointed to endowed chairs. Fazil Erdogan was designated the G. Whitney Snyder Professor of Mechanical Engineering and Mechanics and Donald Rockwell and Robert Wei were named Paul B. Reinhold Professors of Mechanical Engineering and Mechanics. (52)

Professor of Mechanical Engineering and Mechanics Terry Delph won the annual Lehigh-Lafayette Weekend Turkey Trot. (53) Professor Delph was selected by students to receive the 1989 Service Excellence Award for the College of Engineering. (54) In 1990, Professor Delph once again won the Turkey Trot. (55) Kenneth Sawyers, professor of mechanical engineering and mechanics, was appointed associate dean for undergraduate affairs in the College of Engineering and Applied Science. (56)

John Coulter joined the mechanical engineering and mechanics department. (57) James Van Deusen Eppes, 81, professor emeritus of mechanical engineering, passed away. He had been acting head of the department from 1961 to 1963. (58) J. David Walker was named professor of the year for 1991 by Lehigh's honorary society for mechanical engineers, Pi Tau Sigma. (59)

In 1991, the Lehigh Human Powered Vehicle Racing team participated in the annual American Society of Mechanical Engineers Human Powered Vehicle Competition for the first time, hence the name of their entry "First Attempt." (60) In 1992, Dr. Meng-Sang Chew joined the department as associate professor.

The Accreditation Board for Engineering and Technology opined that Lehigh did not meet the mandated 16 credit hours of design oriented courses for the major. (61) Subsequent changes in curriculum to better integrate engineering design led to a very favorable review by ABET. A new no-thesis MS degree program was approved. Professor John Coulter received an NSF Young Investigator grant and received a Presidential Faculty Fellow award for 1992. (62)

In 1993, Professor Erdogan won the Eringen Medal given annually by the Society of Engineering Science.<sup>11</sup>

A two-decade long relationship with the United States Golf Association Research and Test Center began with financial support for graduate students and research topics of mutual interest for undergraduates and graduate students. (63) Professor Fazil Erdogan was inducted into the National Academy of Engineering. (64) Lehigh's Integrated Product Development program was awarded the 1996 American Society of Mechanical Engineers Curriculum Innovation Award. (65)

Dr. Alparslan Öztekin joined the department in September, 1994, and Dr. Herman Nied joined in March, 1995. (66) The department was accredited for the maximum six-year period. The department was ranked 23/104 as a Research-Doctorate program by the National Research Council. (67)

Peter Likins, president of Lehigh since 1982, resigned to become president of the University of Arizona. He had a doctorate in engineering mechanics from Stanford and was a member of the mechanical engineering and mechanics department and co-taught a graduate dynamics course. (68)

Dr. Likins had championed the changing of the Lehigh mascot. Switching from Engineers to Mountain Hawks generated some negative reactions. (69) The mascot question was revisited regularly. President Farrington said, "The students initiated a process to adopt a more inclusive mascot. Not everyone at Lehigh is an engineer." He described the Mountain Hawk as, "cute." (70) The Allentown Morning Call was the last media outlet to comply with Lehigh's request to use the nickname in its publications, seven years after the Brown and White began referring to all sports teams as the Mountain Hawks in the fall of 1997. (71)

The National Science Foundation gave Lehigh a \$350,000 grant to participate in the development of the "next generation" of the Internet, Internet 2. The faculty involved included J. David Walker professor of mechanical engineering and mechanics. (72) A team of students in Lehigh's Integrated Product Development program was invited to present a product it designed at the annual conference of the National Collegiate Inventors and Innovators Alliance at The Smithsonian Institution's National Museum of American History in Washington, D.C. (73)

War came to campus once again. There were 79 students enrolled in ROTC at Lehigh and 12 seniors were expected to graduate in 2003. William D. Kuchinski, professor of military science and leadership said no Lehigh ROTC cadets would be heading to the confrontation in Iraq but did explain that ROTC students have military commitments after graduation that could involve seeing armed combat. (74)

Charles Smith, professor of mechanical engineering and mechanics, participated in the planning to introduce an engineering minor for non-engineering students. (75) An open house was held to provide guests with a taste of the new engineering minor. (76)

Mohammed El-Aasser, professor of chemical engineering and dean of the P.C. Rossin College of Engineering was appointed university provost, replacing Ron Yoshida who was earlier named as senior vice president for external relations and campus life. President Farrington strongly denied that an engineer as provost meant that Lehigh was going to become principally an engineering school. (77)

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<sup>11</sup> Pointed out by one of Fazil Erdogan's PhD students from that era.



In 2005, Lehigh became the newest member of PACE, the Partners for the Advancement of Collaborative Engineering Education. (78)

*In 2008, the Journal of Applied Mechanics published a special issue honoring Erdogan's contributions to problems of inhomogeneous and functionally graded materials. "Professor Erdogan continues to be a source of inspiration to the mechanics community," the journal wrote, "...and in providing selfless guidance to others."*

*Erdogan joined the faculty in 1957. In the 1960s and '70s, he and his students developed the first analytical approaches and solution techniques for the formulation and reduction of fracture mechanics problems involving layered media to systems of singular integral equations.*

*A member of the U.S. National Academy of Engineering, he has twice received Germany's Alexander von Humboldt Foundation Senior Scientist Award, one of science's top honors.<sup>12</sup>*

Terry Hart joined the department as an adjunct mechanical engineering professor. As a NASA astronaut, Hart made the first repair in history on an orbiting satellite in space. He and his mission crew on the STS-41C Challenger repaired the crippled Solar Maximum satellite in 1984. (79) (80)

*As is often said about life, timing is everything, and I certainly had the good fortune to be a student of mechanical engineering and engineering mechanics at Lehigh during a particularly interesting time in our nation's history.*

*I had taken courses given by both departments in the mid-60's from many of our most memorable faculty members, including Ferd Beer, Paul Paris, J. C. Osborn, Ralph Long, Russ Benner, and Al Stenning, as well as other notables in the engineering college, such as Al Pense. It was a spirited time at the dawn of the space age, and the race was on to develop the technology that would take us to the Moon and beyond.*

*Our new president, W. Deming Lewis, began his tenure my freshmen year. He had been a physicist at Bell Telephone Laboratories and was a key executive of Bell Comm, the systems engineering organization that Bell Labs had formed to support NASA during the Apollo program. Little did I know that I would follow in his footsteps at Bell Labs upon my graduation from Lehigh and then again at NASA as the Space Transportation System, better known as the space shuttle, was being designed and built.*

*My first good fortune came in the form of a summer job at US Steel's research center near my Pittsburgh home. Some work I had done for Paul Paris, testing fatigue cracked notch specimens of high-strength steel in Whitaker Lab, had led to that job and gave me my first impressions of working in a research lab. As I approached my senior year, however, my interests in control systems grew, and I took as many systems courses as I could fit into my schedule that year.*

*When it came time to choose between a job and going to graduate school, I found my ideal choice -- doing both at Bell Labs. I hired on at their Whippany, New Jersey, facility where the Labs was designing and building Nike-X/Safeguard, a missile defense system that would protect the US against Soviet ICBMs. It was fascinating work, trying to hit an incoming missile with your own missile accelerating at 200 G's. Part of my employment with Bell Labs included an on-campus masters program at MIT, which took me to*

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<sup>12</sup> Extracted from Lehigh document "Countdown to 150."

*Boston for one year where I continued to take as many courses as I could in controls from their faculty in the mechanical and aerospace engineering departments, as well as MIT's highly respected Draper Labs.*

*As I was finishing at MIT, the US Air Force called, and I was off to officer training school and pilot training for the next two years on a military leave of absence from Bell Labs. It was during pilot training that I first began to understand the real value of my Lehigh education in aerodynamics, control systems, propulsion, and the many other courses I had taken. Finishing at the top of my pilot training class, I had the first choice of the aircraft coming down to our class and chose the F-106 Delta Dart air defense fighter. It was a great aircraft, arguably the best fighter of that era, and I would fly it for two more years on active duty and another five years later in the Air National Guard. After a subsequent assignment in the F-4 Phantom toward the end of the war in Vietnam, it was time to return to my job at Bell Labs and some new work.*

*Bell Labs had completed its efforts on Safeguard by the time I returned, and I was assigned to do a variety of design work on telecommunications equipment for the Bell System. This led me to a second masters, this one in electrical engineering at nearby Rutgers University. Again my Lehigh education had prepared me for new opportunities, and I was busy at the Labs designing mechanical and electrical equipment for the Bell System, while also flying the F-106 with the New Jersey Air National Guard.*

*Without really planning it, all of these experiences and educational opportunities had put me in just the right place for NASA as they began to recruit their first class of astronauts to fly the space shuttle. There remained a warm affection at NASA for Bell Labs, and that, plus all that Lehigh and the Air Force had prepared me to do, allowed me to win the day for one of 35 slots for astronaut training from over 8000 applicants.*

*It was an amazing time at NASA during those years leading up to the first launch of the shuttle. John Young, chief of the Astronaut Office, gave me my first assignment during our training. My propulsion course from Al Stenning years earlier would come in handy as I represented John, who would command the first shuttle mission, during the final development and testing phase for the Space Shuttle Main Engines. That led to a follow-on assignment as Mission Control's CAPCOM for the first three launches.*

*As the shuttle moved into its operational phase, I was assigned to the crew of the first rendezvous mission, the rescue and repair of the Solar Maximum Mission satellite. With my background in controls and orbital mechanics courtesy of Lehigh, I trained with my commander, Bob Crippen, to rendezvous with Solar Max and retrieve it with the shuttle's mechanical arm, so our other crewmates could do the repair work over two space walks. As the weather balloons gathered wind data on the morning of my launch, the analytical methods developed by Ferd Beer, Fazil Erdogan, George Sih, Paul Paris, Bob Wei and others in our department, were being used in NASA's mainframe computers to determine that the structural loads on the shuttle would be within limits. They were. But things almost never go as planned the first time in space, and sure enough we did have to work around some major equipment malfunctions. The NASA team prevailed, however, and we demonstrated our new capabilities with the space shuttle as Solar Max went back into service, ultimately completing its scientific mission over the next five years.*

*I returned to Bell Labs after six years at NASA and became the head of engineering for AT&T's satellite communications division while still flying fighters with the New Jersey Air National Guard on the weekends. We designed and launched a new series of the venerable Telstar satellites as I learned to*

*appreciate the talents of our systems engineers who were applying that discipline first developed for NASA by Deming Lewis and his colleagues during the Apollo program. I felt as though I had come full circle in my engineering career, having seen so much of our technology evolve as it was now being used for new applications like our most powerful communications satellites.*

*Then came something of a career change for me. AT&T decided to divest its satellite division, and I became the president of the new venture. Fortunately I was able to take some very talented people with me to globalize and significantly grow that business over the next seven years. Another famous Lehigh professor, Rich Aronson, came to mind during those years with all of the lessons in macro and microeconomics he taught for many decades.*

*But one final turn in my career still lay ahead. For many years I had been thinking about retiring from industry early enough to make a pivot into teaching, and once again my alma mater was there for me. First as an adjunct, then a visiting professor, and now a professor of practice, I have been privileged to have the opportunity to bring my experiences into our classrooms as so many of our faculty had done for me and our long line of engineering students.*

*It has been a great ride, having come full circle, and I now realize how key my Lehigh education was to everything I have done. Nothing could be more important than preparing our students for the challenges and opportunities they will encounter in their careers, and at that, Lehigh is the best..<sup>13</sup>*

Ten years after the fact, letters to the Brown and White continue to lament the replacement of Lehigh Engineers by the Mountain Hawk mascot. (81)

Arturs Kalnins, professor emeritus of mechanical engineering and mechanics, received a top honor from the American Society of Mechanical Engineers. At ASME's 2008 pressure Vessels and Piping (PVP) Conference, Kalnins received the society's PVP Medal.<sup>14</sup>

On Sept. 2, 2009 on the Bonneville salt flats, Professor Joachim Grenestedt set a new U.S. land speed record for streamlined motorcycles with 125-cc engines running on gasoline of 133.165 miles per hour. He shattered the previous record of 125.594 mph.<sup>15</sup>

*In 2000 Joachim Grenestedt joined Lehigh and founded the Composites Lab. He had an industrial background including analysis and optimization of large composite ships. Sweden and Norway were at this time leading the way in this area, making both civil and military ships of glass and carbon fiber reinforced plastics with lightweight foam cores. Work at Lehigh concentrated on developing technologies for even larger ships made of composite materials, or steel/composite hybrids. Manufacturing and experimental testing were key areas for the lab. A CNC waterjet cutter was acquired for cutting any materials and a very large 5-axis CNC router was obtained for making complex molds. Bill Maroun was hired by the lab to assist in all research projects. A 1:35 scaled model of a destroyer was built and mechanically tested, followed by fatigue testing of a section of a 1:8 scaled specimen weighing 16 tons. The steel/composite concept proved successful and led to the design and manufacturing of the Numerette, a two-seat 9 m long high-speed offshore boat made with a lightweight stainless steel skeleton*

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<sup>13</sup> Professor Terry Hart recalled the eventful career path that brought him to professorial rank at Lehigh.

<sup>14</sup> Courtesy Kurt Pfitzer, manager, Editorial Services, Communications and Public Affairs, October 2015.

<sup>15</sup> Courtesy Kurt Pfitzer, manager, Editorial Services, Communications and Public Affairs, August 2015.

*and closed out with carbon and glass fiber sandwich panels. This craft has been operating at high speeds in the Atlantic since 2010. Riding high-speed boats in waves is in general very uncomfortable and the Numerette was often subjected to over 20 G vertical accelerations when hitting waves hard. A cure for high vertical accelerations was desired and in 2006 work began on "suspension boats", consisting of a main fuselage which is airborne and 2, 3 or 4 sponsons riding in the water. Vertical accelerations of these crafts could be reduced almost an order of magnitude, from 20 G down to around 2 G. Half a dozen small-scale suspension boats were built and at the time of writing a two-seat manned suspension boat is being built. Other projects of the lab include the development and manufacturing of ten LORCA (Lehigh Ocean Research Craft Autonomous) unmanned boats, 1.2 m long self-righting high-speed carbon fiber craft capable of operating in high sea states. Around 2009 Prof. John Spletzer, a roboticist of Lehigh's Computer Science and Engineering Department, became involved with the Composites Lab and in the following years Grenestedt and Spletzer developed a number of advanced autonomous craft, including the JetStreamer. The JetStreamer is an all-carbon fiber glider with a 6 m wing span, designed for 480 km/h (300 mph) maximum speed and 20 G load. The goal was to develop an aircraft that could be powered by dynamic soaring in high-altitude jetstreams, and thus have the potential to fly at high altitude indefinitely. At the time of this writing the aircraft is being completed and ready for its maiden voyage in the strong winds of southern Sierra Nevada. The students working on these projects have ended up in key positions in cutting-edge companies, building rocket ships, high altitude aircraft, flying cars, military vehicles, etc.<sup>16</sup>*

The university catalog for 1999-2000 listed Professors Smith (chair), Blythe, Brown, Delph, Erdogan, Harlow, Hartranft, Johnson, Kalnins, Kazakia, Levy, Liakopoulos, Macpherson, Neti, Nied, Ochs, Ozsoy, Roberts, Rockwell, Sawyers, Varley, Voloshin, Walker, and Wei. At the associate rank were Professors Chew, Coulter, Lucas, and Perreira and Assistant Professor Öztekin. (78) The 2009-2010 university catalog lists Professors Harlow (chair), Blythe, Coulter, Delph, DuPont, Grenestedt, Kazakia, Levy, Macpherson, Misiolek, Neti, Nied, Ochs, Ozsoy, Rockwell, Smith, Varley, and Voloshin. The associate professors were Professors Lucas, Chew, Öztekin, and Perreira, also Assistant professor Schuster. There were four professors of practice in 2010, Professors Angstadt, Hart, Mitchell, and Oztürk. (83) The department was aging and shrinking.

With the beginning of the new millennium, MEM began to experience rather extensive changes in faculty personnel. Since 2004, there have been 14 senior tenure-track faculty who have retired from MEM, including Philip A. Blythe, Forbes T. Brown, Terry J. Delph, Ronald J. Hartranft, Stanley H. Johnson, Arturs Kalnins, Edward K. Levy, Robert A. Lucas, Sudhakar Neti, Richard Roberts, Kenneth N. Sawyers, Charles R. Smith, Eric Varley, Robert P. Wei, and 2 others who succumbed to fatal illnesses, namely, Alistair K. MacPherson and J. David Walker. Eugenio Schuster (control systems with an emphasis on fusion control) was hired in 2004. In spite of losing 8 faculty between 2004 and 2008, no further tenure track faculty were hired in that period. MEM, however, was given permission to hire Professors-of-Practice beginning with Terry J. Hart. Subsequently, Murat Ozturk and David C. Angstadt were hired as Professors-of-Practice. In 2010 MEM was given permission hire tenure-track faculty to rebuild the core teaching and research competency in MEM. Subsequently, MEM has been actively replacing faculty during the last few years. In 2010 Yaling Liu (micro/nanoengineering for biology and medicine), Edmund B. Webb III (high performance computational simulations to explore thermo-mechanical properties of

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<sup>16</sup> Professor Grenestedt recalled some of his engineering career highlights. October 2015.

materials), and Xiaohui (Frank) Zhang (mechanical properties of biological molecules and cells in heart diseases and cancer) were hired. Nader Motee (new paradigms for analysis and synthesis of complex engineering systems with applications to networks of autonomous vehicles, energy and power networks, and social networks) was hired in 2011, and Arindam Banerjee (fluid mixing in various extreme environments, hydrokinetic (river/tidal and wave) energy harvesting and pulmonary drug delivery) was added to the faculty in 2012. Also in 2012, MEM hired Michael Lehman and Marc de Vinck as Professors-of-Practice to help with a new Technical Entrepreneurship program. In 2013 MEM was unusually aggressive in hiring which resulted in an excellent yield of tenure-track faculty. Justin W. Jaworski (mathematical modeling of dynamic interactions between flexible structures and fluid flows in engineered and natural systems, including the silent flight of owls), Brandon A. Krick (materials tribology and surface interfaces), Keith W. Moored III (aerodynamic and hydrodynamic mechanisms used by flying and swimming animals to develop the science behind next generation unmanned aerial and underwater vehicles), and Natasha Vermaak (analytical, computational, and experimental techniques to address problems within the realm of thermostructural performance and optimization) were hired that year. In 2014 MEM was reassigned a Professor-of-Practice, William A. Best, to strengthen instruction in the core undergraduate mechanics courses. In 2015, Hannah L. Dailey (orthopedic biomechanics, bone fracture healing and implant design, IP development, technology transfer, and entrepreneurship) was hired as a tenure-track faculty. This past academic year Subhrajit Bhattacharya (application of topological techniques for solving problems in robot motion planning, coverage, sensor networks, and control theory) was hired as a tenure-track assistant professor. MEM is currently searching for 2 additional tenure-track faculty nominally in the areas of solid mechanics and thermal sciences and energy systems and one additional Professor-of-Practice. With the addition of these, the total faculty size will be 33. Nevertheless, within the next few years, it is anticipated that at least 5 more tenure-track faculty will retire. The renewal of the MEM faculty will continue to be a major area of concern for the next few years. While the MEM faculty is not yet adequately comprised of a sufficient number selected from under-represented groups, some progress has been made by hiring two women tenure-track faculty in recent years. To improve in this area is a significant challenge for the future.

In addition to the hires indicated above, the current MEM faculty are as follows: Meng-Sang Chew (design of mechanisms and advanced machinery, novel car engines, space structures, microgravity suspension systems, robotics; artificial intelligence, neural networks, learning control, and adaptive control for intelligent electromechanical machinery), John P. Coulter (Interim Dean of RCEAS, Associate Dean of Graduate Studies and Research; advanced manufacturing science, new and improved polymer processes), Joachim L. Grenestedt (design and manufacture of advanced manned or unmanned vehicles, including high-speed boats, high-altitude aircraft, and high-speed land vehicles, using fiber reinforced composites as structural components), D. Gary Harlow (probability and statistical modeling of materials subjected to fatigue and fracture, mechanical reliability), Jacob Y. Kazakia (computational and mathematical investigation of problems relating to non-Newtonian fluids behavior), Herman F. Nied (Fracture mechanics, computational solid mechanics, welding modeling and simulation, polymer processing, flexible composites), John B. Ochs (Director of Technical Entrepreneurship Programs, new product development processes, development of teaching methods in technical entrepreneurship and engineering innovation, assessment instruments for measuring ethical awareness and professional development), Tulga M. Ozsoy (Computer-aided geometric modeling and its application in design, manufacturing and inspection processes; PDM and ERP database design, management, maintenance and

integration), Alparslan Oztekin (Computational fluid dynamics, energy systems, renewable energy, separation and mixing processes), N. Duke Perreira (design, development, test, modeling, simulation, and evaluation of mechatronics systems; particularly systems that require multiple levels of control hierarchy and human interaction), Donald O. Rockwell, Jr. (Unsteady separated flows with application to flow-induced vibration, noise generation and aerodynamic performance), Eugenio Schuster (modeling, optimization, and control of energy systems; control of nuclear-fusion plasmas in tokamaks; nonlinear and distributed-parameter control), Arkady Voloshin (modelling cell motility as a function of surface topology and properties).

Year by year, the faculty of the department seemed to change only slowly. But, forty six years after the merger that created the Department of Mechanical Engineering and Mechanics, in Lehigh University's 150<sup>th</sup> year, none of the original twenty seven professors remained active. However, the following table is an alphabetical list of professors who have contributed to the education of mechanical engineers at Lehigh from 1969 to the present.

Abbott	Douglas	E.
Advani	Sundar	H.
Angstadt	David	C.
Arin	Kemal	
Badr	Osama	A.
Banerjee	Arindam	
Bhattacharya	Subhrajit	
Beer	Ferdinand	P.
Benner	Russell	E.
Best	William	Andrew
Biricikoglu	Vahram	
Blythe	Philip	A.
Brown	Forbes	T.
Chen	John	C.
Chen	Tony	
Chew	Meng-Sang	
Coulter	John	P.

Delph	Terry	J.
de Vinck	Marc	
Dimaragonas	Andrew	D.
DuPont	John	N.
Edelen	Dominic	G.
Efthimiadis	Apostolos	
Embley	George	Tyler
Eppes	James	Vandeusen
Erdogan	Fazil	
Farrell	Patrick	V.
Ghadiali	Samir	N.
Grenestedt	Joachim	L.
Gupta	Gopal	D.
Harlow	D.	Gary
Hart	Terry	J.
Hartranft	Ronald	J.
Hilton	Peter	
Hochhalter	Jacob	D.
Hook	Frank	
Irwin	George	Franklin
Jackson	Thomas	E.
Jaworski	Justin	
Johnson	Stanley	H.
Kadambi	Vedanth	
Kalnins	Arturs	
Kazakia	Jacob	Y.

Kosky	Philip	G.
Krick	Brandon	A.
Lang	Mark	S.
Lehman	Michael	
Levy	Edward	K.
Liakopoulos	Antonios	
Liu	Yaling	
Lucas	Robert	A.
Macpherson	Alistair	K.
Misiolek	Wojciech	
Mitchell	Graham	
Moored, III	Keith	W.
Motee	Nader	
Murray	Bruce	T.
Neti	Sudhakar	
Nevis	Benjamin	Edward
Nied	Herman	F.
Ochs	John	B.
Osborn	Joseph	C.
Owczarek	Jerzy	A.
Ozgu	Mustafa	R.
Ozsoy	Tulga	M.
Oztekin	Alparslan	
Ozturk	Murat	
Paris	Paul	Croce
Perreira	N.	Duke



Ries	James	Peter
Rivlin	Ronald	S.
Roberts	Richard	
Rockwell, Jr.	Donald	O.
Salathe	Eric	P.
Sarubbi	Robert	G.
Sawyers	Kenneth	N.
Schuster	Eugenio	
Sih	George	C. M.
Smith	Charles	R.
Smith	Gerald	F.
Stenning	Alan	Hugh
Stephanoff	Kyra	D.
Tanaka	Keisuke	
Terry	Theodore	A.
Updike	Dean	P.
Varley	Eric	
Vermaak	Natasha	
Voloshin	Arkady	
Walker	J.	David A.
Webb, III	Edmund	B.
Wei	Robert	P.
Zhang	Xiaohui	

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Professor D. Gary Harlow, chairman of Mechanical Engineering and Mechanics, faces the 21<sup>st</sup> Century:

The current mission statement for MEM is as follows: *The Department of Mechanical Engineering and Mechanics prepares its students to be learners and agents in both the application and development of technology to better serve the needs of society.* This mission statement is in harmony with the college and university statements. More specifically, the program objectives are that MEM graduates i) will successfully practice mechanical engineering and mechanics and/or pursue advanced education, possibly including other professions such as law, medicine, business, etc., ii) will participate in research, development, and other creative efforts in science, engineering, technology, and/or technological entrepreneurship, and iii) will engage in activities that demonstrate a commitment to professionalism, personal development, and leadership. These objectives have been and will continue to be the hallmark of the MEM programs. MEM has always maintained a strong emphasis on undergraduate education, evidenced by recent self-studies and evaluations from ABET and Middle States.

The simplest proof that MEM is accomplishing these objectives is the extremely high placement rate (nearly 100% prior to graduation) of all of the MEM undergraduates. MEM students, including BS, ME, and MS, obtain employment opportunities in companies ranging from start-up ventures to traditional blue-chip engineering companies. Also PhD students are employed by national laboratories, companies with research and development, and universities as faculty. Likewise, current students recognize the quality of the MEM programs as evidenced by increasing enrollment. Prior to 2008 the undergraduate enrollment in MEM (2<sup>nd</sup> year students and older) was approximately 270. Since then there has been a steady increase to where the current enrollment is over 430. Likewise, the graduate enrollment (full time/part time) was about 65/30, but it has also risen continuously to over 170/30. Another positive aspect of the student body is that MEM has about 18% women in the undergraduate program and about 14% in the graduate programs, both of which are considerably higher than national trends. While the demand to maintain consistent and high quality instruction is taxing, the positive conclusion to these data is that MEM is a vibrant, growing academic department.

There have been minor changes to the central MEM undergraduate program in recent years; however, the core curriculum is constantly being improved in order to provide students with the most up-to-date instruction, computational tools, and laboratory experience as is feasible. Additions to the program that are very popular are three minors: Aerospace Engineering, Energy Engineering, and Mechanics of Materials. The minor in Aerospace Engineering provides a foundation for students who intend to pursue a career in the aerospace industry or who plan to enter graduate programs in this field. The minor in Energy Engineering touches upon the technologies associated with the transformation and use of energy in various forms, including fossil, nuclear and renewable energy. The minor in Mechanics of Materials provides enhanced understanding of mechanical strength and behavior of materials subjected to typical loading conditions.

While the graduate curriculum has maintained the same structure for the last few years, the research emphasis and activity has evolved. Historically, the strength and focus of research in MEM has been primarily in the areas of solid mechanics, with a significant emphasis on fatigue and fracture, and fluid mechanics, where the thrust has been on the experimental and computational modeling of turbulence and unsteady flows. The evolution has been dictated by national research funding and interests of the recent faculty hires. Specifically, MEM has developed strong collaboration among the faculty in topics such as

solid-fluid interface mechanics, nature inspired mechanics, energy research in renewables and carbon based fuels, and additive manufacturing, for example.

With a new university president, John Simon, who is committed to ensuring that RCEAS and MEM is positioned to improve their national and international rankings, and with the anticipation that a new dean of RCEAS, Stephen P. DeWeerth, will strengthen the college even more, it is fully anticipated that MEM will improve as a department in both the undergraduate and graduate programs during the upcoming years. Indeed, this is an interesting and exciting time in the history of MEM. For further information regarding MEM today visit <http://www.lehigh.edu/~inmem>.