01 Apr 1955

Engineer's Day . . . 1955

Missouri School of Mines and Metallurgy

THE UNIVERSITY OF MISSOURI

SCHOOL OF MINES and Metallurgy

ROLLA, MISSOURI

ENGINEER'S DAY . . . 1955

U. S. Air Force

The Future Is NOW! . . .

The scene above is an experimental hydrogen bomb explosion at the AEC Pacific Proving Grounds. Practically unknown as recently as fifteen years ago, atomic energy is now a vital, universal force, shaping the lives of all mankind. Its frightening flash bursts across the face of our earth and gives us all cause for fear and wonder.

Yet we may hope, too. Patterns of world civilization are changing with bewildering rapidity. The scientific and industrial ways of yesterday are obsolete today. Tomorrow's methods will show no less impact of change.

The world of science offers to the hands of young Americans the tools of tomorrow's needs. These hands must be prepared to cope with powers which may reduce mankind to worthlessness, or may elevate him to sublime freedom.

Dean Curtis L. Wilson, Dr. Daniel Kennedy, B.S. in C.E., '25, and Harry H. Kessler, B.S. in Met., '24, attending recent convocation at which Kessler was the speaker. He is a boxing official and appears frequently on television from Madison Square Garden. Kessler invented the Surbo-Mat metallurgical process used widely by foundry operators throughout the U. S., and is holder of numerous patents. Dr. Kennedy is Director, and Regional Engineer in charge of the Topographic Section of the U. S. Geologic Survey.

INTRODUCTION

CERAMICS

The invention and development of new nuclear, electronic, and rocket devices, has increased needs for precision ceramic materials. The development of nuclear reactors for power production, the use of dielectrics and semiconductors in electronics, the need for very high temperature linings in rockets, all are promoting a rapid growth in the ceramic industry. This means the opening of a whole new area of ceramics, so that the "oldest industry" must now become one of our most rapidly changing industries. This rapid development will require the services of many more Ceramic Engineers.

CHEMICAL ENGINEERING

The dynamic growth of the chemical industries will create wonderful opportunities for those who will study this curriculum. It is estimated that chemical industries will quadruple production by 1975. This is a 100% gain every five to six years, and four to five times the expected growth of other industries. Fifty percent of American industry is directed by men trained in engineering, and a substantial portion of these are chemists.

CIVIL ENGINEERING

The outstanding opportunity for Civil Engineers is in the rapidly expanding heavy construction industry. To the enormous backlog of private construction demand is added the insistent need for expanded school facilities at all levels, and the 100 Billion Dollar highway program including rural and urban expressways, city streets and rural highways.

Civil Engineers engage in research, in consulting fields where they design and administer projects and construction programs. Wide opportunities exist also in research, design, and construction of structural hydraulic, sanitary and transportation facilities.

ELECTRICAL ENGINEERING

Possibilities of development and expansion in the electrical industry now appear almost unlimited. Estimates of the future of this industry made by the executives of some of our largest electrical companies indicate they will need to double annual production in the next ten years. This applies not only to electrical goods but also to the production of electrical energy. Thus the electrical industry must produce as much in the next ten years as it has in the past 75 years.

This rapid expansion of all divisions of the electrical industry, particularly notable in the field of electronics, will present exceptional opportunities.

GEOLOGY

Population growth and industrial progress are taxing our natural resources. Additional reserves of metallic ores, fuels, non-metallic minerals and uranium must be found. The trained Geologist is the one who will find them. As the demand for raw materials increases, new and more refined techniques of exploration will be needed. Little explored areas will be subjected to intensive investigation and those which have been well prospected superficially will be probed deeper. Today Geologists are employed not only by oil and mining companies, but also by chemical companies, ceramic producers, railroads, civil engineering firms, and even by banks, which must have Geologists to evaluate mineral resources before making loans. All phases of geology appear assured of even wider application.

MECHANICAL ENGINEERING

Mechanical Engineering is devoted to the pursuit of creative ideas. In the engineering office, in the laboratory, and in the test department, ideas are born by the dozens. Some are excellent. They have given us the steam engine, the automobile, the airplane, the jet engine, the refrigerator, more and cheaper electricity, and the diesel locomotive, to name just a few. The future, like an unopened Christmas stocking, contains more of these wonderful inventions for the benefit of mankind.

METALLURGICAL ENGR.

Metallurgical Engineering is concerned with the extraction of metals from ores and the making and heat treatment of alloys. The field is expanding in many directions because of the demands of modern technology. New metals and alloys are being produced and old ones improved to meet ever increasing requirements of higher strength, lower weight, resistance to higher temperatures, resistance to corrosion, and other special needs. Nuclear energy installations require special metals never used in quantity before. Aircraft and gas turbines require alloys of complex composition. As a result, the demand for metallurgists is increasing rapidly.

MINING

The rich mineral resources of the United States are the principal reasons for our high standard of living and great strength. By 1980 the mining of metals, non-metals, coal, and atomic energy materials, and the production of petroleum can be expected to have increased several fold. New drills have recently been invented which will operate in hard rock at extremly high speeds. New uses are being found for coal. Petroleum supplies the power for a large percentage of our industrial and domestic needs. New methods of obtaining more oil from known deposits are being developed.

PHYSICS

The shortage of Physicists now confronting the country is one of our most serious scientific manpower problems. The development of atomic weapons and atomic power, research on the nucleus, increased research in solid state, expanded research activities in electronics and other fields, have created an unprecedented demand for Physicists. Industry provides many opportunities for Physicists. Others find a most satisfying career in the field of teaching. The United States Government is probably the largest single employer of Physicists. Research foundations are seeking men trained in the field of physics.

EMPLOYMENT PROSPECTS

Demand for Engineers is at an all time high. Representatives of over 200 firms will visit this campus during the current school year. For the services of Missouri School of Mines graduates these agents have offered the following monthly starting salaries during the past few years.

	1952	1953	1954	1955	
High	380	400	440	465	(estimated)
Average	349	361	374	385	(estimated)
Low	300	325	345	365	(estimated)

The maximum salary an engineer can earn is limited only by his ability. Records show that many men are earning $7,000 per year five years after graduation and $10,000 per year ten years after graduation.

CERAMIC ENGINEERING

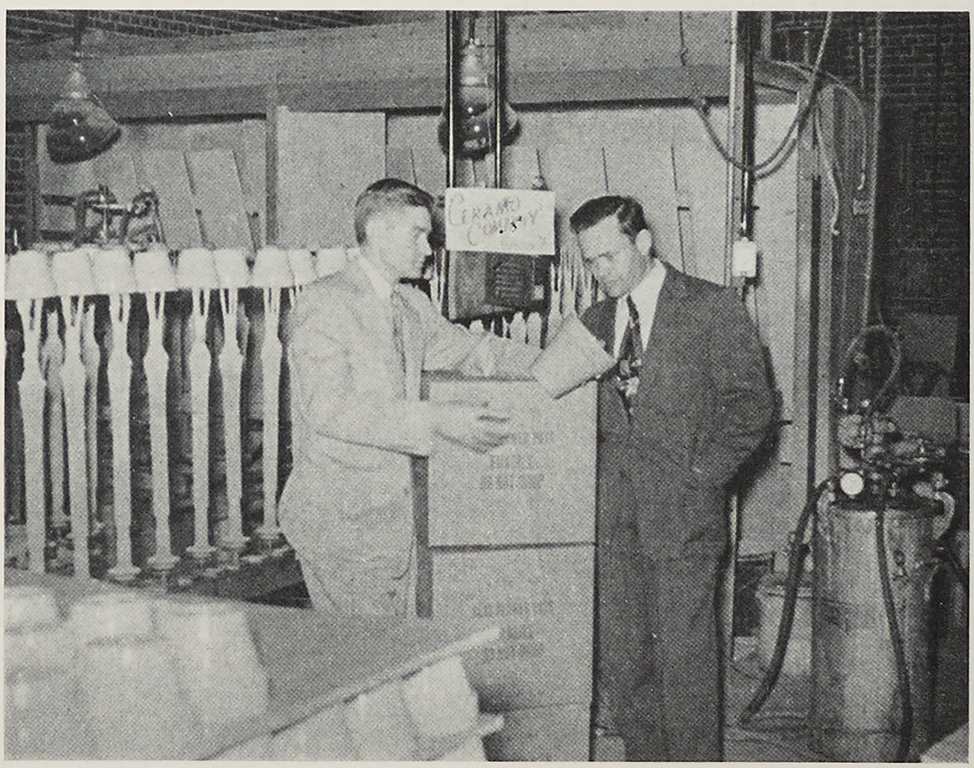
One of this department's recent graduates is John C. Young who won his Bachelor of Science degree in May of 1953. John has been working in the Development and Production Control Laboratory of the Mexico Refractories Company at Mexico, Missouri. He is shown here making test bars of plastic refractory insulation which will be tested later for shrinkage and mechanical strength. John is working in the refractory manufacturing industry, a section of the ceramics business which employs about half of our graduates. The Mexico Refractories is third or fourth largest of the refractory manufacturing companies and employs several of our graduate engineers.

Like many of our graduates, John is a veteran which means that his education was interrupted during his high school training. He entered M.S.M. in the fall of 1947 and left at the end of the fall semester of 1950. He worked for Harbison-Walker Refractory Company at East Chicago, Indiana, where he was in charge of the quality control laboratory. While he was thus earning money to complete his college education he also attended Indiana University, Calumet Center. In 1951 he re-entered M.S.M. and resumed work for his degree.

John is married to an East Chicago girl who teaches in the grade school in the Mexico School system. They have an attractive apartment, a new car and are gradually acquiring furniture.

John Young making test bars in the control laboratory of the Mexico Refractories Company at Mexico, Missouri.

John's job requires that he do physical testing on the many products made by the Mexico Refractories Company. This work means that he is helping to maintain and improve quality of production as well as develop new products. He is thus able to put into practice much of the laboratory training he received during his college preparation. The position he occupies is probably one of the most interesting in the manufacturing plant, since he is in very close contact with all the production and development problems, and hears the customer's complaints. As John says, "there is never a dull moment on this job."



Kenneth and Vernon Kasten examining flower pots in front of the automatic flower pot painting machine of the Ceramo Co., Inc. at Jackson, Mo.

Next we have a graduate who partially owns his own manufacturing plant. Kenneth G. Kasten graduated in May 1950 with the Degree of Bachelor of Science in Ceramic Engineering. He and his brother Vernon, together with their father, own the Ceramic Company, Incorporated, at Jackson, Missouri. They produce red clay flower pots and painted flower pots. The company is one of the major plants producing such wares and their products are sold all over the United States.

The accompanying photograph shows Kenneth (left) and Vernon standing in front of the automatic flower pot painting machine. Incidentally, Vernon received his B.S. in Ceramic Engineering in 1945 and his Master of Science degree

(Continued on Page 12)

CHEMICAL ENGINEERING

The opportunities for men trained in Chemical Engineering and Chemistry are greater than in any period. Demand is ever expanding and men prepared for careers in this profession have before them many avenues of search for success both from an income point of view and from the point of view of satisfaction of achievement. Many interesting careers are found in research, development, plant control, supervision, management and technical sales. A wide variety of specialties is open and includes the cement, fertilizer, plastics, petroleum, paper, glass, paint, leather, solvents, caustics, textile, and many other industries.

The Chemical Engineering department of the School of Mines has conferred B.S. degrees in Chemical Engineering on 665 candidates. Of these only 27 were conferred prior to 1919. The remainder have all been granted since that date. These figures alone indicate something of the growth of the chemical profession in recent years.

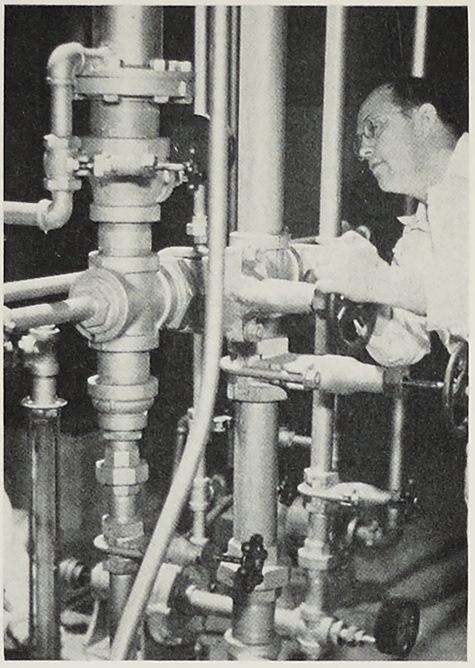
The experiences of a few graduates of this department serve to illustrate the breadth of careers these men are following. Gilbert R. Shockley, B.S. in Chemical Engineering, 1942, joined the staff of the Monsanto Chemical Company in its division at Anniston, Alabama, upon graduation. After having gained professional experience there he went on to the Wood Research Institute at Oglethorpe University, Atlanta, Georgia. Following a period of service in the Navy Gilbert advanced rapidly in industrial posts until he became the manager of the Eimco Corporation plant at Salt Lake City, Utah. Eimco produces industrial filters and employs about 3,000 people.

A more recent graduate of the department is Paul A. Haas, B.S. in Chemical Engineering 1950. Paul took graduate level studies in 1951 and then enrolled in the training School of Reactor Technology at Oak Ridge, Tennessee. Since that time he has advanced in the ranks of employees of the Carbide and Carbon Chemicals Corporation, which is one of the chief operating firms engaged in the atomic energy projects at Oak Ridge. Much of Paul's work is of a highly confidential nature and cannot be described. However, his letters indicate that he is enjoying his duties to the utmost.

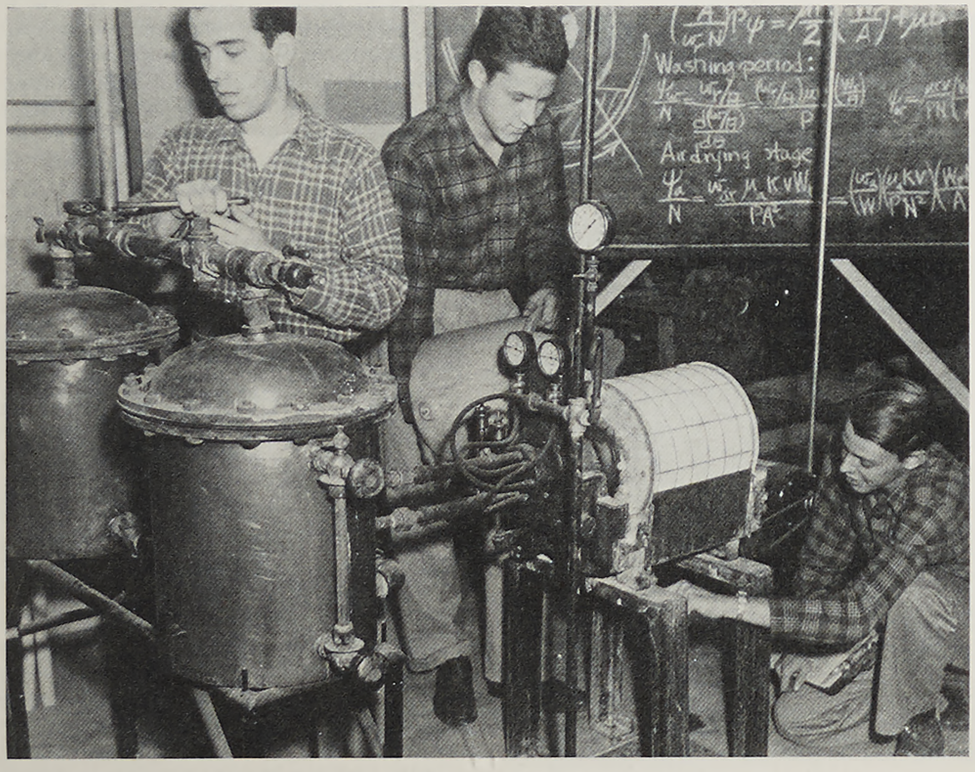
Perhaps some of the most exciting experiences of former students of this department are those reported by Erich Rolaff, B.S. in Chemical Engineering in 1952. After graduation Erich accepted employment with the National Carbon Company at Cleveland, Ohio, where he worked for one year. During that period he was assigned to practically all of the various departments and spent much time in quality and specifications divisions and in the development laboratories. Erich writes that in the latter assignments he was engaged in several projects of more than routine nature, and it was from these that he came in contact with National Carbon's overseas operations. Very shortly thereafter, Erich was assigned at his own request to the offices of the company at Singapore, Federated Malay States. His comments about his life and professional activities in the Far East are most illuminating. He writes "As you know, we are right on the edge of a very hot small war here, and consequently not only are fire arms rigidly licensed and controlled, but also the areas in up country Malaya, which offered good hunting before the war, are now not very safe localities. Believe it or not the most exciting sport on the Island of Singapore is the shooting of giant bats which are called 'flying foxes' here." Erich's company buys materials from all over the world and the examination of these materials at the point of origin is most important in securing economy of operations.

Erich concludes "All in all I enjoy my work, the experience and the unusual conditions of life in the Orient and after my current tour is concluded I will look forward to the time when I may return again."

The basic training received by graduates of this department has qualified them for the widely diversified duties that they have followed. The opportunities they enjoy are open also to those who will follow them.



Conducting liquid flow pressure tests in the modern, well-equipped Lab of the Chemical Engineering Department. This department is housed in an expanded brick and stone structure completed in 1950.



An experiment in filtration in the Chemical Engineering Laboratories on the campus of Missouri School of Mines and Metallurgy at Rolla, Missouri.

CIVIL ENGINEERING

The Civil Engineering Department presents a summary of the professional activities of two recent graduates of the department. We hope that these accounts will indicate some of the possible accomplishments of young men in the broad and growing field of Civil Engineering.

First is James B. McGrath, who received his Bachelor of Science degree in 1949. Upon graduation Jim accepted a position with Fruin-Colnon Company of St. Louis. As a field Engineer his first assignment was on the construction of a complete new cement plant for the Missouri Portland Cement Company. The work included a new storage building, a raw materials crushing building, two new cement kilns, a Feed End Precipitator building, finish mill and a cooler. This job consisted of placement of about thirty thousand cubic yards of structural concrete and a great amount of heavy machinery. Jim served on this job as both cost Engineer and Field Engineer.

After completion of this project Jim was assigned to a construction program for the Pittsburg Plate Glass Company in Crystal City, Missouri. His capacity on this project was that of field engineer. He supervised much of the subcontracting as well as performing engineering duties pertaining to Fruin-Colnon's own personnel.

In May of 1952 Jim was assigned to the Third Street Project in St. Louis. This job consisted of construction of about three quarters of a mile of elevated four lane limited access highway in downtown St. Louis. He was responsible for the layout of the abutment walls on the approaches and for the support piling.

In 1952 and 1953 Jim was assigned as Chief Engineer on construction projects involved in new office buildings for the Monsanto Chemical Company.

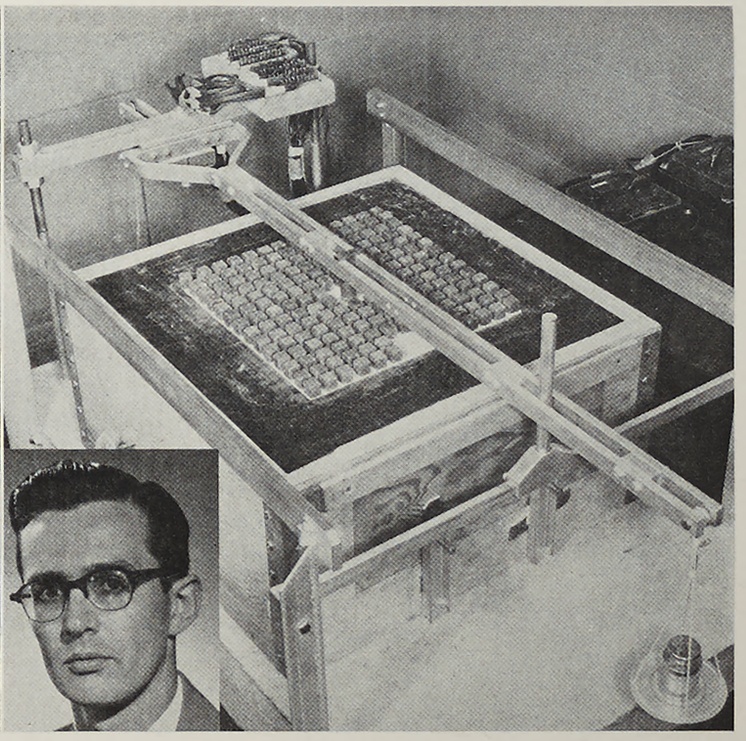
One of his most recent assignments was as Construction Supervisor on the building of a coal storage barrier for the Great Lakes Carbon Corporation. A complete new coke screening plant has been constructed and will allow the owner to take coke directly from ovens through this plant almost completely automatically.

Early this year Jim was assigned as Labor Relations Manager on the Atomic Energy Commission's project at Weldon Springs, Missouri. This job is a joint venture of Fruin-Colnon and the Utah Construction Company of San Francisco.

Since graduation from the School of Mines Jim has remained in active contact with his former fraternity and professional associates.

Another graduate of the Civil Engineering Department is Paul F. Carlton, Bachelor of Science, 1947. Paul is one of a number of former School of Mines students who have gone into government service. His current title is Chief, Research Analysis Branch, The Ohio River Division Laboratories, Corps of Engineers. Paul writes that the work of his branch is concerned primarily with the results obtained from actual field applications of small scale structural models designed in the laboratory. Various combinations of sample pavements and loading conditions are simulated by the static loading of small plaster slabs supported by rubber "sub-grade." These are then tested to determine their potential strengths. It is Paul's duty to plan the research program and supervise and coordinate all phases of the projects. After completion of a particular model test the data must be analyzed and a technical report prepared which describes the tests and the conclusions indicated. Paul either prepares these reports himself or reviews those prepared by assistants. Some of the most interesting recent studies have concerned the effect of high tire inflation pressures on rigid pavements such as those encountered on landing fields used by B-47, B-36, and B-52 heavy bomber craft. At the present time Paul is engaged in model studies of rigid overlay pavements and prestressed pavements.

Jim McGrath, B.S. in Civil Engineering, 1949, surrounded by views of some of the projects on which he has worked.



Paul F. Carlton, B.S. in Civil Engineering, 1947, and a laboratory test machine used for determining strength of pavement samples.

ELECTRICAL ENGINEERING

The field of electrical engineering covers a wide range of activities including electric power generation and distribution, electronics and its wide applications in measurements and control devices, and the related field of communication, including telephony, radio, television, radar and other signaling systems. In such a wide range of activities it would be impossible to present information on the work of a young electrical engineer that would be typical of all. Consequently the experiences related here are simply those of two young men who represent a portion of the field of electrical engineering.

Homer E. Coonce was graduated from the Missouri School of Mines and Metallurgy in May 1952 with the degree of Bachelor of Science in Electrical Engineering. He joined Bell Telephone Laboratries in June 1952 as a member of its technical staff. In addition to his assignment to the Laboratories' Military Electronics Department, Homer has completed all but one semester of the three-year training program conducted at the Laboratories. This Communications Development Training Program is composed of graduate level study for college graduates who are beginning their professional careers as members of technical staffs.

With the growing complexities of communications technology, these Laboratories have found it necessary to institute this program in order to develop well rounded communications engineers. This is accomplished through a unified and coordinated program of part-time classroom work over a three-year period combined with orientation assignments in various departmental laboratories during the first year. Three-fifths of the program is completed in the first year.

While on assignment with the Military Electronics Department, Homer has been concerned with the design and development of a transistorized intermediate freqency amplifier, using tetrode transistors, suitable for radar. He is presently engaged in work on a transistor-operated airborne digital computer. Much of Bell Lab's work is with classified materials used in national defense and consequently cannot be described in detail.

Jesse W. Bowen, Jr. was graduated from the Missouri School of Mines and Metallurgy in May 1949 with the degree of Bachelor of Science in Electrical Engineering. His employment with the Allis-Chalmers Manufacturing Company, Milwaukee, Wisconsin, started in the Graduate Training Course which requires twenty-four months for completion. This training program is typical of courses operated by many manufacturing companies in the electrical industry.

The trainee in the Allis-Chalmers course is permitted to work in almost any part of the company with assignments of approximately two months in each. These assignments range from actual shop construction of huge generators, to sales and application in one of the numerous product departments. The purpose of the Graduate Training Course is to give the young engineer the opportunity to actually participate in, and become acquainted with, the functions of a large manufacturing company and thus fit him for the day when he takes a permanent assignment.

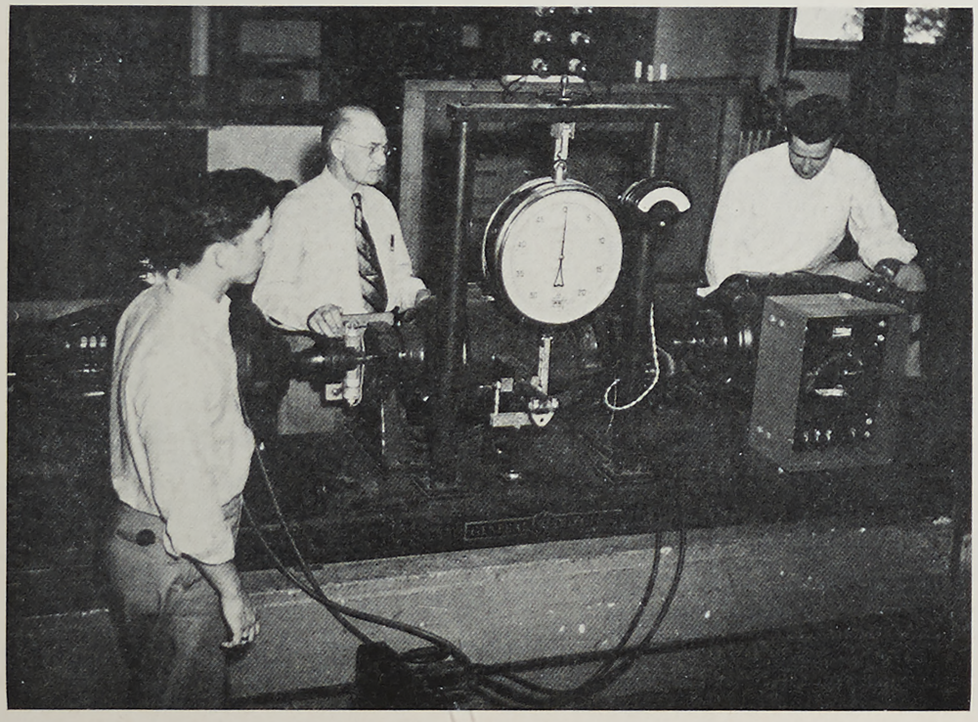
When Jesse finished the training course in August 1950, he went to work in the switchgear section. His work in that section has been in application and factory sales. He works closely with the field organization of the company in preliminary investigations with customers in determining their switchgear requirements. After the customer's needs are worked out, it is his job to make up proposals including prices, detailed specifications, and sketches, and submit a bid to the customer. If the order is obtained it is his job to get the actual engineering and construction work started.

Other men known as "job engineers" order the material and supervise construction but it is his responsibility to coordinate this work with the field sales organization and the customer. This duty requires a working knowledge of electrical and switchgear principles of the equipment itself, and above all, of the customer and his requirements.

The type of equipment classified as switchgear includes circuit breakers, relays, instruments, meters, switches and other items devised to protect the electric circuits on which the switchgear is used. Bids on such jobs range from a few thousand to over a million dollars.

In addition to the work outlined above, Jesse also assists in instruction of trainees in the Graduate Training Course which he has completed. He also is called upon to give talks before various organizations. He writes bulletins and technical articles on equipment, and visits the field sales organization and customers. On these trips he often meets interesting and important people.

Many men with Electrical Engineering training work in other widely diversified areas. Of the employees with technical training in the General Electric Company, about 65 percent are engaged in engineering, about 10 percent are in manufacturing, about 20 percent are in marketing activities, and about 5 percent perform administrative duties. About 75 percent of the 87 department general managers in this company are technically trained. This wide spread use of engineers in executive positions and the extensive expansion of all fields of electrical engineering have contributed to the serious shortage of engineers. Also many companies employ a much larger proportion of engineers now than ever before. For example, the General Electric Company now has one engineer for every 15 employees, while in 1900 American industry in general, employed only one engineer for every 250 employees.



Prof. I. H. Lovett directs laboratory experiments of students in the Electrical Engineering Department. This device rates electric motor power.

GEOLOGY

The field of Geology offers dramatic opportunities of participation in the exploration and exploitation of the world's mineral wealth. No scientific pursuit comes closer to dealing directly with the raw materials with which we have become the world's most advanced society. The experiences of two graduates of this department demonstrate what Geology as a profession has meant for them.

Howard J. Yorston received both of his degrees from the Missouri School of Mines, his B.S. in Geology in 1953 and his M.S. in Geology in 1954. Immediately after graduation he accepted employment with the Carter Oil Company as a seismic interpreter and was assigned to a seismograph crew for training. As a trainee he worked with each member of the crew, performing such duties as surveying, setting and firing explosive charges, and assisting in the operation of recording instruments. This type of geophysical prospecting depends upon the proper geologic interpretation of seismic waves which are generated by explosive charges set off in shot holes and recorded by seismic detectors and recorders suitably located with respect to the shot holes.

Field experience was followed by a six weeks course at the Carter Research Laboratory in Tulsa, Oklahoma, where Howard learned to interpret the records or seismograms made by seismic recorders. Here actual field problems were solved.

Upon completion of the interpreters' school Yorston was reassigned to his former crew as an interpreter. His current duties consist of computing seismic records and, from the data, constructing geologic maps and cross-sections which will be used in searching for oil. In assembling such information, Howard works closely with the area geologist and has access to drilling data, core analyses and other geophysical data such as electric logs of wells. If the data from various sources do not agree, it is up to the interpreter to weigh the authenticity of the data, and ultimately come up with a recommendation for drilling the area or turning it down.

As he gains experience Howard will take on added responsibilities, such as advising extension of sesimic surveys into new areas and planning new exploratory programs with the constant objective of finding new sources of oil and gas.

John A. Emery received his Bachelor's degree in Mining Engineering in 1940. He served in the U. S. Navy during World War II as a pilot and flight deck officer. Upon release from the Navy in 1945 he learned the practical side of mining while working for the Bradley Mining Company and the Bunker Hill and Sullivan Mining Company at Kellogg, Idaho. Desiring to devote his life to mining geology, he returned to his Alma Mater in 1949 for further education and received the degree of Master of Science in Geology in 1951. John then joined the geological staff of the largest lead mining company in the world, the St. Joseph Lead Company of Bonne Terre, Missouri. He became a partner in a team devoted to unravelling the origin and distribution of the lead ore in southeastern Missouri, team-work which has paid off in the finding of new ore-bodies when the future of the district seemed to be limited.

The Bureau of Mines of the Department of the Interior of the U. S., operates this magnificently located experiment station and reduction plant, near Rifle, Colorado. This scene is not far from the Colorado Plateau, where large deposits of uranium have been found.

As a mining geologist he has given attention to the regional and local structures and to the major and minor structures which have influenced the occurrence of the ore. John has worked closely with the miners in guiding them to new ore and with other geologists in developing a long range exploratory program for the district. In this program every conceivable means of exploration is tried; resistivity instruments, magnetometers, gravity meters, and the seismograph have been used, but the ultimate test is the diamond drill which yields cores which can be assayed.

Emery's specific job at the present time is to keep track of the geology of 3 of the more than 20 operating mines in the southeastern Missouri lead belt. Eleven tunnel crews are constantly at work opening new leads of ore where he believes they are likely to exist. A jackhammer prospector examines existing stopes for showings of ore which seem likely to develop into new ore-bodies, or he looks for ore which may have been missed in earlier operations. Several diamond drill crews are kept at work ahead of the actual mining operations to seek new ore bodies and to determine the trend of zone being worked. John's job is to find and delineate new ore bodies and to work with the mine superintendents in order to "put the rock in the box." In carrying out his function as a geologist he also must gain the confidence and reliance of the miners and of his fellow geologists.

John's work has not been confined to the lead belt alone. His company has acquired interests in oil and in other metals in various parts of the world. Occasionally he is called upon to evaluate a mine offered for sale to the company, or he has been called upon to "sit on a well" until it was completed. With his broad basic education and experience he is on the alert to find new mineral deposits and thereby pave the way for new industry and more jobs for more people.

MECHANICAL ENGINEERING

Mechanical Engineering is a major engineering profession. It deals with the art and science of applying to industry the laws of physics and chemistry in a great variety of ways. Those who are trained in the Mechanical Engineering profession find ready applications for their preparation in product invention, design, construction and related fields.

The minimum requirement for a B.S. Degree in Mechanical Engineering is four successful years of study, following a curricula carefully planned by engineering educators and professional engineers. Schools such as this are inspected and approved each fifth year by a national committee of experts. Employment in industry for one summer is also a requirement for graduation.

There are opportunities to participate in athletics, dramatics, fraternal and professional societies. The Chapter of Society of Automotive Engineers at Rolla is larger than on any other university campus in the United States. The American Society of Mechanical Engineers Student Branch here is also very successful. These extracurricular activities afford an opportunity to develop leadership and to make contacts in the industrial world.

Fields of specialization are many and varied. A few of the more common are: air conditioning, heating and ventilating, applied mechanics, aeronautics, automotive, instrumentation, machine design, materials handling fields, fluid flow, heat transfer, machine tools, steam, oil, and gas power, petroleum refining and production, atomic energy, rockets ordnance, foundry manufacturing, and management.

A check on 656 Mechanical Engineering graduates from this school shows that 42% entered manufacturing. Some have chosen large companies on the east and west coasts; others the mid-continent cities, like Chicago, St. Louis, and Dallas. Some have become designers of products, others designers of special tools to manufacture products, still others are in management or are engaged in engineering sales. Eight percent have gone into military service. Six and one-half percent are in civil service. Most of these are doing design, development, and research in government laboratories. Three percent went directly into consulting engineering work. Others transfer to this field after gaining experience elsewhere. Some one and one-half percent have gone to the field of public utility power. Three percent have gone to large chemical manufacturing companies. One and one-half percent are self-employed. Eleven percent have gone to the automobile and aircraft industries. The broad scientific and technical training given Mechanical Engineers makes their services desirable. It also enables them to choose their field of employment or industry after graduation, rather than early in their college life.

A. D. Beverage, B.S. in Mechanical Engineering, 1948, who is employed by the General Electric Company, checks gauges recording operation efficiency of an aircraft gas turbine.

Opportunities for graduate study, such as assistantships, scholarships, or fellowships, probably outnumber the applicants in the field of Mechanical Engineering. The stipend for most of these is sufficient to support the student in graduate school. Industries requiring the services of engineers with advanced training are willing to pay premium salaries. The demand for these men far exceeds the supply.

Opportunities for employment are afforded even before graduation. Represenatives of several hundred companies, usually members of the engineering staffs, or sometimes members of the personnel office or both, visit our campus each year to discuss employment with their companies. At these interviews the student engineer has an opportunity to discuss in detail the many aspects concerned, such as: salary, location, duties, special training, and advancement. Engineers have never been in such great demand, nor have our civilization and standard of living been so dependent upon their services.

The Mechanical Engineering field offers to the student opportunities to participate in these many phases of cultural and physical growth of the American people.

METALLURGICAL ENGINEERING

Metallurgical Engineering covers a wide variety of processes and operations. It is concerned with the procedures involved in extracting metals from ores, refining metals, forming alloys of metals, shaping metals and alloys, and treating them so as to obtain the optimum properties.

The prospective student often asks what type of work a graduate of this department can expect to do. Obviously, his work can range anywhere from the strenuous participation in the large-scale activities of a steel plant or concentrating mill, to the precise, scientific experimentation done in a metallurgical research laboratory.

Likewise, the size and location of the communities in which the metallurgy graduate may work will vary a great deal. Most of the ore concentrating mills and nonferrous metal smelters are in the West and frequently they are in small towns. In contrast, iron and steel plants are chiefly situated in the Midwest and East and in or near large cities. Heat treating plants and foundries are found in towns and cities throughout the country. Opportunities for work in foreign countries are also available to graduates looking for travel and adventure.

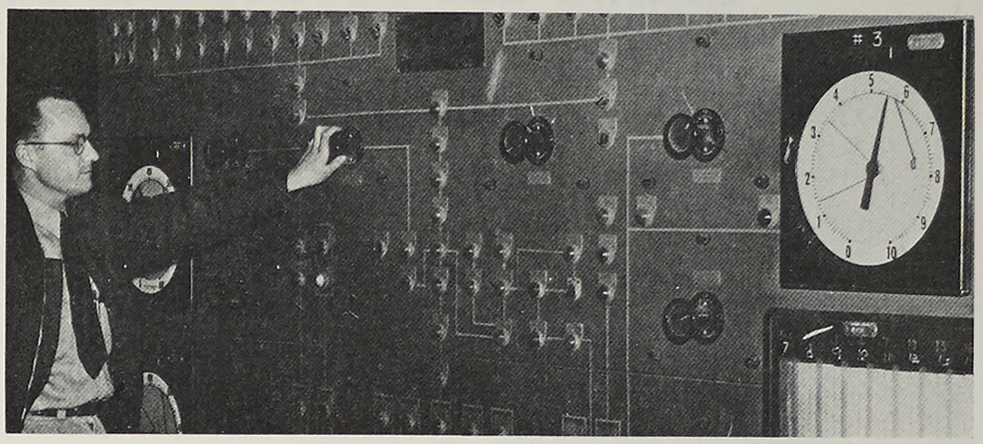
Not many young men are familiar with the field of Metallurgical Engineering, but it is obvious that our modern civilization is built on metals. Further progress will depend on improvements in metallurgy, which in turn can only come from adequately trained men. Comparatively few schools give instruction in Metallurgical Engineering. As a result, there are not enough graduates to meet the demands of industry, and job opportunities are numerous.

Some idea of the professional activities of a young metallurgist may be obtained from a description of the careers of two of our own graduates; one who obtained his degree in 1949 and the other in 1953.

James R. Whanger (B.S. 1948, M.S. 1949) upon graduating went to work for the Hughes Tool Company in Houston, Texas. This well known company manufactures rock bits and tool joints used in drilling of oil wells by the rotary method. Drilling to depths of many thousands of feet through rock formations of varying hardness and composition places a severe stress on drilling tools. Loads are extreme and conditions are such that bits must be of the highest metallurgical quality.

Jim started work as a metallurgist in the metallurgical department and has been advanced to the position of supervisor of the metallurgical control group.

These metallurgists control the hardening and forging operations used in making bits and tool joints. This means that they specify the number of times and temperatures to which the steel must be heated and then quenched to obtain the necessary hardness and toughness. Physical and chemical tests are made to determine the success of the treatment and guide the way to improved methods.

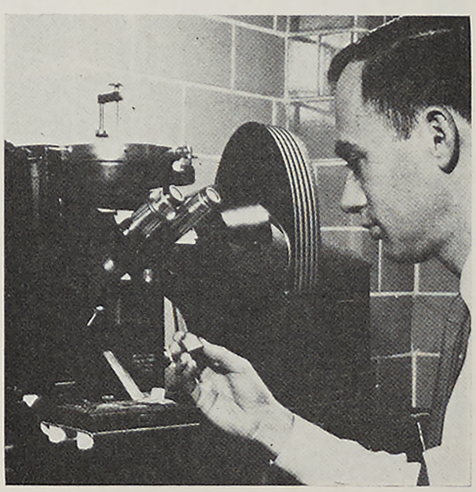


Marvin L. Hughen, B.S. in Metallurgical Engineering, 1953, operating the world's largest sintering machine, Blackwell, Okla.

Microscopic examinations are also made of polished specimens of the steel to determine its structure. The accompanying illustration shows Whanger seated before a large metallographic microscope used for this purpose.

As oil wells are drilled deeper and deeper, tools must be made harder and stronger. It will be up to the metallurgists to develop new alloys to meet these demands.

Marvin L. Hughen (B.S. 1953) was employed by the Blackwell Zinc Company of Blackwell, Oklahoma, immediately after graduation. At this plant zinc ores, chiefly from Mexico, are treated to recover their zinc content. Two main steps are required. First, the ore concentrates are roasted to drive off the sulphur, and second, the product is heated with coal to distill the metallic zinc.



James R. Whanger, B.S. in Metallurgical Engineering, 1948, examines polished steel specimens.

The Blackwell Zinc Company has recently installed the largest sintering machine in the world to perform the desulphurization step. In the accompanying photograph Marvin is shown at the control panel of this enormous device which represents an investment of over three million dollars.

Hughen was at first assigned to metallurgical control duties, but he has recently been promoted to the position of Assistant Superintendent. He works with higher management and other members of the staff on problems concerning the current production of zinc. He helps in planning for future operations by studying new equipment and techniques to improve the present process.

It is obvious that the graduate encounters not only technical problems, but also problems of dealing with other people, whether he is giving orders or taking them.

Increasing numbers of graduate metallurgical engineers are being hired by established producers and fabricators of metals. At the same time, metallurgists are required for new industries. For example, the production and fabrication of uranium and other metals used in nuclear energy installations, need the services of metallurgists.

Little new can be said about uranium, but it is known that zirconium metal which was a rarity a few years ago, is now being produced in tonnage quantities for the Atomic Energy Commission. The details of how it is used are still secret, but its production and fabrication are known to be complex metallurgical problems.

The aircraft industry is reliant in many ways on the metallurgist, but two instances are especially noteworthy. First is the continued development of high temperature alloys used in jet engines. These alloys must retain their shape and strength at temperatures which could

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MINING and PETROLEUM ENGINEERING

Two BROAD DIVISIONS of engineering study are presented by this department. One is the field of Minerals Mining in its engineering phases, and the other is Petroleum Engineering. We would like to present a resume of the experiences of two graduates of this department.

First, from the class of 1952, is Jack R. McBrayer. Upon graduation from the School of Mines Jack was employed by the Artnell Company of Chicago, Illinois. His first assignment was as supervisor of the company's oil operations in southern Illinois. Jack assisted in bringing in the first successful producer in that area by extending an existing field. This extension later "proved" about 100 acres of lands for the company.

In August of 1953 Jack directed the drilling of a "wildcat" about three miles east of the original field. This was a fortunately chosen site, for the "wildcat" was a producer, and from this start his company has now drilled four producing wells and has obtained leases on six hundred acres in the same area.

In March of 1954 Artnell obtained a "farmout" from the Texas Company about three miles east of McLeansboro, Illinois and again a successful "wildcat" was drilled. This new field now has five producing wells of which Artnell owns four.

In September of 1954 Jack was sent to California by the company to study Artnell's operations in that state. During the two and one half months he was there, Jack assisted in the drilling of one 2,700 foot hole and the starting of a 10,000 foot test hole both of which have since been completed.

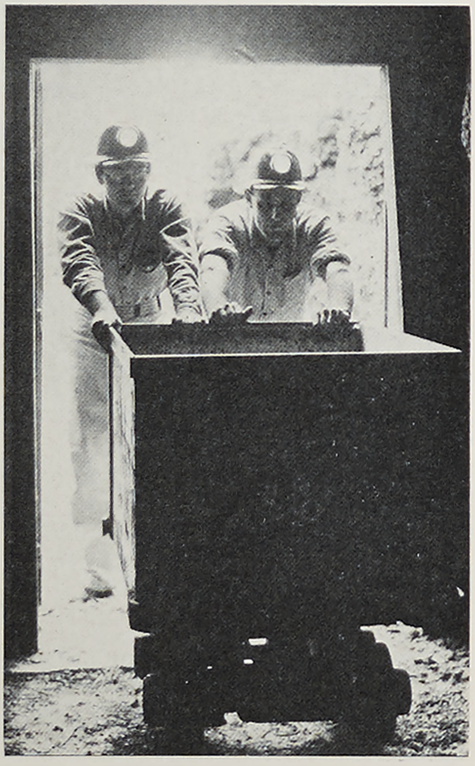
Jack has advanced rapidly in the Artnell Company and has recently been appointed a Vice President. His current job is that of assisting in the overall engineering management of Artnell's oil production in Illinois, Kansas, Texas, Louisiana, Oklahoma, Wyoming and California.

Another graduate of this department who has concentrated in engineering services in the petroleum industry is J. W. Billard. Jim received his degree in Petroleum Engineering in 1948 and went immediately into employment with the Texas Company. His first assignment was as an engineer trainee in the Wichita, Kansas office. After about nine months he was transferred to Lyons, Kansas, as area engineer. In May of 1951 he was transferred to Drumright, Oklahoma where he served for two and one half years in northern and western Oklahoma as Area Engineer.

Jim was then assigned to a new kind of work. He was sent to Tulsa to work in the secondary recovery section of the Division Engineering office. On this job Jim took part in an important program being developed on waterflood methods of recovery of oil.

In July of 1953 Jim moved from the Texas Company proper to its subsidiary, the Texas Petroleum Company, and at his own request was sent to Maracaibo, Venezuela. Jim writes that he has served in a variety of jobs such as Field Engineer, Division Production Engineer, Division Reservoir Engineer, and Division Equipment Engineer. Recently he was appointed District Engineer of western Venezuela.

Jim says "My present job consists of supervising a staff of men and taking the responsibility of engineering problems, pertaining primarily to drilling and producing operations. The daily production from the district is 30,000 barrels. The most unusual thing about this particular area is that approximately 23,000 barrels per day are being produced from granite or rock base. In some wells the granite has been penetrated 2,700 feet and the depth of the wells reaches 11,000 feet. The oil is found in fractures of the granite and production from individual wells is as high as 12,000 barrels a day. The best well we have developed so far is one in which we have used the technique of acidizing. We hope that in the near future this process will increase output by 40 per cent."



Going underground in the experimental mine, located on property owned by the school.

A third graduate of the mining department, Nace Mefford, who received his degree in June of 1948, accepted a position as Petroleum Geologist and Petroleum Engineer with Ashland Oil and Refining Company at Ashland, Kentucky.

Nace writes that he first was assigned to the office concerned with exploration and production of crude petroleum. While on that assignment one of his tasks was to make microscopic examinations of well cuttings from the Illinois Basin. This particular phase of the oil business is vital, Nace has learned, to both the beginner and the experienced Mining Engineer.

The Ashland Company was extremely active during the six and one half years that Nace worked on the Illinois Basin. From 1948 to 1953 the company drilled nearly two hundred wells in that area alone. To quote Nace, "It was a time, too, when I learned that the oil business is a 24 hour a day job. My lack of sleep during the first two years particularly even today confounds me. It was experience gained the best way, by doing it and by having the responsibility." During that time Nace set up data on decline and production curves, well records, base workover records, and reservoir statistics. Nace was promoted to a newly created position, that of Division Production Engineer and later was promoted to Assistant Production Superintendent.

In that latter position Nace worked with waterfloods, well completions, work over operations, a large volume of evaluation work, and helped install a safety program. In his spare time Nace assisted in the training of other Geologists and Mining Engineers.

Recently Nace was promoted again and transferred to the home office of the Ashland Company. His responsibility now is broadened to include planning, approving, and management, of a large secondary recovery program which Ashland is operating in eastern Kentucky, the Illinois Basin, Oklahoma, and north Texas. As chief Production Engineer Nace is now responsible for many production operations and exploration programs in Kentucky, Illinois, Ohio, Indiana, Oklahoma, Kansas, Texas, Arkansas, Louisiana, Montana, Colorado, Wyoming, Nebraska, and Canada. As Nace says "this demands a wide knowledge of nearly every phase of our fascinating oil business."

These former students of the Mining and Petroleum programs of the School of Mines are examples of the immense potentialities open to graduates of these fields. The future holds great promise.

PHYSICS

The Physics Department of the Missouri School of Mines and Metallurgy presents Hulen H. Luetjen and Robert E. Becker, representative graduates of this department during the last five years. Luetjen has gone into industrial work and Becker has gone into graduate work, which is typical of many of our graduates.

Hulen graduated from the University of Missouri School of Mines and Metallurgy in 1950 with a B.S. degree in Physics with minors in Mathematics and Mechanical Engineering. He joined McDonnell Aircraft Corporation as a loads engineer in June 1951 after having served a year as Instructor in Enginering at the School of Mines. While in the Loads Department he performed the catapult launching and arrested landing analysis on the McDonnell F3H-1 "Demon" Navy Fighter.

In September, 1952, he was one of four engineers chosen to enter an executive training program initiated by McDonnell to give a limited number of qualified enginers an opportunity to gain experience in all phases of aircraft engineering. In this program he was transferred to the Aerodynamics Department and until October, 1953, worked in the aerodynamic research group and on the aerodynamic development of the recently unveiled McDonnell F-101A "Voodoo," a long range penetration fighter. Much of the development work in which he took part consisted of wind tunnel tests at the Co-operative Wind Tunnel in Pasadena, California under the direction of Dr. Clark B. Millikan, son of Dr. Robert Millikan, Nobel Prize winner in Physics.

After completing his training in the Aerodynamics Department, Hulen was transferred to the Design Department as a design engineer where he worked on modifications of the F3H-1 "Demon" and on mobile trainer units of the same airplane used for acquainting field representatives with the functions of the craft.

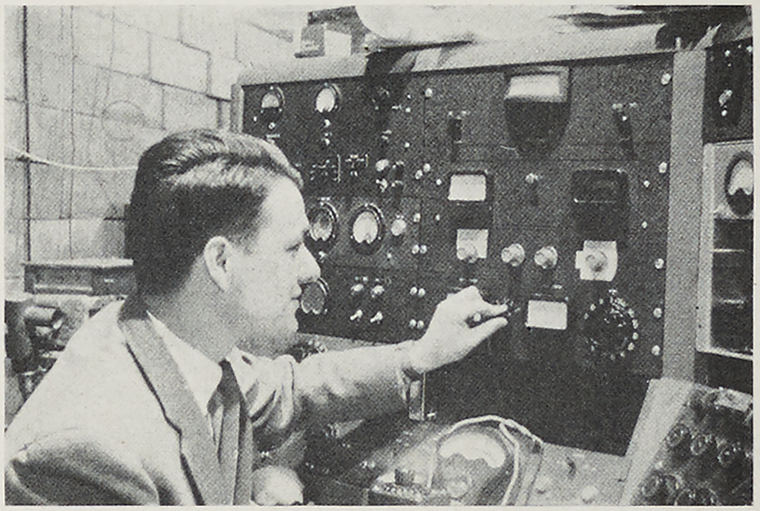
In April, 1954, Hulen completed the executive training program and was transferred back to the Loads Department in the position of group leader. This is the position that he now holds. At present he is responsible for all aerodynamic data used by the Loads Department and for all dynamic studies made by the department. These studies include such problems as rolling pullout maneuvers, catapult launchings, arrested landing analysis, store and bomb trajectory studies, etc. Approximately 95% of these problems are prepared for machine computation on either the Reeves electronic analog computers or the IBM card programmed computers at McDonnell.

Hulen writes that he feels that a background in physics is tops for any person working in the field alien to that in which their degree was given. The diversified subject matter in a physics curricula makes it next to impossible for a physics major to encounter problems with which he does not at least have a speaking acquaintance.

Hulen is a member of the Institute of Aeronautical Sciences, the McDonnell Management Club, and the national honor societies in Engineering and Physics, Tau Beta Pi, and Sigma Pi Sigma. His wife, Joan, is a former airline stewardess. They have one son, Ronnie, and live at 932 Highmont Drive in Ferguson, Missouri.

Robert E. Becker graduated from the Missouri School of Mines and Metallurgy in 1951 with a B.S. degree in Physics and minors in Mathematics and Electrical Engineering. Robert was appointed a graduate assistant in the Physics Department at the University of Wisconsin

Hulen H. Luetjen, B.S. in Physics, 1950, studying aerodynamic stress loads.



Robert E. Becker, B.S. in Physics, 1951, at the control panel of the Van de Graaff generator.

the first semester after his graduation from the Missouri School of Mines. For the academic year of 1951-52 he was research assistant. He is now on his second National Science Foundation Fellowship at the University of Wisconsin. During the last three summers, Robert has been employed at the Los Alamos National Laboratories at Los Alamos, New Mexico. He is doing his research work in the field of nuclear physics under the direction of Professor H. H. Barschall, chairman of the Physics Department, University of Wisconsin. The picture shows Becker at the control panel of the new Van de Graaff generator at the University of Wisconsin.

The Van de Graaff generator builds up a static electric charge on a metal dome. Potentials of four million volts and more can be attained on this dome.

The machine is used to accelerate positively charged nuclear particles, such as protons and alpha particles. A very accurate energy control system makes possible determination of the velocity of the beam of particles to within one one-hundredth of a percent.

The machine is in operation for the purpose of studying the nucleus of the atom. After the particles leave the machine, they are allowed to strike targets of various materials. Counting devices detect the nuclear fragments given off and provide information about the atomic nucleus which is formed in the reaction.

The present experiment involves bombardment of beryllium and carbon-13 with alpha particles from the machine.

In both these reactions, neutrons are emitted. Detection devices count the neutrons and determine their velocity and direction. From this, information is obtained about the properties of the nu-

cleus which is formed in the reaction and left behind in the target.

The neutrons given off in the reaction can also be used as a tool to study nuclear properties by bombarding other materials with them and observing what happens.

Becker anticipates that he will complete the requirements for the Ph.D. degree in physics at the University of Wisconsin in about six months. There will undoubtedly be many opportunities for him in industrial research, government programs and in teaching.

CERAMICS

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in 1946 from M.S.M. The plant was started in late 1944 under Vernon's direction while Kenneth was serving in the Marine Corps.

Kenneth has charge of research and development, and recently the company added 22,000 square feet of space and a new tunnel kiln under his direction. He plans the engineering work required for new products so that when the company decides to add new lines, no time will be lost. His job therefore covers plant engineering as well as product engineering. This is the usual practice in small companies.

These two graduates portray some interesting facts about Ceramic Engineering. *First* of all, Ceramic Engineers can obtain positions in industry in their home state as well as throughout the nation. There are approximately 5000 ceramic plants manufacturing refractories, porcelain enamel products, building wares, sanitary wares, dinnerware, glass, Portland cement, electrical liners, spark plugs, and even false teeth. *Second,* Ceramics is one of the few engineering fields in which a young man can hope to own his own manufacturing plant. Most ceramic plants are rather small and designed to supply local needs. Therefore, a person with limited capital can make a success with a ceramic plant. *Third,* there are only eighteen colleges offering the Ceramic Engineering course of study. They have only graduated 2500 engineers in the last fifty years, and there are wide open fields in the Ceramic Industry.

METALLURGY

(Continued from Page 9)

melt and distort ordinary metals and alloys. The other example is the development of large scale production of ductile titanium metal. Planes constructed of this light but strong material will have greater speed and will be able to withstand the severe conditions of supersonic flight.

These are but a few industrial functions which demonstrate that Metallurgical Engineering is basic in modern technology.