THE WORLD IS YOUR WORKSHOP

THE PENNSYLVANIA
STATE UNIVERSITY
BULLETIN

COLLEGE OF
MINERAL INDUSTRIES
UNIVERSITY PARK, PENNSYLVANIA
The World Is Your Workshop

Thirty-inch globe especially designed and constructed in Pennsylvania's College of Mineral Industries to show the world-wide distribution of minerals and their flow to the processing industries of the United States.

THE PENNSYLVANIA STATE UNIVERSITY LIBRARY

College of Mineral Industries
The Pennsylvania State University
THE WORLD YOU LIVE IN

You will hear it said that there are no new lands to discover, that war has wasted our natural resources, and that our future in the atomic age is dark. There have been pessimists in every age, but somehow man has found new ways to prove his lot.

Your world needs pioneers of a different sort. It needs new tools and men trained to use them to improve standards of living in backward areas, men who believe that countries which work together can live together in harmony.

One field in which you may be able to contribute your share to that world, and carve a rewarding future for yourself at the same time, is the field of mineral industries. Careers available in those industries are described briefly in this bulletin.

YOUR PLACE IN THAT WORLD

Right now, selecting a career is the most important decision you have to make. To decide if you are qualified to train yourself for a career in a mineral industry, you will have to ask some searching questions.

Are you interested in mathematics, chemistry and physics? Have you done well in such subjects? Do you really like to study? Do you set for yourself a code of character and conduct and follow it?

If you can honestly answer yes to such questions, the College of Mineral Industries at Penn State can offer you training for the career of your choice. With such training, you will receive a broad, general education which will prepare you not only for a useful job in our economic society, but also for citizenship in our democracy. With such training, the world can truly be your workshop.

INTRODUCING THE COLLEGE

Pictured on these pages are the buildings in which you will study. They contain the finest equipment available and are staffed by an outstanding faculty. They also have three unusual features:

1. A Mineral Industries Museum which has display cases full of specimens of almost every kind of mineral, from fossils to precious gems.

2. A Mineral Industries Art Gallery which contains more than 150 paintings of various industries and their workers.


In addition to the four-year curriculums for undergraduate students described in this bulletin, the College offers graduate work toward the master's and the doctor's degrees.

Its Experiment Station conducts research which saves Pennsylvania industry many thousands of dollars each year. As a freshman you will have the chance to observe such research. As an upperclassman or a graduate student, you may work on such projects, contributing a share to the discovery of new facts and new methods.

For many who can't go to college, the Extension Services of the College provide on-the-job training for mineral industries workers throughout the State through extension classes or through correspondence courses.
The Mineral Industries
Art Gallery

The Mineral Industries
Auditorium—Below

The Mineral Industries
Library
INTRODUCING THE INDUSTRY

We take for granted many of the labor-saving appliances in our homes, the cars we drive, our radios and television sets, without thinking that these would not exist were it not for the workers who discover mineral deposits, extract them from the earth, and prepare them for our use.

Our earliest ancestors made hunting and fishing tools from minerals. King Solomon’s slaves mined gold in Africa. The difference today is that we have machinery to do the work instead of slaves. Trained men have developed complex tools which provide more minerals with less labor.

Unfortunately, the extraction of minerals from the earth leaves the supply irreplaceably diminished. We must constantly search for new mineral deposits, find better ways of separating valuable minerals from waste products, and find new uses for low-grade minerals. In short, we must use our minerals wisely.

Just one example will illustrate the growing need for workers in this field: During the Civil War we produced one-half pound of steel annually for each person in the United States. Today we produce more than 1300 pounds annually for each person.

These developments have helped to improve our American standard of living. They have also given us a responsibility for world leadership.

YOUR OPPORTUNITY

There have never been enough trained men for the mineral industries. Not enough men are being trained now. Because you may be one who knows little about the opportunities in this field, but who has the ability to succeed in it, we have prepared this booklet for you.

As you read about the 12 fields described in these pages, you may find in one of them your opportunity to prepare for a profession you will like and one in which you will be successful.
SCHOLARSHIPS IN THE COLLEGE OF MINERAL INDUSTRIES

Leaders in the mineral industries as well as many in governmental and educational positions are alarmed at the present shortage of graduates in the mineral science and engineering fields. Large numbers of good students are not now going to college because of the cost. To encourage some of these to enroll in curriculums in the College of Mineral Industries or to help others who have enrolled but are badly in need of funds, scholarships and awards have been established.

The scholarships and awards which are available as of January 1, 1956, are described below. The number and variety of scholarships in the College of Mineral Industries is steadily growing. It is suggested that anyone who wishes more recent information on the scope and value of such awards write directly to:

THE CHAIRMAN, COMMITTEE ON SCHOLARSHIPS AND AWARDS
COLLEGE OF MINERAL INDUSTRIES,
THE PENNSYLVANIA STATE UNIVERSITY
UNIVERSITY PARK, PENNSYLVANIA

SCHOLARSHIPS IN CERAMIC TECHNOLOGY

Two Pfundler Scholarships ($500)
Garfield Refractories Company Scholarship ($500)
Oscar Hommel Memorial Scholarship ($500)
The E. J. Lavino and Company Scholarship ($500)
National Refractories Company Scholarship ($500)
Swindell-Dressler Foundation Scholarship ($500)
North American Refractories Company Scholarship ($500)
Three Harbison-Walker Refractories Company Scholarships ($500)
Two Pittsburgh Plate Glass Company Scholarships ($500)
Stackpole Carbon Company Scholarship ($500)
The Pennsylvania Ceramics Association Scholarship ($250)

These scholarships are all awarded to students enrolled in the Department of Ceramic Technology. Recipients are selected on the basis of scholarship, character, and need. Award of each of these scholarships is made initially to an entering freshman and is intended to continue in succeeding years if good scholarship is maintained. In the fall of 1956, at least one Harbison-Walker, the Lavino, one Pfundler, one Pittsburgh Plate, and the Stackpole scholarships will be available to entering freshmen.

The General Refractories Company Senior Scholarship ($500)

This scholarship is awarded annually to a senior, or under certain circumstances to a junior, in the Ceramic Technology curriculum. The award is made on the basis of scholarship, interest in ceramic science, and financial need.

THE E. J. LAVINO AND COMPANY SCHOLARSHIP IN MINERAL ECONOMICS ($500)

This award provides $500 to an incoming freshman who enrolls in Mineral Economics. The award is made on the basis of scholarship, financial need, character, and science aptitude and is continued as long as these criteria are met.

AMERICAN COAL SALES ASSOCIATION SCHOLARSHIP IN FUEL TECHNOLOGY ($1000)

This award of $1000 will be made to an incoming freshman enrolling in Fuel Technology in the fall of 1956. The recipient will be chosen by a committee selected by the American Coal Sales Association and will receive the same award for each of his remaining three years as well provided a superior scholarship record is maintained.

COOPERATIVE PROGRAM IN METALLURGY SCHOLARSHIP ($255)

Any incoming freshman enrolling in the Metallurgy curriculum is eligible. The recipient is selected by the head of the Department of Metallurgy on the basis of the student's high school record.

RALPH E. TAGGART MEMORIAL SCHOLARSHIPS ($500)

These scholarships, awarded to high school seniors in the southern anthracite region who intend to study mining engineering, pay $500 yearly and are continuing if grades are satisfactory.

AIME COAL DIVISION SCHOLARSHIPS ($1450)

These scholarships, awarded to students in the Mining Engineering curriculum, pay $300 in freshman year, $350 in sophomore year, $400 in junior year and $400 in senior year making a total of $1,450 for the 4-year course.

IMPERIAL COAL CORPORATION SCHOLARSHIPS ($500)

These scholarships are awarded to employees or sons of employees of the Imperial Coal Corporation who are enrolled in the Mining Engineering curriculum and are continued if grades are satisfactory.

JOHNSTOWN COAL & COKE COMPANY SCHOLARSHIPS ($500)

These scholarships are awarded to employees or sons of employees of the Johnstown Coal and Coke Company who are enrolled in mining engineering and are continued if grades are satisfactory.

PITTSBURGH COAL COMPANY SCHOLARSHIPS ($175)

These scholarships, awarded to students in the Mining Engineering curriculum, pay $175 per semester, and are continuing. Scholarships are limited to students interested in mining and located in the vicinity of the company's operations.
EDWIN L. DRAKE MEMORIAL SCHOLARSHIPS
($502 or $252)

Students enrolled in the Geology and Mineralogy, Geophysics, and Petroleum and Natural Gas Engineering curriculums are eligible for these scholarships which cover all fixed charges. In 1956, four scholarships ($252) were awarded to Pennsylvania residents and three ($502) to out-of-state students. One of the latter is available each year to a resident of New York State. The award is made to students in any of the four years with high scholastic averages who are in need of financial assistance.

LANE-WELLS COMPANY SCHOLARSHIP ($500)

Any student in the Petroleum and Natural Gas Engineering curriculum is eligible for this award regardless of race, religion, or nationality. The recipient is selected by the head of the Petroleum and Natural Gas Department.

AMERICAN SMELTING AND REFINING COMPANY SCHOLARSHIP ($500)

Students in the Mining Engineering curriculum are eligible for this scholarship. The award is made annually by the head of the department of Mining on the basis of the applicant's scholastic record and financial need.

AMERICAN SOCIETY FOR METALS, FOUNDATION FOR EDUCATION AND RESEARCH SCHOLARSHIPS ($400)

This scholarship is awarded annually to a sophomore in the Metallurgy curriculum. The recipient is selected by the head of the Department of Metallurgy on the basis of the candidate's scholastic standing and his financial need.

CINCINNATI MILLING MACHINE COMPANY SCHOLARSHIP ($500)

Sophomores in the curriculums of Metallurgy and Ceramic Technology with exceptional scholastic records are eligible for this scholarship. This award may be retained during the junior and senior years, if a satisfactory record is maintained.

LURIA BROTHERS AND COMPANY, INC. SCHOLARSHIP ($400)

Students in Metallurgy are eligible for this award. Selection is based on interest in the foundry industry, personality, and leadership traits. In addition, scholarship and financial need are considered.

THE JOHN AND ELIZABETH HOLMES TEAS SCHOLARSHIPS ($1000)

Students enrolled in the Geology and Mineralogy, Geophysics, and Chemistry curriculums are eligible for these scholarships. Each year a sophomore is selected in each of the above curriculums; the awards continue during the junior and senior years or until the recipient graduates from the selection criteria. The recipients are selected by the President of the University from a group of candidates on the basis of ability, personality, and financial need. Any native-born student is eligible.

AMERICAN BRAKE SHOE SCHOLARSHIP ($500)

Male undergraduates in the Colleges of Mineral Industries, Chemistry and Physics and Engineering and Architecture are eligible for this scholarship. Candidates must have completed their sophomore year. Personality and extracurricular activities are considered in selecting the recipient of this award. A minimum average of C+ (2.5) is required.

SOCONY-MOBIL SCHOLARSHIPS ($750)

One award granted to a senior in the Petroleum and Natural Gas Engineering curriculum and one to a senior in Earth Sciences, each award pays $750 for the year.

SOHIO PETROLEUM COMPANY SCHOLARSHIP ($850)

This award is made to a student in the Petroleum and Natural Gas Engineering curriculum on the basis of scholarship, character, and need.

WILLIAM GRUNDY HAVEN MEMORIAL AWARD ($250)

This award is made to a 6th or 7th semester student in the College of Mineral Industries. The candidate must be a citizen of the United States and a resident of the State of Pennsylvania or at least one of his/her parents should have been a graduate of The Pennsylvania State University. In addition, all applicants must demonstrate their ability to express their thoughts clearly and correctly in writing. They shall have a high scholastic standing and shall be sincerely interested in one or more branches of the mineral arts or sciences.

ELLEN STEIDLE ACHIEVEMENT AWARDS ($250 and $75)

The larger award is made to a senior and the smaller to a junior in the College of Mineral Industries. A minimum all-University average of 2.5 is required and the recipient must have been in residence on the campus for at least three semesters. Candidates are selected from those who have been particularly active in furthering the welfare and improvement of the student body.

LOUIS E. YOUNG AWARD ($200)

This award is presented to an outstanding student in the Mining Engineering, Metallurgy, Petroleum and Natural Gas Engineering, or Geology and Mineralogy curriculums at the close of his junior year. The recipient is selected on the basis of character and high scholarship.

JEROME N. BEHRMANN AWARD ($100)

This award is made to a graduating senior who has enrolled in a graduate school. Candidates are usually selected from students in the Meteorology curriculum on the basis of scholarship, personality, character, and financial need.

THE JOHN G. MILLER MEMORIAL SCHOLARSHIP FUND ($100)

This award is made to a student in the College of Mineral Industries, with priority given to freshmen, and is given on the basis of demonstrated promise in his chosen field.

Applicants are requested to write the Chairman, Committee on Scholarships and Awards, College of Mineral Industries, The Pennsylvania State University, University Park, Pennsylvania, for further details.
Looking for a Future?

Have you thought about GEOGRAPHY?

College of Mineral Industries
The Pennsylvania State University
WHERE AMERICAN GEOGRAPHERS ARE EMPLOYED

As the above map shows, American geographers work in every region of the world except behind the Iron Curtain.

YOUR FUTURE CAREER

Are you spellbound by a map? Do you dream of faraway places and strange peoples? As you drive over the countryside or fly above the earth, are you intrigued by the patterns that nature unfolds before you? Have you ever wondered why the rest of the world differs from your own neighborhood?

If your answer is yes, geography may be the career for you, because the primary objective of the geographer is to find out why people differ from continent to continent, from nation to nation—even from neighborhood to neighborhood. Geography is simply the study of your neighbors, far and near, as they have adjusted themselves to the infinite variety of environments on our globe.

While geography is one of the world's oldest subjects, the earth is still crammed with unsolved riddles about the relationships between man and nature. The day when an explorer can discover new land is past. The day is just dawning when the geographer can unfold new understandings of old lands. Perhaps you would like to be one of this pioneer band of modern "explorers."

NEED FOR GEOGRAPHERS

Never has there been a greater need for understanding the ways in which people live. Modern transportation and communication have made all people neighbors. Learning to know these neighbors is difficult.

You can be sure of one thing: The Russian question, the question of distribution of natural resources, the South African race question, and other major issues of our times will never be solved until all people know a lot more about each other.

As a geographer, you can contribute much to the understanding of such problems. Through your work in the library and your field investigations you can help to solve them.

For more than a decade there has been a growing demand for geographers. The number of positions open exceeds the supply of Geography graduates from our colleges. This is a growing, dynamic field with excellent employment opportunities.
GEOGRAPHERS IN THE FIELD AND LABORATORY

Geographers travel to the far corners of the world to work and study. In the picture on the left Dr. E. Willard Miller, Head of the Department of Geography at Penn State, and his wife study the active volcano of Paricutin in southern Mexico. In the center picture Dr. Miller and Sir Hubert Wilkens are studying glaciation in the mountains of Alaska. In the picture on the right Dr. George F. Deasy, professor of geography, is doing field work in the gold fields of the Yukon River country.

GEOGRAPHY AS A PROFESSION

No longer are geographers limited to teaching. They now find a wide range of employment opportunities. The number of U. S. Civil Service positions in Geography has been greatly expanded.

Penn State graduates are now employed in the Departments of State, National Defense, Interior, and Agriculture; in the Central Intelligence Agency, the Army Map Service, the Library of Congress, and other agencies. They hold positions as regional geographers, cartographers, research analysts, conservationists, economic geographers, physiographers, aerial photo interpreters, and climatologists.

Geographers prepare studies on topics relating to industrial and commercial geography, soils, mineral resources, land use, distribution of vegetation, and related fields. They record such data on maps, and they prepare reports on the physical, economic, social, and political geography of specified areas.

GEOGRAPHY AND THE BUSINESS WORLD

If you are interested in business and industry, many positions are open to you. Although this is a new field, the geographer has already shown that he has much to contribute to the business world.

He can select and evaluate locations for retail outlets, analyze market areas, study the capacity of a region to produce and consume, suggest development programs, outline sales territories, appraise old and new markets, study trends and the geographic shifts of population as they affect industry and wholesale and retail markets.

Geography graduates have been employed by such companies as Pittsburgh Consolidation Coal Co., du Pont Chemical Co., Bethlehem Steel Corporation, Pennsylvania Water and Power Co., and others. They are also employed by state and local planning commissions.

Construction of a soil map in the cartography laboratory at Penn State. Notice the great number of drafting instruments used.

Using a panograph (reducing-enlarging machine) in preparing an economic map of central Pennsylvania.

This is a multiscope—a machine used to interpret aerial photographs for a land use map.
THE FIELDS OF GEOGRAPHY

The above diagram shows the many branches of modern geography. The two main branches of topical geography are physical and human geography. On the left is physical geography which deals with the natural landscape and includes such special branches as physiography, climatology, geography of soils, biogeography, and cartography.

On the right is human geography which deals with the cultural landscape and has four main branches. The first and most important of these is economic geography. The subdivisions below it are industrial geography, mineral geography, agricultural geography, and the geography of transportation. Second is the geography of population, which includes urban geography, rural geography, and studies of the distribution of peoples. The third major division is cultural and social geography. Finally, there is political geography, which includes such items as military geography and geopolitics.

You will notice that all these branches are drawn together in the diagram. Combined, and focused on one particular part of the earth, they are called regional geography.

QUALIFICATIONS YOU NEED

As a geographer, you should have an interest in both the natural and the social sciences. You should have a love for the out-of-doors and a mind that is stimulated by travel. At the same time, since much geographic work is done in the office, you should be willing to work indoors. This is particularly true in such branches as cartography.

Since geography, like medicine, has a code of ethics, honesty is important. You also need to have an open mind and a willingness to learn. It goes without saying that you’ll be expected to be sincerely interested in study.

FACILITIES AT PENN STATE

The mountains and valleys of Central Pennsylvania, together with its farms, mining, and industry, make the area ideal for the study of geography.

Equipment for classroom and field work includes relief models, aerial photograpic equipment, cartographic drafting instruments, plane table survey facilities, and maps representing all phases of geography. A Map Institute emphasizing map-making, interpretation of aerial photographs, and outdoor field training has been established in order to expand research and instruction in these important studies.

More About Geography

Should you desire more specific information about this field of the Mineral Industries, please address your request to:

PROFESSOR E. WILLARD MILLER, HEAD
DEPARTMENT OF GEOGRAPHY
COLLEGE OF MINERAL INDUSTRIES,
THE PENNSYLVANIA STATE UNIVERSITY
UNIVERSITY PARK, PA.
GEOLOGY

An Exciting Career

College of Mineral Industries

The Pennsylvania State University
WHY CHOOSE A CAREER IN GEOLOGY?

Not all detectives are the cops-and-robbers type. Many scientists are detectives of a different sort. The geologist, for example, makes observations in the field and laboratory, then pieces clues together to learn the nature of the rocks he's studying.

If you have that sort of curiosity and an analytical mind, you'll want to consider a career in geology. It's a young and growing science. It attracts highly trained young men to the many varied careers described briefly in this folder. The demand for geologists exceeds the supply. About 15,000 are now in the profession—twice as many as in 1940. There is every reason to believe that the demand will continue to grow.

JUST WHAT IS GEOLOGY?

Geology is a study of the earth's outer crust and the living forms that have inhabited its surface. In your course you will learn the materials of which the earth is made and how its structures have been formed. You will study the fascinating life story of the earth as it is preserved in rocks and fossils.

Some geologists study the processes that affect the earth's surface—streams, glaciers, the wind, and the sea; valleys, caves, sand dunes, and ocean shores. Others study processes within the earth—the wrinkling and breaking of rocks, volcanic eruptions, and earthquakes. They consider how rocks, mountain chains, continents, ocean basins, and deep sea troughs were formed.

Still others trace animal and plant life through the hundreds of millions of years of the earth's history. Fossils help them to date geologic events. These evidences of ancient life provide clues to the geography and climate that existed when the rocks were formed.
WHY IS GEOLOGY IMPORTANT?

All these studies are useful in everyday life. Geologists help to find ground water and valuable metals. By interpreting the underground structure in oil fields, they help the industry to locate oil and to get it out of the earth once it is found.

Such engineering projects as the construction of dams and bridges depend on accurate geological information. Government agencies, military services, and private industry employ geologists to give advice on the strength of foundations, the danger of landslides, and the availability of construction materials.

WHERE DO GEOLOGISTS WORK?

The world-wide search for minerals and huge construction projects in many countries send geologists to all corners of the globe.

Most geologists work for petroleum companies. If you choose such a job, your work may be in exploration or in research. In either case you may eventually advance to an important executive position.

Others are employed by the mining industry. In this field your job may be exploring for metallic ores, coal, and other mineral deposits.

Or you may get a job with a federal or state geological survey. If you go on to take an advanced degree, you may become a university professor.

Although women are in the minority in the profession, some of them teach and others are employed in the laboratories of oil companies or in federal and state geological surveys.
WHAT QUALIFICATIONS ARE NECESSARY?

First, you must have a broad knowledge of the basic sciences, such as chemistry, physics, and mathematics, plus a thorough training in your chosen fields.

But it takes more than book learning to be a good geologist. Before you can interpret data, you will have to learn to gather facts through extensive field work. This means you must enjoy outdoor work—hiking, climbing, and camping. It's a healthful life, but you must be willing to put up with primitive conditions at times, as you can see in the pictures shown above.

You must also be able to get along with people—with farmers whose land you want to examine, with oil-drillers, miners, and construction gangs. If you work in foreign countries, a flair for languages is a help, but even more essential is a sincere desire to understand other countries and their people.

In short, if you are a well-rounded person with a love for science, this field offers you a real challenge.

More About Geology

Should you desire more specific information about this field of the Mineral Industries, please address your request to:

Professor Frank M. Swartz, Head
Department of Geology
College of Mineral Industries,
The Pennsylvania State University
University Park, Pa.
MINERALS AND ROCKS

As a member of the human race you are confined for the greater part of your life to the earth's crust. You may penetrate downward in mines to about a mile and a half; you may, by drilling, reach a depth of 4½ miles. You may climb the highest mountain, 5 miles. This 10 miles is your entire range; you are out of your element anywhere else. Perhaps you would like to learn something about your surroundings, remembering that organisms which failed to adjust are extinct and that all your knowledge of the universe beyond this 10 miles, toward the center of the earth, or outward into space, is known to you only in terms of the crust on which you live. The more you know about the crust the more you know about the universe.

The crust is composed of rocks and rocks are made of minerals; if, then, you wish to learn about this part of your environment you must learn about rocks (petrology) and minerals (mineralogy).

This electron microscope can magnify particles up to 100,000 times. Mineralogy students use it to study clay particles and other fine-grained minerals. (See illustration back page.)

THE SOURCE OF OUR RAW MATERIALS

Seven in every 100 parts of the earth's crust are iron, which is therefore common in minerals and rocks. Before you can develop a steel industry, you must find a place in the earth's crust where there are more than 30 parts of iron in every 100 parts of rock; you must learn to recognize minerals rich in iron and those rocks which contain such unusual minerals. Or perhaps you would like to develop atomic power; uranium occurs in rocks as 1 in 100,000 parts. You must find uranium, as the mineral uraninite (UO₂, see cover), concentrated to at least 1 part in 200 before it is worth while. You have to be an expert mineralogist to recognize these minerals, and an expert petrologist to recognize the rocks which are likely to contain them. Rock containing uranium is illustrated on the opposite page, and to see the ore among the grains of sand in which it occurs you need a microscope (see illustration), and to see the minerals which make the ore you must use still higher magnification by means of an electron microscope.

Perhaps you are interested in still more exotic minerals—emeralds, diamonds, gold—or the basic fuels such as petroleum and coal which play such an important role in determining the standard of living. All these minerals occur in rocks, and mineralogy and petrology are essential to their location and production. The crystal of quartz (SiO₂) on the cover yields oscillator plates which form the basis of radio broadcasting; this mineral is found in a special kind of rock in Brazil.

Whether you decide to learn about the earth you live on from interest, survival value, or as a profession or avocation, mineralogy and petrology will serve you well.
CAREER OPPORTUNITIES

It should be obvious that, as mineralogist and petrologist, you will work for mining companies, petroleum companies, or for the government, represented by national museums, the U.S. Geological Survey, and the Atomic Energy Commission. You may also be your own master as a consultant to government or industry or you may teach in universities.

The work you do may vary from the search for exotic minerals to the testing of concrete, glass, and road aggregate; and it may include visiting foreign countries and working in the laboratory at home. You may choose some unusually exciting problem in fundamental research using instruments such as the microscope, X-ray spectrometer, and electron microscope, or you may apply your information directly to oil-well drilling or in mining uranium, coal, or copper. You will have varied opportunities for a career and ample choice and reward because there are many more openings than trained people to fill them. Your training is specialized, your salary correspondingly high.
WHAT YOU WILL STUDY

Mathematics, physics, and chemistry are basic tools for all scientists and technologists, and you will require a thorough knowledge of these fields. In addition, geology, philosophy, and economics are essential to a well-rounded training in mineralogy and petrology. At Penn State you will, at first, work in the combined curriculum of Geology and Mineralogy and later specialize in mineralogy and petrology.

In these fields graduate training is becoming more important and students frequently find it advantageous to continue to a master's and/or a doctor's degree. Specialists of this kind usually command special treatment and the salaries are commensurate with your investment—the more expert you are the more reward you can expect. The graduate with a master's degree earns 15 per cent more at the start than one with a bachelor's degree, and one with a Ph.D. degree earns up to 33 per cent more.

FINANCIAL AID

If you need a part-time job as an undergraduate, the Student Employment Office on campus will help you to find one.

If you have a good undergraduate record, you can count on financial help for your work toward a master's or a doctor's degree. The number of graduate assistantships and fellowships available to the Division of Mineralogy usually exceeds the number of applicants.

These fellowships and assistantships exempt you from all major fees and pay you various amounts depending upon the service you give to the department.

More About Mineralogy

Should you desire more specific information about this field of the Mineral Industries, please address your request to:

Professor J. C. Griffiths, Head
Department of Mineralogy
College of Mineral Industries
The Pennsylvania State University
University Park, Pa.
Look Beneath the Surface

GEOPHYSICS and GEOCHEMISTRY

College of Mineral Industries
The Pennsylvania State University
TWO NEW SCIENCES

If you have a good imagination and a lot of curiosity about the world around you, if you like to build and use complicated gadgets, you may enjoy a career in the new fields of geophysics and geochemistry.

The geophysicist and the geochemist use the tools of physics and chemistry to study the earth and prospect for oil and minerals. They use Geiger counters to find uranium, and seismometers to study earthquakes and to find oil. They measure the pull of gravity with gravimeters. They study the earth's magnetism, and electric currents in the ground. They test the behavior of minerals and molten rock at high temperatures and pressures to learn how mountains are built and how rocks are formed in volcanoes and deep within the earth.
TRAINED MEN ARE NEEDED

Jobs are plentiful. Your pay will be high from the start, and you can advance rapidly. The oil industry alone has over three times as many openings for geophysicists and geochemists as there are college graduates to fill them. The mining industry is looking for far more men and women than there are available to prospect for ore deposits. Geophysicists are needed to help in planning highway and dam construction.

Your first position is likely to be mostly field work. After some field experience, you can probably get a laboratory job. There are many opportunities for work abroad, where the pay is exceptionally high.

Success in science and engineering comes to those who know how to use the newest methods and instruments. An education in geophysics and geochemistry will get you a good job because you will be trained to use the newest discoveries in solving problems related to the earth.

SUBJECTS YOU WILL STUDY

Penn State's curriculum in Geophysics and Geochemistry is one of the oldest and most complete in this country.

You will begin by getting a broad background in science, especially physics, chemistry, and geology. In geophysics and geochemistry courses you will learn how to "look" into the earth, to map buried rocks, and to find valuable, hidden raw materials.

In no other subjects can you learn to use more varied types of apparatus under a greater range of conditions. Penn State's laboratories give you practice in using the types of equipment pictured on these pages, as well as many others.

You are welcome to visit these laboratories at any time.
More About Geophysics and Geochemistry

Should you desire more specific information about this field of the Mineral Industries, please address your request to:

Professor B. F. Howell, Jr., Head
Department of Geophysics and Geochemistry
College of Mineral Industries,
The Pennsylvania State University
University Park, Pa.
METEOROLOGY

The Science of Weather
Serves the Nation

College of Mineral Industries

The Pennsylvania State University
A RAPIDLY GROWING PROFESSION

You know, of course, that everyone talks about the weather, but perhaps you don't know that the meteorologist does much more than forecast a nice day for a picnic or a football game.

The purpose of this folder is to tell you about the rapidly growing profession of Meteorology which is offering new opportunities to increasing numbers of young men and women.

EFFECTS OF WEATHER AND CLIMATE

Weather and climate have always had a great influence on historical events. For example, it is obvious that the landings on the Normandy beachhead in World War II would have been impossible without the services of meteorologists.

The effect of weather on life cycles and technological advances is not so well known. Every part of our society is affected by climatic conditions, and probably every group in our civilization depends in some way on weather information.

THE WEATHER MAN

Forecasting is an art as well as a science, but the meteorologist does much more than forecast. He studies the physical processes in the atmosphere. He analyzes them mathematically. He applies his knowledge to agricultural, industrial, commercial, and other enterprises. For this reason professional meteorologists are qualified for many various kinds of jobs.
JOB OPPORTUNITIES

In large agricultural enterprises, meteorologists are needed to help plan the sowing, harvesting, canning, and shipping of food products.

Insurance companies that issue policies for hail, windstorm, and other weather-caused damages have meteorologists on their staffs to investigate damage claims and to determine the weather risks for various areas in the United States.

In large industrial firms, meteorologists study air pollution problems (particularly in atomic energy plants) and problems of manufacturing processes that depend on atmospheric conditions. Large manufacturers depend on forecasting for advantageous dates to advertise weather-dependent merchandise.

Private weather consultants serve department stores, radio and television studios, oil companies that have well-drilling and pumping operations off the Gulf shores, trucking and shipping firms, fishing industries, highway maintenance departments, and other users of meteorological information.

The U.S. Weather Bureau employs more than 2,000 meteorology graduates at city offices, airports, and forecast stations in this country and overseas. The Bureau has a great variety of positions, such as hurricane, flood, and aviation forecasters.

THE COURSE AT PENN STATE

Penn State is the only university in the Commonwealth that offers a Meteorology curriculum.

In college you will study mathematics, physics, chemistry, geography, and the humanities during your first two years. These provide a broad, general education as well as the basis for sound professional training. Beginning with your junior year, you will study general meteorology, meteorological instruments and observational methods, climatology, and weather forecasting. Courses in physical and dynamic meteorology give you a knowledge of the physical processes in the atmosphere and their mathematical analysis.

Penn State has excellent facilities for practical work in this field. In its laboratories and its meteorological observatory you can observe the weather, study the theory and operation of the instruments, learn weather codes, master techniques of map construction and analysis, and practice forecasting.

Hurricanes like this one cause a great deal of damage, but many lives are saved by Weather Bureau forecasts.

Photo by the Miami Daily News

Although disruption of communication lines by ice storms cannot be prevented, advance information helps to hasten repairs.

Photo by B. Love, Springfield Newspapers, Inc., Missouri
MORE ABOUT METEOROLOGY

Should you desire more specific information about this field of the Mineral Industries, please address your request to:

Professor Hans Neuberger, Head
Department of Meteorology
College of Mineral Industries
The Pennsylvania State University
University Park, Pa.

This student studies the properties of fog in the Physical Meteorology Laboratory.
MINERAL ECONOMICS

AN OPPORTUNITY
To Choose a Career
Suited to Your Talents

COLLEGE OF MINERAL INDUSTRIES

THE PENNSYLVANIA STATE UNIVERSITY
WHAT MINERAL ECONOMICS GRADUATES DO

When you think about preparing for your future career, one of the first questions you are likely to ask is, “What are the job opportunities in this field?”

In mineral economics, probably the best answer is found in the list below, which shows what 60 Penn State graduates in this curriculum are doing. These students have 50 Bachelor of Science degrees, 13 Master of Science degrees, and one Doctor of Philosophy degree.

<table>
<thead>
<tr>
<th>Type of Job</th>
<th>Number</th>
<th>Type of Job</th>
<th>Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Marketing</td>
<td>7</td>
<td>Teaching</td>
<td>4</td>
</tr>
<tr>
<td>Government Services</td>
<td>10</td>
<td>Research</td>
<td>3</td>
</tr>
<tr>
<td>Production</td>
<td>1</td>
<td>Management</td>
<td>6</td>
</tr>
<tr>
<td>Armed Forces</td>
<td>9</td>
<td>Purchasing</td>
<td>1</td>
</tr>
<tr>
<td>Engineering</td>
<td>9</td>
<td>Publishing</td>
<td>1</td>
</tr>
<tr>
<td>Graduate Study</td>
<td>2</td>
<td>Others</td>
<td>7</td>
</tr>
</tbody>
</table>

The pictures on these pages show six typical graduates who hold the kinds of jobs illustrated on the preceding page.

Richard E. Seidel, Class of 1950, Junior Buyer, Purchasing Department, Bethlehem Steel Co.

NEED FOR MINERAL ECONOMICS GRADUATES

Our complex American industries require that the men who manage them be skilled in solving both business and technical problems. The program that you will follow in mineral economics is designed to provide you with the basic business and technical training needed for a career in business management. Immediately on graduation, you cannot, of course, expect to take over the management of an important mineral industry, but neither do you have to start on the ground floor. Your education will fit you for a job several rungs up the ladder whether it be in government or one of the private mineral companies that produce, process, or sell coal, petroleum, natural gas, the various metals, and a variety of nonmetallic minerals.

Your broad training in mineral economics qualifies you for any one of many kinds of work. The field is new and uncrowded. The supply of graduates has not yet even approached the number of jobs already available. This means that you will have no trouble in finding a job and, what is more important, in finding one you like and in which you will be making a definite contribution to your country’s welfare.
WHAT MINERAL ECONOMICS IS

One reason that you probably have never heard of mineral economics is that few men are actually called "mineral economists." Instead, although their education was in that field, the titles they usually have explain the uses to which they put their training. They may be technical sales engineers, or commodity-industry analysts, or research engineers, but what qualifies them for what they do is the background in business and technology they got in their college days and the experience they have acquired since graduation. Mineral economics, then, is a term which refers to the type of education you receive and not to the name of your future job.

Although the term first came into common use in the 1930's, it is now widely familiar to government and industry.

Let us remind you again that industrial processes are becoming more and more technical. In recent years much industrial administration has been handled by engineers who understand the technical aspects of modern production but who lack a knowledge of business techniques. Many have overcome this deficiency by learning the business aspects through experience or by home study. They have advanced to important positions in sales, management, and administration—business phases of industry which were once the special domain of the business administration graduate.

Because the College of Mineral Industries at Penn State believed that these men would have benefited from a combination of business and technical training, the curriculum in Mineral Economics was established in 1946. It is the only complete curriculum in the field offered in this country.
QUALIFICATIONS FOR STUDENTS

During your first two years you will study chemistry, physics, mathematics, English composition, geology, and mineralogy. These years will give you a broad, general education as well as a sound basis for your vocational training.

During your last two years your technical subjects will include mining, mineral preparation, fuel technology, geophysics, metallurgy, petroleum engineering, and ceramic technology. Your business subjects will be economics, statistics, accounting, and business law. In addition, your mineral economics courses will teach you about the production, distribution, marketing, and technologic-economic problems of the coal, oil and gas, metal, and nonmetallic industries. They also include training in mineral valuation and mineral data analysis.

Twelve credits of electives give you an opportunity for special work in the field that interests you. Some students use these to supplement their business training; others use them for technical subjects.

THE COURSE AT PENN STATE

Your chances for success in this field depend upon a number of factors, including your ambition and industry. Even though you may not be interested in a purely technical career, you should have some interest in the sciences and in the mineral kingdom. You should like mathematics and be able to work with statistics. You should enjoy individual research. As you learned in the preceding section, the field of mineral economics calls for an individual with an equal interest in both the business and the technical aspects of modern industry.

More About Mineral Economics

Should you desire more specific information about this field of the Mineral Industries, please address your request to:

Professor John D. Ridge, Head
Department of Mineral Economics
College of Mineral Industries,
The Pennsylvania State University
University Park, Pa.
MINING ENGINEERING

THE USE OF...

SCIENCE
MACHINES
MEN
MONEY

To Extract Minerals
from the Earth

College of Mineral Industries  The Pennsylvania State University
YOUR FUTURE IN MINING ENGINEERING

If you want a job that has different duties every day, a job that may take you to a different part of the country—or the world—perhaps mining engineering is the job for you. Although the work is difficult, advancement is rapid.

Working in the mines, you will see minerals in their natural state, but you will never be sure what you will find beyond the rock face, or what problems you will have to solve.

Mining men are known for their loyalty and are proud of their profession.

JOB OPPORTUNITIES

There are three times as many jobs as there are mining engineers to fill them. This is not a temporary need since the demand for trained men in this field will continue to grow for many years.

A recent survey shows that mining engineers fill more than 30 different kinds of jobs. Most of the men work directly in the industry. Others work for companies that serve the mining industry, such as manufacturers of equipment and supplies. Still others work for government and service agencies.

Since the profession is not crowded, chances for advancement are good. It is not unusual for a mining engineer to have a responsible position after only five years of experience. He may be in complete charge of a mining operation by that time. Many top executive positions are held by graduate mining engineers.

FIELDS OF EMPLOYMENT

When a graduate goes into the coal-producing industry, he may either enter a training program or be assigned to a job immediately. This is the first rung of a ladder leading to a more important supervisory or technical position. The rate of promotion and increased earnings depend upon individual progress.

A similar pattern is followed in the “hard rock” mining industry. In addition to supervisory work, this field offers opportunities for mining geologists, exploration engineers, and others with broad engineering training. From these jobs you can advance to such positions as chief mining or development engineer, supervising other engineers.

The mining engineer also can enter the manufacturing industry as a sales engineer, or obtain a position with the U.S. Bureau of Mines through a Civil Service examination. Other positions are open with state government and insurance agencies.

What Mining Engineers Do

<table>
<thead>
<tr>
<th>Engineering</th>
<th>Operating</th>
<th>Service</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mechanization</td>
<td>Production</td>
<td>Manufacturing</td>
</tr>
<tr>
<td>Ventilation</td>
<td>Safety</td>
<td>Contracting</td>
</tr>
<tr>
<td>Drilling and Blasting</td>
<td>Transportation</td>
<td>Technical Publication</td>
</tr>
<tr>
<td>Surveying and Mapping</td>
<td>Operations</td>
<td>Consulting</td>
</tr>
<tr>
<td>Materials Handling</td>
<td>Planning</td>
<td>Insurance</td>
</tr>
<tr>
<td>Reclamation</td>
<td>Maintenance</td>
<td>Research</td>
</tr>
<tr>
<td>Valuation</td>
<td>Electrification</td>
<td>Instruction</td>
</tr>
<tr>
<td>Recovery</td>
<td>Construction</td>
<td>Government</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Federal</td>
</tr>
<tr>
<td>Stratagization</td>
<td></td>
<td>State</td>
</tr>
<tr>
<td>Equipment Utilization</td>
<td></td>
<td>Promotion</td>
</tr>
<tr>
<td>Development</td>
<td></td>
<td>Export Sales</td>
</tr>
<tr>
<td>Exploration</td>
<td></td>
<td>Bonds</td>
</tr>
</tbody>
</table>
SALARY AND LIVING STANDARDS

The starting salary of mining engineering graduates is higher than that of the average university graduate. The pay varies with the location and the type of work done. Where travel is involved, the mining engineer's living expenses are paid by the company. Some positions include the use of a company car for business and personal use. In addition, many companies have a profit-sharing plan.

Thus a good living standard is assured for the mining engineer. Earnings increase with experience.

WHERE MINING ENGINEERS WORK

Opportunities for employment are world-wide. The mining engineer works wherever the mineral deposits are located. Graduates are in demand to teach our skills in other countries.

In this country mining engineers find excellent job opportunities, often near their home town. Companies know that trained men are necessary to plan and supervise their work in this age of mining mechanization.

Mining companies may produce coal, iron, zinc, or limestone. A complete list would cover many pages. Included would be all kinds of nonmetallic and ore mining enterprises.

Not all mining is done underground. So-called strip or open-pit mines produce large quantities of minerals. Most of the copper produced in this country comes from one vast open pit mine located in Utah. Many quarry operations also hire mining engineers. These are just as important as underground positions.
SUMMER JOB POSSIBILITIES

Mining companies urge undergraduates to work at the mines during the summer. There are many more jobs than applicants. Summer work is available in many parts of the United States. The pay is almost equal to that of the mining graduate.

Summer jobs in and around the mines are credited to your experience record. When you receive your degree, this work counts as additional training. Very often the result is quicker advancement. Such experience also helps you to understand the theory taught in your courses.

Training for Mining Engineers

Are you qualified to study mining engineering? The answer is yes, if you are interested in mathematics and basic science courses. You do not need a knowledge of practical mining.

At Penn State the curriculum covers mathematics in some detail. At the same time you take courses in drawing, geology, mineralogy, chemistry, and physics. These are followed by electrical, mechanical, and civil engineering subjects.

Surveying, the first course in mining engineering is taken in the second year. Studies of mining methods, systems, ventilation, and mechanization follow.

Elective studies give you an opportunity to specialize and to take courses that give you a broad, general education as well as sound professional training.

Typical Mining Company Training Program

<table>
<thead>
<tr>
<th>Location</th>
<th>Time</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Direct Current Shop</td>
<td>1 month</td>
<td>Repairs to DC Machines</td>
</tr>
<tr>
<td>Mining Repair Shop</td>
<td>1 month</td>
<td>Reconstruction of mechanical mining equipment</td>
</tr>
<tr>
<td>Machine Shop</td>
<td>1 month</td>
<td>Fabrication of equipment parts</td>
</tr>
<tr>
<td>Mine Maintenance</td>
<td>3 months</td>
<td>Maintenance inspection at the mines</td>
</tr>
<tr>
<td>Coal Preparation</td>
<td>2 months</td>
<td>Preparation plant quality control</td>
</tr>
<tr>
<td>Underground Face Work</td>
<td>6 months</td>
<td>Mining methods and systems</td>
</tr>
<tr>
<td>Mine Engineering</td>
<td>2 months</td>
<td>Surveying and mapping</td>
</tr>
<tr>
<td>Industrial Engineering</td>
<td>6 months</td>
<td>Mine production control</td>
</tr>
<tr>
<td>Management Engineering</td>
<td>2 months</td>
<td>Cost, Personnel, Purchasing and Safety</td>
</tr>
</tbody>
</table>

NOTE—Entire program may be shortened or more time devoted to one location, dependent upon the aptitude and interest of the trainee. Periodic reports, required during the training period, are discussed in conference with the training supervisor.

Facilities at Penn State

Excellent laboratories are available at Penn State for teaching how complete mines are designed and operated. Nearby mines afford opportunities for field trips throughout the year to see the latest equipment in actual mining operations.

Because of the summer job opportunities and available scholarships, students in this curriculum can pay part of their college expenses. In addition, the Student Employment Office on campus will assist you in finding a part-time job.

More About Mining Engineering

Should you desire more specific information about this field of the Mineral Industries, please address your request to:

PROFESSOR ARNOLD W. ASMANN, HEAD
DEPARTMENT OF MINING
COLLEGE OF MINERAL INDUSTRIES,
THE PENNSYLVANIA STATE UNIVERSITY
UNIVERSITY PARK, PA.
THE MINERAL PREPARATION ENGINEER SEPARATES THE VALUABLE MINERALS FROM THE WASTE ROCK.
A CAREER IN MINERAL PREPARATION

You've heard about all kinds of mines—coal mines, copper mines, silver and gold mines—but you may not know much about what happens to minerals between the time they are taken from the earth and the time they appear in your home as tools, kitchen utensils, or ornaments.

The purpose of this folder is to tell you something about the romantic history of minerals and the men who work with them. You can't just wave a magic wand over a piece of mineral and have it turn into a useful product. Men with technical training are needed to do that job, and mineral preparation may be just the career you're looking for.

A LOOK AT THE PAST

You know of course, that the California gold rush of '49 was high adventure, but centuries before that, on the other side of the world, copper was in the gold-rush stage. Eight thousand years ago in Persia (now Iran) men molded copper into tools. As they recognized its beauty, they made it into ornaments. In a few centuries it became as scarce as gold.

About 3500 B.C. men discovered smelting processes and learned to convert copper-bearing minerals, such as the chalcocite pictured on this page, into copper. This was the beginning of the Copper Age, which was followed by the Bronze Age, the Steel Age of the last century, and the Atomic Age of today.

AN EXPANDING PROFESSION

Before we tell you about the jobs available in this field, we'll have to say just a word about mineral preparation.

Today the average copper ore contains only one or two per cent of copper. To increase that percentage to 50 or 60 per cent copper, mineral preparation engineers must find ways to remove the waste.

We've used copper as an example, but practically all minerals need similar treatment.

This is a growing profession. Today industry needs high quality minerals for television sets, guided missiles, and jet planes. Tomorrow even higher quality minerals may be needed for new wonders yet to be invented.
A JOB FOR THE FUTURE

The positions available to graduates are shown in a chart on this page. Most graduates start to work as soon as they have their bachelor of science degree. A few take work leading to an advanced degree.

In industry, you may get a job suited to your training and talents in sales, production, or research. You may later advance to consulting or management positions.

We are not exaggerating when we say that every mineral preparation graduate of Penn State can choose from several desirable jobs. Even during the 1929 depression, men with technical training in ore dressing were in constant demand. In addition to choosing the kind of job you like, you can also select the part of the country where you want to work—that is, any part where minerals are found.

FACILITIES AT PENN STATE

Penn State's mineral preparation laboratories have the newest equipment to teach size reduction and concentration of ores. You can study the various types of crushers which break up the minerals into finer particles. You can use various kinds of grinders to separate one mineral from another. Equipment adapted to special cases of size reduction is also available.

Chemical, electrical, and gravity concentrating equipment will enable you to make tests of ores. Some of this equipment is pictured on this page.

In a brand new laboratory, equipment will be about half the size of that used in industry so that your experiments will be almost identical with industrial procedures.

Equipment similar to the type shown below is used in the mineral preparation laboratories at Penn State.

Courtesy Link-Belt Co.

The effects and applications of shaking tables (above) and flotation machinery (below) are studied in the laboratories.
WHAT YOU WILL STUDY

Since few colleges in America give a course in mineral preparation, we want to tell you something about what you will study at Penn State.

Mathematics is important. During your first two years you will study algebra, geometry, trigonometry, and calculus. English is also required so that you may learn to write clearly and precisely. You will also take physics, mining, and chemistry. You will learn the origin and development of the earth’s crust in geology, and you will be taught how to identify minerals and rocks in mineralogy courses.

These subjects will give you a broad, general education as well as a sound basis for your last two years’ work, when you will delve deeper into mineral preparation engineering problems.

You will take electrical and civil engineering courses which will teach you about the water circuits and electrical circuits used in preparation plants. Finally, in mineral preparation courses, you will study crushing, grinding, classification, screening, dewatering, thickening, and concentration.

All these courses will prepare you thoroughly for your future job.

More About Mineral Preparation Engineering

Should you desire more specific information about this field of the Mineral Industries, please address your request to:

Professor H. B. Charmbury, Head
Department of Mineral Preparation
College of Mineral Industries,
The Pennsylvania State University
University Park, Pa.
PETROLEUM ENGINEERS

College of Mineral Industries

The Pennsylvania State University
INTRODUCING THE
PETROLEUM INDUSTRY

In the horse-and-buggy days of the last century—in 1859, to be exact—a man named Colonel William Drake found oil in Titusville, Pennsylvania. Ever since, men have dreamed of “striking it rich” on their land. An occasional newspaper picture of a gusher sparks such dreams.

There is a less spectacular but more practical side to petroleum and natural gas engineering. This folder tells a little about the rewarding jobs in this field.

Why the Industry Needs Engineers

Perhaps you've thought of conservation as saving our trees and wild life. But it is also vital to our country's welfare to preserve such natural resources as oil and gas.

At first we thought that oil and gas were plentiful for all our needs. Then, as we changed from the horse and buggy to the automobile, our supplies dwindled. We began to use oil burners in our homes, and our airplanes demanded more and more high-octane gas. Today our nation uses more than six million barrels of petroleum a day.

As the oil that had been easy to find was used, the industry took its problems to research workers in the laboratories. These men knew there was still oil in the ground and devised new ways of getting it out. Water-flooding and gas drive were two of the methods used. By pushing water or gas into the ground, they forced the oil out.

Such new methods increased the need for trained petroleum and natural gas engineers.
Jobs in the Petroleum Industry

If you enter the petroleum industry, you may work in the fields of drilling, producing, or transporting oil and gas; or in controlling oil and gas reservoirs.

Wells must be carefully surveyed and their depths accurately recorded. Oil and gas must be brought up from great depths, sometimes more than 20,000 feet. There may be thousands of pounds of pressure in these deep reservoirs which the engineer must control. To supply our demand for oil, engineers are needed to keep pipe lines running continuously. These lines bring oil from the well to the refinery.

Jobs in the Natural Gas Industry

If you choose the natural gas industry, you may work on the underground storage of natural gas or in the field of transporting natural gas from the producer to the consumer. Perhaps you will prefer drilling or producing gas wells.

Field Work, Management, and Research Jobs

Both fields offer a variety of work from which to choose. You may design and operate a producing oil field, manage someone else's property, or buy your own.

If you like field work, your job will involve well drilling and oil field operations. As a reservoir engineer, you will control oil production and re-inject fluids into oil-producing reservoirs. In research, you will develop new techniques and methods.

You can be an engineering specialist or a general practicing engineer. You may work with a large or a small company, a state or federal agency, a pipe line or a drilling company.

Where You Can Work

In this country you may work in the Appalachian Area, the Illinois Basin, the Mid-Continent Region, the Gulf Coast, the Rocky Mountain states, or the West Coast. We take our technical knowledge to all parts of the globe. Foreign operations demand a continuing supply of American engineers. You may work in South America, Canada, the Middle East, Burma, the East Indies, or other countries.
A TYPICAL ENGINEERING PROBLEM

The operation shown on this page is one you may have to design and supervise. Near the surface of the ground is a rotating disc. This is used to turn the drilling pipe which extends into the ground. As this pipe turns, it turns the bit at the bottom of the hole, and the bit cuts through the rock.

As the pipe and bit are rotated, a drilling mud is pumped from the surface down the pipe as shown by the arrows. The mud comes up the outside bringing with it the rock that has been cut. It also cleans, cools, and lubricates the bit.

Maintaining a proper drilling mud to perform these functions is one of the many jobs which the petroleum and natural gas engineer does.

THE COURSE AT PENN STATE

Penn State has been a pioneer in the research for new methods of recovering oil. Consequently, it has excellent laboratories for the study of petroleum and natural gas engineering. To enroll in this course, you should have a good background in mathematics and science.

More About Petroleum Engineering

Should you desire more specific information about this field of the Mineral Industries, please address your request to:

PROFESSOR R. F. NIELSEN,
DEPARTMENT OF PETROLEUM & NATURAL GAS
COLLEGE OF MINERAL INDUSTRIES,
THE PENNSYLVANIA STATE UNIVERSITY
UNIVERSITY PARK, PA.
CERAMIC TECHNOLOGY

COLLEGE OF MINERAL INDUSTRIES

THE PENNSYLVANIA STATE UNIVERSITY
THE IMPORTANCE OF YOUR UNIVERSITY COURSE

Today these rank among the most important industries, equally from a scientific and technological standpoint, and in terms of dollars. They include abrasives, glass products, refractories, dinnerware, structural clay products, cements, porcelain, enamels, electrical insulators, capacitors and other products, magnetic components, and so on.

Developments in the fields of atomic energy, jet engines, electronics—these call for new and improved ceramic components which involve the fabrication and heat-treatment of inorganic raw materials. The ceramic industries cover a rapidly expanding field requiring many more trained men than the universities can yet supply.

YOUR UNIVERSITY COURSE

Ceramics schools do not attempt to give you industrial experience, but what they do give is something that ordinarily is not learned except in a college course. That “something” includes selected technological and engineering information and habits of thinking so that you can “go places” faster in industry, and have a career in which you will be happy and of which you will be proud.

During the first two years you will study mainly the basic sciences, physics, chemistry, mathematics, geology, etc., which will be required as the basis for the special training you receive in the third and fourth years. Even in the second year, you are given a general course surveying the whole field of ceramic technology. Elective courses enable you to bias your training toward fundamental science if you are thinking of a research career or toward engineering subjects if your aim is in this direction.

More About Ceramic Technology

Should you desire more specific information about this field of the Mineral Industries, please address your request to:

Professor G. W. Brindley, Head
Department of Ceramic Technology
College of Mineral Industries,
The Pennsylvania State University
University Park, Pa.
FUEL TECHNOLOGY
THE SCIENCE OF UTILIZATION

College of Mineral Industries – The Pennsylvania State University
WHERE IS FUEL TECHNOLOGY USED?

Nearly everything you touch, eat, wear, or do is made possible through the use of fuel in the form of heat, power, or chemical products.

The heating system in your home, the utility company that provides your electricity, the ceramic plant and the steel mill that make your building materials, the transportation industry that moves you and your goods, and the chemical industry that supplies you with plastics, drugs, dyes, fertilizers, and related products—all these depend upon fuel as a source of energy or as a raw material.

The cost of these services and products depends upon applying the principles of Fuel Technology to the efficient use of fuel.

WHERE DO FUEL TECHNOLOGISTS WORK?

Fuel technology is a relatively new but well-recognized profession. Graduates hold various technical jobs ranging from engineering to sales in the coal, oil, and natural gas industries.

They also work for gas and electric utilities; for steel, ceramic, and chemical industries; and for manufacturers of utilization and processing equipment. They hold positions as fuel, design, heating, or sales engineers; as research and development engineers; as fuel chemists; and numerous other jobs.

A recent survey of Penn State graduates shows that they have 65 different job titles in 80 different companies scattered over 20 basic industries.

WHAT IS FUEL TECHNOLOGY?

Fuel technology is concerned with the origin, constitution, processing, and use of solid, liquid, and gaseous fuels. The production of heat, power, and chemicals from coal, oil, and natural gas is the basis of our industrial civilization.

The transformation of raw materials into final products can be efficiently and economically accomplished only with a knowledge of the properties and behavior of fuels and the scientific principles underlying their use.
WHAT
ARE THE JOB OPPORTUNITIES?

The demand for fuel technologists exceeds the number of graduates, and this situation is expected to continue. Energy consumption has doubled during the past 20 years and is expected to double again by 1975. At the same time the cost of all fuels is increasing. These facts increase the necessity for more efficient utilization, and that is the job of the fuel technologist.

If atomic fission should develop as an energy source, it will supplement rather than replace the conventional fuels and will itself probably continue to be a major consumer of mineral fuels.

Not only is the over-all demand for energy increasing, but the demand for fuel in a more convenient form and as raw material for chemical production is also expanding rapidly. Again these are the job of the fuel technologist.

The profession is young and vigorous, and the field is wide open to young men with ability and vision.

A steel plant such as this uses all types of fuel in producing and processing its products.

Fuel-fired rotary kilns serve the ceramic industry in the production of basic refractories, cement, and lime.

IS FUEL TECHNOLOGY
THE CAREER FOR YOU?

The pay is good and job opportunities are plentiful. Job locations are geographically widespread, and the kinds of work are varied. You can gain deep personal satisfaction from an interesting job in this progressive, expanding, and necessary field.

The use of mineral fuels has brought great benefits, comfort, and progress to the human race. As a fuel technologist, you can play a part in further improving these benefits.

Over 70 per cent of our electricity is generated from fuel in plants such as this coal-fired utility plant at Sunbury, Pa.
TRAINING YOU WILL RECEIVE

If you have done well in mathematics and science, and if your high school record will admit you to Penn State, you are qualified to undertake training in fuel technology.

At Penn State you will receive extensive additional training in mathematics, physics, chemistry, and English. Your technical training will include courses in mechanics, engineering drawing and design, chemical engineering, mining engineering, mineral preparation, geology, and all major phases of Fuel Technology.

Elective courses in both technical and nontechnical subjects will give you a broad, general education in addition to sound professional training.

FACILITIES AT PENN STATE

Unexcelled laboratories and equipment are available for training in fuels evaluation, domestic and commercial heating, industrial combustion, coke and by-product chemicals, production of fuel gas and synthesis gas, and for the chemical processing of fuels.

More About Fuel Technology

Should you desire more specific information about this field of the Mineral Industries, please address your request to:

Professor Philip L. Walker, Jr., Head
Department of Fuel Technology
College of Mineral Industries,
The Pennsylvania State University
University Park, Pa.
METALLURGY

College of Mineral Industries

The Pennsylvania State University
THE AGE OF METALS

You need only to look at your mother's pots and pans, your father's tools, and your brother's toys to see that you are living in an age of metals. Even those objects which are not made of metals were manufactured by machines made of metals.

You can easily see that the science of extracting metals from their ores and preparing them for use in industry is extremely important in modern living.

If you choose metallurgy as your career, you will not only work in an important and spectacular industry, but you may also help to search for new and better metals.

WHAT METALLURGISTS DO

When metals are extracted from their ores, they often do not have the properties needed for use in industry. By combining two or more metals, metallurgists frequently obtain a new metal which is more useful than any of those from which the combination was made.

By using heat treatments, metallurgists often bring out new and valuable properties in metals. The unexplored possibilities in this field may be your opportunity for a rewarding career.
FACILITIES
AT PENN STATE

The metallurgist needs special equipment, apparatus, and instruments. At Penn State you will learn to use these devices in unusually well-equipped modern laboratories.

You will take field trips to steel mills, brass plants, copper refineries, and other manufacturing plants, where you will see modern metallurgical industries in action. Such trips will help you to decide which special field you wish to enter after graduation.

WHAT YOU WILL STUDY

During your first two years in college your studies will include chemistry, drawing, geology, mathematics, mineralogy, mineral preparation, and physics. These subjects will give you a background of fundamental knowledge in several basic sciences.

In your junior year you will begin to study methods of recovering metals from their ores, and the behavior of metals during fabrication and heat treatment. Your senior year will be devoted to more complicated phases of metallurgy.

With these subjects you will also take cultural courses which will give you the well-rounded education a college graduate should have.
EMPLOYMENT OPPORTUNITIES

The widespread use of metals demands many more trained metallurgists than are available. Salaries are among the highest in the engineering professions.

There are several types of metallurgists. Some recover metals from their ores. Pyrometallurgists use heat and fire. Hydrometallurgists treat ores with solutions which extract compounds of the metals, and then recover these compounds by chemical operations. Electrometallurgists use electric currents to obtain metals.

Others specialize in preparing metals for use after they are recovered. Physical metallurgists combine individual metals into alloys. Rough blocks, or ingots, of these alloys are rolled, forged, or shaped into sheets, plates, bars, rods, tubes, and other partly finished products useful to manufacturers.

Metallographers specialize in studying the inner structure of metals with the microscope, the X-ray, and other instruments. Through such study they can not only control manufacturing processes but also contribute much to our knowledge of the nature of metals and alloys.

Manufacturers employ metallurgists to control the quality of their materials and to decide which metal or alloy is best suited to their needs. There are also openings in sales and technical service.

You can choose from these a field that best suits your talents.

More About Metallurgy

Should you desire more specific information about this field of the Mineral Industries, please address your request to:

PROFESSOR AMOS J. SHAVER, HEAD
DEPARTMENT OF METALLURGY
COLLEGE OF MINERAL INDUSTRIES,
THE PENNSYLVANIA STATE UNIVERSITY
UNIVERSITY PARK, PA.

The metallurgical microscope is used to study the structure of metals.
A CHANCE TO CHANGE YOUR MIND

Although you are asked to state on your application for admission which curriculum you wish to enter, that decision need not be final.

After reading these descriptions of careers, you may still be unsure which is the best field for you. You may feel, for example, that you would like one of the curriculums dealing with the discovery of minerals. You may state on your application blank that you wish to study Geophysics and Geochemistry, or one of the other Earth Sciences.

Later, after you have studied for a semester, and talked with your adviser and your fellow students, you may find out that you have more interest in the extraction of minerals and would like to study Mineral Preparation, or one of the other branches of Mineral Engineering.

What happens then? The Mineral Industries curriculums have been organized to take care of cases like that. You see, all students in the College take the same work during the freshman year. At the end of that year you can change your curriculum without loss of credit.

Suppose you know, at the end of your freshman year, that you are interested in the processing of minerals, but you are still not sure whether you want to take Fuel Technology, Metallurgy, or Ceramic Technology. You’re still safe, because these three Mineral Technology curriculums have a common sophomore year—as do the Earth Sciences curriculums and the Mining Engineering curriculums.

In short, even at the end of the sophomore year you can transfer to any other curriculum in the College with little difficulty. The fact that you have two years to make your final decision makes it much more likely that you will be sure you’re preparing for the career you’ll like best.

Information About the University

Fees at the University are low, especially for Pennsylvania students, because Penn State is the Land-Grant University of the Commonwealth.

For detailed information about admission requirements, living accommodations, expenses, and courses, write for a GENERAL CATALOGUE. Address your request to:

Dean of Admissions
The Pennsylvania State University
University Park, Pennsylvania