

**The  
Pennsylvania State College  
Bulletin**

**MINERAL INDUSTRIES**  
**Correspondence and Extension-Class  
Instruction**

**Circular 11**

**SCHOOL OF MINERAL INDUSTRIES**  
**The Pennsylvania State College**  
**STATE COLLEGE, PENNSYLVANIA**

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Pennsylvania's School of  
Mineral Industries and  
Experiment Station

*Dedicated to the exploration, develop-  
ment, and conservation of Pennsylvania's  
natural mineral resources, and their prep-  
aration, processing, and efficient utiliza-  
tion.*

FIELD OF WORK

Geology, Mineralogy, Geography  
Petroleum and Natural Gas  
Mining and Geophysics  
Mineral Economics  
Fuel Technology  
Metallurgy  
Ceramics

DIVISIONS OF SERVICE

Resident Instruction  
Extension Instruction  
Correspondence Instruction  
Mineral Industries Research

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THE PENNSYLVANIA STATE COLLEGE BULLETIN

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# The Pennsylvania State College Bulletin



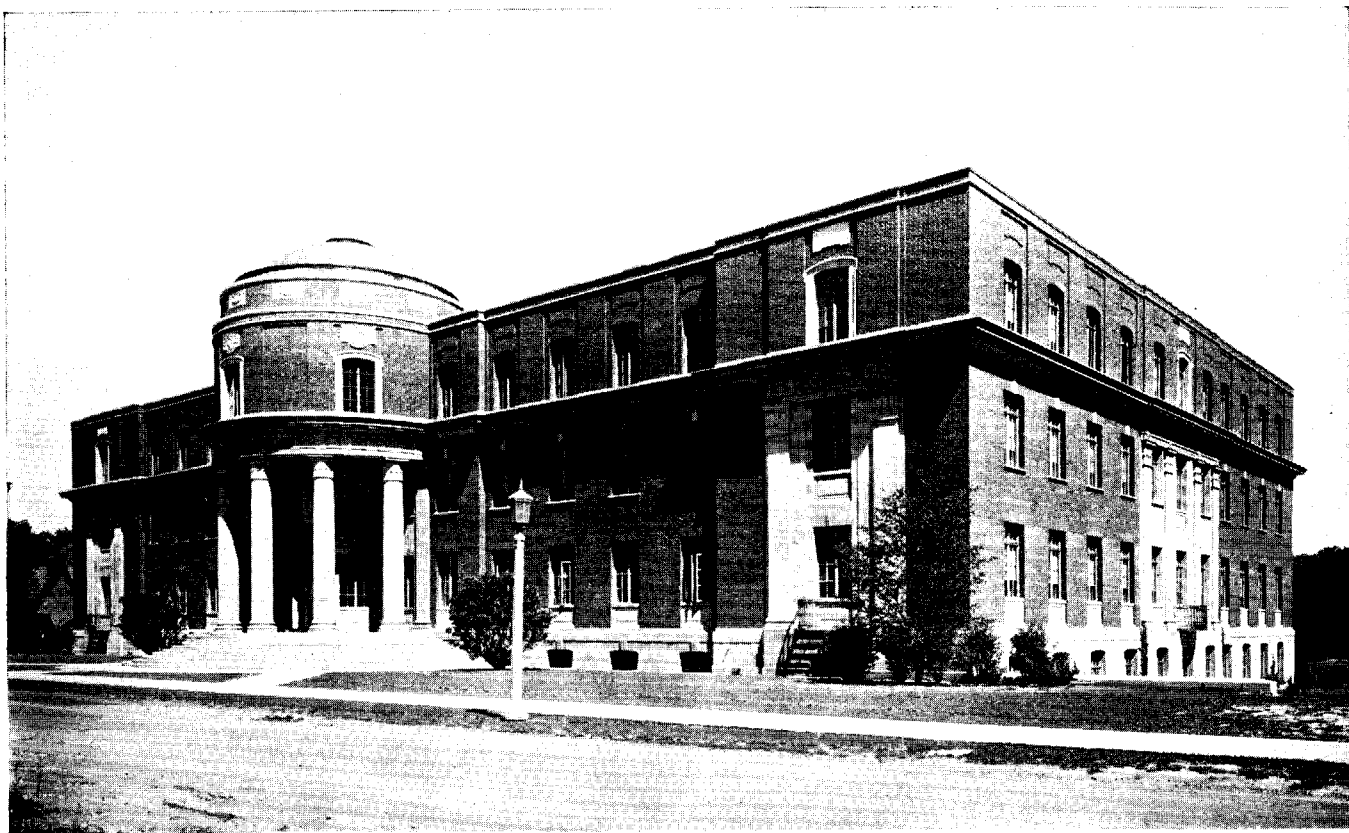
## MINERAL INDUSTRIES Correspondence and Extension-Class Instruction



Subjects available through correspondence instruction  
in Coal Mining, Ferrous Metallurgy, Geography,  
Geology, Geophysical Prospecting and Miner-  
alogy. Extension curricula in Ceramics,  
Coal Mining, Ferrous Metallurgy,  
Petroleum Production, Petroleum  
Refining, Natural Gas Engi-  
neering and data per-  
taining to the ad-  
ministration  
of the  
work.



DIVISION OF MINERAL INDUSTRIES EXTENSION  
School of Mineral Industries  
THE PENNSYLVANIA STATE COLLEGE  
State College, Pennsylvania



MINERAL INDUSTRIES BUILDING

# Foreword

THE School of Mineral Industries is an integral part of The Pennsylvania State College. It is concerned with the exploration, development and conservation of the natural mineral resources of Pennsylvania and their preparation, processing and efficient utilization. The field of work embraces three distinct types of subject matter, namely (1) the *earth sciences*, including geology, mineralogy, geophysics, geography and related subjects; (2) *mineral engineering and economics*, including mining and quarrying, and petroleum and natural gas production; and (3) *mineral technology*, including ceramics, glass technology, metallurgy, fuel technology and petroleum refining.

In the discharge of its obligations to the commonwealth, the School of Mineral Industries has three functions—resident instruction, extension and correspondence instruction, and research. Of these three functional divisions, the second—extension and correspondence instruction—finds expression through the Extension Division. All members of the faculty are concerned to a greater or lesser degree in all three functions of the School. In order that the extension program may have the advantage of the interest and concern of the entire faculty, the Extension Division was set up, not as an independent organization but as the organized expression of an important function of the whole School.

Extension services of the School of Mineral Industries began in 1893 and constituted what is believed to be the first mineral industries vocational adult educational work in the United States. From 1894 to 1899, 27 extension bulletins were printed and distributed free for the benefit of the mining industry. The records show also that a series of free lectures was delivered by a corps of teachers in the mining department "to the mining employees at their customary places of assembly upon matters of interest to them in their occupation."

In 1899, legislative action cut the College appropriation for this type of education and the work had to be discontinued. It was resumed in September 1919 through a small College appropriation and a grant-in-aid from the Central Pennsylvania Coal Producers' Association. The work continued until July 1931, when College funds were made available for reorganizing the extension activities under an Extension Division plan.

In 1929 a new building was constructed to house all the work of the School. Considerable progress has been made in extension as a result of the cooperation of the industries of the state. The Extension Division is now organized so that any additional funds can be spent at the cutting edge of a program of service. The School of Mineral Industries is the only educational institution of the Commonwealth carrying on extension and correspondence instruction in the field of the primary mineral industries.

The division publishes a paper, *Mineral Industries*, monthly from October to June each year; the paper is devoted to the work of the entire School.

This bulletin, prepared by H. B. Northrup, Director, Mineral Industries Extension, describes briefly the functions of the Extension Division, including its policy and the facilities and courses of study available to date. Further inquiries regarding correspondence and extension instruction in the mineral industries should be addressed to Director Northrup.

EDWARD STEIDLE, *Dean*,  
School of Mineral Industries.

## Objectives of THE PENNSYLVANIA STATE COLLEGE

**T**HE Pennsylvania State College, as the Pennsylvania unit of the federal system of state institutions of higher learning, operates under the provision of the federal land-grant college act accepted by the Commonwealth of Pennsylvania in 1863, to provide suitable types of education for persons whose particular needs previously had been neglected by institutions of higher learning. The above-named and subsequent acts and similar provisions by the Commonwealth of Pennsylvania have fostered instruction and research in agriculture, engineering, technology, scientific and liberal studies, military tactics and many other subjects, in order to provide and promote, for the people of the commonwealth and the nation, an education which is both liberal and practical. In fulfilling the obligations and the spirit of the federal land grant and subsequent acts of the legislature of our commonwealth, The Pennsylvania State College is an officially recognized agent in the educational, social and economic progress of the commonwealth and of the nation.

To disseminate knowledge, to discover truth, and to enrich life are the broad objects to which the College pledges the service of its personnel and facilities.

Through its Schools and departmental organizations, The Pennsylvania State College carries forward its program of higher education by means of resident instruction, extension instruction, and research.

The aim of resident undergraduate instruction is to arouse the desire to recognize and the ability to understand personal and social values and to express them in terms of human progress; to cultivate knowledge and the ability to apply it to various vocations and professions.

The aim of extension service is to extend the educational resources of the College throughout the state and to make them effective to all its citizens.

The aim of research is to advance learning, to ascertain truth, to originate, improve and develop methods, processes and products, and to provide enlarged opportunities and new wealth for enrichment of the lives of the people of the commonwealth and the nation.

# CONTENTS

PAGE

Foreword .....	iii
Objectives of The Pennsylvania State College .....	iv

## CORRESPONDENCE COURSES

Groups for Whom Courses are Intended .....	1
Registration .....	1
Regulations for Correspondence Study .....	2
Residence Requirements .....	2
Graduation Requirements .....	2
Credits .....	2
State Regulations Concerning Correspondence Credits ....	3
Evaluation of Credits .....	3
Grading System .....	3
Final Examinations .....	4
Fees .....	4
Textbooks .....	4
Library Extension Service .....	4
Industrial Courses .....	4
Other Correspondence Courses Offered by the College ..	5
Correspondence Courses in Mineral Industries .....	7
Geography .....	7
Geology .....	8
Metallurgy .....	8
Mining .....	10
Mineralogy .....	10

## EXTENSION CLASS INSTRUCTION

Scope of the Work .....	11
Cooperating Agencies .....	11
How Classes May Be Organized .....	12
Teachers Selected from Industry .....	12
Curricula and Textbooks .....	13
Extension Credit .....	13
Class Schedules .....	13
Extension Class Courses in Mineral Industries .....	14
Ceramics .....	14
Coal Mining .....	15
Ferrus Metallurgy .....	16
Natural Gas Engineering .....	17
Petroleum Production .....	17
Petroleum Refining .....	18
Textbooks and Their Costs .....	20

# *This Bulletin . . .*

- describes the two distinct methods of extension instruction conducted by the School of Mineral Industries—correspondence and extramural class work.

IN the first 10 pages that follow, the correspondence courses are described from the standpoint of administration and content, while the latter half of this bulletin explains the scope, organization and content of extension classes.

Industrial credit given for certain class or correspondence courses applies on the industrial diploma awarded for completion of a three-year extension course.

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*Inquiry from any mineral industry or any worker in mineral industries in Pennsylvania, requesting information on correspondence instruction or the formation of an extension class program, will receive prompt attention. Every effort will be made to furnish all the information wanted. The Extension Division will be pleased to render complete assistance in organizing classes to meet the practical requirements of the individual, class or community.*



# Mineral Industries Correspondence Courses

**C**ORRESPONDENCE courses form an important part of the School of Mineral Industries Extension service. These courses are available to all persons when such courses are suitable for their purpose and can be pursued with profit. The quality, as well as amount of work required for college credit courses, corresponds to that prescribed for similar courses given on the campus. This service is available anywhere at any time up to the limit of the facilities of the division. All courses offered by the Division of Mineral Industries Extension are prepared and conducted by members of the School of Mineral Industries faculty. This arrangement insures conformity with College standards in the administration of the work.

## Groups for whom Courses are Intended

The correspondence courses described in this bulletin will be of particular interest to the following groups:

(1) High school graduates who are unable to continue their education immediately. Through correspondence study they can earn advanced credits while they are working to obtain means for financing the cost of a college education. Thus they are enabled to retain the attitude of students until the opportunity of doing resident work in college is presented.

(2) Regular college students compelled temporarily to discontinue resident study, or desirous of completing courses during the vacation period. Through correspondence instruction they are enabled to continue their studies.

(3) Persons who want to keep abreast of the times in their special fields of interest. This they can do through the aid of the Correspondence Study Division.

## Registration

Anyone desiring to pursue a correspondence course should ask for an application blank from the Director of Mineral Industries Extension, School of Mineral Industries, The Pennsylvania State College, State College, Pa. He should then fill out the blank and return it, together with the fee. On receipt of the application blank and fee, the College will notify the student of his registration and will send him the first five assignments for each course.

### Regulations for Correspondence Study

- (1) A student may enroll for a correspondence course at any time.
- (2) Ordinarily it is best to limit correspondence courses taken at the same time to two or three. For sufficient cause, however, there may be exceptions to this regulation.
- (3) A resident undergraduate student may register for correspondence study only with the written consent of his dean.
- (4) A correspondence course should be completed within one year of the date of registration. Only in rare cases will an extension of six months be given, and then only upon presentation by the student of good reasons for his inability to complete the course within the specified time.
- (5) Since the College incurs the expense of preparing outlines and obtaining instructors in advance of the beginning of a course, it cannot agree to refund any tuition because of the inability of students to complete courses for which they have registered.
- (6) Textbooks may be purchased wherever the student prefers. Where the course material has been prepared by members of the Mineral Industries staff, the text is furnished with the course, and the course fee includes the price of the book.
- (7) The student pays postage on all material sent to the College. The College pays postage on all material returned to the student.

### Residence Requirements

The time spent in residence by candidates for degrees shall be: (1) not less than two semesters immediately preceding graduation and covering a minimum of 30 credits, or (2) not less than five summer sessions covering a minimum of 30 credits. These five summer sessions, constituting the last year of a candidate's work in residence immediately preceding graduation, must be completed within a period of seven years from the date of enrollment in the first of the summer sessions in question.

### Graduation Requirements

To be graduated, a student is required to earn the number of credits fixed by his School and an equal number of grade points. Any student who does not have a sufficient proportion of grade points for graduation may obtain the same by repeating subjects in which grade points may not have been earned, or by taking such additional subjects not required in his curriculum as may be approved by the dean of his School.

### Credits

The correspondence courses are either of college or industrial grade. All college grade courses carry college credit in the School of Mineral Industries of The Pennsylvania State College, if the individual who desires such credit has complied with all prerequisites. Individuals who want college credit should consult the general catalogue of the

College for prerequisites, as well as for requirements for degrees conferred in the School of Mineral Industries and should ascertain whether the School in which they wish to obtain a degree will allow credit for the correspondence work they wish to pursue.

Permission has been granted to the Correspondence Division of the School of Education to offer certain mineral industries subjects, carrying college credit. Such subjects are to be offered by that division when it is expressly understood that the credits earned are to be applied toward teacher certification. The School of Mineral Industries cannot issue credits to apply toward certification of teachers, that responsibility having been delegated solely to the School of Education.

A certificate of credit is issued to each student who successfully completes a correspondence course. Only the credits for college grade courses are recorded in the office of the College Registrar when the work of the course is completed. No credit will be given for partially completed courses. A statement of credits will be mailed to the Teacher Bureau, State Department of Public Instruction, or to other school officials only when so directed by the student.

**Correspondence courses do not carry graduate credit.**

### **State Regulations Concerning Correspondence Credits**

Not more than six semester hours of credit toward a standard certificate earned by completing correspondence courses will be allowed in any one semester during which the student pursuing such courses is a regularly employed teacher.

If a student desires to apply the credits that he expects to earn through correspondence study to renew his certificate or to raise his certification, he should write in advance to the Director of the Teacher Bureau, Department of Public Instruction, Harrisburg, to find out whether the course he chooses will be accepted for certificate purposes. All questions concerning certification regulation should be referred to that office.

### **Evaluation of Credits**

Teachers and others desiring to have their work evaluated or their standing in the School of Mineral Industries determined, should communicate with the College Examiner, The Pennsylvania State College, State College, Pa.

### **Grading System**

Final grades are prepared by "grade points": 3, 2, 1, 0, -1 and -2. These grades have the following numerical equivalents:

3=90-100 inclusive	0=60-69 inclusive
2=80-89 inclusive	-1=45-59 inclusive
1=70-79 inclusive	-2=below 45

### **Final Examinations**

A final examination must be taken at the completion of each course taken for college credit. There are exceptions for certain courses, the character of which renders an examination unnecessary. The final examination is conducted by a proctor, preferably a school official, approved in advance by the Director of Mineral Industries Extension.

### **Fees**

The fee for each correspondence course is listed with the description of the course. The fee covering the entire course should be sent at the time the application is submitted to the College. This fee covers all expenses, including postage paid by the College in returning lesson papers to the student, but not the postage paid by the student in sending his completed lesson assignments to the College. Unless stated otherwise, fees for courses do not include textbooks.

Charges for transferring from one course to another in this division will be determined on the basis of the number of lessons completed in the course from which the transfer is to be made, if the transfer is made within the allotted time.

### **Textbooks**

The title, author and publisher of textbooks used in connection with correspondence study courses will be given with the first lesson assignment for each course. These textbooks may be obtained from any good book store or directly from the publishers. Textbooks developed by the School of Mineral Industries staff are supplied with the courses.

Before buying any textbook, the student should wait until he receives his first lesson assignment. Correspondence courses are revised continually. As new and better books and material appear, they are included in the course.

### **Library Extension Service**

Arrangements have been made with the Library Extension Division of the State Library and Museum at Harrisburg which enable correspondence students to borrow reference books. This service is available up to the limits of the facilities of the Library Extension Division. The only expense to the borrower is the postage, insured both ways, upon the books. To borrow books, the student needs an application blank, which may be obtained from the Extension Librarian, Library Extension Division, State Library and Museum, Harrisburg, Pa.

### **Industrial Courses**

In addition to those courses which are offered for college credit, there are courses offered here for the benefit of the practical man who has no need for college credits. These courses are prepared to help the

worker understand the more technical aspects of his job, or of special subjects in which he is interested. The courses are presented from a practical viewpoint and constitute a valuable addition to the worker's information concerning his vocation.

Such courses, considered as service courses, are designated by the letters CS (Correspondence Service) and carry industrial credits only. The fees for these courses are listed with the description of the course.

#### OTHER CORRESPONDENCE COURSES OFFERED BY THE COLLEGE



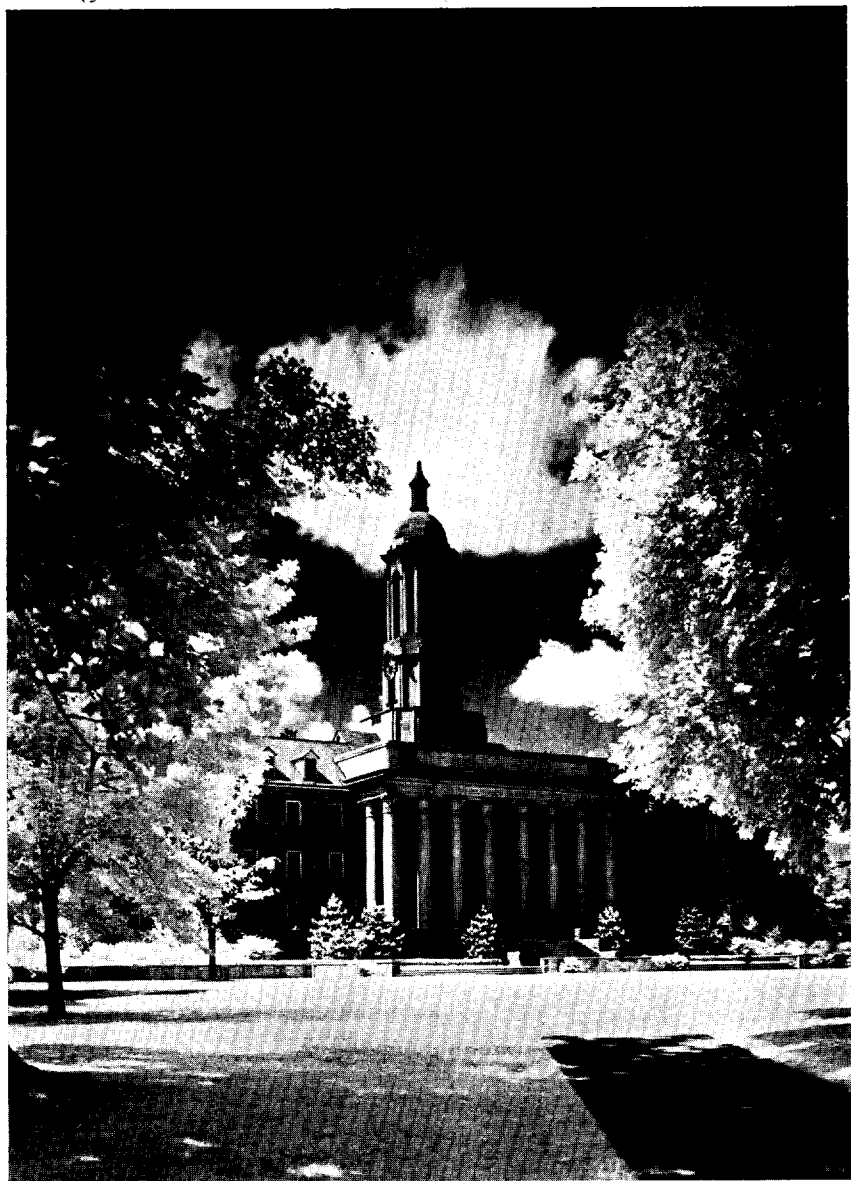
In addition to the courses in mineral industries described in this bulletin, other divisions of The Pennsylvania State College offer correspondence courses in the fields specified below. Students interested in these subjects should address at the College the individuals in charge of each division:

**AGRICULTURE AND HOME ECONOMICS:** Thomas I. Mairs, Director of Correspondence Courses in Agriculture.

**ARTS AND SCIENCE:** David B. Pugh, Director of Arts and Science Extension.

**EDUCATION:** Frank H. Koos, Assistant Director of Education Correspondence Study Division.

**ENGINEERING:** E. L. Keller, Director of Engineering Extension.



## OLD MAIN

This building, familiar to every alumnus and friend of The Pennsylvania State College, is the hub of College life.

## CORRESPONDENCE COURSES IN MINERAL INDUSTRIES

### GEOGRAPHY

**Geog. 20C. World Geography.**—A brief systematic regional description of the earth's surface, including both man-made and natural features, together with explanation of these features. (College credit will not be given to students who have had Geog. 26C.) Textbooks: *Economic Geography*, 3d ed., 1935, by R. H. Whitbeck and V. C. Finch; McGraw-Hill, \$3.50. *Exercises and Problems in Elementary Economic Geography*, 2d ed., 1933, by W. D. Blanchard; McGraw-Hill, \$1.

Fee \$21; 3 credits.

**Geog. 24C. Principles of Geography.**—A general survey of the characteristics of the major types of land surfaces, climate, soils and resources that comprise the natural environment of man. Forms foundation for regional courses in geography and is excellent background for work in economics, sociology, history and kindred subjects. Textbook: *College Geography*, by E. C. Case and D. R. Bergsmark; John Wiley and Sons, \$4.50.

Fee \$21; 3 credits.

**Geog. 30C. Geography of North America.**—A survey of North America; a description and interpretation of the industries, the farms, forests, towns and highways that have developed as a result of the human occupation and use of each of the regions with its characteristic conditions of climate, topography, soil, drainage and natural resources. (College credit will not be given to students who have had Geog. 430C.) Textbook: *North America*, by J. Russell Smith; Harcourt Brace, \$4.75.

Fee \$21; 3 credits.

**Geog. 32C. Geography of Pennsylvania.**—A survey of the geography of the state. The climate, topography, soils, mineral resources and other elements of Pennsylvania's natural environment will be considered, followed by a brief summary of the historical geography. Then the state will be studied by geographic regions, the various outstanding industries being taken up in connection with the regions in which they are most important. (College credit will not be given to students who have had Geog. 432C.) Textbook: *Pennsylvania: A Regional Geography*, by Raymond E. Murphy and Marion Murphy; The Pennsylvania Book Service, Cameron and Kelker Streets, Harrisburg, \$4.

Fee \$21; 3 credits.

**Geog. 34C. Physiography (Physical Geography).**—A study of the natural processes developing the important physical features of the earth, such as mountains, valleys, hills, sinks, shoreline forms, lakes, rivers, plains, plateaus, deserts, etc. Special attention is given to the influence of these natural features upon human activities. The physiographic provinces of the U. S. A. are briefly treated. Textbook: *New Physical Geography*, 1926, by Tarr and Von Engel; Macmillan, \$2.40.

Fee \$21; 3 credits.

**Geog. 442C. Geography of Europe.**—A geographic picture of present-day Europe. Both geographic regions and political units are considered. Textbook: *Europe: A Geographical Survey*, by J. F. Bogardus; Harper and Brothers, \$4. Prerequisite: Geog. 24C or its equivalent. Fee \$21; 3 credits.

### GEOLOGY

**\*Geol. 30C. Physical and Historical Geology.**—A short course combining the fields of Geol. 31C and 32C; practicum includes trips, map work and the study of important rocks and fossils. Textbook: *Outlines of Geology*, by Longwell, Knopf, Flint, Schuchert and Dunbar; John Wiley and Sons, \$4. Fee \$21; 3 credits.

**Geol. 31C. Physical Geology.**—Materials of the earth and their structure; physiography. The practicum consists of field work, the study of topographic and geologic maps, and of rocks and minerals. Textbook: *Textbook of Geology, Part I*, by Longwell, Knopf and Flint; John Wiley and Sons, \$3.75. Fee \$21; 3 credits.

**Geol. 32C. Historical Geology.**—The history of the earth, especially of North America. The practicum consists of field trips, map work and the study of rock and fossil specimens of the various geological periods. Textbook: *A Textbook of Geology, Part II—Historical Geology*, by Schuchert and Dunbar; John Wiley and Sons, \$4. Prerequisite: Geol. 31C. Fee \$21; 3 credits.

**Geol. 51C. Economic Geology.**—An introduction to the study of mineral deposits. Textbook: *Introductory Economic Geology*, by W. A. Tarr; McGraw-Hill, \$5. Fee \$21; 3 credits.

**Geol. 461C. Physiography of the United States.**—The principles of physiography with special reference to the physiographic provinces of the United States. Textbook: *Forest Physiography*, by Isaiah Bowman; John Wiley and Sons, \$5. Prerequisite: Geol. 31C, Geol. 30C or Geog. 34C. Fee \$21; 3 credits.

**Geol. 481C. Geology of Oil and Gas.**—Properties, origin, occurrence and distribution of oil and gas. Textbook: *The Geology of Petroleum and Natural Gas*, by E. R. Lilley; D. Van Nostrand, \$6. Fee \$21; 3 credits.

### METALLURGY

**Met. 30CS. Practical Metallurgy for the Steel Foundry.**—This course deals with the metallurgy of steel and is written in a nontechnical manner which should appeal to the average steel foundry man. It shows the various methods employed in the steel foundry for the production of steel castings; the relative economic value of the different melting furnaces; and the underlying principles governing the melting of steel and the molding of the steel castings. This course will be found of value also to the superintendents, the melters on the various types of furnaces, the molders and their helpers, as well as foundry foremen.

\* Students who have taken Geog. 34C should elect this course rather than Geol. 31C.



### DESCRIPTION OF COURSE

Geog.72-C. Aeronautical Meteorology. The principles of modern synoptic meteorology, including such topics as fronts and air mass analysis; observation of weather elements and mapping for the three dimensions of the atmosphere; weather forecasting. Textbook: "Aeronautical Meteorology," by George F. Taylor; Pitman Publishing Company, New York, 1938 (XV - 429 pages). Price \$4.50. Prerequisites: one year of general college physics and mathematics, including differential calculus.

Fee \$21.00 ; 3 Credits.

OUTLINE.—Organization of the steel foundry; crucible process; Bessemer converter; open-hearth; electric furnace; all melting methods in detail with problems; molding with reference to proportioning; welding and straightening the finished product. Prerequisite: grade school education. Textbook: *The Steel Foundry*, by J. H. Hall; McGraw-Hill, \$4. 24 assignments. *Fee, including text, \$20; 8 industrial credits.*

**Met. 31CS. Practical Metallurgy for the Gray Iron Foundry.**—This course deals with the metallurgy of gray iron and is written in a nontechnical manner which should appeal to the average gray iron foundry man. It shows the various methods employed in the gray iron foundry for the production of gray iron castings; the relative economic value of the different melting furnaces; and the underlying principles governing the melting of gray iron and the molding of the gray iron casting. This course will be found of value also to the superintendents, the melters on the various types of furnaces, the molders and their helpers, as well as foundry foremen.

OUTLINE.—Organization of the gray iron foundry; classification of foundry irons; effects of various elements on melting, casting and solidification; comparison with other processes; effects of chills; effects of shrinkage; all melting methods in detail with problems; molding with reference to proportioning, welding, and straightening the finished product. Prerequisite: grade school education. Textbook: *The Principles of Iron Founding*, 2d ed., by Richard Moldenke; McGraw-Hill, \$6. 24 assignments. *Fee, including text, \$22; 8 industrial credits.*

**Met. 32CS. The Practical Heat Treatment of Steel.**—This course in heat treating is written primarily for the practical man. Much of the theory of hardening has been eliminated and the text is written in nontechnical language which should appeal not only to the superintendents but also to the furnace tenders, helpers, inspectors, and heat-treating foremen. The art of heat treating is no longer a secret, but is based on the fundamental principles taught in this course.

OUTLINE.—Testing of steel; heating furnaces and the loading to secure desired results; forging; microstructure of steel; annealing; hardening; tempering; case hardening; treatments of carbon and alloy steels to secure desired results; pyrometers; determination of critical points. Prerequisite: grade school education. Textbook: *Steel and Its Heat Treatment*, 3d ed., 1935, by D. K. Bullens; John Wiley & Sons, \$5. 25 assignments. *Fee, including text, \$21; 8 industrial credits.*

**Met. 59C. The Metallurgy of Iron and Steel.**—Extraction of iron from its ores and manufacture of steel; microstructure of ferrous materials and their properties. Textbook: *The Metallurgy of Iron and Steel*, 4th ed., 1934, by Bradley Stoughton; McGraw-Hill, \$4. 20 assignments. *Fee, including text, \$18; [REDACTED]*

### MINING

**Mng. 1CS. Elementary Coal Mining.**—This is the first of a series of courses designed to offer the practical coal mining man the knowledge necessary to obtain and hold advanced positions in mining. It includes the fundamentals necessary for applicants who wish to obtain certificates of competency in the annual state examinations. Textbook: *Extension Course in Coal Mining, Volume I*; The Pennsylvania State College, Division of Mineral Industries Extension. 24 assignments.

*Fee, including text and supplies, \$20; 8 industrial credits.*

**Mng. 2CS. Intermediate Coal Mining.**—This is the second course of a series on coal mining for the practical mining man. It includes the study of ventilation, fires, explosions, accident-prevention, and other subjects which the mining man should know. Textbook: *Extension Course in Coal Mining, Volume II*; The Pennsylvania State College, Division of Mineral Industries Extension. 24 assignments. Prerequisite: Mng. 1CS or equivalent.

*Fee, including text and supplies, \$20; 8 industrial credits.*

**Mng. 3CS. Advanced Coal Mining.**—This is the third course of a series on coal mining for the practical mining man. It includes the study of advanced ventilation, mining methods, timbering, drainage, coal preparation and other subjects which are necessary for a well-rounded, practical course in coal mining. Textbook: *Extension Course in Coal Mining, Volume III*; The Pennsylvania State College, Division of Mineral Industries Extension. 24 assignments. Prerequisite: Mng. 2CS or equivalent.

*Fee, including text and supplies, \$20; 8 industrial credits.*

**Mng. 61C. Geophysical Prospecting.**—Geophysical principles that have been or may be used in finding or delineating ores and minerals, including gravity, seismic, magnetic and electrical methods. Prerequisites: one semester of general college geology and one year of general college physics. Textbook: *An Outline of the Methods of Geophysical Prospecting*, mimeographed notes available only through The Pennsylvania State College, Division of Mineral Industries Extension, \$1. 8 assignments.

*Fee, including text and supplies, \$8; 1 credit.*

### MINERALOGY

**Min. 53C. Elementary Mineralogy.**—A short course in mineralogy for engineering, agriculture, chemistry and physics students. The course consists of assignments in practicum and reading. Practicum is devoted to classification and identification of the common minerals and ores. Prerequisite: Chem. 1 or equivalent. Textbook: *Minerals and How to Study Them*, by E. S. Dana; John Wiley and Sons, \$2. Tray of minerals: Ward's Natural Science Establishment, Rochester, N. Y., \$6.50.

*Fee \$14; 2 credits.*

# Mineral Industries Extension-Class Instruction

## Scope of the Work

Mineral industries extension instruction is a form of vocational adult education. It includes education and training of less than college grade, the specific purpose being to equip workers for the effective pursuit of occupations and to prepare them for constantly changing industrial practices. Extension classes may be organized in any mineral industries area or section of the Commonwealth to train adults employed by the industries of that area. Such training enables those who have begun employment, without finishing their schooling, to receive further training which will fit them to do better work, command higher wages and prepare for promotion. For one class of workers this study constitutes a rehabilitation effort, and for another class it constitutes job insurance. It is necessary, in order that this type of education may be effective, to have the fullest cooperation of employers and employees, as well as the appreciation and financial support of the state legislature.

To serve effectively the mineral industries of the state, the entire extension program is being developed with the counsel and assistance of various advisory boards composed of leaders in the mineral industries of Pennsylvania.

## Cooperating Agencies

In August 1931 an agreement was prepared covering a broad cooperative program with the state departments of Public Instruction, of Mines, and of Labor and Industry. It was agreed that The Pennsylvania State College, as the recognized leader in mineral industries education of the state, should be responsible for extension lesson material and should supervise the teaching of such lesson material throughout the state. Under the plan, the College was assured the cooperation of the State Department of Public Instruction, which administers the state and federal funds under the federal and state vocational acts, in forming evening mineral industries extension classes under the public school system of the state.

Under these acts, the federal government allocates certain funds to each state to be used for vocational instruction. These funds must be matched by an equal amount of state funds directed to the same purpose. Money for paying the teacher is supplied by the local school district. After the classes close for the term, the local school district makes affidavit of the money expended for instructional purposes to the State Department of Public Instruction and furnishes other data pertaining to the classes. After audit, the State Department of Public Instruction, as custodian of federal and state funds, reimburses the local school district usually for two-thirds of the amount of money expended

by them in conducting the work. Vocational acts funds have been used in connection with mining extension classes since 1919.

Under the federal and state vocational acts, the vocational student is afforded an education at a minimum cost. His only expense is the purchase of text material, prepared by the College and approved by the State Department of Public Instruction. This text material will be of value to him throughout his vocational employment.

### **How Classes may be Organized**

Extension classes may be organized in Pennsylvania under the federal and state vocational acts by any group of 15 or more men who make a written application to their local school board for the establishment of an evening vocational class. The members of this group shall be more than 18 years of age, residents of the same school district and not in attendance at any public or private school during the day. The Division of Mineral Industries Extension and the State Department of Public Instruction both assist in the establishment of the class and in meeting all the requirements of the law with relation to the state and federal provisions under the vocational acts and in the proper certification of the teacher of such a class, pursuant to the Pennsylvania school code.

The Division of Mineral Industries Extension will assist any group of mineral industries employees in Pennsylvania desiring educational training, or any mineral industry, technical society, or other agency wishing to form a class independently of the State Department of Public Instruction and the local school system. Such classes may be formed within and under the immediate control of the industry. These so-called captive classes are able to confine their efforts to the more intimate problems of the particular industry. Such classes can be formed at the request of 20 or more men under a financial arrangement between the company, the class and the College, upon a strictly non-profit basis. This plan promotes the most effective method of employee training. The Pennsylvania State College either supplies all lesson material for such evening extension classes so formed, or assists in the preparation of such lesson material as may be applicable to the local industry.

### **Teachers Selected from Industry**

To teach such an evening vocational class in mineral industries, the teacher shall have had at least six years of trade or industrial experience, or its equivalent, and training approved by the Department of Public Instruction. In addition, he should be recommended by his employer and he should also have sufficient practical experience and prestige to command the respect of the men in industry. Having these qualifications, he is provided with a vocational teacher's certificate and should then be elected by the local school board, thereby becoming an integral part of the local school system and, as such, should be regularly reimbursed as are other teachers under the same system. The amount of

the teacher's reimbursement should be decided upon by the local school board, subject to the approval of the State Department of Public Instruction, after consultation with a representative of the Division of Mineral Industries Extension. Teachers of captive classes are selected from industry by arrangement and are not required to have vocational teachers' certificates.

### Curricula and Textbooks

The Division of Mineral Industries Extension was organized in 1931 and sufficient time has not been available to prepare either correspondence courses or extension lesson material for all mineral industries subjects which are amenable to correspondence or extension instruction. The courses available through correspondence have been listed in this bulletin. The curricula available through extension-class instruction include: Ceramics, Coal Mining, Ferrous Metallurgy, Petroleum Production, Petroleum Refining, and Natural Gas Engineering.

All the extension curricula are standardized on a three-year basis. A textbook has been prepared for each year's course of a given curriculum by the member of the Mineral Industries extension staff who is responsible for that given curriculum. Members of the extension staff are assisted in this preparation by the resident teaching staff of the School in that particular subject. These textbooks are published in a standardized 6 by 9-inch bound volume. The texts are maintained up to date by constant revision and improvement and an adequate supply is available at all times. All extension textbooks may be purchased from the College by any individual or company at any time through U. S. postal money order or company check with the order. The sales price of the texts is listed on the last page of this bulletin.

### Extension Credit

All mineral industries extension students desiring credit from the Division of Mineral Industries Extension will be required to use the standardized text material of the Extension Division. Credit from the School of Mineral Industries, Extension Division, is given as follows: completion of each year's work with satisfactory coverage of the text material indicated for that year entitles the student to 8 points of credit toward an industrial diploma; upon the completion of the three volumes of the course, which is customarily done in three years of class attendance, the student will receive a diploma in the practical subject which he has studied. This diploma is an industrial diploma. It carries no college credit, but is an indication to any employer that the man holding the diploma has completed satisfactorily a prescribed course of study in the occupation in which he is engaged.

### Class Schedules

All mineral industries extension classes are organized on the basis of a minimum of 120 class hours per year. This requirement is met usually by organizing classes to meet under any one of the following plans:

30 weeks, 2 nights per week, 2 hours per night, or  
24 weeks, 2 nights per week, 2.5 hours per night, or  
20 weeks, 3 nights per week, 2 hours per night.

When a student registers for any mineral industries extension class organized under the vocational acts, he will sign the regular class registration card and make a deposit of \$5. Of this amount, the price of the textbook (see last page of this bulletin) will accrue to the College. The balance will be rebated if he attends 75 per cent of the scheduled class meeting nights. Students of independent or captive classes will be charged pro rata to the number of persons enrolled. Usually a fee of \$15 per person (in a class of 30) is sufficient to meet every expense of the student.

## EXTENSION-CLASS COURSES IN MINERAL INDUSTRIES

### CERAMICS

A three-year extension course in Ceramics has been designed to aid those persons employed in the glass, refractories, clay products, white-ware, Portland cement and allied industries. The primary purpose of this course is to provide training for the worker which will enable him to apply the rapidly-advancing technical improvements to his work. In addition, the course provides a general picture of the industry so that the worker may correlate his particular job with the other operations in industry in which he is employed.

The diversity of this field has necessitated several optional courses of study. This has been accomplished by providing general first and second-year courses for all ceramic workers and several optional third-year courses. This provides a general background in fundamentals, as well as an intensive specialized course in the student's particular field.

**General Preparatory Course.**—Volume I of this title is used as the text for the first-year work in the general ceramic course. The material covered in this volume includes three chapters on mathematics—arithmetic, algebra and geometrical constructions; three chapters on chemistry—general inorganic chemistry, general organic chemistry and applications of chemistry; three chapters on physics—general physics, electricity and mechanics. The work of this general preparatory course is presented in as practical a manner as possible, with frequent illustrations of industrial applications.

**Ceramics, Second Year.**—Volume II, used in the second year of the course, covers the following material in three parts: Part I—raw materials, including mineralogy, occurrence, properties and uses of raw materials; material preparation, handling and storage. Part II—production, control and application of heat, including pyrometry, fuels, combustion, furnaces and kilns. Part III—Physical and chemical properties of silicates and ceramic materials, including ceramic testing, melt-

ing and crystallization of silicates and the heat treatment of ceramic materials.

**Ceramics, Third Year.**—This class group will study an intensive third-year course pertaining to the particular industry in which the members are employed. The present options are as follows: glass, refractories, clay products and whiteware, and enamels. Suitable text material is available for these fields of study and additional options may be made available if there is sufficient demand.

### COAL MINING

The course in Coal Mining offered to students in extension classes has been designed to meet the needs of the workers in the coal mining industries of the state. The constant demand for certified mining men has resulted in the annual examinations given by the State Department of Mines to applicants for fire boss, mine foreman and assistant mine foreman certificates. Students who have attended our classes have been uniformly successful in passing these examinations and in obtaining certification which permits them to occupy positions of greater responsibility. In addition, the course provides information which is more advanced than that required to pass the foregoing state examinations; such information is valuable to the man who has charge of a mine or who expects to take the state examination for mine inspector. Regardless of whether a student expects to take any of the state examinations or merely intends to study for the satisfaction of acquiring knowledge, any person who completes the course is more valuable to his employer and the industry than one who takes no interest in such studies.

The course is designed to cover the fundamental studies of mining in a practical manner. It is equally applicable to the anthracite worker and to the bituminous coal worker. When some portion of the course touches on a phase of mining peculiar to either industry, it is treated separately for the benefit of the workers in that industry.

**Coal Mining, First Year.**—Volume I is the textbook used in the first year's work. The subjects covered include: English, arithmetic, geology, mine gases and their detection, elementary mine ventilation and reports. A thorough study of the mining law is required as a part of the class work. Students who complete this initial part of the course are well prepared to sit for the state examination for fire boss certification.

**Coal Mining, Second Year.**—Volume II is the textbook used in the second year's work. The subjects covered include: Mine lighting, algebra, advanced mine ventilation, mine fires and explosions, rock-dusting, safety and accident-prevention work, surveying and mapping, explosives and elements of electricity. It is customary to include a thorough review of the mining law as part of the class work. Students who complete this year's work are prepared to take the state examination for mine foreman.

**Coal Mining, Third Year.**—Volume III is the textbook used in the third year's work. The subjects covered include: trigonometry, mechanics, ventilation practice, mining methods, mechanical mining, tim-



bering, principles of steam and compressed air, mine drainage, haulage and preparation of coal. Again, the mining law is reviewed thoroughly as part of the class work. This year's studies are classed as "advanced coal mining" and offer the student valuable information which a foreman or superintendent can use to good advantage.

### FERROUS METALLURGY

Since the state of Pennsylvania has long been one of the leaders in iron and steel production in the nation, interest in educational ventures to promote the efficiency and knowledge of its workers in this field should be in demand. After thoroughly considering the needs and the average educational level of the employees to be served, and consulting with the Metallurgical Advisory Board of this School and with industrial leaders, an organized three-year extension course in Ferrous Metallurgy has been designed and is now being offered by this division. This course has, as its purpose, the correlation of practical experience with the more technical phases of the subject, thereby assisting the employer by providing an improved and more efficient personnel, and the employe by increasing his available knowledge and giving him the feeling of greater security in his job through increased efficiency.

The course is designed to cover the ferrous field, from raw material to finished product, together with a review of the fundamentals essential for an understanding of the more specific phases covered in this three-year course. The plan of the course is to present basic principles and include the latest and most accurate data available. The material is presented in sequence; each volume presents advancing steps in processing and manufacture. The very nature of the material covered makes it highly desirable that there be no break in the sequence of the outlined three years' work. It is recommended that the student have as prerequisites high school chemistry and physics. This does not preclude, however, a student not having such a background from studying the work; it merely means that more intensive study is necessary to understand the principles involved.

**Ferrous Metallurgy, First Year.**—Volume I is the first of the three-volume series used in extension study in this field. It is in part a preparatory text in which certain fundamentals are studied which are essential for a full understanding of the phases considered in this and subsequent volumes. The material covered is as follows: chemistry—general inorganic and organic, applications of chemistry; physics—general, pyrometry; metallurgical fuels and their combustion; refractories; fluxes and slags; the blast furnace and the manufacture of pig iron; malleable cast iron, and wrought iron.

**Ferrous Metallurgy, Second Year.**—Volume II of this series covers Bessemer processes; basic and acid open hearth processes; electric furnace processes; special steel making processes; steel ingot, principles and general methods of fabrication; rolling mill practice; manufacture of steel strip, sheet and tin mill products; steel wire and tubular products; forging practice; general welding methods; steel foundry.

**Ferrous Metallurgy, Third Year.**—Volume III of this series covers microscopy; x-ray, gamma ray and magnetic testing; physical testing of metals; constitution of metallic alloys; iron-carbon diagram; metallography of steel castings and cast iron; mechanical treatment of steel; heat treatment of plain carbon steels; theory of hardening steel; grain size in steel; heat treatment of steel castings and cast irons; case hardening of steels; individual effects of alloying elements; alloy steels; carburizing steels, and water and oil hardening steels; special alloy steels.

### NATURAL GAS ENGINEERING

Pennsylvania produces about 5 per cent of the total natural gas utilized in the United States or a total of about 99,000 million cubic feet a year. Early-day production required little more than a practical working knowledge of the crude equipment used, but today the industry is complicated by more exact metering and regulation equipment, new compressor designs, deep well production, underground storage and long pipelines. Strict safety and operation requirements are now enforced by the state. In general, the ability of a company to continue operation in the future depends upon the training of the present workmen. What is true of petroleum production with respect to improving personnel applies, in a large measure, to this industry.

Increasing the education of gas industry employees is necessary; otherwise the companies which use more efficient methods of workmen will eventually take over the field of operation. Evening classes in natural gas engineering are designed to "upgrade" the practical man and may be looked upon as a type of job insurance. Age or previous education does not prevent anyone from profiting by a study of the material as it is presented in this three-year course.

**General Preparatory Course.**—The book used in this year of the course is the same as that mentioned under Ceramics, Petroleum Production and Petroleum Refining.

**Natural Gas Engineering, Second Year.**—The text is the same as that described in Petroleum Production, Second Year.

**Natural Gas Engineering, Third Year**—Volume III of this title contains detailed geological information of the Appalachian area. Metering and regulation are covered in detail. Tables for meter correction, orifice meter calculation and regulation problems contained in the book make it very valuable as a reference book. The course is practical and is presented in a logical and interesting manner.

### PETROLEUM PRODUCTION

Production of crude petroleum in the state of Pennsylvania has increased from approximately nine million barrels in 1929 to more than 17 million barrels in 1937. This increase is attributed to the application of improved production methods discovered by thorough research in cooperation with the laboratories of this College.

At present Pennsylvania is responsible for 5.2 per cent of the total oil production of this country. This favorable percentage, however, can be maintained only by the continued application of improved oil production methods. Water-flooding, gas repressuring, and other so-called secondary recovery methods are now being widely used throughout the oil fields of the Appalachian area. Services of well trained workmen are necessary so that these latest methods may be properly used.

Deep wells are now being drilled to depths of 5,000 to 7,000 feet or more in order that the deeper oil and gas-bearing geological formations may be tapped. Rotary tools and rigs will replace, by necessity, the cable tools used in the eastern oil fields since 1859. The untrained worker will soon find himself confronted with geological, physical, chemical and mechanical problems not previously encountered in the oil production industry in this state. The industry is requiring more highly trained workmen in order that the newer scientific discoveries affecting petroleum production may be carried out to advantage on the oil lease.

A three-year course in Petroleum Production is offered by the Extension Division of this School. This course presents the basic and fundamental training necessary to a thorough understanding of the newer oil production methods. The latter portions of the course are designed to give the worker an understanding of the latest methods of oil production. Lack of previous education need not keep any man from taking the course, since the work is especially designed for those who have not had the opportunity to attend schools of higher education.

**General Preparatory Course.**—The book used in this course is the same as that used in Ceramics, Petroleum Refining, and Natural Gas Engineering. It will serve as a valuable reference book after the course is completed.

**Petroleum Production, Second Year.**—The book used in this course, *Petroleum and Natural Gas Production*, Volume II, is also used as the second-year book of the Natural Gas Engineering course. It includes a practical course in geology, prospecting, mapping and drilling methods now being used in modern practice. The course is equally valuable to foreman and workmen.

**Petroleum Production, Third Year.**—The textbook includes advanced geological information, current methods of water-flooding and gas repressuring. The book also includes oil field engineering practices, together with important tables which are valuable in making any necessary oil field calculations.

### PETROLEUM REFINING

It is only necessary to consider that more than 97,686,000 barrels of crude oil were refined in Pennsylvania last year to appreciate the importance of this industry to the workmen of this state. Approximately 9 per cent of all the oil refined in this country is processed by Pennsylvania refiners.

No industry changes more rapidly than the refining industry. Processes employed less than five years ago, have been replaced by newer methods. The industry in this country pays the highest salaries to its workmen and a higher tax load each year, yet the products are marketed to the public at a price much lower than that in other countries. At present 83 per cent of all the motor vehicles of the world are owned by the people of this country, and current indications are that this figure is rapidly increasing.

Motor vehicle operators are dependent upon the refinery as their sole source of gasoline and lubricating oils. The demand will continue for a number of years without question. Refineries at present are being forced to produce their products at a lower cost, thus requiring the use of more efficient methods of operation and the services of more technically trained men. There is no question that refineries will continue operation in this state only as long as they can obtain workmen who are willing to devote a portion of their spare time to self-improvement.

This course is designed to train refinery employees so that they may be in possession of the latest information concerning the processes used in the refining industry. Students of this course have a clear conception of their responsibility to the industry and are able to work more understandingly and effectively, thus doing their part in making it possible to maintain refinery operations in this Commonwealth.

**General Preparatory Course.**—The book used in this year of the course is the same as that previously described under Ceramics, Petroleum Production and Natural Gas Engineering.

**Petroleum Refining, Second Year.**—Volume II of this title is the textbook for the second-year course in this field. It describes practically all the important methods of refining employed by the industry, including refining by distillation, cracking, filtering, chemicals, polymerization and other methods. Flow diagrams and computed tables make the book a valuable handbook for the refinery worker after the course is completed.

**Petroleum Refining, Third Year.**—Volume III of this title covers the more advanced engineering information related to modern refinery operation. Simplified chemical engineering and specific directions for unit operation are contained in the text and covered in the course.

### TEXTBOOKS AND THEIR COSTS

Textbooks have been prepared by the staff of the Division of Mineral Industries Extension and are available through that office at the prices named, plus a handling and mailing charge of 10 cents per volume to all persons ordering books.

Ceramics, Volume II .....	\$2.50
Coal Mining, Volume I, .....	2.50
Coal Mining, Volume II, .....	2.50
Coal Mining, Volume III, .....	2.50
Ferrous Metallurgy, Volume I, .....	2.50
Ferrous Metallurgy, Volume II, .....	2.50
Ferrous Metallurgy, Volume III, .....	3.50
General Preparatory Course; Ceramics and Petroleum and Natural Gas, Volume I, ....	2.50
Geophysical Prospecting (mimeographed) ...	1.50
Petroleum and Natural Gas Production, Vol- ume II, .....	2.50
Petroleum Refining, Volume II .....	2.50
Natural Gas Engineering, Volume III ( <del>mimeo-</del> <del>graphed</del> ) .....	<del>2.50</del> 2.00
Petroleum Refining, Volume III ( <del>mimeo-</del> <del>graphed</del> ) .....	<del>2.50</del> 1.50
CERAMICS, VOL. III	2.50