Pennsylvania’s School of Mineral Industries and Experiment Station

Mineral Industries Correspondence and Extension-class Instruction

Circular No.19

The Pennsylvania State College, State College, Pennsylvania
1944
MINERAL INDUSTRIES
CORRESPONDENCE AND EXTENSION-CLASS INSTRUCTION

Circular Number 19

MINERAL INDUSTRIES EXTENSION SERVICES
SCHOOL OF MINERAL INDUSTRIES
The Pennsylvania State College
STATE COLLEGE • PENNSYLVANIA
Subjects Available through correspondence instruction in Ceramics, Climatology, Coal Mining, Ferrous Metallurgy, Geography, Geology, Geophysical Prospecting, Meteorology, Mineralogy, Mineral Economics, Natural Gas Engineering, and Petroleum Refining.

Extension Curricula in Ceramics, Coal Mining, Ferrous Metallurgy, Natural Gas Engineering, Petroleum Production, and Petroleum Refining.

Short Courses in Mechanized Mining and Coal Preparation.

Data pertaining to the administration of the work.
FOREWORD

EDWARD STEIDLE, Dean
School of Mineral Industries

The School of Mineral Industries is an integral part of The Pennsylvania State College. The School is concerned with the exploration, development, and conservation of the natural mineral resources of Pennsylvania and their preparation, processing, and efficient utilization. Natural minerals are divided into three general groups: mineral fuels; metallic minerals; and nonmetallic minerals. The mineral arts and sciences embrace four distinct types of subject matter namely: (1) the earth sciences, including geology, mineralogy, geography, geophysics, meteorology, and related subjects; (2) mineral engineering, including mineral economics, mining, mineral preparation, and petroleum and natural gas; and (3) mineral technology, including fuel technology, metallurgy, and ceramics.

Pennsylvania is the greatest mineral industrial commonwealth. Her mines and products derived from minerals account for about two-thirds of the entire productive wealth of the State. Truly, Pennsylvania’s mineral resources have been the very heart of her economic development.

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 Services. 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 Services was set up, not as an independent organization, but as the organized expression of an important function of the whole School.

The Mineral Industries Extension Services is the College medium through which the educational resources of the School are extended and made effective throughout the State. Mineral industries workers usually live in rural communities and extension training is the only form of education which fits their needs. Educational processes taken into the mines, mills, and plants result in the promotion of mutual understanding between employers and employees which is imperative for efficiency, safety, and economy of operation.

The Mineral Industries Extension service program arises from the current economic and social needs of the Commonwealth. Through this service the principles and the truths developed by study and research are translated and carried to the people and applied to the industries. The Extension Services are organized to spend their funds 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 mineral-producing and primary processing industries. The Extension Services publish a paper, Mineral Industries, monthly, from October to May inclusive each year; the publication is devoted to the work of the entire School.

This bulletin, prepared by H. B. Northrup, Director, Mineral Industries Extension Services, describes briefly the functions of the Extension Services, 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

H. B. NORTHRUP, Director
Mineral Industries Extension Services
Mineral Industries Extension Services

MINERAL INDUSTRIES Extension Services began in 1893 under a special maintenance appropriation by the State Legislature for the department of Mining Engineering of the College. The demand for mining extension came about by the enactment of mine laws and regulations in Pennsylvania requiring certification of all underground officials. This was the first organized extension training in the United States so far as the records reveal.

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 and the mining extension work had to be curtailed in proportion. Extension classes in coal mining were carried on by members of the resident faculty in the anthracite region and in central Pennsylvania from 1908-1915 in co-operation with, and assisted by, funds from the Y. M. C. A. and the Central Pennsylvania Coal Producers Association. The program again expanded in 1919 through a small College appropriation, a grant-in-aid from the Central Pennsylvania Coal Producers Association and through the utilization of Federal Smith-Hughes funds, in cooperation with the State Department of Public Instruction and the State Department of Mines. Up to this time, all of the extension instruction had been given by the resident staff in mining, but now a full-time extension man was employed to devote full attention to the program.

In 1931, the extension activities of the School were placed on an organized basis compatible with the unified program of the newly reorganized School of Mineral Industries and a director was appointed to take full charge of the work. He was charged with the responsibility of carrying a program of education and training to mineral industries workers throughout the State of Pennsylvania. This program parallels the work given in resident instruction by the School on the campus and consists of (1) basic, fundamental, upgrading, in-service, extension curricula of less than college grade; (2) short, specialized, advance terminal courses; (3) college credit courses, where warranted; and (4) correspondence courses of (a) college credit, and (b) industrial credit. The formal extension class programs are limited to persons residing within the Commonwealth, but the correspondence courses are available to any person, without geographical limitations.

During the first year of the reorganized program, at a conference in Harrisburg, an agreement was consummated between the State Department of Public Instruction and the College, whereby extension classes in the field of the mineral industries could be organized by the College throughout the Commonwealth under "public supervision and control," with the State Department of Mines and the State Department of Labor and Industry collaborating. During the conference, it was agreed that all vocational industrial classes be organized on the basis of a three-year program and that a textbook be prepared to cover each year of class instruction. Accordingly, with a mass of instruction pamphlets and lesson material as a basis, a three-year program for miners was laid out and by 1932, three textbooks had been printed which covered a three-year program of training in Coal Mining.

In 1932 a program of training was initiated for workers in the petroleum and natural gas industries. Three textbooks were prepared, originally covering the entire field, but as time progressed and more experience was gained in the educational needs of the workers, the text material was expanded to cover three curricula with a three-textbook series for each Natural Gas Engineering, Petroleum Production, and Petroleum Refining.

Similarly, three-year curricula were initiated and textbooks written for ceramics and ferrous metallurgy in 1933. Four short terminal courses were prepared in mimeograph form in 1940 to train employees in the new field of mechanized mining and the maintenance of mechanized mining equipment. These courses are short and intensive and are designed to train men for the particular type of equipment used in each industry. In 1954, a new, one-year course was introduced to train men in coal preparation.

The development of the service has resulted from demands on the part of industry rather than from any educational promotion. The mineral industries extension work has to be planned from the initial contact by mineral industries supervisors who understand the language and the problems of the industry.

Regular extension courses are organized on the basis of 150 class hours yearly. The student is awarded a certificate worth ten industrial credits when he has completed successfully each year of the work, and an extension diploma when he shall have completed successfully any given three-year curriculum. The majority of the effort to date has been in industrial, upgrading training of less than college grade, but college credit training is available upon request. The industrial training costs the student nothing except the purchase of his textbook. College credit training is usually given on a regulated fee basis.

The organization plan of Mineral Industries Extension Services is peculiar to the School of Mineral Industries. The services are integrated with the residence and research divisions of the School. A supervisor, corresponding to a department head, is responsible for the work in each field. All supervisors have had industrial experience and each is responsible for the preparation of textbooks and lesson material and in maintaining it up to date. Textbooks are printed only in sufficient quantity to last two years, according to our
experience, so that each and every book is revised and brought up to date approximately every second year.

The extension supervisors also are in constant and regular contact with industry to ascertain its educational needs and to keep posted on industrial progress. They also are responsible for preparing correspondence courses of less than college grade and for correcting such correspondence lessons, thus insuring the student the best instruction possible in that type of training.

The regular staff of the Services includes, in addition to the director, one supervisor and two assistant supervisors in mining extension, one supervisor each in ceramics, metallurgy, petroleum and natural gas, and fuel technology, and two secretaries. Over the period 1931 to 1944 the regular work of mineral industries extension services has trained personnel for Pennsylvania's mineral industries as follows:

<table>
<thead>
<tr>
<th>Subject</th>
<th>Enrolled</th>
<th>Certified</th>
<th>Completion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ceramics</td>
<td>775</td>
<td>517</td>
<td>81.7</td>
</tr>
<tr>
<td>Coal Mining</td>
<td>21,665</td>
<td>11,898</td>
<td>53.0</td>
</tr>
<tr>
<td>Metallurgy</td>
<td>8,780</td>
<td>5,515</td>
<td>62.0</td>
</tr>
<tr>
<td>Petroleum and Natural Gas</td>
<td>7,029</td>
<td>4,555</td>
<td>64.8</td>
</tr>
<tr>
<td>Meteorology*</td>
<td>20</td>
<td>16</td>
<td>80.0</td>
</tr>
<tr>
<td>Correspondence Enrollments</td>
<td>38,168</td>
<td>22,001</td>
<td>56.8</td>
</tr>
<tr>
<td>Total</td>
<td>38,888</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Mineral industries extension services participated in the Defense and War Training programs given by the College under the sponsorship of the U. S. Office of Education. This work was carried in addition to the regular program. During the period 1940–44, college grade work was given under this program in several fields as follows:

<table>
<thead>
<tr>
<th>Subject</th>
<th>Enrollees</th>
</tr>
</thead>
<tbody>
<tr>
<td>Metallurgy</td>
<td>5,853</td>
</tr>
<tr>
<td>Fuel Technology</td>
<td>1,077</td>
</tr>
<tr>
<td>Ceramics</td>
<td>154</td>
</tr>
<tr>
<td>Petroleum and Natural Gas</td>
<td>54</td>
</tr>
<tr>
<td>Total</td>
<td>7,138</td>
</tr>
</tbody>
</table>

The grand total of persons trained by Mineral industries extension services, therefore, for the period 1931–1944 is: (a) Regular extension training 38,588, (b) Defense and war training 7,138 for a grand total of 42,726, or an average over the 13 year period of 3,517 persons annually. The training has been given in 287 class centers, in 50 of the 67 counties of the Commonwealth.

Mineral industries extension training is available to any person or group of persons in the Commonwealth. The mineral industries of Pennsylvania have profited from such training for their workers in the past. What the postwar demands may be is unpredictable, but the College is prepared to render its extension services to meet any new demands made upon it in training workers to take their proper places under the new order.

* College credit.
describes the courses in the field of the mineral industries that are available through correspondence instruction and extension classes.

In the pages that follow, the correspondence courses are described from the standpoint of administration and content. Many of the courses may be taken for college credit and are so designated. Several of the courses, however, because of the nature of the subject matter and the methods of and reasons for their presentation, are of less than college grade, designed to be of immediate value to men on the job, and carry, therefore, only points of industrial credit.

Industrial credits given for certain correspondence courses apply 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 or 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. Mineral Industries Extension Services 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

CORRESPONDENCE courses form an important part of the extension service of the School of Mineral Industries. The college credit courses are available to any interested person who has acquired the prerequisites necessary for enrollment in any given course; the industrial credit courses, requiring no college prerequisites, are available to anyone. 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 Mineral Industries Extension Services 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 costs 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 and prepare for advancement 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 Services, 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 six college credits or 10 industrial credits. However, there may be exceptions to this regulation for sufficient cause.

(3) A resident undergraduate student may not register for a correspondence study course while in residence at the Pennsylvania State College. Exceptions to this rule may be made only by the Committee on Academic Standards upon written request of the Dean of the School in which the student is enrolled.

(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) The Correspondence Study Division can make no guarantee that a course and its examination will be completed satisfactorily by a certain date. If a student desires credit for graduation or certification by a certain date, the work should be scheduled so that the credit earned may be certified by this division at least two weeks before the date needed.

(6) 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.

(7) Textbooks may be purchased wherever the student prefers. Where the course material has been prepared by members of the Extension Services at the prices quoted.

(8) The student pays postage on all material returned to the student.

Residence Requirements

The minimum time spent in residence by candidates for a degree shall be:

(a) Not less than two semesters immediately preceding graduation and covering a minimum of 30 credits, or

(b) Not less than 30 weeks of full-time residence in summer sessions at The Pennsylvania State College. These 30 weeks, 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 one of the summer sessions comprised in the 30 weeks in question.

(c) In the case of servicemen, it is provided: "that no former student of The Pennsylvania State College who has been inducted and who has served in one of the armed services of the United States be held for the usual Senior Year Resident requirement provided such a student, prior to his induction, shall have spent at the Pennsylvania State College a minimum of four semesters in residence. Credit that such a student might submit to The Pennsylvania State College on the basis of college work that he may have taken while he was in the armed service or for which he has received college credit here either by extension, correspondence, examination or on transfer from another accredited college should, if applicable to his curriculum, be accepted here toward his degree even though such credit should cover, in whole or in part, the credit and residence requirement of his senior year."

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.

In correspondence courses carrying College credit, no more than 15 credits may be applied toward a bachelor's degree, and no more than 6 credits may be earned in any semester. Credits by examination toward a degree are also limited to 15.

Special provision has been made for men in the armed forces and for veterans returning to college. Such persons may earn a maximum of 45 credits, "by examination or through accepted correspondence work or through extension courses or through all three methods combined, provided that the total credit so earned would not exceed 45 credit hours."

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. Students who have earned credits at other colleges or at any other type of institution subsequent to their high school or preparatory school attendance and who desire to be enrolled for a degree at The Pennsylvania State College, should first have their eligibility for admission as degree students determined by the College Examiner before scheduling degree credit courses.

Grading System

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

\[
\begin{align*}
3 & = 90-100 \text{ inclusive} \\
2 & = 80-89 \text{ inclusive} \\
1 & = 70-79 \text{ inclusive} \\
0 & = 60-69 \text{ inclusive} \\
-1 & = 45-59 \text{ inclusive} \\
-2 & = \text{below 45}
\end{align*}
\]

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 Services.

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 book store or directly from the publishers. Textbooks developed by the School of Mineral Industries staff should be obtained from the Extension Services office.

Before buying any textbook, the student should wait until he receives his first lesson assignment. Correspondence courses are revised frequently. As new and better books and material appear, they are adapted to 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 are considered as service courses and carry industrial credits only. The fees for these courses are listed with the descriptions of the courses.
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: William R. White, In Charge of Correspondence Courses in Agriculture.

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

EDUCATION: Frank H. Koos, Assistant Director of Correspondence Instruction, School of Education.

ENGINEERING: E. L. Keller, Director of Engineering Extension.
Correspondence Courses
In Mineral Industries

Earth Sciences

GEOGRAPHY


Fee $21; 3 college credits.

Geog. 24C. Principles of Geography.—A general survey of the characteristics of the major types of land surfaces, climates, 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: Case, E. C. and Bergsmark, D. R., College Geography, second edition, John Wiley and Sons, Inc., $4.50. Set of two maps, no. DD98, A. J. Nystrom Co., Chicago, Ill., $0.05. 25 assignments.

Fee $21; 3 college 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. Textbook: Smith, J. Russell, and Phillips, M. Ogden, North America, Harcourt, Brace and Co., Inc., 1940, $4.75. Set of 12 maps, no. DD5, A. J. Nystrom Co., Chicago, Ill., $0.30. 25 assignments.

Fee $21; 3 college 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. The State will be discussed by geographic regions, the various outstanding industries being taken up in connection with the regions in which they are most important. Textbook: Murphy, Raymond E., and Murphy, Marion, Pennsylvania: A Regional Geography, The Pennsylvania Book Service, $4.00. Set of 20, letter size, outline maps of Pennsylvania, Rand McNally Co., New York, N. Y., $0.25. 25 assignments.

Fee $21; 3 college 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 United States of America are briefly treated. Textbook: Tarr, R. S., and von Engeln, O. D., New Physical Geography, 1925, the Macmillan Co., $2.40. 25 assignments.

Fee $21; 3 college credits.

Geog. 442C. Geography of Europe.—A geographic picture of present-day Europe. Both geographic regions and political units are considered. Prerequisite: Geog. 24C. Textbook: Bogardus, J. F., Europe: A Geographical Survey, Harper and Brothers, $4.00. Set of six maps, no. D2, A. J. Nystrom Co., Chicago, Ill., $0.10. 25 assignments.

Fee $21; 3 college credits.

GEOL OGY

*Geol. 30C. Physical and Historical Geology.—A short course combining the fields of Geol. 31C and Geol. 32C; practicum includes field trips, map work, and the study of important rocks and fossils. Textbook: Longwell, C. R., Knopf, Flint, Schuchert, C., and Dunbar, C. O., Outlines of Geology, second edition, John Wiley and Sons, Inc., $4.00. Set of 15 topographic maps, $1.50. 24 assignments.

Fee $21; 3 college credits.


Fee $21; 3 college 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 rocks and fossil specimens of the various geologic periods. Prerequisite: Geol. 30C, or Geol. 31C, or equivalent. Textbook: Schuchert, C., and Dunbar, C. O., A Textbook of Geology, Part II—Historical Geology. John Wiley and Sons, Inc., $4.00. Set of outline maps. $0.35. 24 assignments.

Fee $21; 3 college credits.

Geol. 51C. Economic Geology.—A study of the more important metallic and nonmetallic mineral deposits, gold, silver, lead, zinc, iron, coal, oil, clays, etc. Mineralogy, geological relationships, geographical distribution, and economic considerations are emphasized. Prerequisites: Geol. 31C, Geol. 32C and Min. 53C, or equivalents. Textbook: Tarr, W. A., Introductory Economic Geology,

* Students who have taken Geog. 34C should elect this course rather than Geol. 31C.
Mineral Industries Extension Instruction

McGraw-Hill Book Co., Inc., $5.00. Set of outline maps, $0.85. 24 assignments.


Geol. 481C. Geology of Oil and Gas. (Note: Not offered this year.)

GEOPHYSICS

Geophys. 1C. 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: Landsberg, Helmut, An Outline of the Methods of Geophysical Prospecting, The Pennsylvania State College, Mineral Industries Extension Services, $1.50. 8 assignments.

Geophys. 11C. 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. Prerequisites: One year of general college physics and mathematics, including differential calculus. Textbook: Byers, Horace R., General Meteorology, McGraw-Hill Book Co., Inc., 1944, $5.00. 13 lessons, 10 practica.


Geophys. 13C. War Meteorology.—Discussion of elements of meteorology; forecasting from local observations; influence of weather on warfare, with particular reference to chemical warfare, aerial warfare, and marine warfare. Textbook: Neuberger, H., War Meteorology, Mineral Industries Extension Services, 1943, $1.50. 15 assignments.

Geophys. 14C. Practical Exercises in Meteorology.—(1) The mean conditions of the atmosphere: Distribution of temperatures, pressures, and rainfall. (2) Instruments and methods of observation: Instrument scales, barometer reductions, humidity, and pilot balloon observations. (3) Exercises in dynamical meteorology: Composition of the atmosphere, hydrostatic equation, wind equations, geostrophic-wind scale, thermodynamic diagram, frontal slopes, isobaric analysis, graphical operations on the thermodynamic diagram, thunderstorm analysis, diurnal pressure variations, barometric tendencies, displacement of pressure systems and fronts. Prerequisite: One year of general college physics and mathematics including differential calculus, and three college credits in an advanced course in meteorology; may be taken concurrently with Geophys. 11C, Aeronautical Meteorology. Textbook: Spilhaus, Athelstan F., and Miller, James E., Workbook in Meteorology, McGraw-Hill Book Co., Inc., 1942, $2.50. 24 assignments.

MINERALOGY

Min. 53C. Elementary Mineralogy.—A short course in mineralogy for agriculture, chemistry and physics, and engineering 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: Dana, E. S., Minerals and How to Study Them, John Wiley and Sons, Inc., $2.00. Tray of minerals: Ward's Natural Science Establishment, Rochester, N. Y., $7.50. 17 assignments.

MINERAL ECONOMICS


Mineral Engineering

MINING ENGINEERING

Mmg. 1C. 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: Jones, D. C., Coal Mining, Volume I, The Pennsylvania State College, Mineral Industries Extension Services, $2.50. 24 assignments.

Mmg. 2C. Intermediate Coal Mining.—This is the second course of a series of coal mining for the practical mining man. It includes the study of ventilation, fires, explosions, accident-pre-
vention, and other subjects which the mining man should know. Prerequisite: Mng. 1C or equivalent. Textbook: Jones, D. C., *Coal Mining, Volume II*, The Pennsylvania State College, Mineral Industries Extension Services, $2.50. 24 assignments.

Fee $17.50; 10 industrial credits.

**Mng. 3C. 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. Prerequisite: Mng. 2C or equivalent. Textbook: Jones, D. C., *Coal Mining, Volume III*, The Pennsylvania State College, Mineral Industries Extension Services, $3.50. 24 assignments.

Fee $17.50; 10 industrial credits.

**NATURAL GAS ENGINEERING**

Nat. Gas Eng. 1C. Natural Gas Engineering.—A preparatory course designed for those who are working in or wish to enter the field of natural gas. The course is essentially constituted of the study of basic mathematics including arithmetic, applied arithmetic, algebra, logarithms and slide rule, elementary chemistry, and elementary physics. Also included are the history and development of the industry, the properties of products, and the testing of products. No prerequisites; but graduation from a four-year high school is desirable. Textbook: Stephens, M. M., *Petroleum and Natural Gas Engineering, Volume I*, The Pennsylvania State College, Mineral Industries Extension Services, $3.00. 24 assignments.

Fee $17.50; 10 industrial credits.


Fee $17.50; 10 industrial credits.

Nat. Gas Eng. 3C. Natural Gas Engineering.—The course is divided into three sections, namely: “Natural Gas Economics and Well Operation,” “Gas Gathering, Compressors, Transmission, and Natural Gasoline,” and “Measurement and Regulation.” The first section includes a study of the early history and the present economics of the industry, the completion and the operation of gas wells, the elimination of gas hydrates, the maintenance of gas wells, measuring the capacity and estimating the value of gas properties. The second section includes gathering systems, flow formulas, pipe line construction, compression, and natural gas-plant operation. The third section includes the measurement of the properties of natural gas, the types and use of displacement and orifice meters, and field and distribution regulation of gas pressure. Prerequisite: Nat. Gas Eng. 2C. Textbook: Stephens, M. M., *Natural Gas Engineering, Volume III*, The Pennsylvania State College, Mineral Industries Extension Services, $3.50. 24 assignments.

Fee $17.50; 10 industrial credits.

**MINERAL INDUSTRIES EXTENSION INSTRUCTION**

**CERAMICS**

Nine short courses have been prepared to meet the demands of students who find it impossible to attend regularly organized extension classes. Also, there are demands for ceramics instruction by groups which are too small to constitute a regular extension class, which can be served by the following courses on a supervised correspondence instruction plan.

The curricula available include a possibility of four courses in refractories, four courses in clay products, four courses in white- wares, one course in glass, and two courses in enamels. Some of the courses are common to more than one curriculum but the student may, by selecting his courses as indicated below, arrange his program of study to earn an extension diploma in refractories, clay products, or whitenes. A suggested curriculum includes: in refractories, courses 1C, 22C, 3C, and 24C; in clay products, courses 1C, 2C, 3C, and 4C; in whitenes, courses 1C, 2C, 3C, and 4C.

Cer. 1C. Ceramic Raw Materials.—This course deals with the occurrence, properties, uses, and preparation of ceramic raw materials. It includes studies of clays: silice, aluminas; feldspars and related materials; the alumina-silica minerals; lime, magnesia, and dolomite; the fluorine minerals; the alkali minerals and compounds; the boron minerals and compounds; and graphite and carbon. The course covers crushing, grinding, screening and mixing as well as the elementary mineralogy, geology, and prop-erties of these materials. Textbook: McNamara, E. P., *Ceramics, Volume II*, The Pennsylvania State College, Mineral Industries Extension Services, $3.00. 18 assignments.

Fee $12.50; 7.5 industrial credits.

Cer. 2C. The Forming and Glazing of Clay Products.—This course treats of the manufacture and properties of heavy clay products with special reference to the soft mud, stiff mud, dry press, and slip casting methods of forming. It also includes many of the standard specifications for heavy clay products. A substan-tial portion of the work is devoted to the manufacture and application of clear and colored glazes. Textbook: McNamara, E. P., *Ceramics, Volume III*, The Pennsylvania State College, Mineral Industries Extension Services, $3.50. 18 assignments.

Fee $12.50; 7.5 industrial credits.
Cer. 3C. Drying and Firing Clay Products.—This course consists of a study of the following subjects: fundamentals of drying; driers; the theory of firing; periodic kilns; tunnel kilns; setting; pyrometry; fuels and their combustion; and refractories for kilns and furnaces. Textbooks: McNamara, E. P., *Ceramics, Volume II* and *Ceramics, Volume III*, The Pennsylvania State College, Mineral Industries Extension Services, Volume II, $3.00; Volume III, $3.50. 18 assignments. Fee $12.50; 7.5 industrial credits.

Cer. 4C. Ceramic Calculations and Testing of Clays and Clay Products.—This course deals with the calculations involved in working with body and glaze batches and the calculations involved in computing the various physical properties of raw clays, fired clay products, and whitewares. It also includes the various physical and chemical tests commonly made on raw clays and fired bodies as well as the apparatus involved in the various tests. Textbook: McNamara, E. P., *Ceramics, Volume III*, The Pennsylvania State College, Mineral Industries Extension Services, $3.50. 18 assignments. Fee $12.50; 7.5 industrial credits.

Cer. 22C. The Forming of Refractory Products.—This course covers the common methods of forming both clay and nonclay refractories, including hand molding, stiff mud, dry press, slip casting, and also the special methods used. Textbook: McNamara, E. P., *Ceramics, Volume III*, The Pennsylvania State College, Mineral Industries Extension Services, $3.50. 18 assignments. Fee $12.50; 7.5 industrial credits.

Cer. 24C. Refractories and Their Testing.—This course consists of a study of the standard methods of testing refractory raw materials and finished products and includes the calculations and apparatus involved. It also includes the uses of and specifications for the various types of refractories. Textbook: Manual of A. S. T. M. Standards on Refractory Materials, $1.50. 18 assignments. Fee $12.50; 7.5 industrial credits.

Cer. 12C. The Forming and Glazing of Claywares.—This course covers the properties, manufacture, and glazing of whiteware products including both vitreous and semivitreous products. It also includes detailed study of the various methods of forming clay wares including throwing, hand molding, jiggering, dry pressing, and slip casting. Textbook; McNamara, E. P., *Ceramics, Volume III*, The Pennsylvania State College, Mineral Industries Extension Services, $3.50. 18 assignments. Fee $12.50; 7.5 industrial credits.

Cer. 30C. Glass.—This is a comprehensive course covering the entire field of glass manufacture. It includes glass raw materials and their preparation; batch preparation and calculations; combustion and fuels; furnaces; melting and glass working processes; strain and annealing; color and decoration; physical properties of glass; testing; defects; and refractories for glass furnaces. Textbook: Scobles, S. R., *Modern Glass Practice*, Industrial Publications $6.00. 24 assignments. Fee $17.50; 10 industrial credits.

Cer. 40C. Enamels.—This is a comprehensive course dealing with the preparation of enamels and their application to metal surfaces. It includes enamel raw materials; physical properties of enamels; opacity and color; the metallurgy of enameling iron and steel; the preparation of metal surfaces; enamel calculations; compositions of enamels; frit making; milling; application of frit to metals; firing (burning); properties and testing of enamels and enameled ware. Textbook: Andrews, A. L., *Enamels*, Twin City Publishing Company, $5.50. 24 assignments. Fee $17.50; 10 industrial credits.

**METALLURGY**

Met. 10C. Process Ferrous Metallurgy.—This course involves a study of the manufacture and processing of steel designed to present the latest information on plant practices. It will be found to be particularly adaptable to the men employed in the phases of operation covered. It embodies a review of inorganic chemistry, physics, pyrometry, metallurgical fuels and refractories, fluxes and slags; a treatise on blast furnace practice; the production of cast iron and wrought iron; Bessemer, open hearth, and electric furnace practice; the steel ingot; general fabrication; rolling mill practice; the manufacture of steel strip, sheet and coated products; general welding methods; forging practice; and, the steel foundry. Textbook: Teichert, E. J., *Ferrous Metallurgy, Volumes I and II*, The Pennsylvania State College, Mineral Industries Extension Services, $2.50 each. 24 assignments. Fee $17.50; 10 industrial credits.

Met. 20C. Physical Ferrous Metallurgy.—This course is a study of the latest theories and practices involved in the heat treatment of plain carbon and alloy steels and will be found to be particularly adaptable to the men employed in this phase of metallurgical work. It embodies a study of the equipment used in test procedures; the iron-carbon diagram; the metallography of steel castings and cast iron; the mechanical treatment of steels; heat treatment of plain carbon steels; grain size; heat treatment of steel castings and cast iron; case hardening; general effects of alloying elements; the carburizing, water, and oil-hardening alloy steels; and special alloy steels. Textbook: Teichert, E. J., *Ferrous Metallurgy, Volume III*, The Pennsylvania State College, Mineral Industries Extension Services, $3.50. 24 assignments. Fee $17.50; 10 industrial credits.

Met. 30C. Practical Metallurgy for the Steel Foundry. (Note: Not offered this year.)

Met. 31C. Practical Metallurgy for the Gray Iron Foundry. (Note: Not offered this year.)
PETROLEUM REFINING

Pet. Ref. 1C. Preparatory Course in Petroleum Refining.—A preparatory course designed for those who are working in or wish to enter the field of petroleum refining. The course is essentially constituted of the study of basic mathematics including arithmetic, applied arithmetic, algebra, logarithms and the slide rule, elementary chemistry and physics. Also included are the history and development of the industry, the properties of products, and the testing of products. No prerequisites; but graduation from a four-year high school is desirable. Textbook: Stephens, M. M., Petroleum and Natural Gas Engineering, Volume I, The Pennsylvania State College, Mineral Industries Extension Services, $3.00. 24 assignments. Fee $17.50; 10 industrial credits.

Pet. Ref. 2C. Elements of Petroleum Refining.—A study of the methods used in the refining of petroleum to produce gasoline, kerosene, fuel oil, lubricating oil, and other products. The course includes a study of the modern methods and equipment used in distillation, cracking, polymerization, hydrogenation, filtration, grease compounding, natural gasoline manufacture and the preparation of petroleum products for market. Safety problems, the storage of products, and marketing and science related to the various discussions are included in the course. Prerequisite: Pet. Ref. 1C Textbook: Stephens, M. M., Petroleum Refining, Volume II, The Pennsylvania State College, Mineral Industries Extension Services, $3.00. 24 assignments. Fee $17.50; 10 industrial credits.

Pet. Ref. 3C. Applied Petroleum Refining.—The course is divided into two sections, namely, “Unit Processes and Basic Laws” and “Design and Operation of Units and Equipment.” A study of fluid flow, pumps, valves, heat transfer, heat exchangers, and an advanced study of distillation is included in the first section. The second section includes the fundamentals of design of stills and pipe heaters, distillation units, cracking units, and the operation procedures of the units. The course also includes instrumentation, automatic control, and refrigeration. Prerequisite: Pet. Ref. 2C Textbook: Stephens, M. M., Petroleum Refining, Volume III, The Pennsylvania State College, Mineral Industries Extension Services, $3.00. 24 assignments. Fee $17.50; 10 industrial credits.

Mineral Industries Extension-Class Instruction

Scope of the Work

Mineral industries extension-class instruction is a form of adult education. The majority of the work consists of programs of 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 to understand and appreciate 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, 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 co-operation of the employer, as well as the appreciation and financial support of the State Legislature. College credit class subjects in the mineral industries field are available also, on a fee basis, upon sufficient demand.

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.

Co-operating Agencies

In August, 1931, the College entered into an agreement with the State departments of Public Instruction, of Mines, and of Labor and Industry, covering a broad program of co-operation. 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 conduct of the extension classes. Under the plan the College was assured the co-operation of the State Department of Public Instruction, which administers the federal and state funds under the federal and state vocational acts, in forming evening mineral industries extension classes under the immediate jurisdiction of the local public school systems.

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,
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 a vocational class. The members of this group shall be more than 16 years of age, residents of the same school district, and not in attendance at any public or private school during the day. Mineral Industries Extension Services and the State Department of Public Instruction collaborate in the establishment of the class and in meeting all the requirements of the law with relation to the federal and state provisions under the vocational acts and in the proper certification of the teacher of such a class, pursuant to the Pennsylvania school code.

Mineral Industries Extension Services will assist any group of mineral industries employees in Pennsylvania desiring educational training, or any mineral industry, technical society, or other agency willing to form a class independent 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 usually can be formed at the request of 20 or more men under a financial arrangement among the company, the class, and the College, upon a strictly nonprofit 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 an evening vocational class in mineral industries under "public supervision and control," 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 prestige to command the respect of the men in industry. Having these qualifications, he is provided with a vocational extension 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 Mineral Industries Extension Services. Teachers of captive classes are selected from industry by arrangement and are not required to have vocational teachers' certificates and need not comply with any of the school laws of the Commonwealth.

Curricula and Textbooks

Mineral Industries Extension Services 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 instruction or extension classes. The courses available through correspondence have been listed in this bulletin. The curricula available through extension-class instruction include: Ceramics, Coal Mining, Coal Preparation, Ferrous Metallurgy, Mine Mechanization, Natural Gas Engineering, Petroleum Production, and Petroleum Refining.

All the extension curricula, excepting coal preparation and mine mechanization are standardized on a three-year basis. Text material has been prepared for each course of a given curriculum by the supervisor of the Mineral Industries extension staff who is responsible for that work. Members of the extension staff are assisted in this preparation by the resident teaching staff of the School in a particular subject. Textbooks are published in a standardized 6 by 9-inch bound volume for most of the subjects; the course in coal preparation utilizes manufacturer's information data; mine mechanization courses are prepared in mimeographed form. The texts are kept up to date by frequent 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 included with the order. The sale prices of the texts are listed on the last page of this bulletin.

Extension Credit

All mineral industries extension students desiring credit from Mineral Industries Extension Services will be required to use the standardized text material of the Extension Services. Credit from the School of Mineral Industries, Extension Services, 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 10 points of credit toward an industrial diploma; upon the completion of the course, which is customarily done in three years of class attendance (with the exception of coal preparation and mech-
anized mining), the student will receive an extension diploma in the practical subject which he has studied. Students completing courses shorter than three years of work will receive certification cards carrying industrial credits on the basis of 15 hours of recitation for each industrial credit. The diploma is an industrial diploma and carries no college credit; but it is an indication to any employer that the man holding it has completed satisfactorily a prescribed course of study in the occupation in which he is engaged.

Class Schedules

Mineral industries extension classes are organized usually on the basis of a minimum of 150 class hours per year. This requirement is met usually by organizing classes to meet under any one of the following plans:

37 1/2 weeks, 2 nights per week, 2 hours per night, or
30 weeks, 2 nights per week, 2.5 hours per night, or
25 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 execute 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 class on 75 per cent of the scheduled 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.

Mineral Engineering

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 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.

First Year.—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 classwork. Students who complete this initial part of the course are well prepared to sit for the State examination for fire boss certification. Textbook: Jones, D. C., Coal Mining, Vol. I.

Second Year.—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 classwork. Students who complete this year's work are prepared to take the State examination for mine foreman. Textbook: Jones, D. C., Coal Mining, Vol. II.

Third Year.—The subjects covered include: Trigonometry, mechanics, ventilation practice, mining methods, mechanical mining, timbering, principles of steam and compressed air, mine drainage, haulage, and preparation of coal. Again, the mining law is reviewed thoroughly as part of the classwork. This year's studies are classed as "advanced coal mining" and offer the student valuable information which a foreman, superintendent, state mine inspector or operator can use to good advantage. Textbook: Jones, D. C., Coal Mining, Vol. III.

COAL PREPARATION

The course in Coal Preparation has been designed to meet the needs of the workers engaged in both underground and surface bene-
fication of coal. The depletion of our higher quality coals, more exacting market requirements, and the rapid increase in the use of mechanical loading equipment have given a tremendous impetus to the growth of cleaning plants and to the institution and observance of operational rules that will help to maintain quality.

Students attending these classes are instructed in all phases of coal preparation. Emphasis in the section on cleaning plants is given in each case to those devices in most common local use, but a survey is made of all types of cleaners and methods for general information.

MECHANIZED MINING

Due to the general interest in and adaptation of mechanized mining equipment, four courses of a minimum of ten weeks each have been prepared especially for training men in the construction, utilization, and maintenance of all types of mechanical mining equipment. These courses are available to any mine organization interested in the installation of mechanized mining equipment and in training men especially in the use, care, maintenance, and safe operation of the machines. The training program may be arranged by appointment by any company interested in initiating this type of work.

NATURAL GAS ENGINEERING

Under normal conditions about five per cent of the total natural gas used in the United States was produced from the petroleum and natural gas fields of the State of Pennsylvania. At present the percentage is somewhat higher, and the total production of natural gas has skyrocketed due to greatly increased industrial demands under war conditions. In practically all areas in the State the demand for natural gas exceeds the production.

Due to this condition and in spite of the difficulties in procuring equipment, new production is being brought in, and more efficient use of transmission and distribution facilities is being effected.

Since the increased production, transmission, and distribution must rely to a great extent upon improved engineering methods, the man who is trained is more valuable than the "practical" man who is not familiar with the technical side of the gas industry. The courses in natural gas engineering are designed to give the workman in the industry basic technical training which will be of great value to him in his job as well as increase his value to the company by which he is employed.

First Year.—This course is designed for all employees of the petroleum and natural gas industry and is so arranged that those men who have not attended school recently or who have a limited education will have little difficulty in mastering the material. Practical arithmetic, mathematics, mechanical problems and maintenance, elementary drafting, slide rule, physics, and applied chemistry are taught by giving a clear explanation of the material involved and illustrating the various points by reference to situations and actual problems originating directly from the field. All students are expected to have completed this course or its equivalent before enrolling for any of the following courses. Textbook: Stephens, M. M., Petroleum and Natural Gas Engineering, Vol. I.

Second Year.—This course is predicated on the student having practical experience in the industry and having completed the first
year course. The work covered includes: Origin and character of the earth; petroleum mineralogy; classes of rocks; geologic forces of the earth; formation of sedimentary rocks; properties and classification of sedimentary rocks; petroleum geology; chemical and physical properties of petroleum and natural gas; exploration for petroleum and natural gas; leases and leasing; drilling practices; well completion; production; and secondary recovery practices. The course is as valuable to the office worker as it is to the field man. Textbook: Stephens, M. M., and Spencer, O. F., Petroleum and Natural Gas Production, Vol. II.

Third Year.—This course pertains essentially to the surface construction and operation involved in gas production and transmission. Gas-well completion, elimination of hydrates, maintenance of lines and wells, measuring well capacity, valuation of gas properties, gas gathering, compression, transmission, natural gasline manufacture, gas measurement, and gas regulation are covered in the course. The material is prepared so that the textbook can be used as a ready reference for calculating orifice constants and making numerous other practical calculations. Textbook: Stephens, M. M., Natural Gas Engineering, Vol. III.

PETROLEUM PRODUCTION

As in the case of natural gas production, crude oil production in the State of Pennsylvania is below the demand. New drilling and increased recovery from old fields through the use of secondary recovery methods is doing much toward making up the deficit between demand and supply.

The use of new methods requires better trained workmen who are familiar with the technical and basic scientific background of the methods.

A three-year course in Petroleum Production is offered by the Extension Services 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.

First Year.—This course is designed for all employees of the petroleum and natural gas industry and is so arranged that those men who have not attended school recently or who have a limited education will have little difficulty in mastering the material. Practical arithmetic, mathematics, mechanical problems and maintenance, elementary drafting, slide rule, physics, and applied chemistry are taught by giving a clear explanation of the material involved and illustrating the various points by reference to situations and actual problems originating directly from the field. All students are expected to have completed this course or its equivalent before enrolling for any of the following courses. Textbook: Stephens, M. M., Petroleum and Natural Gas Engineering, Vol. I.

Second Year.—This course is predicated on the student having practical experience in the industry and having completed the first year course. The work covered includes: Origin and character of the earth; petroleum mineralogy; classes of rocks; geologic forces of the earth; formation of sedimentary rocks; properties and classification of sedimentary rocks; petroleum geology; chemical and physical properties of petroleum and natural gas; exploration for petroleum and natural gas; leases and leasing; drilling practices; well completion; production; and secondary recovery practices. The course is as valuable to the office worker as it is to the field man. Textbook: Stephens, M. M., and Spencer, O. F., Petroleum and Natural Gas Production, Vol. II.

Third Year.—The course includes advanced geological information, current methods of water-flooding and gas repressuring, as well as oil field engineering practices, together with important tables which are valuable in making any necessary oil field calculations. Textbook: Cloud, W. F., Petroleum Production, $5.00.

Mineral Technology

CERAMICS

The scope of the field covered by the term “ceramics” is not generally appreciated by the general public and frequently not even by those engaged in the included industries. From the educational standpoint, ceramics is the study of the silicates and related materials. It includes their extraction and preparation as raw materials, the methods of manufacturing employed in fabricating useful materials from them, and a study of the various properties of the materials which govern the design and operation of the manufacturing processes and also the uses to which the finished materials may be put.

The field of the silicates is very broad. It includes such industries as the heavy clay products, glass, pottery, refractories, porcelain enamel, Portland cement, abrasives, terra cotta, and several others of lesser importance. Each of the industries enumerated is considered as a major part of our industrial life. Individually, each manufactures products worth hundreds of millions of dollars and each employs many thousands of men. As a group they employ nearly 300,000 men and produce goods valued at well over a billion dollars.

Pennsylvania is generously endowed with ceramic raw materials and the fuels necessary to process them. Since the middle of the 19th century this State has been the leading producer of ceramic products. At the present time it has approximately one-fourth of all the silicate industries of the country, and it leads in the production of several of the most important products. This situation has resulted in a vast body of skilled industrial workers whose services do much to make these industries successful.
At present all industries are becoming increasingly more technical. Formerly an employee, by acquiring several years experience in a certain position, had a mastery of this type of work which would hold for the rest of his normal working years. Now in a period of a few years, he may witness a complete change of process, generally dictated by scientific or engineering research. To acquire a thorough working knowledge of a new process in a short time the practical man must have some technical aid.

The three-year curriculum in ceramics is an answer to a demand for the technical education of trained supervisors or employees filling the positions in the various ceramic industries. The diversity of this field has necessitated the provision of several specialized courses of study, each of which pertains to one particular industry. Because of the fact that all of the theory of the various ceramic processes is based on silicate technology, much of the fundamental material is the same regardless of the industrial process to which it is applied. In the present plan of the course, these common studies are presented in the first two years of the course. The third year of the course consists of a specialized study of the particular industry in which the group is employed. All classes study the same texts during the first two years, but in the third year special texts are used which treat specifically the subject under consideration.

With the text material available at present, there is what amounts to five separate three-year courses available to employees in the ceramic industries. They are: Heavy Clay Products, which include the manufacture of building brick, face brick, hollow tile, sewer pipe, terra cotta, stoneware, and allied products; White-wares, which include hotel china, semiporcelain, sanitary ware, electrical porcelain, and white tiles; Refractories, which include fireclay brick, silica brick, basic brick, and all types of special refractories; Glass, which includes the manufacture of glass containers, press and blown ware, plate glass, window glass, and special glasses; and Enamels, which include the preparation of frits and the application of enamels to cast iron and sheet steel. At present no courses are offered for cements or abrasives.

In organizing classes for industries it has been found by experience that the groups are not successful unless the students in each class are from the same plant or the same type of plant. Even though the books used are the same for the different groups, the course is taught from the standpoint of the plant in which the men work and from the standpoint of their experience and requirements. If a man who has completed one three-year course of study desires to pursue work in another field of ceramics he may enter any third-year group which may be available to him without having to repeat the first and second years of the course. Thus, there are available six years of course work which cover the entire field of ceramics.

The textbooks published by Mineral Industries Extension Services for use in classes studying ceramics are numbered in such a way that in any one three-year course the student will have three volumes numbered consecutively, viz.: Ceramics, Volume I, Volume II, and Volume III. There will be, when the entire series is completed, several different books of Ceramics, Volume III, which will be used in the various optional courses. Ceramics, Volume III, Clay Products and Whitewares, is the first volume of this series to be completed. Ceramics, Volume III, Refractories, is now in preparation.

First Year.—The work covered in this course is common for all of the first year class groups regardless of the ceramic industry in which they are employed. This course is an introduction to the whole field of ceramics, and shows how the various ceramic industries are related to each other. It also covers the practical mathematics which apply to industrial operations and machines, the chemistry necessary to understand silicate reactions, and the physics related to operations and physical properties. The physics includes electricity and mechanics as well as general physics. The first year of the course is intended as a preparation to the intensified and specialized studies of the second and third years. Textbook: McNamara, E. P., Ceramics. Vol. I.

Second Year.—The work covered in the second year is common to all ceramic class groups. The course is divided into three parts: Part I—Raw materials; including elementary mineralogy, the occurrence and uses, and properties of ceramic raw materials and raw material preparation which includes grinding and mixing. Part II—The production, control and application of heat; including temperature measurement by instruments and cones, fuels and their combustion, and refractories for furnaces. Part III—Silicate chemistry; including the interpretation of melting and crystallization diagrams for silicate mixtures. Textbook: McNamara, E. P., Ceramics. Vol. II.

Third Year.—The course of study pursued by any class group for the third year depends upon the industry from which it comes. Under the present plan four industrial groups are differentiated. They are: Clay Products and Whitewares; Refractories; Glass; and Enamels. The Clay Products and Whitewares groups use the same book for their third year but for the other groups separate books are provided.

Clay Products and Whitewares. This course is given for classes originating from either heavy clay products plants or whiteware plants. The work is given in three parts: Part I—General manufacturing processes; which includes all the methods of clay forming, drying and driers, and firing and kilns; Part II—Calculations and testing; including calculations for bodies and glazes, standard test procedures for various properties of clays and clay products and test apparatus; Part III—clay products and whitewares; this section includes the properties and specifications of the heavy clay products, the properties and bodies of whiteware products, and glazes and glazing. Textbook: McNamara, E. P., Ceramics, Vol. III.

Refractories. This course covers the general methods of manufacture of all types and compositions of refractory brick shapes.
together with a study of their general properties and their applications in various types of industrial furnaces. The course is essentially a study of the fireclay, silica, magnesite, chrome, silicon carbide and carbon refractories. Textbook: Norton, F. H., Refractories.

Glass. This course includes a study of glass raw materials, glass melting, forming of all kinds of glass products, and the physical and chemical properties of glasses. Textbook: Scholes, S. R., Modern Glass Practice.

Enamels. The work includes a study of the enameling industry from the raw materials through the smelting and fritting of the enamels to their application and firing on both cast iron and sheet steel. It also includes the metallurgy of the irons and steels used for enameling. Textbook: Andrews, A. I., Enamels.

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 programs to promote efficiency and knowledge of its workers in this field should be a natural consequence. After thoroughly considering the needs and the average education 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 better trained personnel, and the employee by increasing his available knowledge and giving him the feeling of greater security in his job through increased knowledge.

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.

First Year.—The course embraces a study of certain fundamentals which are essential for a full understanding of the phases considered in this and subsequent courses. The material covered is as follows: inorganic and organic chemistry, applications of chemistry; physics, 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. Textbook: Teichert, E. J., Ferrous Metallurgy, Vol. I.

Second Year.—The work covered in this course includes a study of the 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. Textbook: Teichert, E. J., Ferrous Metallurgy, Vol. II.

Third Year.—The work covered in this course includes microscopics; 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 iron; case hardening of steels; individual effects of alloying elements; alloy steels; carburizing steels, and water and oil hardening steels; special alloy steels. Textbook: Teichert, E. J., Ferrous Metallurgy, Vol. III.

PETROLEUM REFINING

Pennsylvania is in the position of having a greater refining capacity than crude oil production capacity. Approximately 10 per cent of the oil refined in this country is processed by refineries located in this State while the production is approximately only 5 per cent.

Under normal conditions, the refining industry probably changes more in a given period of time than any other industry. Constant research and development work alters the processing methods constantly. The present war has caused even more rapid changes in processing, particularly due to the necessity for enormous quantities of high octane aviation fuel, butadiene for synthetic rubber manufacture, and various other hydrocarbon chemicals.
Thus, not only must the management and research divisions of
the refining industry be familiar with the new processes and methods,
but the operators in the plants must also know something about
the technical and engineering sides of the processes which they are
running.

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 taking this course
will be able to fit themselves into the rapidly changing refining
industry with much more confidence and ability than the untrained
workman. Thus, they will be of more value to themselves and to the
industry.

First Year.—This course is designed for all employees of the
petroleum and natural gas industry and is so arranged that those
men who have not attended school recently or who have a limited
education will have little difficulty in mastering the material.
Practical arithmetic, mathematics, mechanical problems and main-
tenance, elementary drafting, slide rule, physics, and applied chem-
istry are taught by giving a clear explanation of the material involved
and illustrating the various points by reference to situations and
actual problems originating directly from the field. All students are
expected to have completed this course or its equivalent before
enrolling for any of the following courses. Textbook: Stephens, M.
M., Petroleum and Natural Gas Engineering, Vol. I.

Second Year.—The second-year refining course shows how the
fundamentals of science are applied to the industry. The chemistry
of petroleum is offered in this book as an advanced course over that
given in the first year. The essentials of the various refining processes
employed by the modern oil refiners are covered in detail giving flow
sheets, illustrations of the units and equipment and practical prob-
lems commonly encountered in the plant. Distillation, cracking, the
use of catalysts, polymerization, alklylation, dewaxing, decolorizing,
grease compounding, oil blending, chemical refining, and other
processes are covered in a practical yet technical manner. Tables
and type problems presented in the course are found to be valuable
reference material after the course is completed. Textbook: Stephens,
M. M., Petroleum Refining, Volume II. (Revised in 1941.)

Third Year.—This course is based on the two previous courses
and presents modern refining from an engineering standpoint. The
essentials of unit design and operation are presented in a manner
that makes it possible for the average intelligent workman to master
the information. Plant design, instrumentation and refinery control,
operation of units, refrigeration, and corrosion control are offered
in the course. In all, the three-year curriculum prepares the employee
for more advanced training and gives him sufficient knowledge to
enable him to understand the average engineering article presented
in various technical journals and textbooks. Textbook: Stephens,
M. M., and Van Winkle, M., Petroleum Refining, Vol. III. (Revised
in 1943.)