Mineral Industries

School of Mineral Industries

VOLUME 19

NUMBER 4

The Pennsylvania State College

STATE COLLEGE, PA., JANUARY, 1950

Opportunities in Mineral Preparation Engineering

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Although new as a separate curriculum in the School of Mineral Industries, there have been various courses in mineral preparation ever since the founding of the School. Sometimes they were taught as subjects of the metallurgy curriculum, and sometimes as mining subjects. As the country has become more industrialized and the technology of all branches of the mineral sciences and engineering has become more complex, training in mineral preparation has become a specialized field in itself. A simplified course or two in "ore dressing," as mineral preparation was called in former years, have been found entirely inadequate to meet the demand for training in this field today.

A modern mineral preparation plant in the anthracite field of Pennsylvania. In a yearly period this plant will prepare for the domestic heating market 2.5 million or more tons of anthracite in as many as 12 different sizes.

Few of us realize the enormous increase in demand in the past ten or fifteen years for minerals of various sorts. Our modern civilization rests on the ability to find, exploit, and properly prepare for use the hundreds of minerals used in our daily lives. This refers not only to the metallic but also to many nonmetallic minerals, as well as to those used for fuels or as sources of energy.

The accelerated demand for minerals has brought about the rapid depletion of the richer ore bodies. The cream has been skimmed off. Ores are becoming leaner. Even in the case of coal, the higher grade low ash and sulpher coals are at a premium.

To meet this growing demand, the extractive industries are forced to pay more and more attention to methods of mineral beneficiation in order to be able to mine the lean ores or to concentrate minerals heretofore wasted or considered unprofitable. Processes for concentration of the desired minerals have become highly complex. Numerous unit operations and processes are necessary where heretofore a few simple operations were all that were required.

The operations of crushing, grinding, screening, gravity concentration, flotation, classification, filtering, and drying necessary in the proper preparation or dressing of minerals has become a specialized engineering and technical art, requiring personnel especially trained and educated for that work.

The demand for individuals with this specialized training is very high, and such demand will increase in the future as even poorer grade mineral deposits have to be mined. In the case of coal, a glance at current trade journals will show the feverish building of coal preparation plants needed, not only to improve the high ash and sulphur coal seams being exploited and to remove the impurities induced by mechanical and total seam mining, but also to meet highly competitive market conditions.

Realizing the importance of this branch of mineral engineering and in order to meet the growing demand for graduates who have specialized in this field, the School has formed the Division of Mineral Preparation.

Actually the Division has a two-fold purpose; namely, to train students in this field and to conduct research in mineral preparation. Thus, the Division not only supplies trained personnel, but also actively conducts research in numerous phases of preparation so that improved processes and operations may be found to meet the ever-increasing necessity of extracting minerals from the poorer grade deposits.

A discussion of the many investigations being made by the Division of Mineral Preparation will have to be reserved for a future issue of this publication. The present article is concerned primarily with a description of the curriculum established to train students to become specialists in the field of mineral preparation engineering.

As in the case of mining, metallurgy, or other branches of engineering, a four-

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Mineral Industries

Published monthly by the School of Mineral Industries from October to May inclusive

The Pennsylvania State College

Mineral Industries Extension Services
D. C. JONES, Director

Pennsylvania's School of Mineral Industries and Experiment Station

Dedicated to education in mineral conservation and research by which the means may be found to make conservation effective. This includes diligent search for mineral truths and the energetic discovery, complete extraction, and maximum utilization of irreplaceable mineral resources.

FIELDS OF WORK

Geotechnology

Earth Sciences: Geology, Mineralogy, Geophysics, Geochemistry, Meteorology, and Geography. **Mineral Engineering:** Mineral Economics, Mining, Mineral Preparation, and Petroleum and Natural Gas. **Mineral Technology:** Fuel Technology, Metallurgy, and Ceramics.

DIVISIONS OF SERVICE

Resident Instruction
Extension Instruction
Correspondence Instruction
Mineral Industries Research

Entered as second-class matter at State College Pa., November 1, 1938, under the Act of August 24, 1912.

JANUARY, 1950

Trends and Objectives

By Dean Edward Steidle

INDUSTRIAL RAW MATERIALS

(Eighth in a series of editorials constituting "A Philosophy for Conservation" — a phase of higher education in the mineral arts and sciences.)

The age of specialization has made man increasingly dependent on a larger number of different metals and minerals. Overexploitation during World War II and lavish squandering of irreplaceable mineral wealth in the past has resulted in the rapidly approaching exhaustion of some of the major domestic ore sources. History clearly points out that the United States cannot continue to be a world power on an "import to survive" policy. A constructive program of development and appraisal of the nation's mineral wealth, including the planned conservation of her resources, must be adopted.

Strictly speaking, conservation of minerals must mean the orderly exploitation of our resources and the prevention of waste in use, with due regard for the future. Real concern for the future may not extend beyond a few generations. Eventually science and invention should take care of the problems arising from shortages of some minerals, and the national defense aspects of domestic deficiencies can be provided for by stock piling and other measures. Early conservationists had this viewpoint; but with a rapidly developing industry and population, a farsighted policy that would deny full realization of immediate ambitions became unpopular. Consequently, the politically minded conservationists broadened the concept to include "prudent use of resources" and brought under the conservation umbrella a variety of projects — some of questionable economic merit — designed to bring into production latent resources. A classic example of this is manganese. Now any project designed to foster the development of economic resources is regarded as a conservation measure, and immediately it is supposed to assume an aura of righteousness.

President Truman in his veto message of the extension of the Premium Price bill a year or two ago urged that the United States go easy in adopting measures that stimulate premature exhaustion of our mineral resources. This is a very wise policy.

Coal unquestionably is the No. 1 national asset, since it guarantees the security of the industrial structure for many centuries. Even though the reserves are very large, it is disturbing to note that in converting coal in place into minable coal reserves, a loss factor of 30 to 50 per cent to account for the waste in mining has to be applied. A prudent nation would not continue such profligate waste of its No. 1 asset, even though the reserves can be reckoned in millenniums. Witness the situation in Great Britian at present. British industrial structures basically were made possible by her coal and iron ore resources. The iron ore deposits have long since ceased to be adequate to meet British needs, and England has for decades been a substantial importer of iron ore. This was the first break in her basic strength as an industrial nation and as a political force in world affairs. Now the cream of her coal resources is gone; and this, coupled with the socialization of the industry, probably will result in British industry no longer having the competitive advantage of low-cost, high quality fuel. England has lost permanently a substantial part of her export market for coal which heretofore has been a major factor in balancing British trade. The problem of supporting the indispensable British imports has thus become almost unsolvable.

With England's example before her, it would seem that the United States should take stock of all coal policies and for once become truly conservation-minded. Calculation of reserves must include classification on a basis of quality. Major emphasis is being placed on the utilization of coal measures for the production of synthetic liquid fuels. These can be made from agricultural products. With sufficient emphasis on research the disparity in costs could be substantially reduced.

The United States Bureau of Mines has put to the National Bituminous Coal Council the question of reducing losses in mining, and a subcommittee of that group has been set up to wrestle with the problem. This will be a test of the statesmanship of the coal-producing industry. It is to be hoped that the Council will come forward with some constructive suggestions.

Iron ore ranks second to coal in mineral importance because it is the other essential ingredient for the manufacture of steel, which is required in huge quantities. National security requires that the country does not become dependent on ocean transport for this vital raw material. Consequently, the maintenance of self-sufficiency seems to be fully justified, even though some subsidy, perhaps in the form of tariffs, may be required.

Liquid fuels also are indispensable to modern transportation; and, since they are required in enormous quantities, the United States cannot risk its security in times of emergency on overseas sources of supply. Major emphasis on developing domestic sources is thus justified.

There is a rather easy way to conserve petroleum if there is a will. The average domestic automobile probably runs less than 18 miles to the gallon of gasoline. This consumption is exorbitant in view of the fact that special motor designs and over-drives are available to cut gas consumption at least in half for the same mileage (some European cars make 50 and more miles on a gallon). The public demands more power, more speed; some patents pertaining to gas-saving motor designs are pigeon-holed; and nothing is done to produce cars that run more economically.

Another cliche which has come into wide usage in recent years is "the maintenance of a sound, healthy domestic mining industry." While the present international situation requires drastic measures to maintain war-making ability for the longer view, the maintenance of domestic production of minerals, other than the big three mentioned, does not appear to be absolutely essential. This well-worn phrase has been concocted by the politically ambitious and the intellectually callous. They always are embarrassed when they are asked what they mean by "sound" and "healthy." In nine cases out of ten the phrase boils down to a proposition of subsidizing uneconomic industry. The subsidizing of a marginal mineral producer may not be uneconomic when it is considered that production of essential materials is thereby insured which otherwise might be wasted. But the decision must be realistic!

Another misleading argument used by propagandists is the cry, "We must equalize the cost of production." In the days of the protective tariff, emphasis was plac-

ed on creating a tariff system that would equalize the difference in basic wage rates in the United States and in other manufacturing countries. Now the mineral propagandist asserts that the United States should also equalize the disparity in cost due to the disparity in the grades of ore found in the country as compared with those elsewhere. It has also been proposed, and is even receiving consideration in some committees of Congress, that the United States embark on a program of developing domestic manganese resources. The only resource that is large is the Chamberlain, South Dakota, deposit, which runs approximately 1 per cent Mn. By no stretch of the imagination can it be conceived as a matter of wise national policy that the United States should endeavor to equalize through subsidy the cost of production of such a low-grade deposit as against the higher grade and direct shipping ores available in other parts of the world. On the other hand, the United States should pursue research vigorously in mining and mineral processing, seeking always to achieve what seems now to be impossible. Wisdom dictates that the United States refrain from stimulating "premature" exhaustion of our mineral resources and leave something for posterity.

There is need for mineral consumption data. Pennsylvania leads in mineral processing but depends upon raw materials imported from other states and countries. Viewing the nation as a whole, the flow of mineral products is decidedly complex; and full understanding of Pennsylvania's position, for example, requires adequate data on the national picture. The United States Bureau of Mines plans to provide this service on a national basis, but full co-operation with similar fact-finding activities within the mineral industrial states is highly desirable.

OPPORTUNITIES

(Continued from Page One)

year course is provided leading to a B. S. degree in Mineral Preparation Engineering. Obviously, it is exceedingly difficult to crowd into four years all the subjects desired. The greatest difficulty in planning the curriculum has been that of eliminating many subjects which would be desirable but which would have resulted in overloading the average student, both as to capacity and available time.

It is acknowledged that a student may follow two general careers; namely, one specializing in operation and design and the other in the physicochemical research phases. Students leaning towards the latter are encouraged to take more options in chemistry and the basic sciences, while the former are encouraged to take more mechanical and design courses. Graduate work leading to M. S. or Ph. D. degrees is urged for students whose grades are high enough to indicate that they are capable of achieving these higher degrees or who wish to specialize in research.

The basic four-year curriculum is as follows:

FRESHMAN YEAR

First Semester

Inorganic Chemistry
Physical Geology
Plane Trigonometry and Algebra
Composition and Rhetoric
Mineral Industries Lecture
Physical Education
ROTC

Second Semester

Inorganic Chemistry and Qualitative Analysis
Engineering Drawing
Exposition
Historical Geology
Analytical Geometry
Physical Education
ROTC

SOPHOMORE YEAR

First Semester

Differential Calculus
Introductory Mineralogy
Mine Surveying
General Physics
Physical Education
ROTC
Approved Elective

Second Semester

Quantitative Analysis
Integral Calculus
Petrology
General Physics
Physical Education
ROTC

JUNIOR YEAR

First Semester

Organic Chemistry
Fuel Testing and Calorimetry
Statics
Systems of Mining
Electrical Engineering
Approved Elective

Second Semester

Introduction to Mineral Preparation
Strength of Materials
Kinematics of Machinery
Electrical Engineering
Technical Writing
Junior Field Trip
Approved Elective

SENIOR YEAR

First Semester

Coal Preparation
Mine Mechanization
Elementary Structural Engineering
Elements of Power Engineering
Unit Operations in Mineral Preparation
Approved Elective

Second Semester

Fluid Mechanics
Hydraulics
Flow Sheets and Balances in Mineral Preparation
Material Handling Design
Mineral Preparation Seminar
Senior Field Trip
Approved Technical Elective
Approved Nontechnical Elective

As previously stated, those who wish to concentrate more fully on chemical phases of mineral preparation are encouraged to take more chemistry, especially physical and organic. In addition to the mineral preparation courses listed above, additional courses are offered in preparation plant design, mineral preparation testing, and froth flotation. There are also advanced graduate courses.

Students are encouraged to spend their summers working in or around various preparation plants so that they can gain first-hand knowledge and practical experience. The close proximity of the College to various mining areas permits frequent field trips and intimate contact with the mineral industry.

The demands for graduates in Mineral Preparation Engineering are probably proportionally higher at present than for any other branch of engineering and are considerably greater than the number of graduates available. Earning power of engineers in this field compares favorably with other branches of engineering.

The School of Mineral Industries, in establishing a Division of Mineral Preparation and providing a curriculum for training of Mineral Preparation Engineers, has taken a forward and leading step in meeting the demands of industry and the ever-increasing need for specialists in the concentration and preparation of minerals.

CORRESPONDENCE STUDENT ACTIVE OVER 8-YEAR PERIOD

A recent request from Gerhard B. Deuhs to have a record of his correspondence instruction credits sent to a federal agency brought to light what may be considered the outstanding correspondence study achievement in Mineral Industries Extension Services and possibly in the entire College. Since 1942, Mr. Deuhs has completed 17 courses offered by the Correspondence Study division of Central Extension and 12 courses offered by Mineral Industries Extension Services, a number of them concurrently.

A review of the records indicates that Mr. Deuhs began his correspondence study with Central Extension in 1942, taking courses in mechanical refrigeration and air conditioning. He continued with

his studies from that division in 1943 with courses on steam engines and thermodynamics. In 1944, while taking courses on mechanics, slide rule use, steam boilers, and concrete from the Central Extension Correspondence Study division he enrolled in Mineral Industries Extension Services as a correspondence student and completed three courses in practical coal mining. In the succeeding five years he has completed correspondence courses from Central Extension in heat treating, machine design, dc electricity, strength of materials, and industrial management and supervision. During the same period of time he has completed correspondence courses in ferrous metallurgy, petroleum refining, mineral economics, meteorology, and natural gas engineering offered by Mineral Industries Extension Services. At present he is an active correspondence student in natural gas engineering.

Mr. Deuhs has frequently indicated his satisfaction with the type of correspondence study offered by Penn State. The wide range of courses completed has developed a background of knowledge that has been of service in his capacity of civil and mechanical engineer. He is a registered engineer in the states of Michigan, Minnesota, Nevada, and Pennsylvania, holds a Lt. Colonel's commission in the army engineers, and is at present located at the Pittsburgh Experiment Station of the U. S. Bureau of Mines.

GERHARD B. DEUHS

(U. S. Bureau of Mines Photograph)

DEPARTMENTAL NEWS

Recent promotions, effective January 1, approved by the Executive Committee of the Board of Trustees included Dr. John C. Griffiths, from assistant professor to associate professor of petrography, and Dr. F. Briscoe Stephens, from instructor to assistant professor of meteorology.

Charles W. Stickler, who resigned in August, 1949, rejoined the staff as associate professor of mining engineering, effective December 16. Professor Stickler will conduct research on the mechanization problems of the slate industry.

Dr. P. D. Krynine, Chief, Division of Mineralogy, spent ten weeks during the past summer traveling through the Rocky Mountain and Pacific Coast areas where he studied sedimentary rocks. Numerous specimens were collected from the Badlands, Black Hills, Yellowstone, California, Grand Canyon, Zion, and Bryce National Parks, and also from the Wasatch front and the Idaho-Wyoming boundary. R. L. Folk, instructor in mineralogy, accompanied Dr. Krynine during part of the trip in Idaho and Utah.

While in California Dr. Krynine, at the invitation of the Pacific Section of the American Association of Petroleum Geologists, gave a lecture on "The Origin of Red Beds" at Los Angeles on August 15, 1949.

A paper on "Some Factors Influencing the Froth Flotation of Coarse Coal Particles," prepared jointly by Professor R. E. Zimmerman, Chief, Division of Mineral Preparation, and Dr. Shiou-Chuan Sun, assistant professor of mineral preparation, was presented by Professor Zimmerman at the joint AIME-ASME Coal Division meeting in French Lick, Indiana, October 27.

Theodore S. Spicer, associate professor of fuel technology, also presented a paper at the AIME-ASME coal division meeting in French Lick on October 27. The paper, "Use of Ignition Baffles with Single Retort Stokers," was prepared by Professor Spicer jointly with R. J. Grace and Dr. C. C. Wright of the Division of Fuel Technology.

Extension Services Enrollment

Release by the Director's office of enrollment figures for class and correspondence students in Mineral Industries Extension Services for the period from July, 1949, to January, 1950, indicates a decrease in total enrollment but an increase within certain curricula. The grand total of 3205 students is 483 less than the 3688 students during the same period in the 1948-49 term. Largest decreases were in bituminous coal mining, mechanized mining, and metallurgy, all within the bituminous coal and steel industries which were in a state of unrest, due to strikes and threatened strikes during the fall period. There was little change in the number of centers and classes in these curricula, but classes were smaller. Ceramics experienced a considerable increase in centers, classes, and enrollment; fuel technology added another center and several classes; but petroleum and natural gas had fewer classes and almost 100 fewer students. Supervisory training in mining felt the effect of industrial unrest and had fewer centers, but this type of training was introduced into the steel industry at one location with considerable success. There was a slight increase in the number of correspondence students who were active during the period.

ENROLLMENT — MINERAL INDUSTRIES EXTENSION SERVICES JULY, 1949 TO JANUARY, 1950

Curriculum	Centers	Classes	Teachers	Enrollment
Ceramics	7	7	7	134
Fuel Technology	2	3	2	58
Metallurgy	14	22	22	288
Supervisory Training	1	1	1	21
Mining:				
Anthracite	14	19	19	391
Bituminous	41	56	53	1302
Cleaning Plant Electrical Applications	2	2	4	77
Coal Preparation	1	1	1	19
Mechanized Mining	12	13	13	253
Supervisory Training	2	3	2	62
Petroleum and Natural Gas	6	12	12	328
Total	102*	139	136	2933
Correspondence: Active Students		214		
Completions		22		
Dropped		36		
Total		272		272
Grand Total				3205

** There are 86 centers with one or more curricula. Students in attendance come from 550 towns in 39 counties of Pennsylvania and 12 towns in three adjoining states.*