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FUEL TECHNOLOGY AS A CAREER

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THE FOLLOWING comments refer to opportunities for employment in the production and use of anthracite, bituminous coal, and coke. They should be of interest to students enrolled in various engineering courses, as well as to those who are considering the curriculum in Fuel Technology.

Magnitude of Solid-Fuel Industry

It is the use of solid fuels in tremendous quantities for heat, power, metallurgical, and chemical purposes which has made possible our present industrial civilization. More tons of coal are produced than of any other commodity. The quantity of coal handled by the railroads of the United States is greater than the freight tonnage of all manufactured products. The tonnage of solid fuels is twice as great as the *combined* railroad freight tonnage of all agricultural, animal, and forest products.

The dollar value of the coal and coke produced in this country equals the combined value of *all* metals at the point of production. Coal mining employs more men than all the metal mines, quarries, and oil and gas wells combined. Truly, coal is a giant among industrial products.

Shortage of Fuel Technologists

Yet the solid-fuel industries have not been obtaining nearly as many well-trained young men as they need. Judged by the present situation, it will be many years before the supply of technical graduates who definitely look forward to working in these industries will equal the potential need for such men. This merits the careful consideration of students who are considering courses in more popular but relatively overcrowded fields.

It must be admitted frankly that for many years employment opportunities in the solid-fuel industries were not considered very attractive. The result was that few courses in fuel technology were available in the United States. The reason for this situation, and the far-reaching changes which have led to the present need for young men with various

DR. ROSE

Historical Background

A generation ago, most fuel users paid little attention to obtaining the maximum efficiency from fuels. Coal was hand-fired into simple furnaces, and the skill of the fireman could compensate for considerable variations in the character of the coal used. Cheap hand labor and simple equipment also prevailed in the mining of coal and the manufacture of coke in beehive ovens.

Scientific knowledge of the chemical and physical properties of coal, and its behavior under various conditions of use, were extremely limited. Reliance was, therefore, placed on the experience of practical men, and there was little demand for engineers with special training in fuel problems. In the eastern states where high-grade coal was cheap and abundant, practically no scientific research on coal was sponsored by state institutions. Only those states having inferior coals were interested in research!

resulting from inadequate railroad transportation, focused attention on improving the efficiency with which solid fuels were used. Over a period of years, the efficiency of using coal for practically every industrial purpose was substantially improved. These technical developments were so successful from the consumer standpoint that national coal consumption dropped. The situation was aggravated by the prolonged business depression of the nineteen-thirties, which further restricted the production of coal.

As a result of these conditions, as well as competition from other fuels, the total production of bituminous coal and anthracite dropped from the all-time peak of 678 million tons in 1918 to a low of 360 million tons in 1932. This reduction in volume of business from the World War peak to the bottom of the depression was only 47 per cent, which was not as severe as the drop in production suffered by many other industries. Yet it was sufficient to seriously reduce the employment of new men for a number of years.

Present Conditions

Recently the demand for coal has become fairly well stabilized. The total production of 440 million tons last year was the same as the average for the past five years. At the present time, increased business activity, including national defense measures, has caused a substantial increase in the demand for coal. Production to date is 60 million tons or 27 per cent ahead of production at this time last year, and the present brisk demand is expected to continue for a considerable time.

But more significant for our present discussion is the fact that every phase of mining, preparing, marketing and utilizing coal is constantly becoming more technical and complex. This is increasing the need for well-trained men of many types.

The simple mining methods of the past are being replaced by mechanized mass-production methods underground. Capable men are required to plan and supervise these operations, and to maintain them at high

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Pennsylvania's School of Mineral Industries and Experiment Station

Dedicated to education and research in the exploration, development, and conservation of Pennsylvania's natural mineral resources, and their preparation, processing, and efficient utilization.

Fields of Work

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

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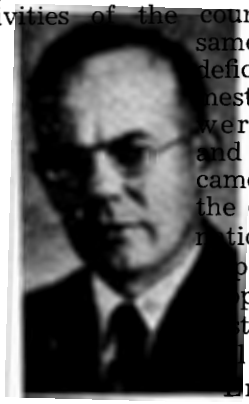
TRENDS and OBJECTIVES

By Dean Edward Steidle

MINERAL TECHNOLOGISTS TO OUR DEFENSE

One of the outstanding lessons of the World War was the importance of minerals in the conduct of military affairs as well as in the normal activities of the country. At the same time certain deficiencies in domestic supplies were emphasized and the public became conscious of the complex international relations involved in applying our industries with mineral raw meterials.



Enormous advances in technology have been made since 1918. These are reflected in the strategy of the present conflict. Mechanized warfare employs the machine to an extent undreamed of in the past. And the machine is essentially a mineral aggregate powered and lubricated with mineral products. Coal, petroleum, and steel are the irreplaceable elements of national defense. They are also subjects of fundamental concern in the curricula of instruction and reasearch of this School.

defense now under way is certain. His responsibility will extend from the securing of adequate supplies of raw materials to their reduction to useful form and if necessary the development of substitutes for mineral products which no longer can be imported from foreign sources.

Pennsylvania will be called upon to carry a large burden of the defense program in the mineral industries since it is the leading mineral industrial commonwealth. Pennsylvania's School of Mineral Industries and Experiment Station has a staff and facilities for instruction and research in all phases of the mineral industries

earth sciences, mineral engineering, mineral economics, and mineral technology. In view of the well established program of instruction, both resident and extension, and of research, the School has much to contribute to the national defense.

The staff of the School feels a certain gratification and pride in the thought that the long list of successful graduates now form a diversified group of technicians skilled and competent to assist in so many activities upon which the future of the nation may depend. It is hardly necessary to state that the School offers its services in the direction of any national

DEPARTMENT NEWS

CERAMICS

Dr. Woldemar Weyl, professor of glass technology, has been appointed chairman of a committee to represent the American Ceramic Society at the meetings of the Inter-Society Color Council for the period April 1940 to March 1941.

EXTENSION

Professor H. B. Northrup, director of mineral industries extension has been appointed a member of the Committee on Vocational Training for the American Petroleum Institute to represent Pennsylvania in vocational training for employees of the petroleum and natural gas industries of the Commonwealth. Dr. Maynard M. Stephens, supervisor of petroleum and natural gas extension, has been designated as an alternate member of that committee.

Mineral Industries Honor Roll

The faculty of the School of Mineral Industries is happy to announce the honor roll for the second semester of the academic year, 1939-40. The honor roll consists of all students who have a 2.5 average or better and is made up for each semester as soon as the grades have been tabulated.

Seniors—J. A. Babcock, J. W. Myers, K. W. Smith, Petroleum and Natural Gas Engineering; J. W. Caum, Metallurgy; J. M. Kellberg, Geology; D. S. Lyons, Mining Engineering.

Juniors—R. P. Aikman, Fuel Technology; J. H. Steeves, Metallurgy; G. A. Thompson, Geology.

Sophomores—E. A. Kachik, Metallurgy; Paul Lazar, Ceramics; J. D. Morgan, Mining Engineering.

Freshmen—V. R. Burkhart, Fuel Technology; R. L. Hess, Ceramics; J. H. Keeler, Metallurgy; J. M. Krese and Andrew Rostosky, Mining Engineering; E. H. Weltsch, Petroleum and Natural Gas Engineering.

Fuel Technology As a Career

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hand-picking methods are being replaced by elaborate preparation plants where coal is sized and cleaned to rigid standards under close technical control. Coal is now produced in many special grades and sizes for special purposes. It may be washed, dried, treated to prevent dust, and even trade-marked.

Coal is perhaps less understood by buyers and sellers than any other major raw material. Through ignorance, it has too often been bought and sold merely on price instead of on the basis of what it is worth. Coal producers have long engaged in the ruinous practice of trying to increase their markets by cutting prices below cost instead of by learning more about coal and serving their customers better. Fortunately, coal producing and sales companies now realize that coal should be sold on its merits. They employ a constantly increasing number of men known as combustion engineers to work with their own sales departments and with the engineering staffs of coal users.

The hand-fired boilers of a generation ago have been replaced by automatic equipment in modern power plants. Considerable technical knowledge and judgment are required to select the coals which will give the best combination of economy and

(Continued on next page)

rformance for each individual pow- plant, and to operate the plant so to get the best possible results. ıere are thousands of coal mines in e United States, and most of them oduce a number of sizes. Therere, most industrial consumers can oose among coals of many sources, ades, and delivered prices. Since e final proof always rests with full- ale tests of the coals in question, is means extensive plant tests un- ır strict supervision, and the prepation of countless engineering re- ırts.

Wasteful beehive coke ovens have ɜen largely replaced by by-prod- ɜt coke ovens, which convert about 0,000 tons of coal daily into coke, ıs, and chemical by-products. Other ıs manufacturing methods use im- ɔved equipment at high capacities, ith complex operating cycles and a ariety of fuels. The coke and gas dustries require many engineers for ant operation, efficiency studies, and ır development work.

New Uses

Recent achievements in the produc- on of new synthetic products and ıemicals from coal have opened up ıanufacturing opportunities for hich both anthracite and bituminous ɔal are technically suitable as the ɜarting point.

There are many other opportuni- es in the processing and utilization f solid fuels which have been scarce- y touched in this country. The use f certain types of powdered fuel in Diesel engines is much more attract- ve technically than might be sup- osed at first thought. Thousands of rucks were propelled on English ighways by coal-fired steam boilers ven before war-time restrictions on asoline were in effect. Slagging gas roducers using extremely low-grade uels, often with the recovery of ıetallic values, have been successful broad, but are practically unknown ı this country. The briquetting of uel fines to increase their value and tility is widely practiced abroad, ut only one-fourth of one per cent f American solid fuels is briquetted ecause of problems which can only e solved by research and engineer- ıg development.

Automatic Heat

The largest single use of fuels is o doubt the heating of homes and ommercial structures. Even the use f coal for house heating is under- oing a revolution at the hands of ngineers. Through the use of oil nd gas, the public has come to de- ıand maximum convenience in house eating. They want the economy, re- ability, and safety of solid fuels

Automatic heat is readily obtained with anthracite, because that fuel is closely sized, absolutely noncaking, smokeless, and practically nonclinkering under normal household conditions. Thousands of anthracite stokers are in use which automatically feed coal from the bin, store or mechanically remove the ashes, and thermostatically control the temperature of the home. A large number of bituminous coal stokers are used for house heating, but most of these require frequent attention and hand removal of clinker, so that they do not come up to the public's ideas of convenience. This is a problem which is receiving the attention of many engineers.

In recent years, there has been enormous commercial development of kitchen ranges, stoves, water heaters, etc., fired with gas, oil, or electricity, but the development of solid-fuel-fired equipment having competitive appeal has been largely neglected. Yet enough has already been accomplished along this line to show that entirely new standards of accomplishment can be obtained with solid fuels, simply by applying the same methods of research and development which have been so successful in other lines of industry. This is a fertile field of fuel technology in which various manufacturers are becoming interested.

Who Employs Fuel Technologists?

From what has been said, it is evident that solid fuels in all their aspects require an increasing number of fuel technologists, as well as mining, mechanical, electrical, chemical, and metallurgical engineers and chemists who have an interest in, and experience or special training qualifying them for these industries. Such men are needed by the coal-producing companies and they are also needed by the equipment manufacturers who design and manufacture mechanical coal mining, loading, and preparation equipment.

The modern selling of coal has become so technical and competitive that qualified combustion engineers are needed to work with the sales departments of large coal producers and wholesale distributors. Even some railroad companies employ engineers to promote the use of coal originating on their lines. Manufacturers of coal handling and industrial furnace equipment are another source of employment. By-product coke and manufactured gas plants use technical graduates entensively for operation and management.

There are a number of companies engaged in the design and manufac- engineers with fuel training, both at the factory and in the wholesale and retail distribution of their products.

Progressive retail fuel dealers are no longer satisfied to merely accept orders and deliver coal. They offer heating service, and many of them have an equipment department which sells, installs, and services stokers and other products. Here is an opportunity, often in his home town, for the young technical man who can make simple layouts and cost estimates, who can take the responsibility for proper installation, and who can develop ability in competitive selling of engineering products. Automatic heat, air conditioning, and other modern developments are coming so fast and offer so many problems in individual applications that they challenge the ability of the engineer and keep him alert. Owing to the diversified nature of the installations and the considerable responsibility and freedom of action afforded the young engineer, this is an excellent training for larger responsibilities.

A considerable number of fuel technologists, including some of the best known members of the profession, are connected with federal and state bureaus and surveys, or with various colleges and universities, or are engaged in the research and development programs supported by various trade and marketing associations.

Types of Training

What kind of academic training is recommended for the types of work which have been described? Obviously the requirements are so diversified that no simple answer is possible.

Some educators and executives favor a training in fundamentals, with no technologic courses during undergraduate years. Others favor offering, to a limited number of interested students, fundamental training plus courses intended to prepare them for special work such as fuel technology. In the writer's own experience, which has included all three major types of solid fuels, both methods of training have produced valuable men.

Large engineering or research organizations, which are well staffed and progressive, can take a young engineer or research man who has had no previous contact with their field of work, and train him to become a valuable member of their organization. Executives who favor this procedure sometimes forget that for every organization which is qualified to do this, there may be a dozen or more small producers, consumers, retail dealers, etc., who need a single

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position to give him engineering training; instead they must look to him for information. If they are not in a position to hire an experienced man away from a competitor, they will prefer a young technical man who has already shown interest in their industry, and who has invested some of his own time preparing for it. They will want a man who already has some familiarity with their problems, if only through textbooks. He will at least have a few reference books of his own, and will know where to go for specialized technical help when he needs it.

This is one reason for the existence of a somewhat specialized curriculum like Fuel Technology (which is the science of preparing and utilizing fuels). Another purpose is to provide elective or post-graduate courses for students majoring in other lines of engineering or science, who recognize the basic importance of fuels. It is gratifying that The Pennsylvania State College has recognized the urgent need for specialized fuel courses and that its Department of Fuel Technology is progressing along sound lines in not only resident instruction and research but in extension instruction as well.

Engineers Study Combustion

It has long been customary for mechanical engineers to receive some instruction in combustion. They have been responsible for much of the improved equipment and operating procedures already mentioned, and will undoubtedly continue to play a major role in the industry.

The writer feels from personal observation that chemical engineers are particularly well qualified to handle certain types of fuel problems. Chemical engineering enrollments have been growing at such a rapid rate that concern has been expressed about the possibility of placing all of the future graduates. It is suggested that a reasonable number of chemical engineering students would find it worth while to consider employment opportunities in some phase of fuel utilization, and to take some additional fuel courses with this in mind. Many metallurgical engineering students will also find that a good knowledge of fuels and combustion is valuable.

A large number of electrical engineers are needed in connection with coal-mining operations, power plants,

Common Bond for Americas

DR. LEIGHTON AND DEAN STEIDLE

An inter-American visit paid by Dean Steidle last summer has now been returned.

The return visit was made by Dr. T. R. Leighton, director of the School of Mines and Engineering, University of Chile, who was Dean Steidle's host during an inspection of Chile's vast mineral industries and its educational facilities in August 1939. He is pictured here with Dean Steidle at Penn State.

Dr. Leighton came to Penn State after attending the eighth Pan-American Scientific Congress in Washington as the representative of his country. He inspected the Mineral Industries building and other campus facilities here with Dean Steidle and then left on his return trip to Santiago, Chile.

Dr. Mencher Also a Visitor

Dr. Ely Mencher, professor of geology at the Institute de Geologia, University of Caracas, Venezuela, also visited the School of Mineral Industries, early in August. He was particularly interested in facilities for work in geology here. He was impressed with the new summer camp, museum exhibits, and new laboratory equipment recently purchased under the General State Authority.

Professor D. R. Mitchell in the November 1938 issue of *Mineral Industries.*

Opportunities for the Future

At the present rate of disappearance, the Nation's reserves of bituminous coal are sufficient to last for more than 3000 years, while the proved reserves of petroleum obtainable by conventional methods are sufficient for less than 20 years' consumption at the present rate. Pennsylvania anthracite has been mined commercially for more than a hun-

heat energy as all of the petroleu that has been produced in the enti world up to the present time, pl the world's known reserves of petr leum obtainable by pumping ar flowing methods.

It has been said that the two mo valuable single mineral deposits the world, measured by the doll value of material extracted, are t anthracite region of northeaste Pennsylvania, and the Pittsburg seam of bituminous coal in southwes ern Pennsylvania and adjoinin states.

Pennsylvania Leads in Coal

The United States contains abo one-half of the world's known co supply. Although coal is comme cially mined in about 30 states, Pen sylvania has long led them all in t production of solid fuel. In fact, sin coal mining began in this country, t single state of Pennsylvania has pr duced 25 per cent of the bituminou coal, 44 per cent of the total coal, 5 per cent of the coke, and more tha 99 per cent of the anthracite. It i therefore, fitting that the only ge eral curriculum on fuel technolog which is at present available in th United States should be at The Penn sylvania State College.

The coal-mining industry has fo years had an unenviable financia record. Yet government income-ta statistics show that there have bee hundreds of coal companies reportin a net income each year. There ar reasons to believe that the financia conditions of the industry will im prove. In any event, coal mining i a stable, basic industry which em ploys more men than all other mi eral-extraction industries combine It will continue in importance as fa in the future as anyone can foresee a present, and it urgently needs youn men who can develop into positions o responsibility.

Other Opportunities

Regardless of the financial positio of the coal-mining industry at an given time, there are many other op portunities for the fuel technologis with companies which produce an sell equipment, with large users o fuel, and with various research o ganizations.

Published figures and observatio indicate that the scale of earnings men in the technical, supervisory, an management phases of fuel produ tion and utilization are similar those in other basic industries. Owi to the shortage of capable and we trained men, and the far-reachi technologic changes which are progress, opportunities for empl