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MINERALS IN A POST-WAR WORLD

By W. M. Myers*

THE IMPORTANCE of minerals in wartime economy has become a matter of common knowledge, and there is little doubt that the general public is now better acquainted with the problems involved in securing a supply of minerals adequate to support national existence than at any time in the past. Coal, petroleum, and steel are the fundamentals of the present era of industrialization. In wartime their importance increases to the extent that the final outcome may well depend upon control of these mineral commodities. The longer the war lasts, the more it becomes a matter of exhaustion in which control of energy in the form of coal, and particularly petroleum, becomes overwhelmingly important. Fortunately, the position of the Allied powers with regard to petroleum is such that we possess in our resources a superiority of supply that will prove to be of the utmost importance in deciding the outcome of the war. Petroleum may well prove to be the most valuable single weapon employed in the conflict.

The history of war is one of a constantly expanding control of energy by man. In the Revolution the quantity of energy at the service of one man seldom exceeded one horsepower, and service in the cavalry was necessary to insure that amount. In the Civil War the use of the steam locomotive increased the radius of active conflict. In World War I the development of the plane and tank marked the first great expansion in the amount of energy placed at the command of an individual. The development of the internal combustion motor to its present status with thousands of horsepower under the control of a single individual has been made possible only by an access to mineral fuels and metals on a world-wide basis and an improvement in their quality which in itself has been an outstanding accomplishment. The capacity of the individual to produce destruction is increased correspondingly and expansion in this direction seems feasible with no immediate limits.

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Minerals and War

The relationship of minerals to war is an interesting and complex subject that has never been explored thoroughly. Briefly, such a relationship is concerned with three phases of a conflict.

1. As a direct cause of hostilities. It is impossible in this mechanized age to become a great power or to assure a high standard of living to the citizens of any country without adequate supplies of all mineral products which in tonnage alone assume magnitudes undreamed of a few years ago. The irregular geographic distribution of resources is one of the most conspicuous characteristics of mineral wealth. Certain countries, notably poor in such necessities but well supplied with an aggressive spirit, have taken what appeared to them to be the easiest short cut to national sufficiency, have turned upon their neighbor, and by force of arms have attempted to acquire those supplies which nature had denied them. It is apparent that the doctrines of national and racial supremacy as enunciated by the Germans and Japanese can be made effective only by control of mineral resources located in many areas outside of their own domain.

2. As a control of strategy. The invasion of Norway was partly occasioned by Hitler's desire to control the shipments of Swedish iron ore. Rumania was brought under Axis domination chiefly to give Germany control of Europe's greatest single source of petroleum. Similarly, the prolonged Japanese conquest of the mainland of China has been based on a desire to acquire control of coal and iron. Many other military movements must have been made to capture less well known but possibly equally important mineral objectives. For example, the U-boat sinkings of oil tankers and ore carriers on the Atlantic coast and the shelling of an oil refinery by Japan in California were obviously directed to interference with mineral supply.

3. As a control of the final decision. In a war of exhaustion such as the present one, the advantages of sudden assault or blitzkrieg are lost, and the final outcome is decided by the spirit of the people plus their material equipment. The irreplaceable nature of minerals tends to control the issue, and the poorly endowed nations gradually approach exhaustion of stored and stolen supplies, and stagnation of military effort is the only possible sequence.

The present conflict is characterized by certain mineral factors to a degree unparalleled in past history. Essentially they are: a consumption of all mineral products in record-breaking tonnages; a corresponding depletion in reserves which in the United States is already reaching serious proportions; the application of research to many problems of production and processing which will supply many new processes and products to the post-war world; and a growing universal recognition of the significance of mineral supplies to American standards of living in peace time and national survival in war.

Post-War Developments

The impossibility of establishing a fixed date for the termination of military action precludes any conclusive discussion of post-war developments. The probability that the end will not come suddenly but will result from the liquidation of successive fronts may present a post-war condition not duplicated in the past. However, a few facts related to the various phases of the mineral industries in the post-war era seem reasonably certain.

The unprecedented demands of the military machine have stimulated every aspect of the discovery, production, processing, and marketing of mineral products. Because of the facility of world-wide transportation, this stimulation has encircled the globe and penetrated to the most remote areas. The only important mineral unaffected by this stimulation has been gold. Owing to the limited utility of this metal, production has been restricted, and the men and materials thereby liberated have been diverted to the production of more useful metals. The very large and immediate demands for minerals have been met only by a rapid exhaustion of the best and most accessible material. The inroads on reserves, particularly petroleum, have been severe, and new discoveries have

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TRENDS and OBJECTIVES

BY DEAN EDWARD STEIDLE

MINERALS WITHOUT END?

THE EARTH—lithosphere, hydrosphere, and atmosphere—furnishes all of our primary wealth. The three fundamentals of existence are animals, plánts, and minerals. The products of agriculture can be reproduced, whereas products of the mines are non-replaceable. This wealth is not money in the bank—much of it is natural minerals generally classified as mineral fuels, metallic minerals, and nonmetallic minerals.

There are 92 elements. Approximately 70 occur as metals or as constituents of minerals. Five occur as rare elements in the atmosphere, and the remainder as unstable members of the several radio-active series.

Water is the most important of all minerals and in the solid crystallized form is known as ice. There are 3.44 per cent dissolved salts of many kinds in sea water. About 15.36 per cent of the total are salts of magnesium. Hence about 0.52 per cent of all sea water are salts of magnesium. One cubic mile of sea water contains 23,582,000 tons of magnesium salts with a metallic magnesium content of more than 5,600,000 tons. Magnesium metal is now mined from sea water and is a competitor of aluminum. Bromine is mined from sea water economically. Some $25,000,000 worth of gold in every cubic mile of sea water awaits the technologist who first learns to remove it at a profit. The hydrosphere offers a virgin field for mineral engineers and technologists.

Oxygen, nitrogen, and other mineral elements are mined from the atmosphere. The fixed nitrogen process upset the economy of Chile at the close of World War I. Neon, one of the five rare elements in the atmosphere, is recovered in commercial quantities in spite of the fact that it makes up only 0.0018 per cent of the atmosphere by volume. Exploitation of the atmosphere warrants further expansion.

The feature article in this issue of Mineral Industries is based on mineral deposits in the lithosphere. Eight elements, oxygen, silicon, aluminum, iron, calcium, sodium, potassium, and magnesium make up 98.32 per cent of average elementary composition of igneous rocks in a 10-mile crust. Distribution of some of the rarer metallic elements of the average rock of the earth's crust, in grams per ton, in relation to 494,000 grams of oxygen is: nickel 100, copper 100, tin 40, lead 16, beryllium 6, silver 0.1, and gold 0.005 grams.

United States reserves of high-grade minerals in the lithosphere are being depleted rapidly, and the problem is acute already with respect to the known supplies of petroleum and many of our common base metals. We do not possess sufficient resources of "strategic and critical minerals" such as antimony, chromium, manganese (ferro grade), mercury, mica, nickel, quartz crystal, tin, tungsten, bauxite (ore of aluminum), cryolite, asbestos, graphite, platinum, vanadium, and industrial diamonds.

But there is no occasion to go down loafing on the job. Only an infinitesimal part of the minerals has been consumed. Mineral engineers and technologists must point the way to the recovery of minerals from widely scattered low-grade deposits of all kinds in the United States. They must excel the geological forces of nature in processes of concentration. Their performance in the past few years is convincing evidence of their ability to carry on. Porphyry coppers carrying as low as 0.8 per cent of copper are being worked economically. Gold can be recovered at a profit from ores assaying 90 cents worth of gold per ton, providing we maintain a gold standard. Molybdenum is being recovered from ores averaging 0.363 per cent molybdenum. We may expect iron to be recovered from low-grade materials such as taconite, and aluminum from almost endless deposits of clay.

The powers that be must have foresight to plan effective world control of the high-grade minerals in the lithosphere. Planners must hold to bed rock truths. Mineral economists sat at the peace table at the close of World War I, but their advice fell on deaf ears. Mineral economics is admirably represented in Washington but thus far is baffled by world politics, scheming, and intrigue.

The people, together with the industries, have a vital stake in the economy which will prevail in this country after the war. Mineral engineers and mineral technologists must take an active part in the solution of post-war problems. They must not ignore the realities of life. They must search every motive behind every world political move. There must be something more than global social approach. The United States is the greatest industrial nation. Our standards of living are the highest. We will have the largest army, the strongest air power, the mightiest seven-sea navy, the most extensive merchant marine, and a prodigious and unprecedented national debt. All of these conditions must be reckoned with at the close of the war. It is apparent for one thing that the destiny and national security of the United States depends, in a large measure, upon the availability of the mineral resources in the world, especially in the Western Hemisphere.

EARTH SCIENCES

Professor Paul D. Krynine presented a paper on "Oil Fields in Time and Space" on March 21 at the meeting of the American Association of Petroleum Geologists in Dallas, Texas. The paper dealt with the future of oil finding.

EXPERIMENT STATION

Dr. A. W. Gauger has been elected Chairman and Professor David R. Mitchell Secretary of the Coal Division of the American Institute of Mining and Metallurgical Engineers for 1944.

Minerals in Post-war

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not kept pace with utilization. Most products of petroleum are entirely consumed by initial use. However, the metals tend to accumulate in spite of a severe loss during transport and employment, and their reuse in the form of scrap will for a long time present substantial competition to the use of metallic ores direct from the mine. In the final analysis, this is a highly desirable form of conservation, but the balancing of the recovery of scrap from war articles with the production of ores will require considerable skill to prevent hardship to producers now active.

The depletion of high-grade material will force diversion to lower grade ores than have been previously considered commercially useful. The necessity for the development of new technologies and men trained in their operation will constantly increase. A more exact knowledge of the reserve of material left for future use and the rate at which it is being consumed will be necessary, and the work of the geologist in exploration and of the mineral economist in tracing the influence of technology on reserves will become more complex and essential. The frontiers of mineral production have been expanded from the land to the sea and the atmosphere. The crust of the earth, however, has not yet been penetrated to any appreciable depth—to some 7000 feet by mining and 15,000 feet by drilling. The possibility of deeper working with the opening of an entirely new zone of production at depth is always present. Production tends to be a function of price, and with no knowledge of future prices, it is difficult to appraise possible output. Higher prices for petroleum, coal, and metals would permit the recovery of very large tonnages of material not even contemplated at present. It is quite possible, therefore, that a future price structure will alter all present ideas as to reserves.

The financial chaos and the curse of inflation which have followed many wars will be difficult to control, particularly in defeated countries. In such periods the confidence of the public in gold is sure to be reawakened and the position of gold as the only satisfactory monetary base with universal acceptance will be enhanced. The problem of attaining a more uniform distribution of the world's gold so that all countries may have a solid financial base is difficult. However, the demand for gold should be such as to cause resumption of production and a renewed search for deposits.

In planning for a post-war world it is inevitable that interest will be centered in acquiring adequate supplies of petroleum. It is generally conceded that a sound oil policy should allow supplies sufficient for normal welfare to all nations. Storing of excess petroleum in sufficient amounts to wage war should be prevented. As most of the world's supply of oil is normally transported by water, control can be effected with relative ease. The possibility of enforcing a world-wide peace by control of oil supplies is attracting much attention. The great allies, The United States, Russia, and the British Empire, at the close of hostilities will control, directly or indirectly, most of the world's oil. If these powers can serve as trustees permitting a fair distribution for normal needs and not allowing accumulation for war, they will make one of the few practical contributions toward a lasting peace.

EXTENSION

World Authority on Refining Reviews Extension Text

Dr. Vladimir N. Ipatieff, chemical research director, Universal Oil Products Co., and one of the world's foremost men of science in the field of petroleum refining, has reviewed the extension textbook "Aviation Gasoline Manufacture" written by Matthew Van Winkle for extension classes in petroleum refining, as a part of the curriculum in that subject offered by Mineral Industries Extension Services. The review, which appeared in the March 10, 1944, issue of Chemical and Engineering News is presented verbatim below.

"This book fulfills a long-standing need in that it has gathered together the widely scattered facts about aviation gasoline—various catalytic processes by which it is produced, the methods of testing, physical and chemical properties, antiknock values, power output, economy, etc. Each chapter contains a list of references.

"The book is well written, with good diagrams and clear tables. There is a chapter on the history and development of aviation fuel from 1918 to 1942, and an orienting chapter on the chemistry of hydrocarbons which is very useful in understanding the processes by which aviation gasoline is manufactured, such as catalytic cracking, polymerization, alkylation, isomerization, etc. These processes are well described, but there is a lack of specific details, which, because of the war, cannot be helped.

"There are a few minor inaccuracies, such as the use of the word 'propenes,' and references to high temperatures and pressures where only one of them need be high. Also the references frequently omit names of associates of works or patents. These inaccuracies, however, are unimportant, and the book should serve as a useful reference work for the chemist, chemical engineer, and other technicians working in the petroleum industry. Its appearance at this time will be hailed by all."

PETROLEUM AND NATURAL GAS

Dr. Carlos Lara, fellowship student from Venezuela, who graduated with a M.Sc. in October 1943, is now working for Mene Grande Oil Company (Gulf Oil Corporation subsidiary) at their San Tome terminal center in eastern Venezuela.

Mr. José V. Lombana, mining graduate of October 1943, who took one additional semester of specialized petroleum engineering, has just left for Bogota, Colombia, where he will join an oil exploratory geological party of the Gulf Oil Corporation.

SEVEN REASONS FOR A FUEL OIL SHORTAGE

The reported fuel consumption of various war units is as follows:—

Mechanized Division	18,000 gal./hr.
To Train One Pilot	12,500 gallons
Destroyer (top speed)	3,000 gal./hr.*
Army Transport	1,375 gal./hr.
Heavy Bomber (250 m.p.h.)	200 gal./hr.
Light Tank	60 gal./hr.
Pursuit Plane (200 m.p.h.)	50 gal./hr.

*Fuel oil, others gasoline.

King Coal's face is washed every day at many coal preparation plants to prepare him to become better coke when he is processed in the by-product ovens and converted into fuel for the hungry blast furnaces. Transported direct from the mines, frequently in river barges, thousands and thousands of tons of coal are daily washed to reduce impurities, such as rock, slate, clay, ash, and sulphur, by torrents of water in modern sluice boxes called "launders" which, with vibrating screens, fill the high factory building with loud noise.

The jet black water that has washed the coal is not allowed to go to waste, but is drained into a pit or basin to precipitate the sediment, which is then dried into dust of coal and utilized by being blown into steam boiler fireboxes as fuel.

METALLURGY

Dr. John R. Low Jr., Assistant Professor of Metallurgy joined the staff of the Department of Metallurgy June 1, 1942. Dr. Low, though a native of Washington, Pennsylvania, graduated from the Oak Park, Illinois, High School in 1927 and received the degree of Bachelor of Science in Chemical Engineering at Purdue University in 1931.

DR. JOHN R. LOW, JR.

From 1931 to 1933 he was employed as metallurgist by the Keystone Steel and Wire Company of Peoria, Illinois, going from there to a metallurgical position with the Republic Steel Corporation at Chicago. In 1936 he was made wire mill foreman in the Chicago works of this company and held this position until 1939 when he came back to Pennsylvania as graduate research fellow in metallurgy at Carnegie Institute of Technology. There he worked with Dr. M. Gensamer on research dealing with physical properties of steels. The next three years were spent in graduate work for the doctorate, and in 1943 he was granted the degree of Doctor of Science in Metallurgical Engineering by the Carnegie Institute of Technology. Dr. Low has been author or co-author of the following research papers:

"The Tensile Properties of Pearlite Bainite and Spheroidites," published jointly with M. Gensamer, E. B. Pearsall, and W. S. Pellini in the Transactions of the American Society for Metals. Vol. 30 pp. 983-1019. (Dec. 1942.)

"Aging and the Yield Point in Steel," presented by Dr. Low to the Chicago meeting of the American Institute of Mining and Metallurgical Engineers in October 1943 and published as Technical Publication No. 1644 Iron and Steel Division.

Dr. Low's very considerable industrial experience and his sound basic and advanced training combined with his four years of research in the field of physical properties of steel have made him a particularly effective teacher.

Because of his special qualifications for research on the physical properties of structural metals, Dr. Low was requested in 1942 by the National Defense Research Council to take up confidential research on certain important problems relating to war time use of metals. This work, which is still continuing, has been carried on with the help of various assistants and has constituted a valuable contribution to the war effort.

Dr. Low was married in 1937 to Miss Dolphia Teasley. They have two children and live at 120 East Hamilton Avenue in State College, Pennsylvania.

The most recent addition to the staff of the Department of Metallurgy is Dr. Eugene Paul Klier, who comes to us from Notre Dame, Indiana, to the position of Instructor in Metallurgy. Dr. Klier was born in 1919 at Flora, Illinois, but his family moved later to Washington, Indiana, where he graduated from the high school. He received his B. S. in Metallurgy from the University of Notre Dame in 1940, M. S. (summa cum laude) from the same institution in 1942, and was granted the Ph.D. in Metallurgy in February 1944.

During his undergraduate days, Dr. Klier starred in Notre Dame basketball. After graduation, he was appointed graduate assistant in Metallurgy. During 1943 he was engaged in research at the University on government work.

At the annual meeting of the American Institute of Mining and Metallurgical Engineers in New York in February, he presented a paper jointly with Taylor Lyman on "The Bainite Reaction in Hypoeutectoid Steels."

Another paper to be presented at the 1944 meeting of the American Society for Metals will be entitled "The Martensite Transformation in Chromium Steels."

DR. EUGENE PAUL KLIER

MINING

Nuisance Mineral in Coal Could Make Sulfuric Acid

Glittery golden streams in some coals are just headaches to fuel engineers. For they are composed of fool's gold, or pyrites, a compound of sulfur that makes a bad smell if chimney smoke reaches human noses, and in any case increases corrosion of any metal that may be exposed to the fumes.

Yet pyrites in coal could be put to work in industry, David R. Mitchell of The Pennsylvania State College told the New York meeting of the Society of Economic Geologists and the American Institute of Mining and Metallurgical Engineers. Pyrites are associated with some kinds of coal, not only in streaks but in solid lumps and can be separated out by means of suitable machinery. Such coal-pile pyrites can be burned, and the resultant sulfur dioxide gas used in preparing sulfuric acid. At present, however, cheaper methods for making sulfuric acid are in use, so that widespread installation of equipment for sorting pyrites out of coal-mine wastes is not anticipated.

D C Jones

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