

CENTRAL WYOMING PHOSPHATE DEVELOPMENT PROGRAM
POSSIBILITIES AND PRESENT STATUS

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SUMMARY

Deposits of medium grade phosphate rock have been known in the Wind River Mountains near Lander, Wyoming, for many years.

In 1945, field work was undertaken jointly by the U.S. Geological Survey, and the Wyoming Geological Survey, the Natural Resources Research Institute cooperating, to better evaluate these deposits. Results of these studies were published in 1947 as Geological Survey of Wyoming Bulletin Number 39.

Laboratory and pilot plant investigation, of processing and up-grading the medium grade rock of these deposits has continued since the start of the field program.

With the growing demands of agriculture, particularly in the Middle West, for phosphatic fertilizers, the strategic location of the Lander deposits assumes more importance.

Liberalizing of Federal leasing regulations of phosphate lands within the public domain, "New Rules Aid Western Phosphate Development", Department of the Interior, Bureau of Land Management, Release of Tuesday, January 25, 1949, the possibility of low-cost strip mining in certain areas near Lander, Wyoming and the probability of sulfuric acid production in large volume in the Big Horn Basin, Wyoming, north of Lander, all bring more sharply into focus, the potentialities of these deposits.

In the following pages, the possibilities for commercial development of these phosphate deposits are briefly analyzed, and the remaining research, exploration, and development problems are outlined.

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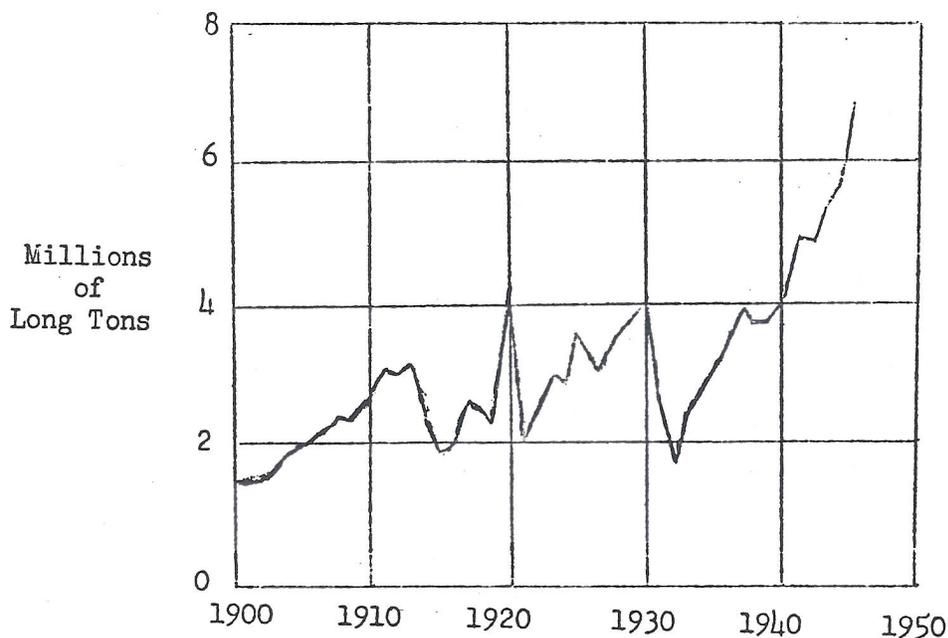
INTRODUCTION

Growing Phosphate Markets and the Western Deposits

Phosphorus is an important element vital to plant and animal life. It also enters industry in numerous forms. Phosphorus never occurs free in nature, like, for example, copper, but is usually found in combination in the form of calcium phosphates. By far the largest tonnage of phosphate is used for fertilizers as super-phosphate (approximately 17% available P_2O_5) and triple super phosphate (about 45% P_2O_5).

The United States has 60 percent of the known world phosphate deposits, and the Rocky Mountain states, Idaho, Wyoming, Montana, and Utah have 60 percent of the reserves in the United States.

Figure 1, reproduced from the Bureau of Mines Minerals Year Book, 1946, shows the marketed production of domestic phosphate rock from 1900 to 1946. It is apparent that phosphate production has generally followed the major business cycles, and that since 1939, has steadily been on the increase.



Marketed Production of Domestic

Phosphate Rock

1900 - 46

Fig. 1

Past domestic production of rock phosphate has come largely from Tennessee and Florida mainly because the soils of the eastern coastal area and the south, due to intensive farming, became impoverished with respect to phosphorus at an early date. As agricultural production from the Midwest has been increased, particularly during and since World War II, the plant food elements, of which phosphorus is the most vital, have been depleted at an alarming rate, and in order for the "farm-belt" to maintain food production at a high level, phosphorus replenishment in the soil is a necessity. (1)

The Mountain States phosphate deposits, particularly those in eastern Idaho and western Wyoming are being actively developed at the present time through operations of the Simplot Fertilizer Company, Idaho, and the San Francisco Chemical Company and Phosphate Mines, Inc., Wyoming. However, these operations are on the west side of the Rocky Mountains - relatively far removed from the growing Missouri - Mississippi Valley fertilizer consuming market.

WYOMING AND THE PHOSPHATE MARKET

Central Wyoming Phosphate Deposits Offer Unusual Advantages

Investigation of the Rocky Mountain phosphate deposits with reference to proximity to the Midwest or "farm-belt" states which constitute a large present and growing market for phosphate fertilizers, shows that phosphate beds in the Wind River Mountains southwest of Lander, Wyoming are closer to the existing market than are other deposits further west. Furthermore, the best of these deposits are ten to fifteen miles from the terminus of the Chicago and North Western Railway at Lander.

Natural gas and coal are abundantly available in close proximity to Lander assuring adequate fuel and a source of carbon (char) for either blast furnace or electric furnace phosphorus production. Lastly, the availability of large supplies of sulfur, to be recovered from "sour" natural gas in a \$3,000,000 plant of the Texas Gulf Sulphur Company at Worland, Wyoming has given new impetus to the Central Wyoming phosphate picture.

In 1945 the U.S. Geological Survey in cooperation with the Wyoming Geological Survey and the Natural Resources Research Institute of the University of Wyoming, undertook a detailed survey of a restricted portion of the Phosphoria formation, of Permian age, in the area on the northeast flank of the Wind River Mountains considered of most interest from an economic standpoint. This work (2) substantiates Condit's (3) earlier conclusions that the Phosphoria of the Wind River Mountains contains persistent beds of medium grade (50 to 60 percent B.P.L.*) phosphate rock. The workable bed in the region varies from three to five feet in thickness usually being less pure where thicker. The phosphate beds dip at the gentle angle of approximately 18 degrees toward the northeast and are generally free from faulting or folding, thus making for favorable mining conditions.

During the summer of 1947, the Bureau of Mines with the support of the U.S. Bureau of Reclamation carried on some core drilling and sunk a test mine shaft to the lower phosphate bed in the Twin Creeks area near Lander. A fifty ton shipment of the phosphate rock procured from a drift in this shaft was sent to the N.R.R.I., and has been employed for laboratory and pilot plant studies.

* B.P.L. Bone phosphate of lime as widely used to express phosphorus content in the fertilizer industry. B.P.L. is equal to P_2O_5 content multiplied by 2.18.

PROGRESS IN RESEARCH INSTITUTE'S PROGRAM TO DATE

Concurrently with the geological field work above referred to, started in 1945, the Institute undertook an investigation of both the economic and technologic factors involved in commercial development of the Lander phosphate deposits. As a result of these studies it became apparent that production of highly concentrated forms of phosphatic compounds with elemental phosphorus as the most desirable, would be highly attractive from the standpoint of reaching the widest possible markets. Electric furnace processing is the means favored by the industry for the production of phosphorus, and ultimately when sufficient quantities of lowcost electric power are available, a phosphorus plant such as has been projected by both the Bureau of Mines (4) and the Federal Power Commission (5) should be located in central Wyoming.

Since, however, it may be several years before electric power will become available, the Institute has given attention to other possibilities and phosphatic products which can be manufactured under present economic conditions.

The Tennessee Valley Authority produced fused defluorinated phosphate rock, considered suitable for agricultural uses, on an experimental scale in 1941 and erected a commercial plant for the production of this product at Godwin, near Columbia, Tennessee, which has been in operation since 1945. At the N.R.R.I., a pilot plant cupola was installed in 1948, and a substantial quantity of fused defluorinated rock has been produced experimentally in this equipment. It has been demonstrated that the production of this product with Lander phosphate rock and natural gas for fuel, is quite feasible. However, economic surveys indicate that the present market for fused rock is rather limited, and it is believed that other products, particularly super-phosphate and triple super-phosphate offer better immediate possibilities.

With the coming production of sulfur from "sour" gas in the Big Horn Basin, Wyoming, availability of sulfuric acid in close proximity to Lander seems assured, and work has been recently oriented toward the objective of acid fertilizer manufacture.

A substantial part of the Institute phosphate research program has been directed toward elemental phosphorus production and consideration has been given to the blast furnace and electric furnace processes. At one time, it was planned to adapt the pilot plant cupola to small-scale blast furnace phosphorus production, but this project was deferred in favor of the electric furnace which is preferred by the industry. Again because of the unfavorable power situation, work has been concentrated on more immediate objectives.

PHOSPHATE RESEARCH PROGRAM PLANNED FOR CONTINUATION

Further Exploration and Testing to Reveal Areas Suitable for Strip Mining of Phosphate Rock Near Lander, Wyoming.

Geological work on the phosphate deposits near Lander has revealed the attractive possibility of economical strip mining of the lower phosphate bed cropping out in certain areas of the Wind River Mountains. Field work involving relatively shallow core drilling and chemical assays in selected locations should be carried on in order to delineate the most suitable areas for strip mining. The sites offering most economical production costs based on combined factors of mining and transportation to a proposed plant would be selected as a result of this work.

It is estimated that twelve man months (four men for three summer months) would suffice for this program, exclusive of the cost of moving drilling equipment to the locations selected. The Institute would contribute supervision and the assay service required, roughly calculated as the equivalent of the direct labor above indicated.

Live Stock Feed Supplement

Work already done in the N.R.R.I. pilot plant cupola has demonstrated the practicability of reducing the fluorine content of the Lander phosphate rock to a low level by fusion. It is proposed that the "sinter" process be investigated for production of a defluorinated phosphate product suitable for a live stock feed supplement. This would produce a premium price commodity and should find a ready market for livestock and poultry feeds in Wyoming and Colorado as well as in the Midwest. A rotary kiln installed in the Institute pilot plant would be employed for this project and six man months should cover personnel requirements.

Beneficiation of the Crude Rock

The Lander phosphate rock is of an intermediate grade (26 to 28% P_2O_5) and has as its chief impurities, quartz (silica) and calcite (calcium carbonate). Laboratory experiments have already revealed the possibility of removing a substantial portion of one or both of these constituents. Elimination of calcite is particularly desirable, although lime is often required on certain types of soils, because of its tendency to consume excess acid in production of super-phosphate or triple super-phosphate by the wet method.

It is proposed that experiments in progress be continued to their logical conclusions and carried to the pilot plant, for economic appraisal. Estimated time requirement - one man year.

Field Evaluation of Fused Defluorinated Phosphate

Although a market analysis on fused defluorinated rock phosphate (20 to 25% P_2O_5) indicates only limited present markets in the Mountain States and the Middle West for this product, field plot tests should be made on a variety of crops to determine the "availability" value of fused defluorinated phosphate rock on western soils. It is estimated that time equivalent to one man for six months would enable completion of this study.

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