SAN FRANCISCO CHEMICAL COMPANY'S NEW PLANT RECOVERS LOW GRADE PHOSPHATE ORES

Phosphate mining and processing have entered a new dimension in the Intermountain area as a result of an intensive 13-year research and development program conducted by San Francisco Chemical Co. First major fruits of the program began to be realized in September 1957 when the company started successfully upgrading and producing quality phosphate from ores running as low as 18 percent P_2O_5; the previous economic cutoff point was 31.5 percent P_2O_5.

This development was the first of a 2-stage construction venture launched about three years ago at company properties near Leefe, Wyoming. It gave San Francisco Chem and the nation its first flotation plant actually floating western phosphate.

The second phase of the construction is scheduled to go into production early in 1959. This facility, a FluoSolids reactor, will enable treatment of low grade phosphate ores having a carbonaceous content - ores which heretofore have also defied economic processing and have been practically worthless for fertilizer purposes.

An additional advantage is expected from the reactor; its design will give a much greater flexibility of operation and enable mining three different ore grades simultaneously and upgrading these ores in a single process.

In 1946, when San Francisco Chem first began the research which subsequently gave the company a prominent spot among the nation's leading phosphate producers, production in the Leefe area was limited to what is

termed the "A" bed of the Phosphoria formation. The "A" bed is underlain by the "B" and the "C" beds, each successively of lower grade.

Production centered on the "A" rock until late 1947. This ore - commercial quality at above 31.5 percent P_2O_5 in its natural state - was merely crushed to minus 2 inches and shipped out. Some went direct to the Government; the rest went to the company plant at Montpelier, Idaho, where it was reduced to specified sizes in a Raymond pulverizer and routed on to fertilizer processing plants. In 1948, two Raymond pulverizers and a screening plant were installed at Leefe to treat "A" bed rock at the mine.

Operations at Leefe were further expanded in 1952 when a dry beneficiation plant was constructed, which enabled upgrading "B" bed ores via an air-swept separation process. The "B" ores run from 25 to 29 percent P_2O_5; the mill operated until October 1957, when the new flotation plant went into full scale production. With the new mill, the company began processing "C" bed rock, 18 to 24 percent P_2O_5, and thus realized a second major extension of its reserves.

The new mill employs desliming methods to make the initial separation of impurities in the rock; final separation is by flotation. Wastes and impurities rejected during processing consist of an agglomeration of clay, calcite, aragonite and silica, with lesser amounts of uranium, fluorine, chromium, manganese and many of the rare earth elements.

Leefe deposits are mined from open pits, with the overburden and ore being moved by shovels and Euc end dump trucks.

Ore is first stockpiled, then drawn as needed for the mill. From a hopper at the top end of the circuit, the rock is fed by a reciprocating pan feeder to a Diamond primary jaw crusher, 30 by 42 inches, where it is

reduced to a minus 4 inches. A conveyor picks up the crusher output and passes it to a 1-inch grizzly.

Fines drop through the grizzly onto a second belt and are bypassed around the next unit, a New Holland - Cedar Rapids breaker which reduces coarse rock to minus 1½ inches. Fines and coarse are again separated, this time at 1/4 inch, by an Allis Chalmers ripple flow hot deck screen. Plus 1/4 inch ore is cycled and recycled as necessary through a Jeffrey hammer mill; fines at minus 1/4 inch pass to a 500-ton feed bin.

In the first step of actual milling, fine ore from the bin is pulped to about 70 percent solids by being passed first over a Simplex screw feeder where water is added, then over an Allis Chalmers screen and to a sump.

From the sump the pulp is pumped to a 20-inch Krebs cyclone for first desliming; slime overflow goes to tailings.

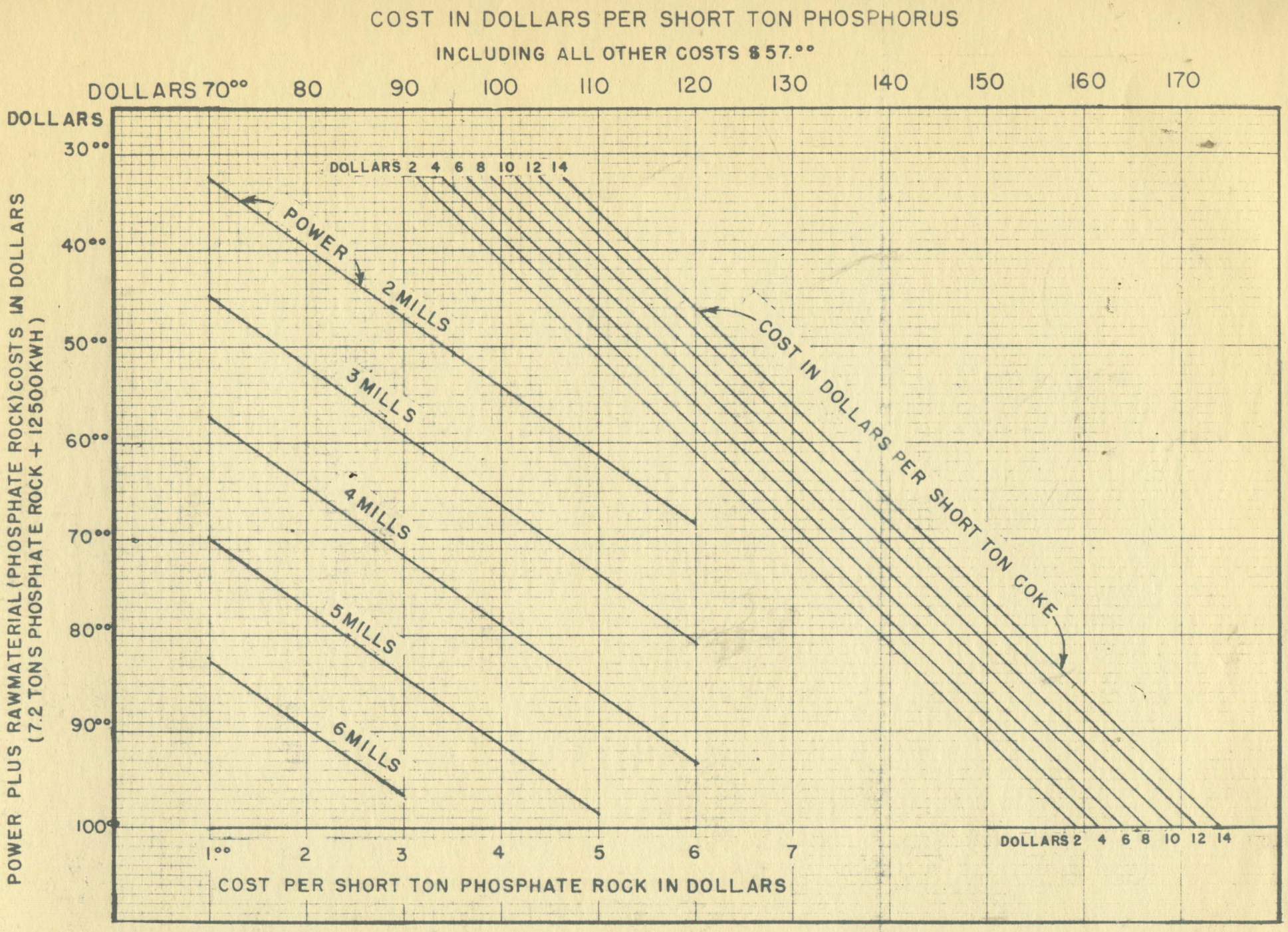
Underflow goes to two of the new DSM screens, operating in parallel, which, only 36 inches wide, offer exceptionally high capacity and efficiency for the small amount of floor space required. Oversize (plus 28 mesh) material rejected by the screen is routed to a 6 x 12-foot Marcy rod mill which discharges to a pump forcing the now minus 28-mesh material back up to the screens.

Undersize passing the screens is piped to another pump and later passed for second stage desliming via four Sweco vibrating screens, also with 28-mesh decks, to two 10-inch Kreb cyclones. As is typical throughout the desliming sequence, the overflow again goes to tails.

Pulp passing the cyclones is fed to a bank of 8 Wemco attrition cells for a cleaning and scouring step, called blunging. Impurities scrubbed off the phosphate are afterwards removed with the slime overflow in four 6-inch Dorrclones.

Dorralone underflow is further washed and deslimed in a Dorr rake classifier. This action in removing additional slimes also thickens the pulp to 80 percent solids. The rake product then goes to a barrel conditioner for reagentizing preparatory to roughing.

From - Intermountain Industry, Vol. 60, No. 12, p. 22-23, December 1958.



1 SHORT TON PHOSPHORUS

FORMULA: RAW MATERIALS, 7.2 SHORT TONS PHOSPHATE ROCK
1.25 " " COKE
POWER 12,500 KWH
ALL OTHER COSTS DOLLARS 57.00

EXAMPLE:

7.2 TONS PHOSPHATE ROCK COST PER TON $1.00	= 7.20
1.25 " COKE COST PER TON $	= 2.50
12,500 KWH COST PER 1 KWH 2 MILLS	= 25.00
ALL OTHER COSTS	= 57.00
TOTAL $	91.70

COPY

(1) U. S. Department of the Interior
Western Phosphate Fertilizer Program

Preliminary Production Cost Estimates,
Phosphorus, Phosphoric and
Triple Superphosphate Fertilizer.

The U. S. Department of the Interior, early in 1947, launched a coordinated program to make available to private industry such information as would be of value in expanding western production of phosphate fertilizer.

The attached estimates were prepared by the Division of Industrial resources and Development in the Bonneville Power Administration as a part of the Departmental program. They should be of value to anyone in their preliminary consideration of the possibilities of phosphorus and phosphate production in the West.

In making these estimates, the published reports of the T.V.A. were drawn upon freely, especially for plant investments. In converting to present day costs, the 1936 figures of the T.V.A. were increased by 70 percent, which was a fair approximation at the time the estimates were made. More recent construction cost indices indicate that an increase of 130 to 140 percent would be better at the present time.

The estimates of required labor were made by reference to the T.V.A. reports and that experience of members of the BPA staff intimately acquainted with electrothermal phosphorus and fertilizer production. Labor rates were adjusted to current rates in the area.

It should be possible to reduce the relatively high cost figure for 25 percent phosphate in a number of potential mining operations. Inasmuch as rock phosphate costs are an important share of the total cost and this is one highly variable item, it deserves careful attention in selecting a site.

The chart - figure 1 - prints estimation of phosphorus production costs under varying costs for phosphate rock, power and coke.

One item which does not appear in these estimates is the cost of sintering or nodulizing. Much, but probably not all, of the Western rock will require such treatment prior to furnacing Because this treatment is fairly costly, studies are justified of the character of specific rock deposits.

In table ___ is shown a comparison of energy costs for phosphoric acid production by three alternative methods at several rate levels. This table was prepared by Mr. W. W. Waggman of the Metallurgical Branch of the Bureau of Mines in consultation with Mr. J. N. Carothers of BPA. In referring to this it must be remembered that these comparisons are for energy only. There are other important differences in the requirements for the process as follows:

1. The rock phosphate required for the sulfuric acid process must be high grade whereas the blast and electric furnace processes can utilize low grade rock.

2. The blast furnace process requires a high strength coke which the electric furnace can utilize coke.

3. Certain phosphate rocks require sintering prior to electric furnace processing whereas the blast furnace process does not require this treatment.

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Some Effects of Transportation Costs upon the Establishment of New Phosphorus Industries in the Western States

ROSCOE E. BELL AND DONALD T. GRIFFITH [1]

ACKNOWLEDGMENT: Gratefully acknowledged is the valuable consultation and assistance of Dan Mater and Edward Margolin, Transportation Economists, Bonneville Power Administration. The rate data were assembled by the Central Traffic Service in the Treasury Department under the general direction of Edward Margolin.

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1 Industrial Analyst, and Agricultural Economist

SUMMARY

This report on transportation costs was prepared as one segment of the Western phosphorus and phosphate fertilizer program of the U. S. Department of the Interior.

It shows that:

1. The transportation item is a significant portion of the final cost of phosphate fertilizer amounting to 10 to 45% or more depending upon origin of fertilizer and form in which it is shipped.
2. Transportation rates for Western produced phosphate fertilizer may also have a very important influence upon the trade area served, the economy of expanded phosphorus industries and consequently the tonnage of freight shipped.
3. Analysis of existing freight rates indicates somewhat the levels which may be expected by new producers.
   a. Conventional rate curves expressed in cents per ton mile show high rates for short distances and lower rates with longer distances, the curves flattening out as the distance increases.
   b. Actual rate curves are poorly defined for rock phosphate but fairly well defined for phosphate fertilizer, phosphatoric acid and elemental phosphorus.
4. Per ton rates usually vary with different phosphorus materials in the following order from lowest to highest: rock phosphate, manufactured phosphate fertilizers, liquid phosphoric acid, and elemental phosphorus.
5. When converted to transportation cost per ton of plant food the order is changed so that elemental phosphorus is the cheapest and ordinary superphosphate is most expensive, with different phosphate fertilizers,

varying inversely with their P_2O_5 content. Rock phosphate is intermediate in it's shipping cost per ton of P_2O_5 between ordinary superphosphate and elemental phosphorus.

6. Established commodity rates from rock phosphate, superphosphate and liquid phosphoric acid are generally lower in the western and midwestern states than for similar shipping distances in the East, South and Southwest.

7. Reductions of as much as 20% below rail rates to the Mississippi River Valley from Florida appear possible through barge transportation.

8. If the existing rate structure from Anaconda (the largest point of origin for Western phosphate fertilizer) were applied to similar shipping distances from Montpelier or Soda Springs, Idaho (possible new manufacturing centers) Western phosphate could reach Chicago and Mississippi River Valley, points as far south as St. Louis at equal or lower cost than rail or water shipments originating in Florida or at Houston, Texas.

9. Shipment of elemental phosphorus from the West in comparison with triple superphosphate produced in Florida extends the Western trade area even further eastward.

10. A Western rate structure for concentrated phosphate fertilizer similar to the Anaconda structure on a ton mile distance basis and a similar rate relationship for elemental phosphorus would do much to encourage expansion of the Western industry to meet the needs of the Western and Central U. S.

An industry large enough to meet these needs would mean large freight movements and consequent rail revenues of more than 2½ million dollars annually. Shipment of elemental phosphorus for the chemical industry would probably amount to an additional volume of not less than half of this amount.

FOREWORD

Phosphate rock is the raw material used in the manufacture of phosphate fertilizers and a large number of phosphorus compounds used in the food and chemical industries. Phosphorus is one of the three plant foods commonly applied as fertilizers; namely, nitrogen, phosphorus, and potash. In fact, it is a key fertility element essential to the production of food, feed and soil conserving crops. So important is it that it has been termed--"the bottleneck of a World Hunger" by the writer, James Rorty.

The world's largest deposits of Rock phosphate are in the United States. In this country they are found in three general areas; namely, Florida, Tennessee, and the Western States (Idaho, Wyoming, Utah, and Montana). The western deposits contain about 60 percent [1] of the Nation's supply of phosphate rock as compared with 38 percent and 2 percent in Florida and Tennessee, respectively. That the western deposits have been little utilized or developed is indicated by their production of only 4½ per cent of the national production of phosphate rock in 1943 as compared to 70 percent from the Florida deposits and 25½ percent from the Tennessee deposits.

In recent years, the need for phosphate fertilizer in the West has increased very rapidly, and it may be expected to continue to grow because the soils are no longer "virgin" soils and the removal of phosphorus in crops far exceeds that returned in fertilizers. Thus western demand now greatly exceeds manufacturing capacity. Pacific Northwest development of hydroelectric generating facilities and the possibility for additional low-cost electricity in the vicinity of the phosphate deposits has resulted in great industrial interest in electric furnace phosphorus smelting in this area.

1 Mansfield, G. R., "Phosphate Rock Deposits of the World." Ind. and Eng. Chem. 34, 9, 1942.

There is good reason to believe (from preliminary studies) that economical processing of western rock is possible and that there is in the west the basis for a greatly expanded industry as low-cost energy becomes available. Economical production of phosphorus and concentrated phosphate fertilizers can best be accomplished at or near the phosphate rock mines if the other factors of production are also there. The principal factors of importance to the industry are low-cost rock phosphate, low-cost energy, and the accessibility of a market for the product. Much of the phosphate rock in the western U. S. is costly to mine and is located in areas off the railroads--thus the locating of low-cost rock phosphate is not always easy.

The three alternative energy sources for processing rock phosphate are sulfuric acid, electrical energy, or coke. Because there is insufficient sulfuric acid manufacturing capacity in the western phosphate area to meet needs it has been necessary to ship it into Idaho from Salt Lake City and Denver and California points. Additional manufacturing capacity could be developed at these points as well as in Montana and northern Idaho but sulfuric acid is expensive to ship. Hydroelectric energy potentials in the Pacific Northwest are the greatest in the nation and the area is one of low-cost power. Low-cost coke is not now available in the Rocky Mountain area. Low-cost transportation to the lange markets would help to offset some of the other high-cost factors, such as rock phosphate and coke costs.

About half the phosphate fertilizer used in the Western States in 1944 was produced at Anaconda, Montana; Trail, B. C.; San Francisco and Los Angeles, California. New production facilities have been established in Pocatello, Idaho, and Permanente, California. However, these are not adequate to meet western needs hence Florida and Tennessee phosphate is brought in by water and rail to fertilizer mixing plants at California and Pacific Northwest ports.

The development of a large phosphorus and phosphate fertilizer industry in the West has been delayed by the absence, until recent years of large western markets for the products, the lack of developed energy resources, and the high cost of western rock phosphate.

Recognizing that the present keen interest of the fertilizer and chemical industry is based on a real economic opportunity in the west and that the development of the resource is important in the agricultural and general economy of the western half of the U. S., the U. S. Department of the Interior, early in 1947, launched a Departmental program of investigation directed towards developing such facts as would be of value to private industry in utilizing the western resources to meet an important part of national needs.

Included in the Departmental program are:

1. Raw material phases:

   a. Geological surveys
   b. Mining cost investigation
   c. Metallurgical process and by-product recovery studies.

2. Industrial phases

   a. Processing cost studies
   b. Industrial processing tests
   c. Information service to industry

3. Power phases-- power supply studies.

4. Market phases

   a. Transportation and trade area studies
   b. Marketing and market demand studies.

5. Public land phases--modification of policies to encourage industrial development.

The Department of the Interior has recognized the immediate need for additional investigation of all Agronomic phases and has encouraged the Land Grant Colleges and the U. S. Department of Agriculture to launch the work which they have planned in this field.

This report constitutes a part of the work included under market phases of the program assigned by the Secretary's Office to the Bonneville Power Administration for investigation.

TRANSPORTATION COST AND ITS EFFECT UPON THE ESTABLISHMENT AND LOCATION OF NEW PHOSPHORUS INDUSTRIES IN THE WESTERN STATES.

Introduction

The cost for transportating a product from the factory or source to its market is an important factor in determining the price at which it can be offered to the consumer. It likewise is important in determining whether the producer can offer his product to the consumer of any particular area at a price within the range of competing products being offered by competing producers at other points. Fertilizers characteristically are bulky and heavy and have a relatively low value per unit as compared to many other manufactured products; therefore transportation cost is often a major item in the delivered cost of the product, ranking with sales cost as second or third in magnitude of separate cost items. Thus, this item becomes an important determinant of the area within which fertilizer can be marketed.

Freight rates on phosphate fertilizers between Anaconda, Montana, and Denver, Colorado, amount to 14 per cent of the retail ceiling [1] price of triple superphosphate or 24 per cent of the ceiling price of ordinary superphosphate. This item becomes progressively greater as the fertilizer moves greater distances. Thus freight costs from Anaconda to Chicago amount to 15.6 per cent of the sales price of triple super and 34.4 percent of the cost of ordinary superphosphate. When one considers the freight charges on raw material from mine to plant, on phosphate fertilizer from factory to mixing plant, and on mixed fertilizer from mixing plant to farm, it is apparent that

1 Although ceiling prices are not now in effect the general price structure throughout the country is fairly well represented by these prices. These therefore serve as a satisfactory general price reference, for use in this study.

transportation costs may constitute as much as half the cost of the fertilizer to the farmer. This point is illustrated by Figure ___, which shows movements of phosphate fertilizer into Idaho and Table 1 showing the corresponding cost figures.

Table 1 Approximate cost of moving phosphate plant food to Boise, Idaho from present sources of supply.

A. Originating in Florida, processed at Baltimore, mixed at Portland.

Product	Origin	Destination	Shipping Rates Per ton of frt.	Shipping Rates Per ton of plant food (P_2O_5)
Rock Phosphate (32%)	Bartow, Fla.	Baltimore, Md.	$ 3.50	$10.94
Superphosphate (20%)	Baltimore, Md.	Portland, Ore.	12.00	60.00
Mixed Fertilizer (6-10.4)	Portland, Ore.	Boise, Ida.	5.80	29.00
	Total Florida to Boise			$99.94
	Retail Price [1] of Fertilizer		45.80	
	Freight charges as Per Cent of Retail Price			45.2%

B. Originating in Idaho, processed at Anaconda, Montana

Rock Phosphate (32%)	Conda, Ida.	Anaconda, Mont.	1.72	5.38
Superphosphate (43%)	Anaconda, Mont.	Boise, Ida.	5.80	13.50
	Total			$18.88
	Retail Price [1] of Fertilizer		52.00	121.00
	Freight charges as Per Cent of Retail Price			15.6%

C. Originating in Idaho, processed at Pocatello, Idaho

Rock Phosphate (32%)	Fort Hall, Ida.	Pocatello, Ida.	1.85 [2]	5.90
Superphosphate (18%)	Pocatello, Ida.	Boise, Ida.	4.00	22.15
	Total Mine to Boise			$28.05
	Retail price [1] of fertilizer		30.50	169.45
	Freight charges as Per Cent of Retail Price			16.6%

1 Ceiling Prices OPA Maximum Price Regulation 135 Rev.
2 Approximate Trucking Charges

The transportation costs of the above magnitude in the western area, the wide variation in transportation costs for different type products and in rates between equi-distant points in the United States, the possibility of adjusting rates through negotiation, and the great potential volume of freight movement which may result from an expanded phosphate and phosphorous industry in the West, make this subject one of great interest and importance to fertilizer manufacturers, transportation companies, and farmers.

Location of present and potential market

In a previous report the location of potential markets for fertilizer was indicated by states [1]. Further study of the potential market is of particular value in studying the transportation problem. The ultimate market for plant food may be judged approximately by the amount of plant food removed from the soil by crops. Phosphate plant food exists in the soil in limited quantities A small part of this is immediately available to crops and the remainder to become available to crops to a greater or less extent through the years. In many soils (especially in semi-arid areas) the soils contain sufficient available phosphate plant food to produce several crops. Phosphate fertilization becomes necessary after producing crops on the land for 10 to 30 years (more or less) depending upon the natural fertility and chemical character of the soil, the kind of crops produced, and the tonnage of crops produced.

A great amount of further study of the soils of western United States will be required before any precise determination can be made of the fertilizer requirements of the entire area. In the absence of this information, it is necessary to depend upon phosphate plant food removal from the soil by crops as a guide to ultimate potential markets for plant food.

1 Roscoe E. Bell--"Preliminary Analysis of the Western Phosphate Fertilizer Industry" U.S.D.I. Bonneville Power Adm. Mimeograph 1946.

The estimated amounts of phosphate plant food removed by plants and replaced in application of fertilizers in 1944, by groups of states, are as follows: (4) (5)

PHOSPHATE FERTILIZER CONSUMPTION AND PHOSPHATE REMOVAL BY CROPS, 1944.

Areas	Phosphate removal by crops		Phosphate fertilizer application by areas	
	Tons P_2O_5 (5)	Per-Cent of Total	Tons P_2O_5 (4)	Percent of Total
United States	1,710,474	100.0	1,284,719	100.0
11 Western States	233,138	13.6	69,036	5.4
11 Central and Northern States ...	963,276	56.3	154,702	12.0
26 Eastern and Southern States ...	514,060	30.1	1,060,981	82.6

(4) Mehring, A. L. Et. al., Journal of American Society of Agronomy #8, August 1945.

(5) Nutrient Status of Soils in Commercial Potato Producing Areas of the Atlantic and Gulf Coast. Mimeograph USDA, BPI. SAE, 1945.

It is evident that the phosphate plant food (P_2O_5) required by crops grown in the 11 Western States in 1944 was only a small portion (13.6 per cent) of the United States requirement and that the amount applied in fertilizers was even a smaller portion (5.4 per cent) of the total application in the United States. The requirement for crops grown in the 11 Central and North Central States amounted to over one-half (56.3 per cent) of the United States requirement; wheras, of the total application in fertilizers in 1944, only 12 per cent was applied to soils in these states. Crops grown in the 26 Eastern and Southern States have 30 per cent of the United States phosphate plant food (P_2O_5) requirements; whereas more than three-fourths (82.6 per cent)

of the total United States application of phosphoric acid was applied to soils in these states.

These data clearly indicate the location of the potential "volume" market for phosphate fertilizers and give some indication of the potential size of these markets. The 11 Central and North Central States had a phosphate plant food removal by crops of about 963,000 tons in 1944. The application of only 155,000 tons in fertilizers indicates an ultimate additional market for 800,000 tons of phosphate plant food (P_2O_5) per year and represents the large market area for phosphate fertilizers. The estimated size of this potential market is believed to be a conservative estimate because, as in the case of 23 of the 26 Eastern and Southern States, more phosphoric acid may be applied in fertilizer than is actually removed from the soil by the crops grown in any particular year. Further, as a potential market for phosphate fertilizers produced in the Western States, much of the tonnage supplied these states in 1944 from Tennessee and Florida deposits may be competed for in the future by western producers, provided they are able to maintain favorable production and distribution costs. To illustrate the value of the Midwest as a marketing area for phosphate fertilizers, the state of Iowa alone--with a removal of 175,883 tons of phosphoric acid in 1944, an application of 11,643 tons in fertilizers, and a deficit, or potential market, of 164,240 tons--equals the deficit of 164,102 tons of the combined 11 Western States.

The 11 Western States will provide a smaller but attractive market for additional western phosphate fertilizer producers. The USDA estimates cited above show that in 1944, the crops grown in these states removed about 233,000 tons of phosphoric acid from the soil as compared to about 70,000 tons applied

in fertilizers. With the cropping systems used, it would require the application of about 163,000 tons of phosphoric acid each year to maintain the phosphoric acid content of the soil. The extensive new irrigation planned for the West will greatly accelerate the rate of removal of soil phosphate through increased crop production.

It is apparent that producers of phosphate fertilizers from the phosphate rock deposits in Southern Idaho or adjacent Western States must be able to reach the markets of California and the Central and North Central States to enjoy the large volume market for their products. To reach these states as well as California requires shipment over distances of 1,000 to 1,500 miles.

Freight rates are largely the result of bargaining between the carrier and the prospective shipper. However, they are subject to review and approval by the Interstate Commerce Commission. The carrier bases its rates upon such factors as the distance to be shipped, the physical characteristics of the product, the type of equipment required to handle it safely, the volume to be moved, and whether the movement can be handled throughout the haul by one carrier. Above actual costs, the carrier may bargain for all the traffic will bear according to the value of the product to be shipped. Rates will be tempered considerably by the existence of competitive carrier.

Shippers of western phosphate products interested in reaching the large markets point out that it costs little more to ship additional miles after a product has been loaded and started on its way. They also point out that a small reduction in rates may enable them to reach a large market which otherwise would be out of their marketing area--thus if the rates are not low enough, there will be no shipment and hence no revenue for the railroad.

Recognizing the better bargaining position resulting from location on more than one railroad, new producers select as first preference those sites which are so favored.

Figure ____ shows that within the Western phosphate area there are alternative locations, some of which have access to competing lines. Four railroads penetrate the phosphate rock deposits in Montana, two in Utah, and one in Idaho and Wyoming.

Analysis of Rail Freight Rates [1] For Various Classes of Phosphorus Materials and Fertilizers

Phosphorus may be shipped as rock phosphate, as manufactured fertilizer, as liquid phosphoric acid, or as elemental (pure) phosphorus. Rates per ton vary in the order indicated above.

Phosphate fertilizers may be produced which contain varying amounts of phosphoric acid as well as in combination with either nitrogen or potassium. Because these fertilizers all move at the same rate per ton (in the West), the transportation cost per ton of plant food varies inversely with the per cent of plant food contained.

The following analyses of freight rates will indicate to potential producers what products can be shipped most economically and what general levels of rates may be expected. It also indicates the potential volumes of freight movements which may be anticipated if the industry develops to meet the needs.

1 Freight rates used throughout this study were those in effect prior to July 1, 1946. Because the increases which have been effected since that time are blanket increases these changes have no significant effect on the conclusions.

Because the transportation of each phosphorus product involves differences in handling characteristics and consequently in rates, each will be considered separately.

Rock Phosphate. The phosphate plant food (P_2O_5) in phosphate rock as it comes from the mine is not readily available for plant use even though high-grade ore contains as much as 30 to 35 per cent total P_2O_5. Although finely ground raw rock phosphate applied to acid soil in large quantities may give acceptable results in some parts of the U. S., this is not generally true in the western U. S. In the West, the more available forms of phosphate fertilizer are required.

To be made available as a plant food phosphate rock must be treated with sulphuric acid or treated in an electric or blast furnace. The sulfuric acid method is the one which is commonly used for the production of fertilizer, although the electric furnace method is in use by the TVA and has also been used commercially.

Because it is cheaper to ship phosphate rock than to ship sulfuric acid, existing western shipments of phosphate rock essentially are movements from the deposits or mines to the various processing plants in this country or aboard. The cost of such transportation has much bearing upon the location of processing plants in respect to the phosphate rock deposits. Consequently, railroad charges for movements of phosphate rock in various parts of the United States were examined to determine whether a definite rate structure was in existence. To permit an accurate comparison of the rates in effect between points of differing distance, all rate information was reduced to a common denominator, the rate in cents per ton, per mile of haul. (Ton mile Rate)

It might be assumed that an equitable rate structure would be one which would show a relatively high ton mile rate for short distance hauls and

would be expected to decrease rapidly as the length of the haul increases. At longer distances, the effects of the terminal charges are minimized, the more or less constant cost of movement becomes more important, and the ton mile rate should tend to level off with only small changes in the rate per ton-mile as the distance becomes greater. If such a structure existed, it might be expected that rates would follow this pattern with only minor deviations from an "average" line.

Railroad charges for rock phosphate shipment are shown on Figure ____ on a ton-mile basis. These include movements from Tennessee, Florida, and Idaho phosphate rock deposits to various processing plants. The data used were selected to represent known movements of rock phosphate from mines to factories. It is apparent from the scatter of these points that a wide variation exists in the rates charged by various railroads for carload movements of phosphate rock. No well-developed rate pattern exists for the shipment of this commodity.

There is a wide variation in rates for similar distances. Notably low rates apply for large movements from Southeastern Idaho points to Anaconda, Montana, San Francisco, and Los Angeles. Bargaining power of manufacturers at these points, together with the possibility of shipping rock to coastal points from Florida by water, appear to be important factors affecting rate levels. In the case of other large western movements from Montana to British Columbia, the manufacturer apparently does not have the alternative sources which give him good bargaining position. Possibly the arrangements for interchange of lading between the two freight lines handling the movement work against the manufacturer, resulting in a relatively high rate.

It is also apparent from Figure ___ that rail rates charged for hauling phosphate rock in the Western States are lower than those being charged in the Eastern and Southern States. For example, rail rate for carload lots of

rock phosphate from Mt. Pleasant, Tennessee, to Little Rock, Arkansas, a rail distance of 353 miles, is $3.99 per ton or 1.13 cents per ton-mile; whereas the rate for a similar shipment from Conda, Idaho, to Anaconda, Montana, a rail distance of 349 miles, is $1.72 per ton or .49 cents per ton-mile.

Actual freight charges do not vary consistently with the length of the haul. For example, a rate of $4.32 per ton is charged for carload shipments from Conda, Idaho, to Twin Falls, Idaho, a rail distance of 191 miles; whereas, the same rate is charged for similar shipments from Montpelier, Idaho, to Los Angeles, California, a rail distance of 1,000 miles. It is a common practice among railroads to charge the same rate for shipments to various points within a general area. These "blanket" rates, if the area is large, are exceedingly discriminatory to the nearby points in the area and are also highly favorable to the more distant points within the blanket. Equitable rates cannot be based on extensive blankets.

The volume of business or volume shipments of phosphate rock undoubtedly has considerable influence on the rates which have been established for certain movements. Thus, if large tonnages were shipped to Twin Falls, Idaho, adjustments undoubtedly would be sought and granted. In bargaining with the carrier or carriers to establish the rate, the new shipper presents information on the volume he anticipates moving and the additional volume that a lower rate would allow him to move by extension of the marketing area.

It is not possible to accurately predict from existing rates just what rate levels might be established through negotiation because no definite rate pattern is in existance. The data in Table 2 indicate, however, that there does appear to be precedent for western rates of .5 cents per ton-mile for shipments of 350 miles or more in the case of larger movements of 25,000 or more tons annually. For movement of 75 to 100 miles, a rate of .8 to .9 cents per ton-mile appears to be well established.

TABLE 2. COMMODITY RAIL RATES ON ROCK PHOSPHATE FOR KNOWN ORIGIN AND DESTINATION POINTS OF LARGE SHIPMENTS.

Origin	Destination	Rail mileage [2]	Rate [1] per ton [3] (Dollars)	Rate per ton-mile (Cents)
Conda, Idaho	Don, Idaho	74	.65	.88
Conda, Idaho	Anaconda, Montana	349	1.72	.49
Conda, Idaho	Portland, Oregon	791	4.32	.55
Conda, Idaho	San Francisco, California	918	4.32	.47
Conda, Idaho	Los Angeles, California	974	4.32	.44
Montpelier, Idaho	Don, Idaho	99	.80	.81
Montpelier, Idaho	Portland, Oregon	816	4.32	.53
Montpelier, Idaho	San Francisco, California	942	4.32	.46
Montpelier, Idaho	Los Angeles, California	999	4.32	.43
Montpelier, Idaho	Joplin, Missouri	1180	6.50	.55
Montpelier, Idaho	Warfield, B. C.	848	6.60	.78
Garrison, Montana	Warfield, B. C.	435	3.92	.90
Garrison, Montana	Seattle, Washington	604	4.32	.72
Garrison, Montana	Portland, Oregon	680	4.32	.64

1. Rates used were those in existence prior to July 1, 1946.

2. Distances were computed from short line mileages published in the Southwestern Traffic Manual published by the St. Louis and Southwestern Railroads, and the Official Guide of the railroads.

3. Rates specified for minimum tonnages of 80,000 pounds or 90 per cent of the marked capacity of the car.

Phosphate Fertilizers. Superphosphate is obtained by treating phosphate rock flour with sulphuric acid or with liquid phosphoric acid. Transportation of superphosphate represents the movement of a processed commodity from the factory to the consumer's market. There are various grades of superphosphate, as well as other processed phosphates and combinations with nitrogen and potash. Insofar as transportation rates are concerned, they all move at the same rate [1], even though their plant food content and value are considerably different. Consequently, the study of superphosphate rates lays the basis for rates that may be excpected for the following fertilizers:

Fertilizer	Content	Per cent Plant Food
Ordinary superphosphate	18-20 per cent P_2O_5	18
Ammonium phosphate	16 per cent nitrogen 20 per cent P_2O_5	36
Triple superphosphate	43-48 per cent P_2O_5	48
Ammonium phosphate	11 per cent nitrogen 48 per cent P_2O_5	59
Calcium metaphosphate	65 per cent P_2O_5	65
Potassium metaphosphate	6 per cent P_2O_5, 33 per cent potash (K_2O)	93

Production of triple ("Treble") superphosphate at Anaconda, Montana, has long been established and there has been opportunity for developing freight rates to a wide trade area. Therefore, a study was made of the rail rates in effect for superphosphate shipments from Anaconda, Montana, to various destinations in the Far Western, Central, and Southwestern States. These rates are plotted on a ton-mile basis on Figure ___ . It is apparent from these data that two distinct rate structures have developed. A lower rate structure exists for destinations in the Western and Midwestern States than for destinations in the Southwestern States. Inasmuch as the large potential market for phosphate fertilizers is in the Central and Western States, the lower rate

1 In some Central and Eastern areas, ammonium phosphate and ammoniated superphosphates carry high rates. This is not the case in shipments originating at Anaconda, Montana, or Trail, B. C., Western manufacturing points.

for phosphate fertilizers is in the Central and Western States, the lower rate structure is used in subsequent studies to indicate the approximate cost of rail transportation of the various concentrations of superphosphate fertilizers. On this basis and because of the fact that he must compete with the present production at Anaconda, the new producer of these fertilizers might present a good case for approximately the following rates:

Miles	Rate ton-mile (Cents)	Rate per ton (Dollars)	Miles	Rate per ton-mile (Cents)	Rate per ton (Dollars)
200	1.96	3.92	800	.84	6.72
300	1.59	4.77	900	.77	6.93
400	1.35	5.40	1,000	.71	7.10
500	1.17	5.85	1,100	.66	7.26
600	1.03	6.18	1,200	.62	7.44
700	.92	6.44	1,300	.57	7.44
...	...	...	1,400	.53	7.44
...	...	...	1,500	.50	7.44

Blanket rates established for superphosphate movements result in rate uniformity over long distances for the longer hauls. As a matter of fact, the same rate ($7.40 per ton) applies on superphosphate shipped from Anaconda, Montana, to Dyer, Utah, a distance of 550 miles, and Anaconda to St. Louis, Missouri, a distance of 1,550 miles, for $7.40 per ton. While blanket rates are discriminatory to the nearby consumer, they are a distinct advantage to the Western producer in that the large markets are far removed and, consequently, can be reached at a lower rail rate than might otherwise be the case.

Liquid Phosphoric Acid. Liquid phosphoric acid can be produced from elemental phosphorus obtained by electric or blast furnace volatilization or by the wet process which uses sulphuric acid as a reagent.

Commercially liquid phosphoric acid is about 53 per cent phosphate plant food (P_2O_5). To be converted to a fertilizer than can be handled readily, it is mixed with phosphate rock flour to produce concentrated superphosphate. It can also be combined with ammonia, calcium, soda or potash to produce fertilizers or chemicals. In The Western States, it is being used directly as a liquid fertilizer introduced into the irrigation water. It is also used directly in the beverage and chemical industries. Because of the widespread use of liquid phosphoric acid in the food, beverage, and chemical industries, as well as in agriculture, commodity rates have been established from manufacturing points in Florida, South Carolina, New Jersey, New York, Illinois, Missouri, and Texas. Phosphoric acid movements originate either with the company which processes the rock phosphate to produce phosphorus, and ultimately phosphoric acid, or with a firm which purchases phosphorus, burns and hydrates it to form liquid phosphoric acid.

In Figure ___ are shown the commodity rates governing all such established movements in tank car lots.

Rail movement of liquid phosphoric acid is accomplished in specially designed tank cars (usually rubber lined). This factor and the value of the phosphoric acid result in rail rates which are higher than phosphate fertilizers.

Two or possibly three definite rate structures seem to have been developed. The lowest rate structure is composed of movements originating at Anaconda, Montana, and destined to West Coast points. This represents a movement of fertilizer-grade phosphoric acid. A large number of movements originating in the West, East, and South, which move at comparable costs, form a fairly

well-defined rate structure. This represents a chemical or food-grade of phosphoric acid. A third, and the highest, rate structure seems to have been developed for shipments moving from eastern and southern origins to West Coast destinations. Perhaps the volume of these movements is not large enough to have made possible rate reductions. Because of its wide distribution and the large number of shipments represented, the second rate structure was used in this analysis to indicate to potential producers what rail charges they might anticipate for movements of liquid phosphoric acid.

Apparently the new producer of chemical grade liquid phosphoric acid might expect to pay about the following charge per ton.

Miles	Rate per ton-mile (Cents)	Rate per ton (Dollars)	Miles	Rate per ton-mile (Cents)	Rate per ton (Dollars)
200	3.13	6.26	1,200	1.18	14.16
400	2.00	8.00	1,400	1.07	14.98
600	1.67	10.02	1,600	.98	15.68
800	1.47	11.76	1,800	.90	16.20
1,000	1.31	13.10	1,900	.87	16.53

A good case could be presented for lower rates in the case of fertilizer phosphoric acid. It is possible that a larger shipper could obtain more favorable rates to important destination points.

Blanket rates are also applied to movements of phosphoric acid to destinations within a general area. However, the areas appear to be considerably smaller than those for either phosphate rock or superphosphate rail shipments. Blanket rates have been obtained to cover rail charges for shipments originating at Anaconda, Montana, to destinations as far East as Superior, Wisconsin, at $13.20 per ton; Northwest Coastal points at $7.87 per ton; and California Coastal points at $8.20 per ton. Blanket rates for the Pacific Coastal and

for Midwest areas would be to the advantage of the new Western producers and might represent a very significant source of revenue to the carriers.

Elemental phosphorus. Elemental phosphorus is produced commercially only through the electric or blast furnace volatilization processes. The resulting product is essentially pure phosphorus. As stated previously, it has a wide variety of uses of which phosphate fertilizer is one important potential use. To be converted to a phosphate fertilizer, it must be additionally processed. It is burned and hydrated to convert it to liquid phosphoric acid in which form it may be mixed with ground phosphate rock to produce varying concentrations of superphosphate. It may also be mixed with carriers of other plant foods such as ammonia to form ammonium phosphate fertilizers.

Elemental phosphorus is a combustible solid at low temperature when it is exposed to the air. Consequently, it requires special equipment, including steam-jacketed tank cars which, when loaded, are kept free from air by a water seal. Special loading and unloading equipment is required at the points of origin and destination. The product is heated and pumped into water-filled tank cars, the phosphorus displacing the water and solidifying at the bottom of the car. Upon unloading, steam is pumped into the outer jacket of the car, thus melting the phosphorus so it can be pumped from the car. These techniques have been well-developed and are a matter of routine in the handling of phosphorus. The hazards are about the same as those involved in the handling of gasoline.

Due to the special equipment necessary and its relatively high unit value, rail rates are higher for elemental phosphous than for other phosphorus compounds. Established rail rates for elemental phosphorus are shown on Figure ___ , together with average curves drawn through the scatter of the points charted.

As elemental phosphorus is not produced in the Western States at the present time, no shipments have occurred from western points of origin. Inasmuch as western rail rates on comparable phosphorus commodities are somewhat lower than eastern rates, it is possible that new western producers of elemental phosphorus could obtain somewhat lower rates than indicated by the average rate curve shown on Figure ___. The lowest of the two curves representing Tennessee origin are somewhat lower than the average, probably because larger volumes originate in the Tennessee area.

On the basis of existing Tennessee rates, the new producer of elemental phosphorus could expect to pay about the following charges per ton for specified mileages the commodity is moved in tank car lots.

Miles	Rate per ton-mile (Cents)	Rate per ton (Dollars)	Miles	Rate per ton-mile (Cents)	Rate per ton (Dollars)
400	2.95	11.80	1,800	1.51	27.18
600	2.43	14.58	2,000	1.45	29.00
800	2.14	17.12	2,200	1.40	30.80
1,000	1.95	19.50	2,400	1.36	32.64
1,200	1.80	21.60	2,600	1.32	34.32
1,400	1.68	23.52	2,800	1.29	36.12
1,600	1.59	25.44	3,000	1.27	38.10

The only significant rate blankets are to West Coast points from southern or eastern origins. Blanket rates to the Midwestern areas would increase the competitive ability of western producers in these markets and permit large additional shipments over western routes.

Comparison of Transportation Cost Per Ton Of Plant Food

Each of the phosphorus carriers previously discussed contain different amounts of plant food. In order to compare their transportation cost, it is necessary to convert the rail rate for each to a rate per ton of plant food. The following comparison is made on the basis of the estimated cost per ton of plant food to move each type of fertilizer a similar distance. These comparisons are shown in Table 3 and on Figure ___ . It will be noted that for phosphate fertilizers the shipping costs are not included beyond 1,500 miles, the point at which the breaks occur in Figure ___ . Similarly, the transportation cost for liquid phosphoric acid does not extend beyond 1,800 miles.

TABLE 3. ESTIMATED RAIL TRANSPORTATION COSTS PER TON OF PLANT FOOD (Dollars)

Mileage	Ordinary Super phos-phate 18%	Liquid Phos-phoric acid 53%	Amon-ium phos-phate 36%	Triple Super-phos-phate 48%	Ammon-ium phos-phate 59%	Calcium Meta-phos-phate 65%	Ele-mental phos-phorus 229%	Potas-sium meta-phos-phate 93%
200	21.80	11.82	10.90	8.18	6.65	6.04	....	4.22
400	30.04	15.09	15.02	11.27	9.16	8.32	5.15	5.81
600	34.44	18.90	17.22	12.92	10.51	9.54	6.38	6.67
800	37.12	22.15	18.56	13.92	11.32	10.28	7.49	7.18
1000	39.50	24.77	19.75	14.81	12.05	10.94	8.50	7.65
1200	41.06	26.72	20.53	15.40	12.53	11.37	9.43	7.95
1400	41.11	28.21	20.56	15.42	12.54	11.38	10.27	7.96
1600	...	29.43	...	...	...	....	11.09	....
1800	...	30.52	...	...	...	....	11.89	....
2000	...	...	...	...	...	....	12.69	....
2200	...	...	...	...	...	....	13.46	....
2400	...	...	...	...	...	....	14.20	....
2600	...	...	...	...	...	....	14.96	....
2800	...	...	...	...	...	....	15.76	....
3000	...	...	...	...	...	....	16.62	....

Because of the apparent lack of a definite rate structure for rail movement of rock phosphate, it is not possible to compare accurately the transportation cost per ton of plant food with other fertilizers. However, the cost of moving the equivalent of a ton of plant food in the form of high-grade phosphate rock (32 per cent phosphoric acid content) from Conda, Idaho, to Salt Lake City, Utah, a rail distance of 200 miles, is $8.59; whereas, the cost of moving a similar rail shipment from Tampa, Florida, to Chicago, Illinois, a rail distance of 1202 miles, is $33.13 per ton of plant food. Thus rock phosphate moves much more cheaply than ordinary superphosphate but more costly than triple superphosphate per ton of phosphate plant food (P_2O_5). A high concentration of plant food, whether it be nitrogen, phosphoric acid, potash, or a combination, is fundamental in obtaining the most economical form in which to transport fertilizer materials. One ton of elemental phosphorus, equivalent to 2.29 tons of P_2O_5, is the most economical form (with the exception of potassium metaphosphate) in which to transport phosphorus. Potassium metaphosphate, which contains 93 per cent plant food, appears to be the most economical form but because potassium and calcium metaphosphate are not being processed commercially, the lower cost for transporting potassium metaphosphate in the 700 to 1,500 mile range does not have immediate significance. However, it should be kept in mind as should the possible manufacturing of di-ammonium phosphate (21-53-0) having 73 per cent P_2O_5. It is apparent that, even though liquid phosphoric acid is more concentrated than triple superphosphate, it cost considerably more to ship per ton of plant food than triple super or elemental phosphorus.

Such comparisons are, perhaps, an over-simplification because elemental phosphorus requires additional processing after it is shipped. After being

converted to liquid phosphoric acid at the destination point, it may be used:

1. Directly in industry or agriculture.
2. Combined with phosphate rock to form concentrated superphosphate, 30-48 per cent phosphate plant food (P_2O_5).
3. Combined with ammonia to form ammonium phosphates.

Thus, only by the use of phosphoric acid directly or for production of ammonium phosphates can full advantage be taken of the cheapness of shipping elemental phosphorus.

In alternative 2 appropriate amounts of rock phosphate must also be shipped. Table 4 presents a comparison which indicates that, for specified points, the advantage of shipping elemental phosphorus is considerably less when that phosphorus goes into the production of superphosphates. Even so, there is distinct advantage in the movement of phosphorus to the areas of established phosphate fertilizer industry. In the Midwestern and Eastern states, as well as California, a large part of the phosphate fertilizer is used in the manufacturing of mixed fertilizers. The agricultural colleges and the fertilizer industry have pointed out that increasing the plant food content of these fertilizers constitutes a most promising means of decreasing fertilizer cost to the farmers. Because of its low analysis, ordinary superphosphate (18-20 per cent P_2O_5) is not an effective product for use to increase the concentration of mixed fertilizer, whereas, the concentrated superphosphates (32-48 per cent) or ammonium phosphates (11-48-0) can be used effectively for this purpose.

TABLE 4. COMPARISON OF SHIPPING COSTS OF PHOSPHATE FERTILIZER MATERIALS

Origin	Material shipped	Pounds Shipped	Cents Per Cwt.	Total shipping cost per ton of material equivalent to Triple Superphosphate
TO CHICAGO:				
Montpelier, Idaho	Triple Super	2,000	43	$ 8.60
Montpelier, Idaho	Raw Rock Phosphate (32 per cent P_2O_5)	3,000	38.5	11.55
Montpelier, Idaho	Elemental Phosphorus (For use in manufacturing ammonium phosphate)	420 [1]	120	5.04
	(Elemental Phosphorus	283 [1]	120	3.40) 6.87
Montpelier, Idaho	(Rock Phosphate	900	38.5	3.47)
TO GRAND RAPIDS, MICHIGAN				
Montpelier, Idaho	Triple Super	2,000	51	10.20
Montpelier, Idaho	Rock Phosphate	3,000 [1]	40	12.00
Montpelier, Idaho	(Rock Phosphate	900 [1]	40	3.60) 7.17
	(Elemental Phosphorus	283 [1]	126	3.57)
Montpelier, Idaho	Elemental Phosphorus	420 [1]	126	5.29
TO LOS ANGELES:				
Montpelier, Idaho	Rock Phosphate	3,000	.216	6.48
Montpelier, Idaho	Triple Superphosphates	2,000	.37	7.40
Montpelier, Idaho	Elemental Phosphorus	420 [1]	.97	4.07
Montpelier, Idaho	(Elemental Phosphorus	283 [1]	.97	2.75) 4.69
	(Rock Phosphate	900	.216	1.94)

1. No rate established, assumptions based on existing rates as possible rate for similar distance.

Expansion of nitrogen production in California is probable. Thus, a logical manufacturing organization for the far West contemplates the production of phosphorus near the phosphate mines, shipping it as phosphorus to California and to the midwestern and north central states for phosphoric acid and ammonium phosphate production, as well as for the production of more concentrated superphosphates. Ammonia may be shipped to a western phosphorus plant from the Midwest or California for combining with phosphoric acid to produce ammonium phosphates to serve Intermountain and Pacific Northwest needs. Large ammonia production

does not appear probable in the Pacific Northwest because of a lack of certain raw materials.

Partial or total substitution of phosphoric acid for sulfuric acid in the superphosphate manufacturing is a practicable possibility without major changes in the equipment of an ordinary superphosphate plant. This substitution will also greatly increase the plant food output of existing fertilizer plants, will decrease fertilizer handling costs, and should make possible important reductions in the cost of fertilizers to the farmers in a wide area.

Thus, production of elemental phosphorus through furnace processes (blast or electric) provides a means through saving of transportation costs of insuring competitive ability of the western states in meeting an important part of the phosphorus fertilizer requirements of the large market area of the Midwest. It probably will be shipped to all destinations requiring a sufficient volume to justify the installation of burning plants and other facilities of conversion of phosphorus to commercial forms.

Definition of Trade Area for Western Phosphorus and Fertilizer Materials

On the basis of the available information, it is possible to delineate a trade area which might be served from western sources. Consideration must be given to alternative production points and possible production processes and costs at these points. The location of phosphate rock deposits has been indicated previously.

It is generally accepted that the most economical industrial organization includes placing a plant as close to the source of raw materials as possible. Other studies have shown that, when the sulfuric acid process is used, it is considerably cheaper to ship rock phosphate to the sulphuric acid than sulphuric acid to the rock.

In considering the electrical method of processing, it is much cheaper to transmit power than to ship rock, provided power is transmitted in economical quantities. To illustrate this further: Shipment of rock phosphate from Montana or Idaho to Columbia River points cost $4.32 per ton whereas transmission of blocks of power for 400 miles can be accomplished at a cost of about 1 mill[1] per kilowatt-hour. Transmission costs of 1 mill per kilowatt-hour add about $2.50 per ton to the cost of triple superphosphate fertilizer in comparison with $7.78 which would be added by the transportation of rock required to make 1 ton of triple superphosphate (1.8 tons). Potential power generation exists in Montana and Idaho at distances of less than 400 miles from the phosphate deposits. Processing near the phosphate deposits places the finished product much closer to the large midwestern markets, an essential if these large markets are to be served from the West.

Whether western production costs can be kept as low as eastern costs is the subject of careful appraisal by the phosphoric and phosphate industry as well as Governmental agencies. Careful consideration must be given to reducing to a minimum all cost items if the industry is to develop to meet western needs. Besides energy costs, raw material costs and transportation costs are extremely important. Studies of the Department of the Interior are being directed to each of these points and they will be covered in separate reports. Because raw material costs and other production costs will vary with specific locations which cannot be adequately presented in this report, the western production costs are assumed to be equivalent to production costs at competing points for purposes of this study.

1. According to estimates of Sol E. Schultz, Chief Engineer, Bonneville Power Administration.

In dividing the United States into trade territories, two potential fertilizer producing points were considered in addition to the West, as follows: Tampa, Florida, is favorably located with respect to low-cost phosphate rock and sulfur (Gulf Coast) for sulfuric acid. Probably this will be the site of expanded production of triple superphosphate fertilizer by the sulfuric acid process. Houston, Texas, now has a large plant for the manufacture of high analysis phosphate. Because of the low shipping cost of rock phosphate to Houston and the available supplies of sulfuric acid, economical production at this point will probably continue and possibly expand. Because of the lack of large low-cost hydroelectirc potentialities in the southeastern United States area, development of a large electric furnace industry for the production of phosphorus for fertilizer in this area is not anticipated. Blast furnace production of phosphorus for fertilizer may occur in the southeastern or western United States when this process has been proven to be feasible commercially.

No analysis was included of fertilizer transportation costs from Tennessee because important expansion of fertilizer manufacturing appears unlikely in this area in view of declining phosphate rock supplies.

The development of an electric furnace phosphorus industry for fertilizer production will probably be confined to the parts of the West where low-cost electrical energy can help to offset probable higher phosphate rock and coke costs.

Montpelier, Idaho, was selected as a western point located on the railroad near the geographic cneter of the phosphate deposits and, therefore, a potential producing point. Soda Springs or other points within the phosphate area might have been selected.

The studies reported this far have been confined to railroad rates. However, ship and barge transportation of rock phosphate and phosphate is possible from Gulf Coastal points to Mississippi, Great Lakes, and Atlantic Coastal ports. Seagoing barges are customarily loaded at Tampa, Florida, and moved to New Orleans where the load is transferred to river barges and moved up the Mississippi, Missouri, and Ohio Rivers to be unloaded for distribution or use in fertilizer manufacturing or mixing plants. Such movements are regulated by the Interstate Commerce Commission at rates shown in published tariffs. However, full cargo contracts may be made at lower than the published rates. It is, therefore, difficult to evaluate accurately competitive movements of fertilizer from Florida or Houston to points which might also be served by a western industry.

Limited data on recent barge movements up the Mississippi River indicate that for bulk shipments of 500 tons or more rates 20 per cent, or more, below rail rates are entirely possible. Shipments in bags only result in savings of about 10 per cent. Because rate curves tend to flatten out with greater distance, a 10 per cent saving in shipping cost may increase shipping range a much larger per cent.

The data in Table 5 permits a comparison of the lowest published commodity rail or water rates from Montpelier, Tampa, and Houston to specified destination cities.

TABLE 5. Transportation rates per ton for superphosphate fertilizer from Montpelier, Idaho; Houston, Texas; and Tampa, Florida, to selected destinations. (Cheapest means whether rail, water, or combination thereof.)

Destination	Points of Origin					
	Montpelier, Idaho		Houston, Texas		Tampa, Florida	
Kansas City, Kansas	1	$ 7.40	1	$ 7.40	6	$ 9.80
Joplin, Missouri	1	7.40	1	6.80	1	11.80
St. Louis, Missouri	1	7.40	2	6.80	1	7.45
Omaha, Nebraska	1	7.40	1.	8.60	4	14.00
Des Moines, Iowa	1	7.40	1	9.80	1	11.85
Clinton, Iowa	*1	7.40	5	8.00	1	8.35
Minneapolis, Minnesota	*1	7.40	2	8.60	6	10.80
La Crosse, Wisconsin	1	7.40	5	8.40	6	10.40
Springfield, Illinois	1	8.60	5	7.60	1	7.75
Chicago, Illinois	1	8.60	5	8.00	1	8.15
Milwaukee, Wisconsin	1	8.60	5	8.20	1	8.45
Phoenix, Arizona	1	9.80	1	8.20		....
Evansville, Indiana	*1	10.20	5	7.40	1	6.95
Grand Rapids, Michigan	1	10.20	1	10.80	1	8.25
Louisville, Kentucky	*1	10.40	5	8.20	1	7.05
Oklahoma City, Oklahoma	1	10.60	1	6.00	1	12.40
Cincinnati, Ohio		....	5	8.60	1	7.15
Wheeling, West Virginia	*1	11.00	5	9.60	1	8.05
Buffalo, New York	*1	11.00	5	10.40	1	8.75
Amarillo, Texas	1	11.20	1	6.80	1	15.10
Albuquerque, New Mexico	1	11.40	1	8.60		....
El Paso, Texas	1	11.40	1	8.00	1	16.90

1 Rail
2 Rail-barge
3 Barge
4 Barge-rail
5 Rail-barge-rail.
6 All water

Savings which might be made by contract shipment of barge load lots of superphosphate fertilizer or by owner operation of barges by fertilizer companies would improve materially the competitive position of Houston or Tampa in the midwestern markets at river points. As more intense competition develops for these markets, it is probable that such steps will be taken to capture this important new market.

Figure ___ constructed on the basis of the data in Table 5 and other available rate data divides the United States into trade areas which may be served by triple superphosphate from Montpelier in competition with Houston, Texas, or Tampa, Florida, assuming equal production costs at these three points.

Manufactured phosphate fertilizer has never been produced at Montpelier; consequently, present rates are not the same as might be developed if a large industry were established. To picture accurately the trade area which might possibly be served from Montpelier, the Anaconda rate scale was applied to this point on a mileage basis. Figure ___ shows that application of the Anaconda schedule would bring Arizona and New Mexico into the western trade area. It would also add about half of Missouri, half of Illinois, a fourth of Indiana, and all of Michigan. The potential amount of the market thus added to the western producers would approximate the following:

State	P_2O_5 Need [1] Tons	Triple Superphosphate equivalent Tons [2]
Arizona	8,705	18,135
New Mexico	4,521	9,419
Missouri (one-half)	23,841	49,669
Illinois (one-half)	69,335	144,448
Michigan	37,963	79,090
Indiana (one-fourth)	17,596	36,658
Total	161,961	337,419

1 State Production Adjustment Committee. U. S. Dept. of Agriculture Production and Marketing Administration, 1947.

2 Forty-eight per cent P_2O_5. Part of this might actually be shipped as

Roughly computed rail revenues from shipping this amount of fertilizer would be about $2.4 million annually. The western railroads will undoubtedly be sufficiently interested in this amount of business to make serious study of possible rate adjustments to encourage this important new industry.

The Arizona-New Mexico area is served by the Southern Pacific and the Santa Fe Railroads. Inasmuch as the Southern Pacific would handle freight from either Houston or the West, there is apparently less inducement for that company to make rate adjustments than there would be for the Santa Fe to whom a haul from the West would mean new business.

Elemental phosphorus may become a very important new commodity to be handled by western railroads. It has been indicated previously that this is the cheapest way to ship phosphate plant food from the West, that competing producing points will be limited to triple superphosphate, ammonium phosphate or rock phosphate shipments, and that these competing points have the advantage of water shipment to increase their competitive ability in the large midwestern markets. The data in Table 6 indicate the advantage of elemental phosphorus transportation-wise in important market centers. This table attempts to evaluate the savings possible by water transportation from the competing sources of phosphorus for fertilizer, e. g. Florida rock phosphate and Florida triple superphosphate.

TABLE 6. ESTIMATED TRANSPORTATION COSTS FOR COMPETING FORMS OF PHOSPHORUS AT SELECTED DESTINATION POINTS.

Destination-City	Form and source of phosphorus containing material				
	Elemental Phosphorus from Montpelier, Idaho	Rock phosphate from Bartow, Florida		Triple Superphosphate from Tampa, Florida	
	Estimated transportation costs per ton of phosphate plant food (P_2O_5).				
	Dollars [1]	Rail Dollars	Water [2] Dollars	Rail Dollars	Water [2] Dollars
St. Louis, Missouri	10.05	18.69	14.95	15.52	12.42
Buffalo, New York	12.40	....	....	18.23	14.58
Chicago, Illinois	10.35	33.13	26.50	16.98	13.58
Grand Rapids, Michigan	11.00	33.75	27.00	17.19	13.75
Pittsburgh, Pa.	11.85	22.32	17.86	16.77	13.42
Milwaukee, Wisconsin	10.50	33.75	27.00	17.60	14.08
Springfield, Illinois	10.10	31.25	25.00	16.15	12.92
Clinton, Iowa	9.80	22.32	17.86	17.40	13.92
Wheeling, West Virginia	12.05	20.51	16.41	16.77	13.42
New York City	13.85	22.60	18.08	....	....

1 Estimated from Figures ____ .

2 Arbitrarily estimated at 80 per cent of the cost of rail transportation on the basis of limited comparison of existing rail and barge movements in bulk. It is believed that is approximately the rates which might be obtained for bulk movements in lots of 500 or more short tons.

Figure ___ illustrated graphically the trade area which western elemental phosphorus might service in competition with other forms. Service to this area would require annual shipments of as much of 100,000 tons of phosphorus to meet the need for supplementation of phosphates used in mixed fertilizer in California and the midwestern states. It might exceed this figure greatly because of the great demand for this commodity in the chemical industry. At the current rail freight rates for this commodity for approximate distances of 1,000 miles, this would amount to $2 million per year.

The foregoing discussion and charts have indicated the areas which may be served by phosphorus and concentrated superphosphate fertilizers produced in the Western U. S. There appears to be little question that if production costs can be kept down through the use of low-cost energy and the use of selected phosphate rock deposits in accessible locations, the Western industry may be expected to serve a very large area in Central and Western U. S. The application to new producing points of the freight rate structure which exists from important Western producing points or comparably low rates in the case of elemental phosphorus will ensure competition of the Western production in not less than 17 states for triple superphosphate and not less than 4 additional states for elemental phosphorus.

With the volume of northwestern phosphorus and fertilizer industry estimated at not less than 400,000 tons of fertilizer and 100,000 tons of elemental phosphorus it is evident that the transportation industry may well be interested in doing all that is within its power to facilitate this development. The combined effect of this industry may be expected to be far reaching indeed not only in direct rail revenues, employment, markets for local products but a much needed service to agriculture in the West.

Arthur D. Little, Inc.

ACORN PARK
CAMBRIDGE, MASSACHUSETTS 02140
AREA CODE 617 864-5770

March 5, 1965

Mr. Ralph S. Mason, Mining Engineer
Department of Geology and Mineral Industries
1069 State Office Building
Portland, Oregon 97201

Dear Mr. Mason:

Enclosed is a copy of the paper you requested in your letter of January 28, discussing the markets for California phosphorite deposits. I hope you find it useful.

Very sincerely yours,

George C. Sweeney

George C. Sweeney

GCS/bd
Enclosure

May 14, 1952

Mr. G. Donald Emigh, Production Superintendent
Monsanto Chemical Company
Phosphate Division
Soda Springs, Idaho

Dear Mr. Emigh:

You may remember that I met you and talked with you briefly at one of the Spokane A.I.M.E. sessions. I mentioned then that I was very much interested in certain phases of the phosphate industry and might ask you some questions concerning it.

I have been given a letter written by a high government official concerning the cost of phosphate fertilizer to the farmers in the Northwest. The statement is made that because of long railroad hauls the Oregon farmer is paying about 70 percent more for his phosphate fertilizer than the farmer in Alabama. This seems like a very exaggerated statement but I have not up to this time been able to check it.

I have also received a printed statement made by the Manager of the Central Farmers Fertilizer Company which is a corporation owned by 15 agricultural cooperatives operating in the midwest. The statement was presented to the subcommittee hearing held in Washington in March to obtain evidence for and against construction of the high Snake River dam by the government. This statement alleges that there is now insufficient power to take care of any new electric furnace installations in southwestern Idaho and stated that the Central Farmers Fertilizer Company desires to install electric furnace capacity but can get no assurance of reasonably cheap electric energy for an installation. This company is urging construction of a high dam on the basis that such construction is the only way that this company would be assured of sufficient hydro power to allow them to put in the installation they would like to plan for.

Have you any opinion concerning this latter statement presented to the subcommittee hearing? I would appreciate your opinions very much.

Sincerely yours,

Director

FWL:jr

June 5, 1952

Mr. G. Donald Emigh, Production Superintendent
Monsanto Chemical Company
Soda Springs, Idaho

Dear Mr. Emigh:

I appreciate very much your letter dated May 29 giving me detailed information on phosphate fertilizer matters as requested in my letter of May 14. Your data has been most helpful and has enabled me to make a comprehensive report.

I hope very much that I shall see you in the not too distant future so that we may have a little more extended contact than we were able to have in Spokane. I may be obliged to go into the phosphate deposit country to make some studies since I have been appointed as a member of a task force set up by the Columbia Basin Inter-Agency Committee to make a report on many phases of production and marketing of phosphate fertilizer.

With kind regards and sincerely thanking you for your letter,

Cordially yours,

Director

FWL:jr

MONSANTO CHEMICAL COMPANY

SODA SPRINGS, IDAHO

May 29, 1952

RECEIVED
MAY 31 1952
STATE DEPT. OF GEOLOGY
& MINERAL INDS.

Mr. F. W. Libbey
Director
State Department Geology &
Mineral Industries
1069 State Office Building
Portland 1, Oregon

Dear Mr. Libbey:

This reply to your letter of May 14th has been delayed by my absence. I indeed remember with pleasure meeting you and having our short conversation in Spokane. I had hoped I would have occasion to talk with you again at the meetings; however, such did not turn out to be the case, and it is something that I look forward to at our next meeting.

I am interested in the information contained in your letter, and will do my best here to give you my thoughts on the general subject.

The first question that you raise is that a statement has been made that, because of long railroad hauls, the Oregon farmer is paying about 70% more for his phosphate fertilizer than the farmer in Alabama. To the best of my knowledge this is not correct, and I shall list here the information I have at hand which leads me to this opinion.

Our Birmingham sales office tells us that P_2O_5 in fertilizer in Alabama costs the mixing plant 90¢ a unit; a unit of course being 20 pounds. This is the price to the mixing plants themselves, and naturally the price to the farmers would have to be higher. The O.P.S. selling price in Birmingham, Alabama on fertilizer is 95¢ a unit at the factory in bulk. Incidentally, the first price I mentioned of 90¢ I assume must also be in bulk.

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In order to compare the above quoted prices, it would be necessary to bring all final products around to the same packaged and sales conditions. This means that for material quoted in bulk, we should add about $4.50 per ton in order to get it in bags, we should add say maybe $6.00 a ton handling charges to the dealer and maybe we should add about $10.00 a ton freight, although this figure may of course vary. Taking these factors into account, I would say, therefore, that we would come up with the prices on the attached sheet to this letter for treble or superphosphate delivered to the farmer of bagged fertilizer in the different locations. On the attached sheet you will note that in case of Idaho we have added freight in the amount of $6.00 per ton. In all cases I have taken pretty much a shot in the dark as to the amount the dealer takes for handling the material; however, I imagine that this amount is pretty much the same all over the country. I don't know whether I have the right quantities in for dealers, but it doesn't make too much difference for comparison purposes.

As you will see from the prices I have shown, it is pretty much the same whether the farmer is in Birmingham, Alabama or Oregon or Washington. You realize of course that there is no reason for thinking that the price of fertilizer would be the same at any two points in the United States. In some areas, for example, fertilizer can be produced cheaper because of cheaper phosphate rock perhaps, because of cheaper sulfuric acid, because of larger plant facilities, and therefore larger production, etc., etc. One of the big factors which influences the final, delivered price to the farmer is transportation, and certainly the farmer who is further away from the processing plant must expect to pay more than the farmer who is closer. The Alabama country, as you know, is surrounded by the fertilizer producers and I would say in general the Alabama farmer is closer to the fertilizer producing plant than is the farmer in Oregon or Washington, or even Idaho for that matter. I think it is also true that, in general, our freight rates are higher in the West than in the South which is another factor in the picture.

The second point you brought up in your letter of May 14th was in connection with a statement by the Central Farmers Fertilizer Company that there is now insufficient power to take care of any new electric furnace

installation in Southwestern Idaho and that that association desires to install electric furnace capacity but can get no assurance of reasonably cheap electric energy. I am not certain whether the word "Southwestern" which was in your letter is correct or not inasmuch as the phosphate properties of Central Farmers Fertilizer Company are located in the southeastern part of Idaho, and certainly I would not expect the company to ship their phosphate rock completely across the state of Idaho just to get to the power.

As you know, we are at present installing an electric furnace here in Soda Springs which will be the largest electric furnace used in the production of elemental phosphorus in the world and will use the largest amount of electricity for any single furnace. We had no difficulty last summer in obtaining contract for power from Utah Power and Light Company for this furnace, and also an option for power for a second furnace at any time we wanted it. Furthermore, we have been assured by Utah Power & Light Company that they will provide any additional power to us that we will want at any time. Of course, in such a case we would give them probably a year's time to prepare, but you can't build a plant that quickly anyway. Before we decided to come into Soda Springs last summer, we seriously contemplated installing our plant at Pocatello, Idaho, and obtaining our power from the Idaho Light and Power Company. This company in turn advised us that they would furnish our power requirements regardless of their size.

The Westvaco Division of the Food Machinery and Chemical Corporation in Pocatello has, as you know, a three electric furnace operation producing elemental phosphorus. All of this capacity has been installed in the past three years and a fourth furnace is now being added. This power all comes from the Idaho Light & Power. At present, Westvaco in their three furnaces is using 52,000 KW and their new furnace will raise this an additional 25,000 to a total of 77,000 KW.

Victor Chemical Company last November completed their electric furnace plant at Silver Bow, Montana for the production of elemental phosphorus and are now building a second furnace which, when completed, I believe gives their capacity with the two furnaces 40,000 KW load. This power, as I understand, is being purchased from the Bonneville installation of the Federal Government. I think it is pretty general knowledge that the Federal Government has been selling this power at a far cheaper rate than can private industry. It seems to me that the cheap power that Central Farmers Fertilizer Company wants as pointed out in your letter would be a power similar to that furnished by Bonneville, that is power probably considerably below cost and furnished by the Federal Government.

I am enclosing a typed copy of a newspaper article which appeared May 22nd in the Salt Lake Tribune and which contains information in which I am sure you are interested. By way of further information for you, some rough figures that I have compiled indicate that if triple superphosphate were produced from phosphoric acid produced by an electric furnace, the final cost of the triple would only vary between $4 and $5 a ton with power priced at a minimum of 2.5 mills per KW or power priced at about 5 mills per KW. These two figures I think represent the approximate respective prices of power when purchasing from Bonneville and when purchasing from private industry. It does not seem to me that this difference of $4 or $5 is substantial enough to make much difference in production of triple super, when taken into consideration with the many other variable cost factors, among them being the mined cost of the raw rock, freight on the raw rock to a plant, cost of sulfuric acid delivered to a plant, and finally cost of freight on the triple super to the farmer.

This has been a rather long and, I am afraid, rambling letter, Mr. Libbey, but I hope that I have been able to give you some information which may be of use. Should you get down this way, we will be very glad to acquaint you with what we are doing in this country now in the way of developing and mining phosphate properties and building a large electric furnace plant. We expect to be in operation sometime this late fall; however, we are commencing our mining on June 2nd and will mine for the next four or five months, stockpiling at the plant site. Our mining is of course open pit and therefore we are restricted in our mining season to the summer months.

With kindest regards and best wishes,

Very truly yours,

G. Donald Emigh

G. Donald Emigh

GDE:g
Encls.

COST/TON DELIVERED TO FARMER

	Treble (42 -45% P_2O_5)	Super (19% P_2O_5)
Birmingham	63.20	36.60
95¢ x 45 = 42.70 Freight 10.00 Bagging 4.50 Dealer 6.00 $63.20		95 x 19 = 18.10 Freight 10.00 Bagging 4.50 ~~Dealer 4.00~~ $36.60
Baltimore	?	35.00
		87 x 19 = 16.50 Freight 10.00 Bagging 4.50 ~~Dealer 4.00~~ $35.00
Oregon and Washington	70.00	38.00
Cost to Dealer 63.00 Dealer 7.00 $70.00		2.00 x 19 = 38.00
Idaho	70.00	36.20
		1.14 x 19 = 21.70 Bagging 4.50 Freight 6.00 ~~Dealer 4.00~~ $36.20
Kansas	75.00 *	45.00 *

*From Kansas State Board of Agriculture. Report dated March 1952, Vol. 61, No. 307 "Kansas Fertilizer Trends". These figures show cost of fertilizer in Kansas in 1951.

Article Appearing in the Salt Lake Tribune May 22, 1952

HELLS PROJECT SEEN NO PHOSPHATE AID

POCATELLO, IDA. (Special) -- Electric Power from the proposed Hell's Canyon Dam would not reduce the cost of triple superphosphate fertilizer even if the power sold for 2.5 mills per kwh, the Idaho Farm Bureau contended in an information department study issued Wednesday.

John B. Webb, secretary of Idaho Farm Bureau Federation, said cost even with cheaper power would still be approximately $10 per ton higher than when the triple strength fertilizer is made by the "wet" or acid process. The research project was conducted "because of the long-held behlief that no matter what the cost of electric power, the wet process method would be cheaper for production of 48% available phosphate plant food."

INFORMATION SOURCES

Sources of information were articles by W. H. Waggaman, U. S. Bureau of Mines, and R. E. Bell, Portland, Ore., both of the U.S. Department of Interior.

The Farm Bureau study said the writers explained that the sulfuric acid needed in the wet process can be produced from the slag pile of any western smelter using a "metalliferous ore."

Manufacturing costs are broken down as $52.21 per ton by the wet process, $62.85 per ton by the electric furnace method and $66.47 per ton by the blas furnace method.

The Farm Burea report said cost by the electric method was computed on 2.5-mill power "which is not and cannot became a reality in southern Idaho.

MORE EXPENSIVE

"It should also be noted that an electric furnace plant with the same capacity as a wet process plant will cost about three times as much to build. These figures were arrived at by two companies now in phosphate production.

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into giving up their water rirhgts for electric power that will be of no benefit to them."

Bonneville power adminstration proponents of the electric furnace have contended that wet process allows use only of high grade phosphate rock while low grade shale used in electric furnaces is "far more plentiful".

COPY

STATE DEPARTMENT OF GEOLOGY AND
MINERAL INDUSTRIES
1069 STATE OFFICE BUILDING
PORTLAND 1, OREGON

May 14, 1952

Mr. G. Donald Emigh, Production Superintendent
Monsanto Chemical Company
Phosphate Division
Soda Springs, Idaho

Dear Mr. Emigh:

You may remember that I met you and talked with you briefly at one of the Spokane A.I.M.E. sessions. I mentioned then that I was very much interested in certain phases of the phosphate industry and might ask you some questions concerning it.

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Have you any opinion concerning this latter statement presented to the subcommittee hearing? I would appreciate your opinions very much.

Sincerely yours,

F. W. Libbey
Director

FWL:jr

COPY

MONSANTO CHEMICAL COMPANY

Soda Springs, Idaho

May 29, 1952

Mr. F. W. Libbey, Director
State Department of Geology &
Mineral Industries
1069 State Office Building
Portland 1, Oregon

Dear Mr. Libbey:

This reply to your letter of May 14th has been delayed by my absence. I indeed remember with pleasure meeting you and having our short conversation in Spokane. I had hoped I would have occasion to talk with you again at the meetings; however, such did not turn out to be the case, and it is something that I look forward to at our next meeting.

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With kindest regards and best wishes,

Very truly yours,

/s/ G. Donald Emigh

COST/TON DELIVERED TO FARMER

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MORE EXPENSIVE

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Bonneville Power Administration proponents of the electric furnace have contended that wet process allows use only of high grade phosphate rock while low grade shale used in electric furnaces is "far more plentiful".

Phosphate
Geologist

June 9, 1952

Capt. Garland Peyton, State Geologist
Department of Mines, Mining and Geology
425 State Capitol
Atlanta 3, Georgia

Dear Captain Peyton:

I appreciate very much your assistance in providing prompt information in answer to my inquiry regarding phosphate fertilizer. You were very helpful in having Mr. Furcron write me and your letter dated June 4 has contributed to allowing me to make a comprehensive report.

With best regards,

Sincerely yours,

Director

FWL:jr

DEPARTMENT OF MINES, MINING AND GEOLOGY
STATE DIVISION OF CONSERVATION

425 STATE CAPITOL
ATLANTA 3, GEORGIA

May 30, 1952

Dr. F. W. Libbey, Director
State Department of Geology & Mineral Industries
1069 State Office Bldg.
Portland 1, Ore.

Dear Doctor Libbey:

Your airmail letter of May 27 to Captain Peyton was received by him this morning, but because he found it necessary to leave immediately for the field, he asked me to take care of it for him. I have been able to obtain the following information which I hope will be of help to you.

The price of the phosphate rock mentioned in your letter is sold in Georgia at $23.45 per ton, delivered. This price applies only to dealers located within the State. It is shipped in 100-lb. bags. The price to manufacturers at the plant is 84¢ per unit. Of course, freight is added if necessary. At the present time, due to the limited supply of sulphuric acid, there is no additional phosphate available in the State.

Under the AAA program, part of the cost of the phosphate is borne as a subsidy by the Federal Government. In the event a dealer distributes the fertilizer on the farm itself, I understand that he is entitled to a subsidy.

Trusting that this satisfactorily complies with your request, I am

Sincerely yours,

A. S. Furcron

A. S. Furcron
Assistant State Geologist

f/g

RECEIVED
JUN 2 1952
STATE DEPT. OF GEOLOGY
& MINERAL INDS.

DEPARTMENT OF MINES, MINING AND GEOLOGY
STATE DIVISION OF CONSERVATION

425 STATE CAPITOL
ATLANTA 3, GEORGIA

June 4, 1952

Dr. F. W. Libbey, Director
State Department of Geology & Mineral Industries
1069 State Office Bldg.
Portland 1, Oregon

Dear Doctor Libbey:

Reference is made to your air mail letter of May 27 which reached our office just as I was leaving on a field trip. My associate, Dr. A. S. Furcron, attempted to bbtain the information and forwarded it to you the same day. I trust that it proved to be of some assistance in connection with your urgent need at that time.

I find that not much information was obtained concerning the superphosphate which was produced at Wilson Dam, Alabama, by TVA and shipped to various states throughout the nation on some sort of subsidy basis. It is understood that TVA does not attempt to make any profit because they do not wish to be considered in competition with the regular fertilizer manufacturers. I believe that shipments made by TVA are made to certain areas on a basis of recommendations obtained from county agents, farm associations, and such. No doubt such associations agree to pay the freight and loading and unloading costs of such shipments, and to parcel out car-load lots according to the need of various farms in the district to which shipment is sent.

If you should desire more definite information in connection with this type of material, please do not hesitate to write us again.

With best wishes, I am

Sincerely yours,

Garland Peyton

Garland Peyton
Director

p/g

RECEIVED
JUN 9 1952
STATE DEPT. OF GEOLOGY
& MINERAL INDS.

May 27, 1952

AIRMAIL

Capt. Garland Peyton, Director
Department of Mines, Mining and Geology
425 State Capitol
Atlanta 3, Georgia

Dear Captain Peyton:

I have been asked to obtain some information regarding the cost of phosphate fertilizer in Oregon as compared to the south, say in Alabama and Georgia.

Could you obtain for me a cost which would be comparable to the cost of $33.60 per ton in bags for single superphosphate carrying 19 percent P_2O_5 to the Oregon dealer? I am eager to obtain this information as soon as practicable and will appreciate your valuable assistance.

In your statement of cost, if you can obtain a comparable figure to the above, would you please inform me if part of the cost to the farmer or dealer is borne by the P. & M.A. in the Department of Agriculture or T.V.A. itself. In other words, the cost to the Oregon dealer does not contain any element of subsidy. Our phosphate fertilizer comes, for the most part, from the Consolidated Mining and Smelting Company plant at Trail, B.C.

With kind regards,

Sincerely,

Director

FWL:jr

Fertilizers (Oregon)

July 30, 1952

Dr. R. E. Stephensen
Agricultural Experiment Station
Oregon State College
Corvallis, Oregon

Dear Dr. Stephensen:

Thank you very much for replying to my questions regarding fertilizer problems which the Oregon farmer has to solve. Your expert knowledge of the matter will be of substantial assistance to me.

Very truly yours,

Director

FWL:jr

OREGON STATE COLLEGE
SCHOOL OF AGRICULTURE EXPERIMENT STATION
EXTENSION SERVICE
CORVALLIS

RECEIVED
JUL 30 1952
STATE DEPT. OF GEOLOGY
& MINERAL INDS.

July 28, 1952

Mr. F. W. Libby, Director
State Dept. of Geology
1069 State Office Building
Portland, Oregon

Dear Mr. Libby:

My opinion on your questions is:

1. More phosphate would be used if the price were lower, and the fertilizer were more plentiful and easier to get. The supply is short at times now.

2. Farmers object to constantly increasing prices of all fertilizers, especially since the prices of products to sell are generally going down instead of up.

3. Freight rates are an important item of cost in providing fertilizers especially since the shipping distance is relatively great.

4. The higher the grade of the fertilizer the more value obtained for the money, and farmers are aware of this fact.

We need perhaps more than any other form of fertilizer a cheaper source of nitrogen, such as anhydraus ammonia, which is already coming in to Oregon.

Ammonia combined with phosphoric acid, is an excellent fertilizer for many uses.

The ammophos fertilizers 16-20-0 and 11-48-0 are popular with Oregon farmers, except for the price which is high. Much of this fertilizer comes from Trail, B.C. We need a cheaper and more convenient source of such materials.

Very truly yours,

R. E. Stephensen
Prof. of Soils

RES:he

July 24, 1952

Dr. R. E. Stephenson
Agricultural Experiment Station
Oregon State College
Corvallis, Oregon

Dear Dr. Stephenson:

I am on a committee representing the Columbia Basin Inter-Agency Committee which is supposed to investigate various elements connected with the phosphate fertilizer industry. Can you give me any pointers on any problems connected with the availability of phosphate fertilizer to the Oregon farmer?

Would you say that much more phosphate fertilizer could be used to advantage in Oregon if the price were lowered? Do you hear any complaints among the farmers of high prices for fertilizers in general and phosphate fertilizer in particular? Do you feel that high railroad freight rates have a considerable influence in affecting the price of the phosphate fertilizer to the farmer, or is the transportation item a small percentage of the delivered cost in the fertilizer form usually used - that is, in mixed fertilizers? One question which I suppose would be very difficult to answer is if the farmers would use a phosphate fertilizer of much higher grade in P_2O_5 content than the ordinary super and triple grades.

I would appreciate any information you can supply in regard to these or any other problems or obstacles in the use of phosphate fertilizer in Oregon.

Yours sincerely,

Director

FWL:jr

Phosphate Fertilizer

Geological Survey of Alabama
Survey Staff

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STEWART J. LLOYD, Asst. State Geologist
E. F. BURCHARD, Geologist
HUGH D. PALLISTER, Geologist
WINNIE McGLAMERY, Paleontologist
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FREIGHT AND EXPESS, Tuscaloosa, Alabama

May 29, 1952

Dr. F.W. Libbey, Director
State Department of Geology and
Mineral Industries
1069 State Office Building
Portland 1, Oregon

Dear Dr. Libbey:

Dr. Jones has referred your letter of May 27 to me for reply.

In order to get the comparitive cost, I talked to the head of the Farmers Marketing and Exchange Association here in Tuscaloosa and he told me that a price comparable with your $33.60 per ton in bags for single superphosphate carrying 19% P_2O_5 to the Oregon dealer would be $25.10 for 20% P_2O_5. Further, the government gives a credit allowance of $11.60 to the dealer and on crops which are proved, it would amount to about a dollar per acre to the farmer.

Hoping that this information is what you desire and with kindest regards from Dr. Jones and myself, I am

Sincerely yours,

Hugh D. Pallister

Hugh D. Pallister
Consulting Geologist

RECEIVED
JUN 2 1952
STATE DEPT. OF GEOLOGY
& MINERAL INDS.

May 27, 1952

AIRMAIL

Dr. Walter B. Jones, State Geologist
Alabama Geological Survey
University, Alabama

Dear Dr. Jones:

I have been asked to obtain some information regarding the cost of phosphate fertilizer in Oregon as compared to the south, say in Alabama and Georgia.

Could you obtain for me a cost which would be comparable to the cost of $33.60 per ton in bags for single superphosphate carrying 19 percent P_2O_5 to the Oregon dealer? I am eager to obtain this information as soon as practicable and will appreciate your valuable assistance.

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With kind regards,

Sincerely,

Director

FWL:jr