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Recent Developments in the Economics of the Potash Industry, with Particular Reference to Carlsbad, New Mexico

Louis Hayner Kurrelmeyer

ECONOMICS OF THE POTASH INDUSTRY - KURRELMEYER

RECENT DEVELOPMENTS IN THE ECONOMICS OF THE POTASH INDUSTRY, WITH PARTICULAR REFERENCE TO CARLSBAD, NEW MEXICO

A Thesis

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the Faculty of the Department of Economics

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In Partial Fulfillment

of the Requirements for the Degree

Master of Arts

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by

Louis Hayner Kurrelmeyer

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Although much background material on the potash industry is contained in the standard references, and a considerable amount of recent data is available through governmental and private sources, this study could not have been completed without the generous cooperation of men within the industry.

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County Agent for Eddy County; Mr. C. D. Smotherman, of the United Mine-Mill and Smelter Workers Union; and the staff of the County Treasurer's office.

Special thanks are due the following members of the faculty of the University of New Mexico: Professor Jack E. Holmes, of the Division of Government Research; Professor Ralph Edgel, Director of the Bureau of Business Research: Professor David Hamilton, of the Department of Economics; and the members of the thesis committee, Drs. Nathaniel Wollman, Mervyn Crobaugh, and Julian Duncan of the Department of Economics.

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The economic importance of the potash industry may best be considered in terms of its importance to three politico-economic areas: the United States, the State of New Mexico, and the City of Carlsbad, New Mexico.

From a strictly economic point of view, the domestic potash industry is not of extreme importance to the United States. Potash is a constituent of soap and munitions, to mention two of its industrial uses, and it is a necessary plant food. The fertilizer industry annually consumes 90% of total consumption. Our national economy could not long survive its complete absence. The industry employs between three and four thousand workers at wages substantially above the national average, and it makes a modest contribution to the federal budget in the form of royalties on leased lands. But European producers, even though largely cartelized and supporting considerable excess capacity, can in normal times compete favorably with the American producers because of lower transportation costs.

Politically, however, the American potash industry is vital both to the United States and to Canada. Twice within thirty years our foreign sources of supply, located primarily in France and Germany, have been cut off by war. In World War I, when we had no domestic supply, every available source was tapped, without regard for cost. Prices rose as high as $484 per ton, approximately eleven times the pre-war level, while 128 small plants could provide only one fifth of the normal consumption.[1]

1. Thorp, Willard L., and Ernest A. Tupper. The Potash Industry, a Report Submitted to the Department of Justice by the Department of Commerce, May 1, 1940. p. 9.

I - INTRODUCTION

As soon as imports were restored,prices fell to former levels and all but one of the domestic producers were forced out.

By the beginning of the second World War, the domestic potash industry had achieved considerable stature. In 1940 the output of the three major producers was 380,000 short tons K_2O equivalent, or about 77% of all sales in this country. By the following year imports had dropped to a negligible 13,000 tons K_2O, but domestic production of 525,000 tons K_2O more than supplied the difference. By 1944 production had reached 838,000 tons K_2O. This remarkable increase was accomplished without any increase in price. The American potash industry has proved that it can supply our needs.

The State of New Mexico consumes a negligible amount of potash each year. (Around 5/1000 of 1% of total U.S. consumption.) The importance of the industry to the state lies in the revenue which is derived from the three firms operating in the Carlsbad-Loving area. In addition to state income and sales (school) taxes, which are paid by all corporations, the state receives funds from lands leased to the firms, and also collects 2½% of the gross value of the potash mined, as a severance tax. The state also receives from the federal government 37½% of all royalties paid in on the federal leases. An accurate figure for the total revenue received by the state is not available, but in 1949, severance tax payments alone amounted to $208,500. This is second only to the amount paid by the oil and natural gas industry.

That the city of Carlsbad, New Mexico, has changed in the past thirty years is quite evident. In 1920 the population was 2205; in 1930, 3708; and by 1940 it had risen to 7116. A conservative current estimate, based

upon the postmaster's estimate for a slightly larger area, runs around 24,500. The total non-corporate tax valuation of Carlsbad has risen from $249,600 to $1,820,200. The city still shows the signs of its too-rapid growth. Many streets in the newer parts of the city are not paved. The schools are badly overcrowded, although energetic measures are being taken to remedy this condition. Much new construction is expected this year. It remains to isolate and weight the factors affecting the growth of Carlsbad.

Eddy County, New Mexico, includes two large cities, Artesia and Carlsbad, which serve as shopping centers and transportation centers for a substantial part of the county. The principal economic assets of the county are oil and natural gas, sheep, cattle, alfalfa, cotton, potash, and the Carlsbad Caverns, which support a flourishing tourist trade. This last is aided no small amount by the mild winter climate of the region. Table I gives a comparison of various pertinent data for the years 1933 to 1949.

The livestock industry has had little, if any, influence on the recent growth of Carlsbad. The number of cattle and sheep grazed in the county depends mainly on the rainfall on the ranges. Moreover, most of the cattle are shipped out for fattening and slaughter. Since 1948, water conditions have been poor, with the result that herds have been reduced. The only industry which has grown with Carlsbad has been the dairy industry, which supplies bottled milk only. It has been a result of the growth of Carlsbad, and not a cause.

The main crops of Eddy County are cotton and alfalfa, all of which must be irrigated. In 1941 there were 71,100 acres under cultivation, of

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TABLE I - Data for Carlsbad and Eddy County, 1933 - 1949.

Year	Cavern Attendance[1]	Value Cattle[2]	Value Sheep[2]	Land and Improvements[2]
1933	56,000	$385,600	$ 10,500	$1,911,000
1934	92,400	414,900	133,700	2,146,500
1935	116,500	287,100	101,000	2,137,900
1936	155,400	387,400	96,500	2,173,000
1937	207,000	410,900	107,500	2,194,300
1938	200,600	477,600	145,900	2,236,800
1939	218,400	421,600	125,400	2,193,100
1940	241,600	390,200	120,300	2,294,000
1941	285,400	416,500	116,500	2,318,400
1942	124,800	503,400	153,800	2,391,400
1943	89,100	523,400	159,800	2,473,400
1944	122,500	547,300	152,300	2,573,300
1945	193,200	533,600	117,800	2,540,000
1946	380,500	562,500	132,000	2,618,800
1947	405,200	646,900	188,400	2,703,200
1948	435,500	532,400	168,500	2,885,200
1949	431,200	559,200	141,000	3,026,600

Year	Number of Tax Payers[3]	Total Noncorporate Valuation[3]	Value Potash Mines[2]	Total Corporate Valuation[4]
1933	856	$2,012,700	$ 806,900	$ 926,900
1934	821	2,182,000	2,438,400	2,025,800
1935	845	2,268,000	2,408,800	2,066,300
1936	855	2,401,000	3,602,800	2,929,100
1937	1,124	2,560,500	4,538,200	3,637,300
1938	1,063	2,816,600	5,800,700	4,113,100
1939	1,100	2,885,100	5,934,600	3,363,000
1940	1,238	3,025,900	6,295,600	3,363,600
1941	1,352	3,321,200	8,437,100	4,859,000
1942	1,463	3,679,600	9,684,100	5,912,300
1943	1,659	4,441,200	11,135,500	7,404,200
1944	1,574	4,061,100	13,566,200	9,165,200
1945	1,770	4,335,200	13,672,600	8,743,100
1946	1,969	4,598,400	13,094,600	14,983,600
1947	2,165	5,499,300	17,176,400	11,293,700
1948	2,398	6,493,000	18,623,200	12,364,800
1949	3,911	8,777,100	20,281,600	13,000,000 *

1 - Source: Carlsbad Daily Current Argus weekly summary.
2 - For all of Eddy County. Source: Public Tax Rolls.
3 - For the City of Carlsbad. Source: Public Tax Rolls.
4 - Since many corporations doing business in Carlsbad are listed for Carlsbad School District to avoid paying city taxes, this area has been included. Source: Public Tax Rolls.
* - An estimate: Carlsbad School district was altered in 1949.

TABLE I - Data for Carlsbad and Eddy County, 1923 - 1949.

Year	Tavern Attendance[1]	Value Cattle[2]	Value Sheep[2]	Land and Improvements[2]
1923	56,000	305,600	10,500	1,211,000
1924	52,100	414,900	123,700	2,116,500
1925	116,500	287,100	101,000	2,137,300
1926	155,400	327,400	96,500	2,173,000
1927	207,000	410,900	107,500	2,184,300
1928	209,600	417,600	118,900	2,236,800
1929	218,400	421,600	125,400	2,273,100
1930	214,600	390,200	120,300	2,294,000
1931	285,400	416,500	116,500	2,318,400
1932	124,800	507,400	153,800	2,391,400
1933	89,100	523,400	159,800	2,417,400
1934	122,500	514,300	152,300	2,573,300
1935	193,200	533,600	137,800	2,580,000
1936	380,500	562,500	132,000	2,618,800
1937	405,200	614,900	138,400	2,703,200
1938	435,500	542,400	168,500	2,885,200
1939	433,200	559,200	141,000	3,026,600

Year	Number of Tax Payers[3]	Total Nonoccupancy Valuation[3]	Value Total Taxable Items[3]	Total Corporate Valuation[4]
1923	856	2,012,700	806,300	926,300
1924	821	2,189,000	2,138,400	2,025,800
1925	845	2,260,000	2,408,800	2,066,300
1926	895	2,402,000	3,602,800	2,929,100
1927	1,124	2,560,500	4,513,200	3,637,300
1928	1,063	2,726,600	5,800,700	4,113,100
1929	1,100	2,885,400	5,934,600	3,363,000
1930	1,298	3,082,300	6,295,600	3,383,600
1931	1,352	3,321,200	6,417,100	4,559,000
1932	1,413	3,672,600	9,684,100	5,912,300
1933	1,659	4,412,000	11,135,500	7,104,200
1934	1,571	4,064,100	13,566,200	9,165,200
1935	1,770	4,335,200	13,672,600	8,713,100
1936	1,969	4,598,400	13,094,600	11,983,600
1937	2,165	5,402,300	17,176,400	13,293,700
1938	2,398	6,423,000	16,623,200	12,364,800
1939	3,213	8,277,200	20,231,600	13,000,000*

1. - Source: Carlsbad Daily Current Argus weekly summary.
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which about one third was watered by the Pecos River, and the remainder by wells. At the present time there are about 75,000 acres under cultivation.[2] Some of the alfalfa is used locally for feed, but most of it, and all of the cotton, is shipped out of the county for processing. There are also three or four vegetable growers of only moderate size in the county. Most of the fresh vegetables are shipped in from Southern Texas and even California.[3] The agricultural acreage is determined largely by the supply of water for irrigation, and has not been directly related to the growth of Carlsbad. A considerable number of farm and ranch children have gone to work for the potash companies, but this is the only obvious connection between the two industries.

The city of Artesia is located in the northern part of Eddy County, and is the center of a large oil and natural gas producing area. There are, however, no oil wells within fifteen miles of Carlsbad, although some persons in Carlsbad receive income from oil properties. If the rapid growth of Carlsbad is to be attributed to any of its major economic activities, then the tourist trade and the potash industry must be responsible.

The Carlsbad Caverns, known locally for many years, were made a National Monument in October, 1923. Since then they have served as a central attraction of Carlsbad's large tourist trade. No accurate index of the latter is available, but the attendance figures for the Caverns may serve as a rough estimate. The number of service stations, eating places, motels,

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curio shops, and the like in and around Carlsbad attest to the importance of the visiting dollar.

The first discovery of an exploitable potash deposit in New Mexico was made from an oil drilling core in 1925 by Victor H. McNutt, an oil geologist. By 1929 the United States Potash Company had started construction of its mine and refinery, and in January 1931 the first carload of ore went out. "Carlsbad never knew there was a depression."[4] Since then two more firms have entered production, and at the present time a third is preparing to do so. The corporate tax valuation of the three present firms is given in table I. Since the valuation is based on both physical assets and value of product, it gives a fair idea of the growth in size of the industry in Carlsbad.

At the present time the potash companies employ about 2700 hourly workers, and pay them slightly under $1,000,000 in wages every month.[5] Thus, one person in nine in the city of Carlsbad work for the three companies. About twenty-five of the families live at the mines,[4] and the remainder, almost without exception, reside in Carlsbad. It has been estimated that some 40% to 45% of the workers own their own homes.[6]

The importance of the potash workers' wages to Carlsbad may be seen from data collected after the recent strike, which cut off the wages of

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4. Information and quote received in an interview with Mr. Victor Minter, Vice-President of the Carlsbad Chamber of Commerce, January 26, 1950. Mr. Minter has been a member of the Chamber for over twenty years, and has played an important role in the growth of Carlsbad.

5. The average annual wage is $4200, the average family 3.6 persons. Confidential industry source.

6. Industry estimate. Mr. Minter gives a figure of not less than 50%. Union data is not available.

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some 2300 workers for 73 days. By the end of this period furniture sales had dropped 25%, department store sales 39%, and food sales an estimated 15% to 20% over the corresponding period of the previous year.[7] That the decline in retail sales was not greater is largely due to shoppers from outside the city, and to salaried workers who were not affected by the strike.

Practically all of the wages paid by the three potash companies are spent in Carlsbad; practically none of the dividends paid by the firms go to residents of the city. During the recent strike, the residents of Carlsbad, while paying lip service to the potash firms, supported the strikers by extending credit to them.[8] It was only during the closing weeks of the strike, when it was obvious that the union had lost, that popular support seems to have turned toward the firms. Since the end of the strike the parent Mine-Mill Union has been expelled from the C.I.O. for alleged Communist tendencies, and this is the reason most often advanced to the author for the city's refusal to support the strike publicly.

There can be very little doubt that the potash industry has played a major role in the growth of Carlsbad. And by the same token, the closing

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7. Before the strike sales had been running somewhat ahead of the previous year. Source: Personal survey by the author of leading places of business in Carlsbad.

8. During the strike the union, Local 415 of the United Mine-Mill and Smelter Workers, C.I.O., received in the neighborhood of $5,000 in aid from sources outside Carlsbad. (Totaled from accounts in the Carlsbad "Daily Current-Argus".) It is possible, and indeed seems probable, that additional contributions were made secretly by the residents of Carlsbad although no evidence of any such contributions has been discovered by the author. The data and some of the inferences of this paragraph were supplied by a confidential industry source.

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down of the American potash industry in peace time to preserve our resources for use in times of emergency would leave Carlsbad something of a "ghost town".

II - THE PRODUCT

The name potash is used to designate the theoretical equivalent in potassium oxide (K_2O, a compound never found in nature, but which is used as a yardstick.) of the various potassium-containing chemical compounds. Potassium is present in nature in many forms, but in order to be utilizable in agriculture and in most industries, it must be in a water-soluble form; and this limits the sources from which it may easily be secured.[9] Table II gives a list of the various potash minerals. Only the chlorides and the sulphates are water-soluble. The major water-soluble sources are salt brines, including sea water; certain minerals deposited by the Permian Sea many eons ago; and by-products of certain processes, such as cement making, distillation, wood fires, and the like, from which relatively small amounts are obtained.

The first major source of potash in the United States was Searles Lake, in the extreme north-west corner of San Bernardino County, California. In 1863 John W. Searles recognized the lake as a possible source of borax, and staked out a claim to it. Borax was produced from the early 70's until 1895, when more economical sources were brought into production. In 1912, under the stimulus of reduced imports from Germany, the Hornsey process was developed for extracting potash from the salt brines. These brines are chemically complex, and the process is quite complex as well, since soda ash, salt cake, and boron products are produced along with potash in the main plant. The ratio of potash production to borax production is fixed,

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TABLE II - The Potash Minerals.

Name	Composition	Equivalent K_2O Content
Chlorides:		
Sylvite	KCl	63.1%
Carnalite	$KCl.MgCl_2.6H_2O$	17.0
Chloride-Sulphates:		
Kainite	$MgSO_4.KCl.3H_2O$	18.9
Sulphates:		
Alunite	$K_2(Al(OH)_2(6)SO_4)_4$	11.4
Polyhalite	$K_2SO_4.MgSO_4.2CaSO_4.2H_2O$	15.5
Langbeinite	$K_2SO_4.MgSO_4$	22.6
Leonite	$K_2SO_4.MgSO_4.4H_2O$	25.5
Syngenite	$K_2SO_4.CaSO_4.H_2O$	28.8
Krugite	$K_2SO_4.MgSO_4.4CaSO_4.2H_2O$	10.7
Apthitalite	$(K,Na)_2SO_4$	42.5
Picromerite	$K_2SO_4.MgSO_4.6H_2O$	23.3
Kalinite	$K_2SO_4.Al_2(SO_4)_3.24H_2O$	9.9
Nitrates:		
Niter	KNO_3	46.5
Silicates:		
Leucite	$KAl(SiO_3)_2$	21.4
Feldspars:		
Orthoclase	$KAlSi_3O_8$	16.8
Anorthoclase	$(Na,K)AlSi_3O_8$	2.4 - 12.0
Micas:		
Muscovite	$H_2KAl_3(SiO_4)_3$	11.8
Biotite	$(H,K)_2(Mg,Fe)_2Al_2(SiO_4)_3$	6.2 - 10.1
Phlogopite	$(H,K,Mg,F)_3Mg_3Al(SiO_4)_3$	7.8 - 10.3
Lepidolite	$H,Li(Al(OH,F_2)Al(SiO_3)_3$	10.7 - 12.3
Zinnwaldite	$H_2K_4Li_4Fe_3Al_8F_8Si_{14}O_{42}$	10.6
Roscoelite	$H_8K(Mg,Fe)(Al,V)_4(SiO_3)_{12}$	7.6 - 10.3
Glauconite	$KFeSi_2O_6.nH_2O$	2.3 - 8.5
Carnotite	$K_2O.2U_2O_3.V_2O_5.3H_2O$	10.3 - 11.2
Nephelite	$K_2Na_6Al_8Si_9O_{34}$	0.8 - 7.1

SOURCE: Johnson, B. L. Potash. Economic Paper 16. U.S.Bureau of Mines.

TABLE II - The Potash Minerals.

Name	Composition	Equivalent K_2O (Wilson)
Chlorides:		
Sylvite	KCl	63.1%
Carnallite	$KCl.MgCl_2.6H_2O$	17.0
Chloride-sulphates:		
Kainite	$KCl.MgSO_4.3H_2O$	18.9
Sulphates:		
Alunite	$K_2(Al_2(OH)_4)_2(SO_4)_4$	11.4
Polyhalite	$K_2SO_4.MgSO_4.2CaSO_4.2H_2O$	15.5
Langbeinite	$K_2SO_4.2MgSO_4$	22.7
Leonite	$K_2SO_4.MgSO_4.4H_2O$	25.5
Syngenite	$K_2SO_4.CaSO_4.H_2O$	28.8
Krugite	$K_2SO_4.4CaSO_4.MgSO_4.2H_2O$	10.7
Aphthalite	$(K,Na)_2SO_4$	42.8
Picromerite	$K_2SO_4.MgSO_4.6H_2O$	23.3
Kainite	$KMgSO_4.Al_2(SO_4)_3.24H_2O$	7.9
Nitrates:		
Niter	KNO_3	46.5
Silicates:		
Leucite	$KAl(SiO_3)_2$	21.6
Feldspars:		
Orthoclase	$KAlSi_3O_8$	16.9
Amorthoclase	$(Na,K)_2O.Al_2O_3.6SiO_2$	8.4 - 12.0
Micas:		
Muscovite	$H_2KAl_3(SiO_4)_3$	11.8
Biotite	$(H,K)_2(Mg,Fe)_2Al_2(SiO_4)_3$	0.2 - 10.1
Phlogopite	$(H,K)_2(Mg,Fe)_3Al_2(SiO_4)_3$	7.8 - 10.3
Lepidolite	$H_2Li_2(Al(OH,F)_2)_2Al(SiO_3)_3$	10.1 - 12.3
Zinnwaldite	$H_2O_{12}Li_2K_2Fe_2Al_2Si_6O_{24}$	10.6
Roscoelite	$H_2K(Mg,Fe)_2(Al,V)_2(SiO_3)_6$	7.6 - 10.3
Glauconite	$(Fe,Al)_2O_3.nH_2O$	2.1 - 8.1
Carnotite	$K_2O.2UO_3.V_2O_5.3H_2O$	10.3 - 11.2
Nephelite	$K_2Na_2Al_2Si_2O_8$	0.8 - 7.1

SOURCE: Johnson, L. Potash. Economic Paper 10. U.S. Bureau of Mines.

and is approximately two to one. Except for this fact, there is nothing to be gained from a description of the process. Such a description may easily be secured from one of the chemical journals. The potash is in the form of KCl, averaging 97% pure.

The Permian Basin, extending over parts of New Mexico, Texas, Colorado, Oklahoma, and Kansas, is largely subsurface, and has not yet been clearly defined. The only parts of it which are known at the present time to be suitable for economic production are those in a relatively small section of Eddy County, New Mexico. Many potash-bearing minerals have been found in this area, some of the most important being polyhalite, sylvite, kainite, carnallite, and langbeinite. The basin has been surveyed by some 97 core tests, a large majority of which are in New Mexico.[10] The part of the basin in which minerals averaging as much as 14% K_2O in beds at least four feet thick occur is known to cover some thirty-five square miles, and may be even more extensive.

No careful examination of the Carlsbad processes will be attempted here. The general bibliography contains articles on the individual processes, together with detailed accounts of the mining procedures. It is, however, desirable to mention certain saliant features of the three processes.

USPC uses the old European process of fractional crystalization, and the baxic elements of the process are not covered by patents. (This is true of the other methods as well.) Important developments have been

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10. This is the latest published figure obtainable, although some recent prospecting has been carried on, and more test cores certainly have been secured.

10. This is the latest published figure obtainable, although more
prospecting has been carried on, and more light could certainly have
been secured.

made in some of the specific phases of the method, especially the cooling phase, and these are patented. They give USPC a definite cost advantage over the European producers.

PCA refines by crushing the ore and then floating the impurities off the potassium chloride. Not all of the KCl is recovered, and the remainder is secured by crystallization. Potassium sulphate is produced for PCA by another firm in Texas.

IMCC reverses the flotation method, floating the KCl off the impurities. This method is superior to that to PCA in that no further refining is necessary. Vital elements of these two flotation methods aree patented.

The relative costs of the three methods are closely guarded by the three firms; but certain inferential material from a confidential but reliable source indicates that IMCC has the advantage. IMCC produces the purest product in the industry, a chemical grade of potassium chloride which averages 99.97% pure.

Recent deep wells in Grand County, Utah,have revealed the presence of both sylvite and carnallite. Little is known about the exact thickness of these beds, since much folding has occurred, but they lie at a depth of about 2000 feet. This is roughly equal to the depth of the German deposits, and about twice the depths of the New Mexico ores. Lake Bonneville, a large mud flat in Toole County, Utah,is the site of one of the present potash companies. Nothing is known about their process.

Since the United States has only a finite quantity of first-order reserves (sources now productive), the question of potash reserves is quite

important. The first-order reserves were estimated in 1946 as follows:[11] Searles Lake, 20,000,000 tons K_2O (14,000,000 tons recoverable); New Mexico, 86,000,000 tons (58,000,000 recoverable); and Lake Bonneville, 1,000,000 tons recoverable

As far as is known, this data is correct for Searles Lake and Lake Bonneville. However,recent ore discoveries and improvements in mining methods have greatly increased the known recoverable first-order reserves in the Carlsbad region.

Considerable prospecting has been carried on in the past ten years. According to reliable industry sources, at least 20,000,000 tons of first-order reserves of K_2O have been discovered since 1942, and of this amount at least 10,000,000 tons have been discovered since the date of publication of the Dolbear report. It is therefore possible that even more of the total is not included in the Dolbear estimate. These considerations yield a minimum figure for first order reserves in the Carlsbad region of 96,000,000 tons K_2O.

The Dolbear estimate of recoverable reserves was based on recovery of 75% of ore in mining and a subsequent loss of 10% in refining. Recent experiments carried on by IMCC indicate that up to 93% of the ore may eventually be recovered in mining by reducing the size of the pillars after the main ore-body has been worked out. Further, 8% of loss in refining is now considered average. Using figures of 90% recovery and 8% loss, the present minimum recoverable reserves in the Carlsbad area are about 80,000,000 tons K_2O.

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11. Potash Reserves of the United States. Samuel H. Dolbear (New York, 1946).

This yields a total for the United States of 95,000,000 tons recoverable K_2O, representing about 2% of the world's known reserves. The remainder is distributed as follows: Germany, 50%; France, 6%; Spain, 5%; U.S.S.R., 14%; and Palestine, 23%. At present consumption these first-order reserves will last the United States about 85 years; and further exploration of the West Texas-Eastern New Mexico area may reveal much greater reserves.

Second order reserves consist of alunite and carnallite, which are also under consideration for the production of magnesium and aluminum. The chief source of these two minerals is Utah. The theoretical K_2O content of alunite is 11.4%, but tests indicate that the actual content is of the order of 7.7% to 9.8%. The available reserves of K_2O from this source is probably of the order of 3,000,000 tons. Substantial but unknown reserves are available in the form of carnallite. The United States Government is currently financing explorations which may lead to the development of these minerals.

The list of so-called third-order reserves, those which are potentially available but probably will not be developed for some time, is quite long. It includes polyhalite, leucite, greensand, sericite, feldspar, and others. Of these, polyhalite and greensand are perhaps the most important: polyhalite because it occurs in large quantities in the Carlsbad region, which is already developed (and hence could be mined at very little additional overhead cost), and greensand, also called Marl, because it is present in large quantities relatively near the centers of consumption. (It could be mined by open-pit methods in New Jersey and Delaware.)

The proper classification of sea water is rather difficult. It contains about .05% K_2O, and methods have been developed to extract about 70% of this amount. Cost of operations has been estimated at about $.50 per 20 pound unit of K_2O, and it is likely that a price of $1.00 for the mined product (compared with the current price of $.37 per unit, f.o.b. Carlsbad, and $.455 f.o.b. Trona, California.) would be necessary to make this source available. The great advantage of sea water would be that the plants could be located near the Atlantic and Gulf states, where about 60% of consumption occurs.

It has often been suggested that the United States should either reduce or cease its production of potash in peace, so as to preserve its reserves for times when foreign sources are not available. For one example, we may quote a recent paper by C. Kenneth Horner, of the Chemicals Division, Office of International Trade.

"While it appears that potash production and demand are approaching a balance, (he is speaking of the United States) it is believed that the United States imports should constitute a fair proportion of consumption as a policy of conservation of natural resources. Known reserves of high grade water-soluble potash salts in present operations are relatively limited, and are estimated will last from 50 to 100 years."[12]

It is possible to disagree with his opinion here, although his estimate of first-order reserves agrees with the figure above, which seems to be the minimum defensible figure. First, new first-order reserves are being developed all the time, as is evidenced by the discoveries of the past three years. Second, the history of technological progress made by the American potash industry has been so amazing that to doubt the

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12. Potash-World Production and Supply. Page 15. (March, 1950).

possibility of further advances bringing new minerals and sources into economic production would be a definite error, especially in view of the steps already taken, in connection with minerals that can be made yield more than one product. The Carlsbad field was developed only 20 years ago. We still have 80 years to develope new reserves.

Basically, the product of the potash industry is the element potassium, in a water-soluble form. There are no substitutes for potash, and the only choice offered the consumer is whether or not to consume potash. All of the firms produce potassium chloride, the so-called "muriate of potash". The KCl averages 99% pure and between 60% and 62½% K_2O content, whence the name "60% muriate".[13]

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13. Since, in converting various forms of potash to their equivalent potassium content in terms of K_2O, it is necessary to use the atomic weights of the various elements, it seems desirable to present these weights together with the method of calculation. This elementary chemistry is of technical interest only. It was provided by Professor B. Kurrelmeyer of Brooklyn College, Brooklyn, New York.

    The atomic weights of the elements of potassium chloride, potassium sulphate, and the double sulphate of potassium and magnesium are as follows: (Correct to the nearest .01)

Oxygen	O	16.00
Magnesium	Mg	24.32
Sulphur	S	32.06
Chlorine	Cl	35.46
Potassium	K	39.10

    The molecular weights of K_2O, KCl, K_2SO4, and $K_2SO4MgSO4$ are simply the sum of the atomic weights of the elements:

K_2O	94.20
KCl	74.56
K_2SO4	174.26
$K_2SO4MgSO4$	294.64

    The K_2O content of 100% pure muriate, sulphate, and double sulphate are therefore:

KCl	63.17%
K_2SO4	54.01%
$K_2SO4MgSO4$	31.97%

All of the major firms market potash in other forms, and in this restricted sense there is competition between products.[14] Two of the three Carlsbad firms, Potash Company of America and United States Potash Company, produce "manure salts", which is unrefined "run-of-the mine" ore, crushed, and if necessary, brought up to a certain percentage of K_2O by the addition of potassium chloride. The K_2O content varies between 22% and 30%. The important feature of manure salts is that the total output does not depend upon refinery capacity, and cantherefore be increased quickly and without danger of resultant excess capacity.

USPC and PCA also market a 50% muriate, made by mixing 60% muriate with manure salts. International Minerals and Chemicals Corporation, the third Carlsbad producer, refines from langbeinite potassium sulphate and the double sulphate of potassium and magnesium, which have important uses in agriculture. The sulphate of potash, averaging 95% to 98% pure, is also produced by PCA, The American Potash and Chemical Company of Trona, California, and Bonneville, Ltd, located at Bonneville, Utah. Small quantities of kainite were delivered by the importer just prior to the war. The importer has also supplied all of the products mentioned above.

Chemical uses account for about 10% of all the potash consumed in the United States. It is treated to yield certain other potassium compounds, and then is utilized for many purposes. Among these are: explosives, matches, analine dyes, glass, medicine, X-rays, photography, tanning, glues, engraving and lithography, soap, paint, gasoline, drinking water,

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14. With the exception of manure salts, 50% muriate, and 60% muriate, the different products differ in the chemical form in which the potassium appears; and the uses differ correspondingly.

tobacco, and ceramics. For some chemical uses a specially refined grade of potassium chloride, produced by APCC, PCA, and IMCC, is used, while the 60% muriate of USPC is often used for industrial purposes. This muriate, produced by fractional crystallization, is more useful for the purpose than are those produced by a flotation method.

For most soils and crops, potassium chloride is recommended. Potassium sulphate is used extensively on tobacco, and also where the chlorine content of the soil is already high. The double sulphate is used on sandy soil where magnesium is also lacking.

Since transportation charges amount to between one-third and one-half of the delivered cost of potash, the more highly refined is the KCl, the cheaper is the actual K_2O content delivered. It is therefore necessary to find an explanation for the consistently large sales of manure salts and 50% muriate.[15]

In addition to the three main plant-food constituents of fertilizer-nitrogen, phosphate, and potash - many other elements are occasionally lacking in certain soils. Among these are: iodine, magnesium, sulphur, calcium, and borax. It is also possible that there are others, the need for which has not been recognized. Many of these are present in the potash ore, but are removed in refining. One remedy would be to replace certain elements after refining, and this is done by APCC. This method would not, of course, replace any of the unknown elements, and it has been found more satisfactory in many instances to make use of less highly refined ore.

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15. The information summarized in the following two paragraphs was received in an interview with Mr. Ted G. Cramer, Resident Manager for USPC in Carlsbad. Mr. Cramer was very generous with his time and provided a large amount of hitherto unpublished material.

The same problem arises again at a different stage. Why does not the farmer simply buy nitrogen, phosphate, and potash in concentrated form (instead of in a mixture with four parts or more of organic matter) and spread it himself? The answer is two-fold. First, fertilizer is spread so thinly that it would be difficult to apply evenly plant food in such a concentrated form. And if the farmer were to try to mix the plant food with a base, such as sand, it would not only require much effort, but it would also be difficult to achieve a satisfactory mixture. Second, the organic base contains valuable plant food. As a result, the farmer is satisfied to pay shipping charges on a large quantity of relatively useless matter, in addition to the plant food.

III - THE INDUSTRY

The correct delimitation of the American potash industry is not too easy. Prior to 1915, all sales were made by the German and French cartel. From then until 1919, the sales, such as they were, all came from domestic producers. Only one of these survived the reappearance of the cartel's imports. Beginning with 1933, the products from the Carlsbad field began to reach the market.

Before 1941 one could, with some justification, regard the industry as being composed of four firms: the import firm M. V., the American Potash and Chemical Corporation, the United States Potash Company, and the Potash Company of America. Since 1941 imports have dropped to a negligible figure, and a fourth major domestic firm, the International Minerals and Chemicals Corporation, (IMCC), has started production. In addition to these there are three minor companies: Dow Chemical Company, producing from brine wells near Midland, Michigan: North American Cement Corporation, with a plant at Security, Maryland; and Bonneville, Limited, producing at Lake Bonneville, Utah.[16] The three Carlsbad plants produce about 85% of the national total, APCC produces about 10%, and the remaining firms the other 5%.[17]

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16. Very little is known about this firm. In certain rather restricted regions it competes on an equal basis with the Carlsbad firms, but their production at the present time is only three percent of the total. At times it will be necessary to class Bonneville with the major firms.

17. Source: U.S. Bureau of Mines - Minerals Yearbook: 1946.

It seems most nearly correct and useful to define the American industry as consisting of all seven of the domestic producers. The industry then becomes a case of mixed oligopoly.[18] The industry is a mixed one, because while APCC and the three Carlsbad firms are large enough to influence the market by their actions, the other three firms must abide by the prices established, and are therefore in a nearly competitive position.[19]

The high percentage of deliveredprice represented by transportation costs leads to an effective regional monopoly in the case of APCC. It supplies most of the needs of the three Pacific Coast states (at a slightly higher price than the F.O.B. Carlsbad price), and of Hawaii and Japan. As far as is known, it does not sell muriate on the East Coast.[20] New Mexico lacks even a half-way decent outlet to the sea, and therefore cannot compete in the overseas markets. The states midway between Trona and Carlsbad use negligible amounts of potash, and are not important to either producing area. This whole aspect will be considered at greater length in the following chapter in connection with transportation.

It seems to be the fear of those close to the potash industry that in a short time foreign production will be sold in the United States in

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18. It is not known who originated this term. It may have been Lloyd G. Reynolds in "The Canadian Baking Industry: A study of an Imperfect Market", Quarterly Journal of Economics, LII:659 (1938). The use of the term here is a corruption of that example, since the small firms are few in number.

19. They could sell at a lower price, but would gain nothing,since they are able to sell their entire output at the market price. They could not sell at a higher price, except where geographical location gives them an advantage.

20. APCC produces two-thirds of the sulphate sold in this country.

large quantities, and at prices ranging from present levels to below cost, depending upon whether sales are made for profit or for the purpose of securing American dollars.

In such case, clearly, the foreign producer might have to be reckoned as part of the American industry, for purposes of analysis, at least. For the present, however,it is best merely to recognize that the presence of the foreign potential sets an effective short-run upper limit on the range of possible prices, and in addition exerts a much greater long-run pressure on many aspects of the industry, notably costs. A brief history of the foreign potash industry is now in order.[21]

In 1861, factories were opened in both Anhalt and Prussia for the production of potash. Until 1875 these two states enjoyed a monopoly of potash production, although the refineries themselves were privately owned. A revision of the German mining laws in most of the states between 1870 and 1875 was followed by the entry of several private producers into the mining field, and as a result, vigorous price competition.

In 1879, under the leadership of Prussia, a loose cartel was formed, which survived until the potash law of 1910 put the industry under government regulation. The syndicate took the form of a marketing agency which allocated production quotas among the various members.

The control exercised by the syndicate provided attractive profits, and speculation set in. In 1900 there were 15 shafts with quotas, but by 1910 this number had climbed to 73. The loose syndicate was unable to withstand this pressure, and by 1909 individual producers were making agreements with American firms for deliveries below cartel prices. The 1910 law stopped price cutting by the simple expedient of fixing prices,

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21. An excellent treatment of the European situation prior to 1930 is to found in Stocking, George Ward. The Potash Industry: A Study in State Control. New York,1931.

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The control exercised by the syndicate provided attractive profits,
and speculation set in. In 1890 there were 19 shafts with quotas, but by
1910 this number had climbed to 74. The loose syndicate was unable to
withstand this pressure, and by 1929 individual producers were making
agreements with American firms for deliveries below cartel prices. The
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21. An excellent treatment of the European potash cartel prior to 1930 is to be found in Chester Lloyd Jones, Caustic Soda and Allied Products: A Study in Industrial Control. New York, 1931.

but it further stimulated shaft sinking, and the number of shafts reached 194 by 1914. Average output per shaft declined to 42,121 metric tons, compared with 202,469 tons in 1900. This reduction was not due to an exhaustion of the ore beds.

At the close of the first world war, Germany lost 17 Alsatian mines, among her best and newest, to the French; and along with them went her world monopoly. Further, the remainder of the German industry was hampered by excess capacity, obsolescent machinery, and the loss of its foreign markets. An intensive program of rationalization was started, which achieved considerable results by 1928.

Immediately after the war competition between Germany and France was keen, but in 1924 a division of the American market was agreed upon. In 1925 a syndicate was formed to divide the world market; 70% to be supplied by Germany and the remaining 30% by France. This agreement was effective in preventing competition.

In April 1927, the American end of the cartel's arrangements was disturbed momentarily by an anti-trust prosecution. The next month the . V. Export Firm was organized under the laws of the Netherlands, to purchase potash from the producers abroad and sell it in this country. The Attorney General's office approved this company, as it was considered unwise to interrupt potash deliveries completely. This company made all deliveries of non-Russian origin to this country until the outbreak of the second world war prevented further connection between French and German nationals, and the company ceased to function. Meanwhile, Poland, Spain, Palestine and Russia had entered the Cartel in varying degrees, and had received their quotas. Throughout the history of the cartel, it has

proved impossible to prevent the entry into the industry of speculative firms,[22] which had then to be taken into the organization. Speculative firms have thus contributed in large measure to the development of excess capacity.

The present situation in the foreign industry has been very well described by Mr. C. K. Horner in his recent article mentioned above. The following material is based upon his presentation. (All figures are in metric tons of 2200 pounds.)

The German industry suffered relatively slight damage during the war. Output, however, ceased in 1945; and recovery has been retarded by lack of transportation, coal, and storage, and by the need for replacement machinery.

The situation is complicated by the fact that 61% of the active German mines are in the Russian Zone of occupation.[23] Prior to the recent war, these mines produced virtually all of Germany's export surplus. In 1946 the Soviet Union "requisitioned" all of the mines in the Eastern Zone, and have retained direct control of the best seven. The remainder have been returned to the country as "people's enterprises". Production has been increased in all mines, and exports have been made to Sweden, Norway, the United Kingdom, the Netherlands, Japan, Korea, and Poland, in addition to Russia.

Every effort has been made to increase production in the Western Zones. Supply is still short even for domestic requirements, but some exports,

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22. That is, firms which enter upon the hope of discovering a superior ore bed, or which enter on the basis of a belief that they can force admission to the cartel.

23. The remainder are divided as follows; U.S. Zone, 14%; British Zone, 22%;

chiefly to Belgium, Czechoslovakia, the United Kingdom, the Netherlands, and the United States,have been made. Exact production figures for the Eastern Zone are not available, but an estimate by officials in the U.S. Zone puts total German production at about 1,350,000 tons K_2O, compared with a pre-war average of about 1,700,000 tons K_2O per year. In the past year production levels are estimated to be very near the pre-war level.

The French mines suffered considerable damage during the war, both in destruction of plant and mine facilities and in the dislocation of the labor force. This damage was largely repaired during the two years following the end of hostilities, and by 1948 production of 775,000 tons K_2O had surpassed the pre-war (1941) peak of 750,000 tons K_2O. Of this amount about 35% was exported, the major destinations being the United Kingdom, the Netherlands, and Belgium.

The French 10 year plan for potash, initiated in 1946, calls for production of 1,200,000 tons K_2O by 1957, of which some 40% - 50% will be available for export. French domestic consumption is rising and can be counted on exceeding pre-war levels. The Economic Cooperation Administration has provided aid in the amount of $4,000,000. It is reported by a reliable industry source that the basic elements of the IMCC flotation method have been introduced by E.C.A. into certain French mines, and French production costs may therefore be expected to be lower than other European producers' costs, and more in line with the costs of the United States producers.

The expansion of the Spanish potash industry was delayed by the disruption of export trade during the war. Current production goals are

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23. Cont'd. French Zone, 3%.

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The expansion of the Spanish potash industry was delayed by the disruption of export trade during the war. Current production goals are

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25. Cont'd. French Zone, 5%.

200,000 tons K_2O for 1950 and 250,000 tons K_2O for 1952. Domestic consumption is low and not likely to increase, so that some 80% of this total may be available for export.

Palestine produces potash by evaporation from the waters of the Dead Sea. Production reached a peak of 123,000 tons K_2O in 1947; an average of 97% (adjusted for periods of several years because of accumulated inventories) of production is exported, the chief destination being the United Kingdom, which has taken between 65% and 72% of total exports since the war. Production facilities are still being expanded.

Little is known of the situation in Russia. Despite her vast reserves she is apparently not producing enough for her domestic needs. Potentially, however, she is a large producer. Other foreign producers of relatively small quantities of potash are Japan, Italy, Chile, Poland, and Canada. The major non-producing consumers of potash are the United Kingdom, Belgium, the Netherlands, and Australia. All of the minor producers listed just above also import some potash.

It is not possible to evaluate the likely future foreign competition in this country without some discussion of world consumption. Table III gives consumption (also in metric tons) for the pre-war years and for three years since the end of the war. In view of the current world-wide expansion of production (a rough estimate for 1956 would be 3,590,000 tons K_2O, excluding Russian-dominated areas), current (1948-1949) consumption of 3,220,000 tons K_2O (excluding Russia and satelites) will leave an excess of production over consumption of about 370,000 tons K_2O. Germany, France, the United States, and some of the smaller nations are expected to absorb some, but not all, of this excess. There are excellent grounds, therefore,

TABLE III - World Potash Consumption, Prewar and 1947 - 1949,
1000 metric tons (2200 pounds) K_2O.

Country	Average 1936-38	1946-47[1]	1947-48[1]	1948-49[1,2]
Europe:				
Austria	8.9	8.9	9.9	17.0
Belgium - Luxembourg	65.6	73.5	120.5	124.6
Czechoslovakia	28.1	70.3	59.9	24.5
Denmark	32.2	50.3	61.7	80.0
Finland	15.8	22.7	33.1	30.0
France	260.3	350.0	380.0	400.0
Germany	950.4	605.0 *	750.0 *	850.0 *
Italy	14.9	9.0	12.1	13.0
Netherlands	167.4	68.5	100.4	104.0
Norway	15.1	24.0	38.0	45.5
Poland	81.1	55.0 *	65.0 *	70.0 *
Spain	24.5 (3)	16.0	19.4	30.2
Sweden	47.8	44.0	53.1	40.0
Switzerland	8.3	12.9	14.0	14.0
United Kingdom	75.7	122.5	183.7	199.7
U. S. S. R.	148.3	n. a.	n. a.	n. a.
Other countries	28.1	17.0	14.4	17.3
Total Europe	1,972.5	1,549.5	1,915.2	2,059.8
North and South America:				
Brazil	-	6.5	7.5	8.0
Canada	22.6	47.1	50.1	51.0
Chile	-	4.8	5.5	4.9
Cuba	1.5	5.5	6.8	7.8
U.S. and Territories	392.3	780.0	835.0	925.0
Other Countries	12.2	9.2 *	10.9 *	11.2 *
Total Americas	428.6	853.1	915.8	1,007.9
Asia:				
Japan	99.8	55.0	3.0	68.0
Other Countries	18.3	12.0 *	19.9 *	37.8 *
Total Asia	118.1	67.0	22.9	105.8
Africa and Oceania:				
Australia and New Zealand	15.2	8.8	9.8	9.0
French North Africa	7.4	19.9 *	22.0 *	24.0 *
Other countries	9.4	9.2 *	14.2 *	13.5 *
Total Africa and Oceania	32.0	37.9	46.0	46.5
World Total	2,551.2	2,507,5	2,899.9	3,220.0

1. Year ending June 30. * Estimate
2. Preliminary.
3. Average for 1933 - 1935.

SOURCE: Prewar - United States Department of Agriculture, Misc.Pub.No.593.
1947-49 - F. A. O. Bulletin Number 17, September 1949.

TABLE III - World Potash Consumption, Prewar and 1947 - 1949.
1000 metric tons (2200 pounds) K_2O.

Country	Average 1936-38	1946-47	1947-48	1948-49
Europe:				
Austria	8.9	8.2	9.9	17.0
Belgium - Luxembourg	65.6	73.5	120.5	128.6
Czechoslovakia	28.1	70.3	59.9	94.5
Denmark	32.2	50.3	61.7	80.0
Finland	15.8	22.7	33.1	30.0
France	260.3	350.0	380.0	400.0
Germany	950.4	605.0 *	750.0 *	850.0 *
Italy	11.9	9.0	12.1	13.0
Netherlands	167.4	68.5	109.4	108.0
Norway	15.1	24.0	38.0	45.5
Poland	81.1	55.0 *	65.0 *	70.0 *
Spain	28.5	(3) 16.0	32.4	30.2
Sweden	47.8	44.0	53.1	40.0
Switzerland	8.3	12.9	14.0	14.0
United Kingdom	75.7	122.5	143.7	139.7
U. S. S. R.	148.3	n. a.	n. a.	n. a.
Other countries	28.1	17.0	14.4	17.3
Total Europe	1,972.5	1,519.5	1,915.2	2,058.0
North and South America:				
Brazil	-	6.5	7.5	8.0
Canada	22.6	47.1	50.1	52.0
Chile	-	4.8	5.5	4.9
Cuba	1.5	5.5	6.8	7.8
U.S. and Territories	392.3	720.0	834.0	925.0
Other Countries	12.2	9.2 *	10.9 *	11.2 *
Total Americas	428.6	893.1	915.8	1,007.9
Asia:				
Japan	99.8	55.0	3.0	68.0
Other Countries	18.3	12.0 *	19.9 *	37.8 *
Total Asia	118.1	67.0	22.9	105.8
Africa and Oceania:				
Australia and New Zealand	15.2	8.8	9.8	9.0
French North Africa	7.4	19.9 *	22.0 *	24.0 *
Other countries	9.4	9.2 *	14.2 *	13.5 *
Total Africa and Oceania	32.0	37.9	46.0	46.5
World Total	2,551.2	2,507.5	2,899.9	3,220.0

1. Year ending June 30. * Estimate
2. Preliminary.
3. Average for 1933 - 1937.

SOURCE: Prewar - United States Department of Agriculture, Misc. Pub. No. 591.
1947-49 - F. A. O. Bulletin Number 17, September 1949.

to expect foreign import competition in this country by 1956. It is the opinion of the author, as well as of a reliable industry source, that 1955 will be the first year in which this competition will be felt in this country.

IV - TRANSPORTATION AND MARKET AREAS

Because the potash producers are located at a finite number of points (3), all distant from the major consuming areas, it is natural to find that certain production areas tend to supply certain market areas. Since the agricultural market consumes more than 90% of all potash produced, and since industrial users require mainly specific special products generally offered by only one firm, attention will be confined to the market areas for agricultural consumption. The three Carlsbad firms are located at one point, in so far as freight rates are concerned. The other two major producing points are Trona, California and Wendover, Utah.

Because of the purchasing policies of the fertilizer mixers, discussed later, the market areas of the three Carlsbad firms are identical. Since the markets for the individual products vary, it is necessary to consider twelve product market areas: the areas for muriate, sulphate, double sulphate, and manure salts, for each of the three producing points mentioned above.

Since the double sulphate is produced only at Carlsbad (by IMCC), as are manure salts (by FCA and USPC), the market areas for these products for Carlsbad correspond to the total market area, which is considered by common usage to be the Continental United States, its territories, and Canada. Market areas for the other two points do not exist for these products.

This statement is true only for the present definition of the industry; when the importer was in the market it offered all products. The importer also used a basing-point system of pricing,which was followed by the domestic firms. This will be discussed at length below in connection with

IV - TRANSPORTATION AND MARKET AREAS

price policy.

Before the discussion of market areas can be pursued further, it is necessary to examine transportation costs, since these play a major determining role. Attention is first turned to the situation prior to World War II.[24]

Transportation costs, whether incurred before or after processing, are a part of production costs, and are a factor in determining the location of the plant. Since a large amount of completely useless material is eliminated in refining potash, all refineries are located at the mines,[25] and all transportation costs are incurred after processing.

The Franco-German mines and Trona are located near enough to suitable ports that rail costs are fairly low. Carlsbad, however, suffers from the lack of accessible water transport. The nearest ports are Houston and Galveston, Texas; and most of the shipments were made to Texas City, which is the port at Galveston. Some shipments were also made to New Orleans, Louisiana.

Prior to the growth of USPC, rates on potash salts from Carlsbad and Loving, New Mexico[26] to Houston and Galveston were $14.90 per ton, and to New Orleans, $15.60. In April, 1931, rates of $6.50 and $7.50, respectively, were established to enable USPC to compete on the East Coast. Later in the

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24. The information on conditions prior to World War II contained in the following four paragraphs is drawn largely from Horton, Leo V., New Mexico State Planning Board, Potash Production and Marketing. Santa Fe: 1937.

25. With the exception of USPC, whose refinery is located at a point some twenty miles distant, to facilitate disposal of waste materials. The plant and refinery are linked by a narrow-gauge railway which the company owns.

26. All rates are from both Carlsbad and Loving. Hereafter, only Carlsbad will be mentioned.

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Prior to the growth of USPC, rates on potash salts from Carlsbad and Loving, New Mexico[26] to Houston and Galveston were $16.50 per ton, and to New Orleans, $18.00. In April, 1931, rates of $6.00 and $7.00, respectively, were established to enable USPC to compete on the East Coast. Later in the

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same month an export rate for foreign and coastwise reshipment was set at $5.50 to Houston and Galveston; and in July, 1932, this was further reduced to $4.50. In September, 1936, a similar rate to New Orleans was set at $5.50. The railroads have found it desirable to keep the potash business, even at a very low rate, considering the distance involved.

Prior to the war, foreign shipping rates were as follows:

Mines to port, approximately	$1.50 per ton of 2200 pounds
Loading on ship	1.00 per long ton
Ocean rates to U.S. ports	2.80-3.25 per long ton

This gives a total cost of between $5.30 and $5.75 per long ton, or between $4.75 and $5.12 per ton. The Thorp-Tupper Report gives an average figure of $5.00 per short ton. Combined rail-water rates from Carlsbad and Trona, subject to certain minimum load requirements, were as follows:

Ports	Carlsbad	Trona	Foreign
Mobile, Alabama	$11.40	$8.60	$5.00
Savannah, Georgia	12.75	8.60	5.00
Charleston, S.C.	9.35	8.60	5.00
Norfolk, Virginia	7.95	8.60	5.00
Philadelphia, Pa.	8.40	8.60	5.00
New York, New York	8.95	8.60	5.00

SOURCE: Leo V. Horton, op. cit., page 28.

It must be emphasized that the above rate differentials do not mean that the Carlsbad producers were unable to compete at these ports, since a basing point system was in effect. It does mean, however, that a substantial amount was added to the production costs of PCA and USPC, and a lesser amount to APCC. C.i.f. prices for the 1939 season were 53½¢ per unit, less discounts, for muriate of potash. This amounts to a price per ton (figured on the basis of 62% K_2O, less 12% discount), of $29.19. At Charleston, for instance, this leaves a margin for all other expenses and profits of $24.19 for the foreign producers, $20.59 for Trona, and $19.84

for the Carlsbad producers. On the same K_2O basis, f.o.b. Carlsbad prices netted the two producers $20.46 during that year.

The existence of an f.o.b. system means that while transportation costs can no longer be treated as production costs, they have a much greater importance than heretofore. When conditions are such that the closest producer (in terms of cost) can supply the whole market, the other producers must either abandon the market or make some sort of price concessions. This situation has not yet arisen, since demand is still greater than supply for the whole country, but as soon as Duval enters the industry this is likely no longer to be true. If this happens, there will result either a modified basing point system or else a rewording of the clause in the contracts regarding meeting lowest quoted price. All of these aspects will be discussed in later chapters.

Since the advent of f.o.b. pricing, there have been several complaints brought before the Interstate Commerce Commission regarding the rates from Wendover, Utah, where Bonneville produces, and Carlsbad, to various consuming points in official, southwestern, western trunk-line, and southern territories. Two of these were brought by Bonneville and PCA respectively, and the others by various consumers. The first two mentioned will be discussed at length, since they were upheld and caused revision of the then existing rate structure.

In Bonneville, Ltd. vs. Alton Railroad Company et al. (245 ICC 751), decided June 20, 1941, Bonneville argued that since its product averaged only 55% K_2O, rates on potash from Wendover were unjust and prejudicial, and did not allow it to compete with other producers. Bonneville also argued that on the basis of several previous I.C.C. decisions, rates on

fertilizer and fertilizer constituents should be as low as possible, since fertilizer was necessary to farm prosperity, and since transportation costs constituted a large proportion of delivered prices. The Carlsbad producers intervened on behalf of the defendents and argued that a rate reduction would not be consonant with ton-mile earnings in an absolute sense, and in relation to ton-mile earnings on similar rates from Carlsbad.[27]

The Commission denied that rates had been unreasonable in the past and denied reparations, but found present rates unreasonable for the future, and said that rates in the future would be unreasonable if they exceeded:

1) $1.00 higher than corresponding present rates from Carlsbad to points in southern territory.
2) $0.50 higher than present rates on acid phosphate from Anaconda, Montana to points in official territory.
3) present rates on acid phosphate to points in western trunk-line territory.
4) $1.50 higher than present rates, Carlsbad to Memphis, Tennessee or New Orleans, Louisiana, whichever may be higher, for points in southwestern territory. (This resulted in a blanket rate of $9.75 for points in southwestern territory.)

One commissioner dissented from the decision on the grounds that railroad revenues were too far reduced.

In Potash Company of America vs. Aberdeen and Rockfish Railroad Company et al. (258 ICC 109), decided March 2, 1944, defendant claimed that rates on potash to points in western trunk-line and central freight

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27. The only territory for which this evidence seems to be valid is western trunkline territory. Data introduced by the intervener is as follows:

To:	From: Carlsbad			From: Wendover		
	short line distance	car mile rate	car mile earnings	short line distance	car mile rate	car mile earnings
Chicago	1272	$9.35	36.0¢	1612	$11.00	33.3¢
Indianapolis	1460	10.20	34.0	1730	11.60	33.0
Columbus	1590	11.00	33.8	1915	12.60	32.1

fertilizer and fertilizer constituents should be as low as possible; since fertilizer was necessary to farm prosperity, and since transportation costs constituted a large proportion of delivered prices. The Carlsbad producers intervened on behalf of the defendants and argued that a rate reduction would not be consonant with ton-mile earnings in an absolute sense; and in relation to ton-mile earnings on similar rates from Carlsbad.[27]

The Commission denied that rates had been unreasonable in the past and denied reparations, but found present rates unreasonable for the future; and said that rates in the future would be unreasonable if they exceeded:

1) $1.00 higher than corresponding present rates from Carlsbad to points in southern territory.
2) 90¢ higher than present rates on acid phosphate from Anaconda, Montana to points in official territory;
3) present rates on acid phosphate to points in western trunk-line territory.
4) $1.50 higher than present rates; Carlsbad to Memphis, Tennessee or New Orleans, Louisiana, whichever may be higher, for points in southwestern territory. (This resulted in a blanket rate of $9.75 for points in southwestern territory.)

One commissioner dissented from the decision on the grounds that railroad revenues were too far reduced.

In Potash Company of America vs. Aberdeen and Rockfish Railroad Company et al: (289 ICC 109), decided March 2, 1944, defendant claimed that rates on potash to points in western trunk-line and central freight

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27. The only territory for which this evidence seems to be valid is western trunkline territory. Data introduced by the intervener is as follows:

To:	From Carlsbad			Weighover		
	short line distance	rate	per mile earnings	short line distance	rate	per mile earnings
Chicago	1272	$9.36	36.0¢	1812	$11.00	33.3¢
Indianapolis	1460	10.20	34.0	1720	11.80	33.0
Columbus	1580	11.00	33.8	1815	12.80	32.1

association territories were, are, and will be, unduly prejudicial to complainant and unduly preferential to shippers at Wendover, Utah. The other Carlsbad producers intervened on behalf of complainant, and Bonneville intervened on behalf of defendants.

Complainant argued in part that since the producer at Wendover has improved the purity of his product, and since said shipper does not ship manure salts, the purity of complainant's product does not equal that of shipper at Wendover. It was contended that rates should be lower than those from Wendover, since a greater distance, over mountainous terrain, is involved from Wendover to the points in question. The matter of comparative ton-mile revenue was also raised.[28] The Commission found:

"We find that rates on muriate of potash, sulphate of potash, and manure salts, in carloads, minimum weight 80,000 pounds, for the future will be unreasonable to the extent they may exceed, to points in western trunk-line territory, including St. Louis, Mo., East St. Louis, Ill., and points taking the same rates, rates equal to the present rates on the same commodities to the same destinations from Wendover, Utah; to Chicago and points taking the same rates to the extent they exceed rates equal to $1 per net ton less than from Wendover, Utah, and to other points in central territory; and to the extent they exceed rates equal to $1 per net ton less than the present rates from Wendover, Utah, to the same destinations. We further find that the rates assailed were not unreasonable.

"Undue prejudice to which complainants are alleged to be subjected will be removed by the establishment of rates prescribed. Complainants are not shown to have been damaged by unduly prejudicial rates.

"An order for the future will be entered."

In two other cases since then, (269 ICC 406) and (272 ICC 101), consumers have complained against rates on potash salts to specific points. Both complaints have been dismissed.

Present rates on muriate, sulphate, and manure salts from Carlsbad, Wendover, and Trona to selected points are shown on Table V. Delivered

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28. Table IV shows car mile earnings for present and proposed Carlsbad rates in comparison with Wendover rates to the same points.

TABLE IV - Present and Proposed Rates from Carlsbad New Mexico to Selected Points, Together with Corresponding Car-mile Earnings; Compared with Similar Data for Present Rates From Wendover, Utah to the Same Points. October 13, 1943.

	From Carlsbad					From Wendover		
		Rates		Earnings				
To	Distance	Pre-sent	Pro-posed	Pre-sent	Pro-posed	Distance	Rates	Earnings
Denver,Colo.	726	$8.80	$7.40	60.0¢	50.5¢	692	$7.40	52.3¢
Omaha,Nebr.	928	8.80	7.40	46.9	39.5	1,148	7.40	31.4
Sioux City,Iowa	1,005	9.02	7.40	44.4	36.5	1,191	7.40	30.4
St.Louis,Mo.	1,070	8.80	7.40	40.7	36.0	1,527	7.40	23.7
Sioux Falls,S.D.	1,096	10.80	7.40	48.8	33.5	1,280	7.40	28.2
Cedar Rapids,Iowa	1,106	8.80	7.40	39.4	33.2	1,393	7.40	26.0
Chicago,Illinois	1,249	9.35	7.40	37.1	29.4	1,610	9.10	27.7
Minneapolis,Minn.	1,258	9.90	7.40	39.0	29.1	1,449	7.40	25.0
Aberdeen,S.D.	1,270	12.00	7.40	46.8	28.9	1,344	7.40	26.9
Wyocena,Wis.	1,315	9.90	7.40	37.3	27.9	1,599	7.40	22.7
Fargo,N.D.	1,383	11.60	7.40	41.6	26.5	1,432	7.40	25.3
Duluth,Minn.	1,402	10.45	7.40	36.9	26.0	1,599	7.40	22.7
Grand Forks,N.D.	1,463	11.60	7.40	39.1	25.0	1,511	7.40	23.9
Average	1,176	9.99	7.40	42.1	31.2	1,367	7.53	26.9
Indianapolis,Ind.	1,304	10.20	8.30	38.8	31.5	1,730	10.70	30.3
Louisville,Kty.	1,332	10.20	8.70	37.9	32.4	1,793	10.90	29.7
Jeffersonville,Ind.	1,334	10.20	8.70	37.8	32.3	1,793	10.90	29.7
Grand Rapids,Mich.	1,417	10.20	8.70	35.7	30.4	1,787	10.70	29.3
Lansing,Michigan	1,440	10.20	8.90	35.1	30.6	1,810	10.90	29.5
Toledo,Ohio	1,464	10.20	9.10	34.5	30.8	1,841	10.90	29.0
Columbus,Ohio	1,484	11.00	9.10	36.7	30.4	1,895	10.90	28.1
Detroit,Michigan	1,515	10.20	9.10	33.3	29.8	1,877	10.90	28.4
Cleveland,Ohio	1,560	11.00	9.10	34.9	28.9	1,943	10.90	27.4
Butler,Penna.	1,675	11.00	9.50	32.5	28.1	2,066	11.50	27.2
Buffalo,N.Y.	1,747	11.00	9.50	31.2	26.8	2,108	11.50	26.7
Average[1]	1,460	10.46	8.89	35.6	30.2	1,859	10.92	28.7

1. Certain points included by complainant in this section of the table have been omitted. These points are included in the average.

SOURCE: 258 ICC 129,130.

TABLE IV - Present and Proposed Rates From Garfield Van Mexico to Selected Points, Together with Corresponding Car-mile Earnings; Compared with Similar Data for Present Rates From Jendover, Utah to the Same Points. October 13, 1943.

To:	From Garfield				From Jendover			
	Distance	Rates: Pre-sent	Pro-posed	Earnings: Pre-sent	Pro-posed	Distance	Rates Present	Earnings Proposed
Denver, Colo.	726	98.80	37.40	69.08	50.58	692	37.40	52.48
Omaha, Nebr.	928	8.80	7.40	81.66	68.72	1,318	7.40	74.4
Sioux City, Iowa	1,005	9.02	7.40	90.70	74.37	1,392	7.40	70.4
St. Louis, Mo.	1,070	8.80	7.40	94.16	79.18	1,529	7.40	73.1
Sioux Falls, S.D.	1,096	10.80	7.40	118.36	81.10	1,280	7.40	74.4
Cedar Rapids, Iowa	1,106	8.80	7.40	97.32	81.84	1,393	7.40	72.0
Chicago, Illinois	1,249	9.35	7.40	116.78	92.42	1,510	9.20	27.7
Minneapolis, Minn.	1,258	9.20	7.40	115.74	93.09	1,4[illegible]	7.40	25.0
Aberdeen, S.D.	1,270	12.00	7.40	152.40	93.98	1,3[illegible]	7.40	26.2
Syracuse, Neb.	1,315	9.90	7.40	130.18	97.31	1,599	7.40	28.7
Fargo, N.D.	1,393	11.60	7.40	161.59	103.08	1,432	7.40	25.3
Duluth, Minn.	1,402	10.45	7.40	146.59	103.78	1,595	7.40	22.1
Grand Forks, N.D.	1,463	11.60	7.40	169.71	108.26	1,521	7.40	23.2
Average	1,176	9.99	7.40	117.48	87.02	1,397	7.53	26.2
Indianapolis, Ind.	1,304	10.20	8.30	133.01	108.23	1,730	10.20	30.2
Louisville, Ky.	1,332	10.20	8.70	135.86	115.88	1,793	10.20	29.2
Jeffersonville, Ind.	1,334	10.20	8.70	136.07	116.06	1,793	10.20	29.1
Grand Rapids, Mich.	1,417	10.20	8.70	144.53	123.28	1,727	10.20	29.3
Lansing, Michigan	1,440	10.20	8.90	146.88	126.96	1,810	10.20	29.2
Toledo, Ohio	1,468	10.20	9.10	149.74	133.58	1,918	10.20	29.0
Columbus, Ohio	1,488	11.00	9.10	163.68	135.41	1,895	10.20	29.1
Detroit, Michigan	1,515	10.20	9.10	154.53	137.86	1,877	10.20	28.4
Cleveland, Ohio	1,560	11.00	9.10	171.60	141.96	1,983	10.20	27.6
Butler, Penna.	1,675	11.00	9.50	184.25	159.12	2,066	11.50	27.6
Buffalo, N.Y.	1,717	11.00	9.50	188.87	163.11	2,103	11.50	26.7
Average[1]	1,460	10.46	8.89	152.76	129.70	1,859	10.92	28.7

1. Certain points included by computation in this section of the table have been omitted. These points are included in the average.

SOURCE: 258 ICC 129,130.

TABLE V - Present freight rates and corresponding delivered prices, for muriate of potash, sulphate of potash, and manure salts.

Rates and prices per ton of 2000 pounds:

To	Freight from Carlsbad	Clsbad Price KCl	Clsbad Price K_2SO_4	Freight from Trona	Trona Price KCl	Trona Price K_2SO_4	Freight from Wendover
Texas City,Texas	$10.11	$33.36	$45.46	$13.55	$41.76	$54.51	$13.55
Albuquerque,N.M.	10.37	33.62	45.73	12.60	40.81	53.56	13.55
Denver,Colorado) Fargo, N. D.) Minneapolis,Minn) Omaha,Nebraska) Sioux City,Iowa)	11.02	34.27	46.44	13.55	41.76	54.51	11.02
St. Louis, Mo.	11.02	34.27	46.44	13.68	41.89	54.64	11.12
Chicago,Illinois	12.43	35.68	47.93	14.61	42.82	55.57	12.97
Los Angeles,Cal.	12.60	35.85	48.13	5.00	33.21	45.96	21.80
Troy, Alabama	13.30	36.55	48.86	16.02	44.23	56.98	15.48
Indianapolis,Ind.	13.63	36.88	49.22	15.81	44.02	56.77	14.72
Cincinnati,Ohio) Columbus,Ohio) Detroit,Michigan) Louisville,Kty.) Toledo,Ohio)	13.84	37.09	49.44	16.02	44.23	56.98	14.93
Albany,Georgia	13.84	37.09	49.44	16.46	44.67	57.42	15.91
Jacksonville,Fla.	14.39	37.64	50.02	17.11	45.32	58.07	16.57
Buffalo, N. Y.	14.50	37.75	50.13	16.68	44.89	57.64	15.59
Rockingham, N. C.	14.93	38.18	50.58	17.99	46.20	58.95	17.44
San Francisco,Cal.	15.00	38.25	50.66	8.80	37.01	49.76	21.80
Portland,Oregon	16.00	39.25	51.73	12.60	40.81	53.56	12.00
Seattle, Wash.	16.00	39.25	51.73	12.60	40.81	53.56	12.80
Boston, Mass.) Portland, Maine)	16.02	39.27	51.75	17.88	46.09	58.84	17.88

SOURCE: Panhandle and Santa Fe Railway Company. Computations by the author.

TABLE V — Present freight rates and corresponding delivered prices, for muriate of potash, sulphate of potash, and manure salts.

Rates and prices per ton of 2000 pounds:

To	Freight from Garfield	Garfield Price f.o.b.	Freight from Trona	Trona Price f.o.b.	Trona Freight from Henderson
Texas City, Texas	$10.11	$32.36	$15.46	$13.55	$14.76	$52.51	$13.55
Albuquerque, N. M.	10.37	32.62	15.72	12.60	10.81	53.56	13.55
Denver, Colorado Fargo, N. D. Minneapolis, Minn. Omaha, Nebraska Sioux City, Iowa	11.02	34.27	16.44	13.55	11.76	54.21	11.02
St. Louis, Mo.	11.02	34.27	16.44	13.68	11.89	54.64	13.12
Chicago, Illinois	12.43	35.68	17.93	14.01	12.82	55.57	12.97
Los Angeles, Cal.	12.60	35.85	18.13	5.00	33.21	45.96	21.80
Troy, Alabama	13.30	36.55	18.86	16.02	14.23	56.38	15.43
Indianapolis, Ind.	13.63	36.80	19.22	15.81	14.02	56.27	14.12
Cincinnati, Ohio Columbus, Ohio Detroit, Michigan Louisville, Ky. Toledo, Ohio	13.84	37.09	19.44	16.02	14.23	56.38	14.23
Albany, Georgia	13.34	37.09	19.44	16.46	14.67	57.42	15.24
Jacksonville, Fla.	14.39	37.64	20.02	17.13	15.32	58.07	16.57
Buffalo, N. Y.	14.50	37.75	20.13	16.46	14.89	57.64	15.59
Rockingham, N. C.	14.23	39.13	20.58	17.79	16.20	58.95	17.14
San Francisco, Cal.	15.00	38.25	20.66	5.80	37.01	49.76	21.80
Portland, Oregon	16.00	39.25	21.13	12.60	10.81	53.56	12.00
Seattle, Wash.	16.00	39.25	21.13	12.60	10.81	53.56	12.80
Boston, Mass. Portland, Maine	16.22	39.27	21.35	17.38	16.09	58.84	17.68

SOURCE: Panhandle and Santa Fe Railway Company. Computations by the author.

price for muriate is calculated by adding freight charges to the f.o.b. price for muriate containing 62% K_2O. Since the pricing and K_2O content of the Carlsbad and Trona sulphate is not identical, the calculation of delivered price for sulphate is not as simple. For the Trona product delivered price is figured by adding freight charges to the price of sulphate 96% pure. Since Carlsbad (IMCC) sulphate is priced per ton on the basis of 90% pure sulphate, the price corresponding to Trona's is found by multiplying the sum of price and freight charges by 1.067. Price data is not available for Bonneville.[29]

The final step preparatory to considering the market areas is a discussion of the regional nature of consumption. Potash consumption by products and states in 1949 is given in Table VI.

The thirty states with the largest consumption fall very neatly into four regions. The largest is the Southern region (roughly Southern freight territory), comprising Georgia, North Carolina, Virginia, Florida, South Carolina, Maryland, Alabama, Tennessee, Mississippi, Arkansas, Louisiana, Kentucky, Missouri, and Texas. This region consumes 55.2% of all muriate and 75.4% of all sulphate. The second region contains Ohio, Illinois, Indiana, Wisconsin, Minnesota, and Iowa, in the north central region of the country (roughly central and Western trunkline territory). This region consumes 31.0% of all muriate and 8.7% of all sulphate. The third region is the north Atlantic (roughly official territory), including New Jersey, Pennsylvania, New York, Maine, Massachusetts, Delaware, and Connecticut. It consumes 11.2% of all muriate and 6.7% of all sulphate. The fourth

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29. A letter to the president of the firm failed to secure any information about the company or its operations.

price for muriate is calculated by adding freight charges to the f.o.b. price for muriate containing 85% K_2O. Since the pricing and K_2O content of the Carlsbad and Trona sulphate is not identical, the calculation of delivered price for sulphate is not as simple. For the Trona product delivered price is figured by adding freight charges to the price of sulphate 90% pure. Since Carlsbad (IMCC) sulphate is priced per ton on the basis of 90% pure sulphate, the price corresponding to Trona's is found by multiplying the sum of price and freight charges by 1.087. Price data is not available for Bonneville.[29]

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The thirty states with the largest consumption fall very neatly into four regions. The largest is the Southern region (roughly Southern Freight territory), comprising Georgia, North Carolina, Virginia, Florida, South Carolina, Maryland, Alabama, Tennessee, Mississippi, Arkansas, Louisiana, Kentucky, Missouri, and Texas. This region consumes 56.2% of all muriate and 76.4% of all sulphate. The second region contains Ohio, Illinois, Indiana, Wisconsin, Minnesota, and Iowa, in the north central region of the country (roughly central and Western trunkline territory). This region consumes 31.0% of all muriate and 8.7% of all sulphate. The third region is the North Atlantic (roughly official territory), including New Jersey, Pennsylvania, New York, Maine, Massachusetts, Delaware, and Connecticut. It consumes 11.2% of all muriate and 8.7% of all sulphate. The fourth

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29. A letter to the president of the firm failed to secure any information about the company or its operations.

TABLE VI - Deliveries[1] of Agricultural Potash Salts, 1949.
In tons of 2000 pounds, K_2O.

Point of Delivery	60% Muriate	50% Muriate	Manure Salts	Sulphates	Total
Ohio	80,287	5,219	2,789	2,393	90,688
Georgia	61,204	10,557	7,055	4,376	83,192
Illinois	66,141	7,096	4,588	721	78,547
North Carolina	51,361	4,928	1,937	8,819	67,045
Virginia	54,639	3,617	660	5,730	64,645
Florida	41,735	3,196	1,650	15,645	62,226
Indiana	46,341	5,792	2,859	1,479	56,471
South Carolina	36,776	6,291	2,427	2,166	47,659
Maryland	40,968	3,813	615	1,773	47,168
Alabama	32,696	6,893	2,584	160	42,333
New Jersey	29,425	977	41	699	31,142
Tennessee	22,169	4,237	2,837	1,742	30,986
Wisconsin	21,761	1,674	1,754	518	25,707
Mississippi	15,301	5,631	1,697	127	22,755
Arkansas	12,207	4,151	2,901	614	19,873
Louisiana	13,088	3,984	1,590	392	19,054
Pennsylvania	15,703	1,343	785	947	18,806
New York	16,363	150	27	455	16,997
Minnesota	15,180	500	784	169	16,637
Maine	13,248	75	54	616	13,993
Kentucky	8,913	525	999	3,345	13,783
Missouri	9,643	1,540	1,944	505	13,632
Iowa	11,863	1,484	172	32	13,551
California	8,576	-	-	4,867	13,443
Massachusetts	10,534	272	108	766	11,631
Texas	7,088	1,079	1,086	402	9,655
Delaware	4,208	237	26	67	4,538
Connecticut	3,655	25	-	502	4,182
Washington	3,679	-	-	20	3,699
Oregon	2,936	-	-	168	3,104
North Dakota	1,173	-	-	-	1,173
Arizona	675	-	-	281	956
Colorado	903	-	-	34	937
Oklahoma	663	104	46	22	835
Kansas	728	25	26	-	779
Vermont	580	-	-	-	580
New Mexico	260	77	28	9	373
West Virginia	210	49	89	-	347
Nebraska	211	50	-	-	261
Idaho	257	-	-	-	257
Montana	123	-	-	-	123
Utah	68	-	-	47	115
Rhode Island	61	25	-	-	86
New Hampshire	54	-	-	-	54

1. Because of subsequent shipments of fertilizer across state lines, deliveries need not equal actual consumption.

SOURCE: American Potash Institute mimeographed press notice.

TABLE VI – Deliveries[1] of Agricultural Potash Salts, 1949.
In tons of 2000 pounds, K_2O.

Point of Delivery	KCl Muriate	K_2SO_4 Sulphate	Manure Salts	Sulphates	Total
Ohio	80,287	5,219	2,789	2,393	90,688
Georgia	61,204	10,557	7,055	4,376	83,192
Illinois	66,111	1,096	4,588	721	72,517
North Carolina	51,361	4,928	1,937	8,829	67,065
Virginia	51,639	3,617	660	5,730	61,645
Florida	41,735	3,196	1,650	15,685	62,266
Indiana	46,341	5,792	2,859	1,479	56,471
South Carolina	36,776	6,291	2,427	2,166	47,659
Maryland	40,968	3,813	615	1,773	47,168
Alabama	32,696	6,893	2,581	760	42,333
New Jersey	29,425	977	41	699	31,142
Tennessee	22,169	4,237	2,837	1,782	30,986
Wisconsin	21,761	1,671	1,751	518	25,707
Mississippi	15,301	5,031	1,597	127	22,755
Arkansas	12,207	4,151	2,901	614	19,873
Louisiana	13,088	3,981	1,590	392	19,051
Pennsylvania	15,703	1,313	785	947	18,806
New York	16,363	150	27	455	16,997
Minnesota	15,180	500	701	769	18,637
Maine	13,218	75	514	616	13,993
Kentucky	8,913	525	999	3,315	13,703
Missouri	9,613	1,510	1,910	505	13,532
Iowa	11,863	1,481	172	32	13,552
California	8,576	–	–	4,867	13,443
Massachusetts	10,531	272	108	766	11,631
Texas	7,088	1,079	1,086	402	9,655
Delaware	4,208	237	26	67	4,538
Connecticut	3,655	25	–	502	4,182
Washington	3,679	–	–	20	3,699
Oregon	2,936	–	–	168	3,104
North Dakota	1,173	–	–	281	1,454
Arizona	675	–	–	–	956
Colorado	903	–	–	34	937
Oklahoma	663	108	46	22	835
Kansas	758	25	26	–	779
Vermont	580	–	–	–	580
New Mexico	260	77	28	9	373
West Virginia	210	49	89	–	347
Nebraska	211	50	–	–	261
Idaho	257	–	–	–	257
Montana	123	–	–	–	123
Utah	68	–	–	47	115
Rhode Island	61	25	–	–	86
New Hampshire	54	–	–	–	54

1. Because of subsequent shipments of fertilizer across state lines, deliveries need not equal actual consumption.

SOURCE: American Potash Institute mimeographed press notice.

region, the Pacific Coast, has ifornia, Oregon, and Washington: it uses 1.7% of all muriate and 8.3% of all sulphate. These thirty states together consume 99.1% of all muriate and 99.1% of all sulphate; the remaining 18 states may therefore be safely neglected.

The exact definition of product market areas is strictly limited by the lack of sales data for the individual firms and by the lack of production data for the separate products. Carlsbad produces about 85% of the nation's total K_2O output, Trona about 10%, and Wendover slightly more than 3%, according to the best data available. Trona, however, produces more than half of the total for sulphate.[30]

With the aid of the delivered price calculations from Table V, and inferential data from the case PCA vs. Aberdeen and Rockfish Railroad,[31] it is possible to construct an approximate picture of the product market areas for muriate and sulphate.

The summation may begin with the north central region. Delivered prices from Trona to this region are considerably higher than those from

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30. Figures for sulphate consumption above include the double sulphate. As far as is known, Florida is the only state consuming a very large proportion of the double sulphate in comparison with sulphate.

31. This inferential data may be summarized as follows: in Bonneville vs. Alton Railroad Bonneville attacked rates to all points East and South of Wendover, and secured reductions in all cases. In PCA vs. Aberdeen and Rockfish Railroad PCA attacked only rates to points in the north central region above, with the exception of one point each in western New York, western Pennsylvania, and western Kentucky; all of which are on the border of the north central region. Since the main ground for Bonneville's complaint was the impurity of their product, and since this disadvantage had been removed equally for all points before PCA filed their complaint, it is correct to reason that the competition of Wendover was felt by Carlsbad only in the north central region.

Carlsbad, and Trona does not compete in the muriate market. It is possible that Trona sells some sulphate, although since the region consumes only 8.7% of all sulphate this is at best an unimportant market for Trona. Moreover, since Wendover sells some sulphate, and has a freight advantage over Trona, it is much more likely that Wendover supplies the western half of the region (western trunkline territory), and either Carlsbad or Wendover the eastern half (central territory). Since Wendover produces only 3% of the nation's total,it cannot supply all of the north central region with muriate. It is therefore likely that Wendover supplies part of the needs of the western half (the only region East of Wendover in which it is not at a freight disadvantage), and Carlsbad provides the remaining muriate for the whole region.

In the southern region Trona is at a distinct disadvantage in freight rates. Since 75% of all sulphate consumed is used in this region, Trona nevertheless supplies a considerable portion of this product area, with Carlsbad contributing the remainder. Unless Trona makes tie-in sales of muriate, Carlsbad supplies all of this product area.

Carlsbad supplies most of the sulphate and muriate needs of the north Atlantic region. It is possible that Trona sells some sulphate, since Trona does have a regional sales office in New York City. In the entire Pacific area, Carlsbad is at a freight disadvantage to either Trona or Wendover. The complete absence of sales of 50% muriate is further evidence that Carlsbad does not compete in this region. Trona certainly controls the market in California, and probably does so in Washington and Oregon as well, although Wendover has a freight advantage in these two states and may well make some sales.

The present point of export for the Pacific area is Los Angeles, California, where Trona has a delivered price advantage. Carlsbad nevertheless exports some potash from this point. Delivered prices from Carlsbad at Texas City, however, exceed the price from Trona at Los Angeles by only $0.15 per ton for muriate, and the price for sulphate from Carlsbad is $0.50 less than the Trona price at Los Angeles, so that Carlsbad is not at a disadvantage as far as the South American trade is concerned.

At the present time no potash for domestic consumption is shipped by water, since low charter rates are not available. It is not known how long this situation will prevail, although it was originally a result of the recent war. The condition does not seem to be causing much concern in the industry at the present time. In the event that foreign competitors reenter the market, it is probable that cheaper rail rates for reshipment will again be instituted. The lack of cheap water transportation from Texas City to the Atlantic and Gulf ports may conceivably hamper the Carlsbad industry within the next few years.

On 60% muriate only, all firms are currently equalizing freight charges on the basis of 62% K_2O. That is, whenever the K_2O content runs below 62%, the shipper pays the freight on the excessive impurities. On a ton of muriate containing 60% K_2O, the shipper therefore pays 3.23% of the shipping charges. This has the effect of making all 60% muriate exactly equivalent.

V - DEMAND FOR POTASH

It has long been recognized by writers in the field that the demand curve for potash is almost completely inelastic. That is, the amount of potash consumed is almost independent of the price charged. In addition, the factors which do affect consumption have long been isolated.

Approximately ten percent of potash sales are made to the chemical industry. As far as can be determined, no attempt has been made to isolate the factors influencing the demand for this portion of sales. Rather, it has been neglected for a consideration of agricultural demand. Because of the small quantities of potash, relative to the total product, that are used, it is probably quite safe to assume that price is not a determining factor. Because of the large variety of chemical uses, it is probable that the only major factor is the level of national income.

The situation in regard to agriculture is quite different. The percentage of potash used in mixed fertilizers has been steadily increasing (except for the period of World War I) for the past forty years. But the determining factors here are the state of scientific knowledge concerning the use of fertilizer materials and the awareness of the farmer of the findings of science. The problem of awareness will be discussed later in connection with selling costs and techniques.

Aside from the industrial and chemical users, potash is consumed mainly by commercial fertilizer mixers and farm cooperatives. Both of these groups of consumers are thoroughly sophisticated; that is, they are completely aware of the differences between the products offered on the market and of the prices quoted by the various firms. This is the chief reason for the identity of prices in a given market area, and for

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the absence of advertising at this level. This sophistication also results in the importance of personal relations between the various sales forces and the consumers.

Prior to 1941, potash was sold only to the cooperatives and to commercial mixers. Farmers wishing to purchase pure potash were forced to do so through the mixers, at prices substantially above market levels.[32] Since the advent of f.o.b. pricing the potash firms have sold to any purchaser who could take a full car load.

In the 1938-1939 season, sales were made to over 600 mixers, of which the six largest took 36% of the total potash delivered.[32] More recent data on the concentration of deliveries is not available, but an industry source gives the total number of consumers as currently in excess of one thousand.

In the early stages of its development the domestic potash industry was greatly aided by the purchasing policies of the major commercial mixers. These firms contracted in advance for the new firms' entire output (at least for the first several years of operation), and divided the purchases so that each producer sold to all of the firms involved.[33] Whether this policy is still in effect is not known, but the purpose which was served, the removal of dependence upon the foreign producers, has long since been accomplished.

Among the subsidiaries of IMCC are four fertilizer mixers. These four consume about 30% of IMCC's output, and also make occasional purchases

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32. Thorp-Tupper Report, page 45.

33. Samuel P. Hayes, Jr. "Potash Prices and Competition." Quarterly Journal of Economics, Vol.57 page 57. (1942-43).

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on the open market. This close connection enables IMCC to dispose readily of any of its output which happens not to come up to market standards for purity. This is the only instance of vertical integration in the potash industry.

During the past fifteen years many studies have been made of the relation between farm income and fertilizer consumption. The results are unanimous and conclusive that time trend (the result, in all probability, of a process of education and advertising) and farm income explain almost all of the variations in the use of fertilizer. Total farm income, real farm income, cash farm income, cash crop receipts, fertilizer tonnage, and expenditure on fertilizer have all been used in these studies; and all of them show a considerable degree of correlation. The best combination (from an ex-ante as well as an ex-post point of view) seems to be cash farm income and expenditure on fertilizer in the following year. This procedure was used by A. L. Mehring and B. T. Shaw in 1944 (the most recent study available) and the results are fairly conclusive. For these same periods, such variables as fertilizer price and sales, and potash price and fertilizer price show an insignificant correlation if not a negative one.

Of these variables, the only significant pair for this topic are potash price and fertilizer price. It is extremely difficult to obtain a significant composite price for either of these two commodities. Fertilizer prices vary with the type of mixture (there are several hundred in common use) and with the region in which the mixing plant is located and the distance from the mixer, in some cases. Potash prices vary from product to product, from place to place, and from time to time within a given year. Since 1941 there is the further complication of the existence of c.i.f.

and f.o.b. prices, which makes any composite price confusing if not meaningless. This fact accounts for the seeming contradiction between the industry statement that potash (muriate) prices have not changed since 1939, and the composite price figures for the past ten years, which show small variations throughout.

One particular set of fertilizer and potash price data, used here because it has been used for this purpose before and not because the data seem especially defensible, is given in Table VII. An examination of the data reveals no significant correlation between potash price and fertilizer price. In particular, the drastic cut in potash prices in 1934 (due to a price war between Spanish producers and the cartel) was actually accompanied by a rise in fertilizer price.

The only known attempt to include time trend in the calculations was made by Samuel P. Hayes, Jr.[34] In 1942. His coefficient of multiple correlation between fertilizer sales, real cash farm income, and time trend, was .913 for the years 1924-1939. This figure is well over the significant level. Table VIII shows cash farm income, fertilizer sales, and plant food content of fertilizer for the years 1910 to 1943. Later data are not available.

Data on fertilizer expenditures since 1943 are not available, but a coefficient of correlation between fertilizer tonnage and cash farm income has been calculated for the years 1930 to 1947, and it is .964. There is, therefore, no reason to expect that the recent war has affected the situation.

In view of the above, any attempt to forecast demand for potash (as is prerequisite, for instance, to entering the industry) must include

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34. Potash Prices and Competition, pages 36-40.

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34. Potash Prices and Competition, pages 36-40.

TABLE VII - Potash Prices and Fertilizer Prices, 1923 - 1941.

Year	Potash Price[1]	Change	Fertilizer Price Index[2]	Change
1923	$0.627		115	
1924	.622	-.005	128	13
1925	.622	0	125	- 3
1926	.575	-.047	119	- 6
1927	.620	.045	131	12
1928	.634	.014	132	1
1929	.633	-.001	126	- 6
1930	.640	.007	119	- 7
1931	.626	-.014	103	- 16
1932	.619	-.007	91	- 12
1933	.630	.011	104	13
1934	.300	-.330	106	2
1935	.392	.092	95	- 11
1936	.440	.048	102	7
1937	.471	.031	100	- 2
1938	.471	0	100	0
1939	.471	0	98	- 2
1940	.471	0	69	- 29
1941	.471	0	111	42

1. Lowest port price obtainable during year, per unit K_2O, after all discounts.
2. Fertilizer price for the first quarter of the year following year used for potash price. (1910 - 1914 equals 100.)

SOURCE: Hayes, Potash Prices and Competition, page 33.

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1930	.640	.007	119	- 7
1931	.626	-.014	103	- 16
1932	.619	-.007	91	- 12
1933	.630	.011	104	13
1934	.300	-.330	106	2
1935	.392	.092	95	- 11
1936	.440	.048	102	7
1937	.471	.031	100	- 2
1938	.471	0	100	0
1939	.471	0	98	- 2
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2. Fertilizer price for the first quarter of the year following year used for potash price. (1910 - 1914 equals 100.)

SOURCE: Hayes, Potash Prices and Competition, page 33.

TABLE VIII - Fertilizer Consumption, 1910 - 1943.

Year	Cash Farm Income[1] ($1,000,000)	Fertilizer Sales[1] ($1,000)	Plant Food Content[2]		
			Nitrogen	Phosphates	Potash
1910	4,990 *	158,000	2.10 %	9.30 %	3.40 %
1920	14,600	416,100	2.30	9.20	2.40
1925	10,200	280,700	2.50	9.40	4.10
1930	11,300	276,100	3.10	9.80	5.00
1931	9,020	188,500	3.20	9.70	5.10
1932	6,370	111,400	3.30	9.60	5.20
1933	4,740	116,000	3.40	9.40	5.30
1934	5,450	156,600	3.55	9.18	5.37
1935	6,780	177,400	3.49	9.32	5.51
1936	7,660	205,500	3.61	9.29	5.69
1937	8,650	252,800	3.68	9.34	5.84
1938	9,220	226,500	3.72	9.41	6.09
1939	8,170	232,700	3.74	9.43	6.18
1940	8,680	237,500	3.76	9.61	6.37
1941	9,110	265,800	3.84	9.64	6.40
1942	11,740	313,200	3.70	9.70	6.96
1943	16,180	404,700	3.20	9.90	7.20

1. Mehring, A.L., and B.T.Shaw. "Relationship Between Farm Income and Farmers' Expenditures for Fertilizer . . ." American Fertilizer. Volume 100, Number 6 (April 8, 1944).
2. Data compiled by A.L.Mehring, Bureau of Plant Industry, Soils, and Agricultural Engineering, United States Department of Agriculture.

* Estimate.

TABLE VIII* — Fertilizer Consumption, 1910 - 1943:

Year	Cash Farm Income[1] ($1,000,000)	Fertilizer Sales[1] ($1,000)	Plant Food Contents[2] ... Nitrogen	Phosphates	Potash
1910	4,990 *	458,000	2.10 %	9.30 %	3.40 %
1920	10,600	446,100	2.30	9.20	2.40
1925	10,200	480,700	2.50	9.40	4.20
1930	11,300	276,100	3.10	9.80	5.00
1931	9,020	169,500	3.20	9.70	5.10
1932	6,370	111,400	3.30	9.60	5.20
1933	4,780	116,000	3.40	9.80	5.30
1934	5,450	156,600	3.55	9.48	5.27
1935	6,780	177,100	3.49	9.32	5.21
1936	7,660	205,500	3.41	9.29	5.49
1937	8,650	252,800	3.48	9.34	5.38
1938	9,220	226,500	3.42	9.41	6.09
1939	8,470	232,700	3.44	9.43	6.14
1940	8,680	237,500	3.46	9.41	6.37
1941	9,420	265,800	3.48	9.48	6.40
1942	12,780	313,200	3.40	9.40	6.46
1943	16,200	404,700	3.20	9.30	7.20

1. Herring, A.J., and J.T. Slaw. "Relationship Between Farm Income and Farmers' Expenditures for Fertilizer," " American Fertilizer. Volume 100, Number 6 (April 8, 1944).
2. Data compiled by A.J. Herring, Bureau of Plant Industry, Soils, and Agricultural Engineering, United States Department of Agriculture.

* Estimate.

an estimate of national income (and in particular, farm cash income) for the period involved. In 1945 the United States Tariff Commission estimated postwar consumption and resulting domestic production as follows:

	Consumption	Imports	Domestic Production
a. per capita income 75% above 1939 level	550,000 to 600,000	245,000 360,000	190,000 to 355,000
b. per capita income at 1939 level.	350,000 to 400,000	155,000 240,000	110,000 to 245,000

Source: United States Tariff Commission, Postwar Import Trade of the United States and Production of Related Items. Vol. II, Sec. I, Schedule 1.

While this is one of the more pessimistic predictions, even the more hopeful prophecies have proved so far to be conservative. Factors accounting for this include: the failure of European producers to develop an exportable surplus at a price equal to the prevailing domestic price; increased knowledge of the benefits of fertilizer utilization, and artificialy maintained levels of farm income, through government subsidies.[35] United States potash imports for the first three years after the war averaged 25,000 tons K_2O per year.

The correlation between fertilizer sales and fertilizer prices is not nearly so great as might be expected. The actual situation is probably pretty much as follows: The amount of money spent on fertilizer is determined by cash farm income, and the amount of plant food secured for this money upon the price of fertilizer.

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35. It is interesting to note that the Carlsbad Daily Current Argus, while supporting the potash industry at every opportunity, nevertheless attacks government farm subsidies.

Potash costs have been estimated as about 6% of total fertilizer costs. Since the proportion of potash in a given type of fertilizer is determined by the type of crop and soil, potash price has very little affect on the amount of potash used in fertilizer. Table IX shows potash deliveries in North America by grades for the years 1936 to 1949.

This does not mean, however, that soon-to-be-realized profits are not the goal of those who use fertilizer. A.P. Brodell and M.R. Cooper, in a 1940 study for the Bureau of Agricultural Economics,[36] point out that a large proportion of fertilizer is used on high-value, cash crops such as: cotton, potatoes, tobacco, corn, wheat, oats, citrus fruit, and certain vegetables, notably tomatoes.

While fertilizer undoubtedly increases production from a given plot of land, the farmer is interested in the net addition made to his income by the purchase of a given quantity of certain type of fertilizer. While the amount of fertilizer needed for maximum production depends solely upon the crop and the condition of the soil, and is not likely to vary greatly over periods as long as several years, the same is not true of the most profitable amount of fertilizer. To quote from Brodell and Cooper:

"In the case of cotton, for example, South Carolina farmers used an average of about 360 pounds of fertilizer per acre during the period 1924 to 1939, whereas fertilizer experiments at Bishopville, South Carolina, indicate that the average quantity of a '3-1/3 - 8 - 3' fertilizer that would yield a maximum net return for its use during the period was about 760 pounds. These averages do not describe the situation at any particular time in the sixteen-year period. The experimental data indicate that in 1924, when cotton prices averaged about 22.8¢ per pound, maximum net returns per acre would have been with an application per acre of almost 1600 pounds of fertilizer, ... and in 1931, when cotton averaged 6¢, an application of about 220 pounds would have resulted in maximum net return."[37]

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36. Some Factors Affecting Fertilizer Consumption (Washington: 1940).

37. Op. cit., p. 19.

TABLE IX - Potash Deliveries in North America, by Grades, 1936 - 1949.
(In tons of 2,000 pounds K_2O.)

Year	60% Muriate	50% Muriate	Manure Salts	Sulphate	Chemical Grades	Total
1936	227,520	78,725	32,314	38,291	18,174	395,024
1937	293,144	119,975	37,528	47,914	17,997	516,558
1938	267,130	120,659	25,972	44,879	15,585	474,225
1939	245,009	78,578	11,262	30,206	24,284	389,339
1940	315,366	82,139	12,131	34,442	38,028	482,106
1941	348,523	45,002	32,560	34,231	51,962	512,278
1942	458,613	42,518	48,268	46,987	63,844	660,248
1943	489,413	51,152	53,819	51,610	84,367	730,361
1944	561,663	52,614	51,244	57,727	83,120	806,367
1945	620,300	64,564	37,031	60,433	85,858	868,186
1946	689,248	63,980	22,561	73,017	76,137	924,943
1947	813,139	69,445	46,272	79,464	82,707	1,091,024
1948	859,342	73,692	68,439	84,343	88,226	1,173,842
1949	873,377	89,254	46,092	70,504	66,564	1,145,793

Data include imports of European potash prior to 1942 and since 1946 French and German imports of non-Russoan origin.

SOURCE: American Potash Institute mimeographed press notice.

TABLE IX.- Potash Deliveries in North America, by Grades, 1936 - 1949.
(In tons of 2,000 pounds K_2O.)

Year	Muriate	SO_4 Muriate	Hamm Salts	Sulphate	Chemical Grades	Total
1949	827,820	78,765	36,311	38,291	18,171	395,358
1948	293,344	119,975	37,528	47,914	17,997	516,558
1938	267,130	120,659	25,972	44,879	15,585	474,225
1939	215,009	78,578	11,962	30,206	21,284	359,339
1940	315,366	82,139	12,131	31,182	38,028	482,106
1941	348,823	45,002	32,560	34,231	51,962	512,278
1942	458,613	42,518	46,268	46,057	63,814	660,278
1943	489,439	51,452	53,819	51,610	84,367	730,361
1944	561,663	52,614	51,214	57,127	83,420	806,367
1945	620,300	64,564	37,031	60,433	85,858	868,186
1946	659,248	63,980	22,562	73,017	76,127	921,934
1947	813,439	69,415	46,272	79,464	82,407	1,097,028
1948	959,348	73,692	68,439	84,348	88,226	1,173,882
1949	873,377	89,258	46,092	70,508	66,564	1,146,799

Data include imports of European potash prior to 1942 and since 1946
French and German imports of non-American origin.

SOURCE:- American Potash Institute mimeographed press notice.

This factor of net returns can have great significance under certain circumstances. When agricultural products are sold in a nearly competitive market, prices depend largely on weather and other such unpredictable circumstances. In this case, fertilizer use will be determined by a sort of roughtly averaged guess and by the amount of cash in the sugar bowl. However, when the government sets, well in advance of the fertilizer buying season, minimum or parity prices for agricultural products, and when short term farm credit is available, anticipated profits become the controling factor.

This change in the relation between fertilizer demand and farm income has been noticed by S. P. Hayes, who recognized that the closest correlation with fertilizer sales is achieved by using previous year's income up to 1932, and the same year's income thereafter.[38] It may not be accidental that this change coincides with the advent of the New Deal. Hayes found this interesting correlation while analyzing data, but he offers no explanation for it.

The complete inelasticity of the industry's demand curve for potash (this is not true, of course, of the demand curve for the individual firm, which will be considered in the next chapter) means that the variation of price alone will not result in the maximization of profits for the industry as a whole. It is therefore necessary to vary output as well to achieve this aim. The next three chapters will be devoted to price, product, selling cost, and output analysis.

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38. Op. cit., page 39.

VI - PRICE POLICY

American industry, and which for some time was accepted out of respect for the strength of the importer. Since then the structure has been almost completely revised.

In 1934, APCC was faced with the problem of putting their 60% muriate on a competitive basis with USPC's new 62½% muriate. This was accomplished by pricing on the basis of 62½% K_2O, less an allowance for undertest. To simplify accounting, the muriate was offeredfor sale not on a tonnage basis, but in terms of 20 pound "units" of K_2O, the price per ton now being figured by multiplying the percent of K_2O by 100 and by the price per unit. This relatively convenient manner of quoting prices was immediately adopted by the other firms, although certain products are still sold by the ton.

The multiple basing point system was the natural one for the importer, who shipped all his potash by sea and stored it at the coastal points, if necessary, until sale. When APCC entered the industry, it adopted the same scheme, shipping by rail to the Pacific Coast (mainly Los Anglees) and then by sea to the Eastern consuming areas. The Carlsbad firms, in turn, shipped by rail to Galveston, Texas, and thence by sea. Since shipping costs from Europe were substantially lower than those from the U. S. points, the importer was in a much more comfortable position.

This system continued in effect, the importer being unwilling to change and the domestic producers thinking it unwise to do so, until the publication of the Thorp-Tupper Report in 1940. That report examined the basing-poing system carefully, and while it found that neither extensive cross-hauling nor uneconomic location of industry were fostered, there were nevertheless certain areas west of the Alleghenies which did not benefit from their location with respect to Carlsbad and Trona. The report

American industry, and which for some time was accepted out of respect for the strength of the importer. Since then the structure has been almost completely revised.

In 1924, APCO was faced with the problem of putting their 50% muriate on a competitive basis with USPC's new 85% muriate. This was accomplished by pricing on the basis of 85% K_2O, less an allowance for undertest. To simplify accounting, the muriate was offered for sale not on a tonnage basis, but in terms of 20 pound "units" of K_2O, the price per ton now being figured by multiplying the percent of K_2O by 100 and by the price per unit. This relatively convenient manner of quoting prices was immediately adopted by the other firms, although certain products are still sold by the ton.

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therefore suggested a price f.o.b. Carlsbad and Trona, based on c.i.f. prices less rail costs to Galveston and Los Angeles, respectively. This reduction amounted to about $5.00 per ton at Trona, and $7.00 at Carlsbad.

This recommendation was immediately put into effect by the firms, and by the end of 1941, about one-third of all sales were being made f.o.b. During the war the charter craft were no longer available for shipping potash via the sea, and hence all shipments were made by rail. Beginning June 1, 1947, all sales were made on a straight f.o.b. basis which is still in effect.

The history of discounts has been long and complicated. After 1927, however, the only ones remaining were those to discourage heavily seasonal demand for deliveries. These seasonal discounts, which ran from 4% to 12% as a whole, are for two purposes: First, they encourage advance commitments, which enable the producers to plan; and, second, they promote storage facilities. However, these discounts were really only buyers' options, since orders could be cancelled at any time.

These cancellations were one of the bugbears of the industry, and when the Thorp-Tupper Report suggested a split discount it was promptly adopted.[39] The following quotation from the USPC price list for the current year will show the exact details of the present discount system. The discounts of all the other firms are identical. These discounts are very effective, since cancellations are almost negligible, and about 90% of all sales are made at the maximum discount.

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39. The Report suggested three discounts (p. 91.); one to encourage advance contracting, one to encourage equal deliveries spread over the year, and one to discourage cancellations. The industry combined the first two functions into one specific discount.

"CONTRACT DISCOUNTS:

A. On orders placed for June arrival and on orders placed prior to July 1, 1949, delivery of the total of which buyer agrees to accept in approximately equal monthly tonnages over the period June 1, 1949 to March 31, 1950: - 8% from above f.o.b. prices will be granted.

Upon completion of the entire tonnage for which contract has been executed, buyer will receive a credit of 4% additional.

B. On orders placed after June 30, 1949, and prior to October 1, 1949 delivery of the total of which buyer agrees to accept in approximately equal monthly tonnages over the period October 1, 1949 to March 31, 1950: - 4% from above f.o.b.prices will be granted.

Upon Completion of the entire tonnage for which contract has been executed, buyer will receive a credit of 2% additional.

C: The above f.o.b. prices are net after September 30, 1949 for deliveries to May 31, 1950."

Potash is in general sold in carloads of 80,000 pounds in bulk form. Most of the products of the individual firms may also be secured in 100 pound bags at an additional cost in the neighborhood of $4.00 per ton. So much for price structure.

Basically, the price level is determined by the price per unit or per ton. But variations in basing-points, discounts, and product purity all effectively alter the level of prices. All but the last factor will be considered here.

Since for agricultural purposes there are no differences between the products of the various firms, and since the buyers are a completely sophisticated group, all prices must be identical at a given point. It follows that any downward movement in price must be followed.[40] For the

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40. While the importer, with great excess capacity, was in the market, this was obviously true. Now that the importer is not in the market, and now that each firm is easily selling all its output every year (since 1941 no firm has built up more than momentary inventories), it is not at all clear that a firm could not sell a large portion of its

"CONTRACT DISCOUNTS:

A. On orders placed for June arrival and on orders placed prior to July 1, 1949, delivery of the total of which buyer agrees to accept in approximately equal monthly tonnages over the period June 1, 1949 to March 31, 1950: - 6% from above f.o.b. prices will be granted.

Upon completion of the entire tonnage for which contract has been executed, buyer will receive a credit of 4% additional.

B. On orders placed after June 30, 1949, and prior to October 1, 1949 delivery of the total of which buyer agrees to accept in approximately equal monthly tonnages over the period October 1, 1949 to March 31, 1950: - 4% from above f.o.b.prices will be granted.

Upon Completion of the entire tonnage for which contract has been executed, buyer will receive a credit of 2% additional.

C: The above f.o.b. prices are not after September 30, 1949 for deliveries to May 31, 1950."

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same reasons, upward movements must either be followed by the other firms or immediately abandoned. The chances are that at the present an upward change would not be followed.

The price history of the potash industry has little bearing on the present situation, except as it influences the psychology of the present members of the industry. Since the end of World War I, the general price trend has been steadily downward, as competition and technical improvements have made themselves felt. In 1934-1935 there occurred some dumping by Russian and Spanish producers, but that has been the only disorderly influence. It was removed by widening the cartel agreements. Since 1938, no price changes have occurred.

The main problem of the industry has been that of price leadership.[41] The position of leader was in general assumed by the importer, although reductions by the other firms were always followed. This leadership, which was quite natural because of the power of the importer, extended to acceptance of the basing-point system and of the discount structure, with the later qualifications already noted. The pressure has always been for upward movements, and in this direction the importer has almost always been

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40. Con'td. output at a price higher than the rest were charging. As far as can be determined from conversations with men in the industry, however, this possibility does not exist. (This is true only of the three Carlsbad producers. The discussion of product market areas, especially sulphate in the southern region, should be kept in mind).

41. A price leader is a firm whose status in the industry is such that it can successfully initiate price changes. The other firms are in general willing to abide by the price decisions of the leader. United States Steel in the steel industry may be cited as an example of a price leader.

the leader. This is probably the real test of price leadership in an industry.

The following of downward movements has been facilitated by clauses in the contracts which permit the buyer, upon receipt of a bona fide offer of a lower price from some other producer, to either secure this new price on his original contract, or else cancel all or part of it. This had the effect of protecting the buyer against loss from signing a contract early in the season, and thus has greatly facilitated contacting and planning.

Whether the importer could have maintained his position as leader in the industry in the face of the rising domestic industry is a moot point, since the war interrupted all imports. Since then there have been no changes in the price of muriate (except for the readjustment from basing-point to f.o.b. prices), and only minor changes in the prices of some of the more specialized product. It is not therefore possible to speak of leadership at the present time.

The future is not easy to predict. As long as the supply runs slightly behind demand, and as long as the importer is priced out of the market, the present situation is likely to continue. There are, however, certain factors which may act to disturb the status.

First, demand may decline, and/or the entry of Duval, now definitely committed, may bring supply up to demand. In this case prices may fall; with the newcomer being the probable leader. Or, the existing firms may cut prices to a point where Duval is kept out, although this is not considered likely by the author.

Second, ocean transportation from Los Angeles and Galveston to the Atlantic area may again become available, and may result in a revival of the

basing-point system, since individual consumers would not be able to take sufficient quantities to enable them to contract for shiploads on an f.o.b. Carlsbad or Trona basis. This, however,is not predicted for the near future.

Third, the importer will eventually return to the market in considerable strength. The earliest probable date, according to an estimate by the author which has been confirmed by the opinion of one of the best informed men in the industry, is 1955. The result in this case is not clearly defined, although an "orderly" agreement between domestic and foreign producers may be reached, if the courts do not interfere. The major factor hindering such an agreement would seem to be the ability of the domestic firms to supply the industry themselves, coupled with a desire to maintain production at full capacity. Lower prices are predicted, with an added probability of some governmental intervention. This aspect will be discussed later.

Two questions remain to be considered. First, why the growth of the American industry was not met by stronger resistance from the importer in the form of price cuts; and second, why prices have not risen since 1938.

The first is answered partly by the policy of the fertilizer firms, which contracted for the entire output of the new firms (as long as their price was equal to that of the importer) and divided it up so that several firms took the products of each producer. This virtual guarantee to the new firms was the result of the fertilizer industry's desire to be rid of the foreign dependence which had always plagued it, and which now seemed to be at an end. The beneficial effect of this policy on the growth of the American industry should not be overlooked. In addition, the importer

was bound by German governmental regulation not to offer potash for sale for less than a stipulated percentage of domestic prices, and a large price cut would have meant corresponding cuts in the monopoly price to the German consumers. Further, there was always the fear of U. S. retaliation in the form of tariff protection.

The second, the maintenance of pre-war prices, is explained partly by pride in the industry, partly by fear of anti-trust action,[42] and largely because technological improvements have acted to hold production costs practically constant, despite the large and still-continuing rise in labor and certain other costs. It is also possible that prices were kept down to help discourage entry. In any event, no increase occurred, despite the fact that one could well have been made and maintained with little difficulty. Higher prices might well have damaged future customer relations, which play a large part in the sale of potash by the individual firm. During the past twenty years, the tendency has been toward product and sales competition, rather than toward price competition. In view of the disastrous excess capacity which has accompanied vigorous price competition in Europe, this is a healthy tendency in this industry.

Present potash prices are:

F.O.B. Carlsbad: 60% muriate - 37.5¢ per unit K_2O, 50% muriate - 37.5¢ per unit, manure salts - 20¢ per unit, Sulphate of potash (basis, 30% K_2SO_4 and 18.5% MgO) -$14.50 per ton.

F.O.B. Trona: 60% muriate - 45.4¢ per unit, granular 60% muriate (chemical grade) - 47¢ per unit, sulphate of potash - 79¢ per unit.

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42. The Thorp-Tupper Report was prompted by the thought of a Sherman Act prosecution against the fertilizer industry and against the potash industry in its relation to the former. The Report cleared the

Trona can charge a higher price for muriate because of her regional monopoly, since she ships only sulphate and chemical grades to the Eastern section of the country.

Quotations of import prices vary greatly and are extremely difficult to obtain. The only available report is 85¢ per unit, probably on a chemical grade.

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42. Cont'd. industry, but a consent decree was entered into by the three major producers (IMCC was not yet in the industry) in 1940.

VII - PRODUCT VARIATION AND SELLING COSTS

A firm may vary its product either by changing the K_2O content, or by changing the form and occurrence of the K_2O to yield a different product. In addition, it may control the amount and type of the "impurities" present in the product. In changing the K_2O content, the original product is supplanted, while in changing the form it generally is not.

Since potash is bought on the basis of its K_2O content, an increase in K_2O without a price increase is equivalent to a reduction in price. This device has been used extensively by the domestic firms in gaining entry to the industry.[43]

A brief history will serve to show the kinds of product variation of the first type above. When APCC first entered the industry the borax content of its muriate exceeded the 0.5% maximum established by the Department of Agriculture. It was therefore obliged to sell at a price less than the importer's. As soon as it had the borax content under control Trona followed the leadership of the importer. By 1932 the Trona process had been so improved that it could guarantee muriate of no less than 60% K_2O, and it stopped charging for overtest. The importer immediately followed the same policy.

A year later USPC entered the industry with a 62½% muriate at the 60% muriate price, and the other firms were forced to adopt a basis of 62½% minus undertest, since their processes could not match USPC's for purity. Since that date the processes, at least of the domestic firms, have been

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43. These considerations apply only as long as prices are quoted on a

steadily improved, with all muriate now running around 62% pure. With the exception of certain of the chemical grades and the USPC muriate, the products of the separate firms now yield almost identical products.

Variation of product has two important aspects in this industry. The first concerns the individual products offered. The various forms of KCl and K_2SO_4 have different uses, and the individual firm must decide which it wants to produce, although this choice is in some instances limited by the source of K_2O. One of the main considerations is the purity of the product, and so 60% muriate is produced by all of the major firms.

In addition, there is a definite advantage in selling a wide range of products. Prior to the war, the importer carried the only complete line, and as a result many consumers would purchase at least part of their basic requirements as well from him. This was graphically illustrated in the case of APCC, whose sales of muriate shot up as soon as it was able to offer sulphate in addition. IMCC now carries the most complete line of products.

In general, the product variation is determined for the firm by problems of technology, and hence by the question of production costs. There has been and can be no variation in product for the sole purpose of advertising, with the slight exception of the use which PCA makes of the red color of its muriate, resulting from the use of a flotation process. Even this publicity for the color of the product is probably an attempt to conceal what was originally a disadvantage, since IMCC, which followed with

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43. Cont'd. tonnage basis. They do not hold for unit pricing, except in so far as freight must be paid on the impurities present.

a similar product, did not find the same strategy necessary.

Because of the identical products,sophisticated buyers, and identical prices, selling techniques play a large part in determining who sells potash to whom. This has not been too important during the past ten years, but in light of past and, presumably, future problems,it cannot be neglected, even as present policy for the firms.

Selling is generally concentrated in a period of two or three weeks after June 1 of each year, when the new price list becomes effective, and when the maximum discounts obtain. All of the major firms have sales offices in New York City, and most of them have offices is the South as well. The personal relations between salesman and purchaser are very important, and most of the off-season is spent by the sales force in developing good will. The Thorp-Tupper Report found that selling expenses ranged from 2% to 4.4% of net sales.[44] In 1948 APCC's selling costs were 3.9% of net sales, and in 1949, 4.1%

There is practically no advertising directed at the fertilizer industry. There is rather an extensive program of education and promotion directed at increasing the use of fertilizer. This advertising is not aimed at promoting the sales of one firm at the expense of another, but rather at raising the demand for fertilizer and hence potash.

This educational work is carried on partly by the individual firm, partly by county agents the country over (from a purely objective standpoint, of course), and largely by the American Potash Institute.

This group was organized on July 1, 1935 by the domestic producers and the importer for the promotion of potash. It has three functions: first,

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44. Page 49.

to carry on scientific research on the proper use of potash and fertilizer; second, to work with various government agencies to make the results of this research available through official channels; and third, to make the findings known to farmers and to induce them to act accordingly. The aim of the research is not only to determine the proper use of fertilizer, but also to determine the proper amount of potash for fertilizers used in various parts of the country and under various conditions.

The Institute is active in the continental United States, Puerto Rico, Hawaii, Cuba, and Canada, and is financed by contributions made by its members on the basis of K_2O tonnage sold in these areas. Information is made available through the Potash Journal and Better Crops and Plant Food, an agricultural magazine. The effectiveness of the Institute's work cannot be doubted.

The advertising policies of the potash industry seem to be very sound, both in regards to their economic value to the industry and to the country as a whole. This is especially true in comparison with other oligopolistic industries. One might perhaps point to the cigarette industry, where the basic ingredient is little more differentiable. The difference lies in the sophistication of the consumer.

VIII - OUTPUT POLICY

Because of the extreme inelasticity of demand for potash, price variation does not determine the amount of potash sold. Within a wide range of prices, bounded only on the upper side by the present costs of the importer, it is unlikely that a price change would have any effect whatever. While this is true of many industries, it is especially in the present one, because of the absence of substitutes.

Since there have been no price changes in the past ten years, it is obvious that if the firms are making any short-run effort to maximize profits,[45] they are not using price policy to do so. Two other variants have been examined in the previous chapter, and there remains only the problem of output variation.

The problems of output and cost analysis would be numerous under any circumstances. The three New Mexico firms are deathly afraid of their competitors, and data pertaining to individual output and cost analysis is simply not to be obtained. Strenuous efforts have been made to secure this information by indirect methods, with astoundingly little success. All data that might be useful is either withheld or is not interpretable.

Output is of course limited by plant capacity. Present capacity is 6000 tons of ore per day for PCA and USPC, and 7200 tons for IMCC. The K_2O content of this ore varies with the ore body, IMCC having the lowest content by a considerable margin. While this capacity output is often exceeded on particular days, repairs must occasionally be made, and there are many slow downs in particular phases of the mining and refining

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45. Sufficient data for a careful evaluation of this assumption are not available.

processes. Since a slowdown affects every stage of production, and since the plants run twenty-four hours per day, there is no way to make up the lost production. In calculating annual productive capacity it is necessary to consider a working year of from 330 to 340 days, instead of 365. Use of the latter figure gives an annual capacity of 2,040,000 tons of ore for PCA and USPC, and 2,448,000 tons for IMCC. On the basis of a recoverable K_2O content averaging 18% in this ore, annual K_2O capacity for the State of New Mexico is 1,175,000 tons. The actual output in tons K_2O for the state from 1941 to 1948 are as follows:

1941 - 433,700	1945 - 733,200
1942 - 548,700	1946 - 789,500
1943 - 604,400	1947 - 880,600
1944 - 679,700	1948 - 969,700

Source: U.S. Bureau of Mines Minerals Yearbook.

As far as can be determined, there is no projected expansion of these three companies.

The details of production costs are not available. It has been estimated that between 75% and 85% of total costs are attributable to production costs. This figure seems high, unless depreciation costs are meant to be included. The only available information on the variation of cost with size is presented by the Thorp-Tupper Report on the basis of information submitted to it by APCC. The important quotation is:

"The experience of the American Potash and Chemical Company, which added a second unit to its plant in 1927 and a third unit in 1934, sheds some light on the effect of size on the cost of operation in potash production. The process at Trona is a 24 hours a day continuous process with a fairly inelastic limit of production, not to be exceeded by speeding up or working overtime.

Approximate estimates have been prepared by the plant officials indicating the expenses and output which would result from the operation of all three units, from the operation of two and from the operation of one alone. These estimates are as follows:

	Units 1-2-3	Units 1-2	Unit 1
Tons Produced	194,000	123,000	71,000
Percentage	100%	63.4%	36.6%
Expenses			
Cost	$3,275,000	$2,521,000	$1,843,000
Depreciation	630,000	630,000	630,000
Selling & General	740,000	582,000	498,000
Other charges	468,000	201,000	33,000
Total expenses	$5,113,000	$3,934,000	$3,004,000
Percentage	100%	76.9%	58.3%"

It is presumed that, taking only direct production costs into consideration, no firm has passed the lowest point on its average cost curve, and it is possible that none have reached this point.[46]

In constructing an average cost curve for a potash firm, the following costs must be taken into consideration: Production costs; selling and administrative costs; depreciation and depletion; and severance tax payments.[47] Severance tax payments are slightly progressive, since there is an exemption for the first $200,000 of production. Selling and administrative costs are assumed to be regressive, although the opposite might be the

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46. Within the past year, for the first time, IMCC considers that it has brought the various factors of production in its plant into optimum relations with one another, and has eliminated all bottlenecks. Whether this could have been achieved with a smaller plant is not known. The other two Carlsbad plants are slightly smaller than IMCC's.

47. Severance taxpayments are made on the basis of value added in refining;

Approximate estimates have been prepared by the plant officials indicating the expenses and output which would result from the operation of all three units, from the operation of two and from the operation of one alone. These estimates are as follows:

	Units 1-2-3	Units 1-2	Unit 1
Tons produced	196,000	182,000	91,000
Percentage	100%	83.4%	25.6%
Expenses			
Cost	$3,276,000	$3,031,000	$1,963,000
Depreciation	680,000	630,000	330,000
Selling & General	740,000	682,000	498,000
Other charges	468,000	301,000	32,000
Total expenses	$5,113,000	$4,654,000	$3,004,000
Percentage	100%	76.9%	58.8%[47]

It is presumed that, taking only direct production costs into consideration, no firm has passed the lowest point on its average cost curve, and it is possible that none have reached this point.[46]

In constructing an average cost curve for a potash firm, the following costs must be taken into consideration: Production costs; selling and administrative costs, depreciation and depletion; and severance tax payments.[47] Severance tax payments are slightly progressive, since there is an exemption for the first 200,000 of production. Selling and administrative costs are assumed to be representative, although the opposite might be the

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46. Table the past year, for the first time, IMCO considers that it has brought the various factors of production in its plant into optimum relation with one another, and has eliminated all bottlenecks.
Whether this result have been achieved with a smaller plant is not known.
The other two Carlsbad plants are slightly smaller than IMCO's.

47. Severance taxpayments are made on the basis of value added in refining.

case beyond a certain point. Production costs are regressive, at least at present levels of output.

The rate of depreciation per unit of output is doubly dependent upon the rate of production. First, since all plant is designed for continuous production, a larger plant would be necessary to raise output, and physical wear and tear would be greater. In the case of less than full utilization of plant, depreciation would remain constant or decline slightly. Second, the period of time over which certain initial costs (mainly prospecting and shaft-sinking) must be amortized depends upon the quantity of reserves in relation to the rate of production.[48] In case no alternate ore body were available, certain other costs, such as those of building plant and providing utilities, would become non-recoverable, and would have to be written off as well. Depletion is directly dependent upon the rate of production.

The cost curve for the industry is certainly U-shaped, although relatively flat and without a well-defined minimum.

Once a firm has developed capacity, it has in the past been unwilling to let any of it sit idle. This is mainly because of the heavy prospecting and shaft-sinking costs which must be amortized. It is therefore willing to continue selling for considerable periods at prices just covering all costs. This happened for a time during the price war of 1934-1935.

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47. Cont'd. royalties and all other taxes are figured on sales value and are directly proportional to that value.

48. Thus, if a firm had located and opened an ore body containing 1,000,000 tons of recoverable ore, and if it decided to mine at the rate of 100,00 tons per year, all non-recoverable costs would have to be written off within ten years. Since first order reserves of the present firms are estimated to last over 80 years at present production rates, this problem is not acute. From the above table it is evident that this factor is not considered in the short-run.

Output policy may be summed up as follows: As long as prices are high enough to ensure profits, the firm is interested in selling as much as it can. If it cannot sell enough, it will resort to price reductions, the ultimate goal being a large output at a price at which it can profit while the other firms cannot. This condition is unstable, and the long-run result will be either exit, which is extremely difficult in an extractive industry, or a working agreement between the firms. The unwillingness of the firms to divulge cost data is evidence that the firms fear the reoccurrence of excess capacity in the industry.

Since 1940, the domestic producers have been in the first situation above. This is certain to continue for another 18 months, until Duval's products reach the market, and will probably continue until the importers reach it. With the possible exception of France, the importers will be at a cost disadvantage, but at a transportation advantage. The outcome is uncertain.

Now that the average cost curve for the firm has been developed, to what considerations does it lead? If one has the power of regulating entry into the industry, as the Federal Government does, the optimum number of firms in the industry can be determined on the basis of demand divided by optimum size, and limit the industry to this number.

In the past three years the government has issued additional prospecting permits, and has thereby implied that the price of potash is too high and it is seeking to induce competition to effect a lowering of the price. This policy should indicate a willingness to protect the industry from excess foreign competition, should this competition make domestic capacity idle in the future. From the past unwillingness of the

farm bloc to permit a tariff on fertilizer materials, the possibility of such protection does not seem too great.

IX - GOVERNMENT CONTROL AND TAXATION

Patents have been shown to play a considerable role in protecting the various refinements of process which contribute to the efficiency of the American processes for refining potash. Because of the standard nature of the product and the educational nature of the advertising, copyrights are relatively unimportant, although each of the firms has some sort of an emblem by which it identifies its product and literature. In addition to these government-provided protections, there are certain federal and state controls to which the potash industry is subject.

Federal corporate income tax, state income tax, and county property tax are paid by all of the firms. The three New Mexico firms also pay a state sales (school) tax, as do all corporations in the state. The sections of this tax law which pertain specifically to the potash industry are here reprinted:

SECTION 101. Purpose of the Act. - The purpose of this act is to meet the emergency existing in regard to the public schools of the state, and to provide funds for the proper maintenance and support of the public schools.

SECTION 201. Privilege Taxes. - There is hereby levied, and shall be collected by the Bureau of Revenue, privilege taxes, measured by the amount or volume of business done, against the persons, on account of their business activities, engaging or continuing, within the State of New Mexico, in any business as herein defined, and in the amounts determined by the application of rates against gross receipts, as follows:

A. Mining, quarrying or extracting. - At the amount equal to the percentages herein after ... specified of the gross receipts of the business of every person engaging ... in the business of mining, quarrying or extracting from the natural resources of this state for sale, profit, or commercial use, any oil, natural gas, potash, copper, gold, silver .. (etc.) ...

Rates of Tax. - Upon natural gas, carbon dioxide gas and potash, at the rate of two per cent of the gross receipts, and upon all other businesses ... at the rate of one-half of one per cent of gross receipts.

Measure of tax. - The measure of the tax imposed by this paragraph is the value of the entire production in this state, regardless of the place of

sale or the fact that the delivery may be made to points outside of the state.

Application of law to mining etc., versus manufacturing, etc., - Any person engaging ... in any of the businesses taxed by this paragraph (A) who shall refine, smelt, ... or otherwise prepare for sale or use as manufactured... products any minerals ... so that the character or condition thereof is materially changed, in mills or plants located in this state and taxable under paragraph (B) of this section, shall not be required to pay the tax levied by this paragraph (A) on account of the production of such minerals .., where the value of such products is included in the measure of the tax levied upon and collected from the taxpayer under paragraph (B) of this section. ...

Taxability of royalties; exemptions. - ... Royalties or rentals paid the United States or the State of New Mexico shall be deducted from the gross receipts of the business, and shall not be subject to the tax hereby imposed.

B. Manufacturing, etc., rates of tax. - At an amount equal to one-fourth of one per cent of the gross receipts of the business of every person engaging ... in each or any or all of the businesses of manufacturing, smelting, refining, ... commodities or material products ...: provided that the tax ... shall be at the rate of one-half of one per cent of the gross receipts of the business ... of smelting, ... , refining, ... oil, natural gas, carbon dioxide gas, potash, gold, silver, ...

A large proportion of the potash-bearing lands of New Mexico are owned either by the state or by the federal government, and are leased from them by the individual firms. The salt lakes or marshes used as sources of potash by APCC and Bonneville are also federally owned. Under an act of congress approved February 7, 1927, entitled "An Act to promote the mining of potash on the public domain", (44 Stat. 1057, 30 U.S.C. 281) The Secretary of the Interior is authorized to issue prospecting permits for a period not to exceed two years, subject to such rules and regulations as he may prescribe. The following sections are from the Code of Federal Regulations, Title 43 - Public Lands: Interior. Part 194 - Potassium permits and Leases (as amended):

Section 194.1 Purpose of regulations. In order to provide more adequately for the proper development in different areas and for conservation of the potassium resources on the public domain so as to assure sufficient supplies of potassium and associated minerals to meet current

and future needs of the United States and to guard against monopoly, these regulations, superseding existing regulations on the subject, are hereby promulgated. ...

Section 194.5 Rights under permit. The permit will confer upon the recipient the exclusive right to prospect for potassium deposits in the land. ... .

Section 194.7 Reward for discovery. A permittee who shows to the satisfaction of the Secretary that, prior to the expiration of his permit, he has made a discovery of valuable potassium deposits within the area of the permit, is entitled, under section 2 of the Act of February 7, 1927, to a lease ... of any or all of the permit land chiefly valuable therefore, the area to be taken in compact form. Such a discovery must be one which demonstrates the existence of potassium deposits in commercial quantities . ... The lease will be issued at such royalty rate and acreage rental as may be fixed pursuant to sections 2 and 3 of the Act.

194.12 Statutory authority. Section 3 of the Act of February 7, 1927, authorizes the Secretary under such general regulations as he may adopt, to lease for the production of potassium deposits public lands known to contain such deposits in commercial quantity and character and found in some or any of the forms described in said Act. Invitations to bid for such leases may be made by the Secretary in accordance with the procedure hereinafter set forth. (Leases were originally made for twenty years, renewable upon reasonable conditions. A law approved by the president on June 3, 1948, made all potash leases indeterminate in length as long as the lands are being mined, with adjustments in terms permissable every twenty years.)

194.15 Royalties and Rentals. The rate of royalty will be fixed prior to the offer of the lands for lease, but in no case can the royalty rate be less than 2 per cent of the quantity or gross value of the potassium compounds and other related products at the point of shipment to market.

The rentals fixed by the act are to be paid annually in advance - 25 cents per acre or fraction of an acre for the first calendar year or fraction thereof, 50 cents per acre for the second, third, fourth and fifth years, respectively, and $1 per acre for each year thereafter, such rental for any year being credited against royalties accruing for that year.

194.16 Leases for potassium deposits and associated minerals. ... potassium leases may also provide for the development of sodium, magnesium, aluminum, or calcium deposits, ... , on terms and conditions not inconsistent with the sodium provision of the Act of February 25, 1920, as amended.

194.24 Sec. 3, d. Sale of production. The right to purchase after one year's notice of intention to do so in specified quantities for a specified period up to one-fourth of the quantity of potassium produced from the leased land at the point of shipment to market at not more than prevailing prices f.o.b. refinery, as determined by the Secretary, (shall be reserved by the lessor.) (This section was amended to read "one-tenth of the quantity" on March 24, 1947, and was deleted on January 29, 1948.)

194.25 Operations. Prospecting and mining operations under permits and leases will be governed by operating regulations, approved by the Secretary. Before beginning operations permittees and lessees should consult with the district mining supervisor of the Geological Survey for the area in which operations are to be conducted and obtain from him a copy of the operating regulations.

194.26 Limitations on holdings. ... , no person, corporation or association will be granted, either directly or indirectly or by approval of assignments, permits and leases, an area which exceeds in the aggregate 15,360 acres. (Several years ago this section was changed to permit a corporation to hold, in addition to 15,360 acres under lease, an additional acreage of 30,720 acres under permit for prospecting.)

Since almost all of the major productin areas in this country are located on the public domain, the rules and regulations under which the Secretary of the Interior issues permits has a vital effect upon entry into the industry. In the past the Secretary has interpreted this section (194.2, not quoted here) to give him the power to withhold permits when he considers further expansion of the industry unwarranted. From 1934 to 1937, the Secretary refused to grant permits, but since then certain permits have been granted, and additional reserves and working ore bodies have been outlined. In particular, the past three years have seen considerable prospecting, and the discovery of four new ore bodies.

At Searles Lake the technological difficulties have been so great that the Secretary has become unwilling to grant leases to any firm which has not previously shown that it was able to undertake economical extraction. At the present time APCC leases almost all of the valuable sections of Searles Lake. The same considerations hold true for Lake Bonneville, where only Bonneville, Ltd.is in production.

Since there is no limit to the amount of land to be leased by one corporation from the Stateof New Mexico, holdings of state land run quite large. Following are exerpts from the lease between New Mexico and USPC.

Terms of the other companies' leases are not known, although all pay the same 5% royalties. In addition to these royalties, the State of New Mexico receives 37½% of all royalties paid the federal government on the public domain.

POTASH MINING LEASE
(Under Act Approved March 12, 1929)

WHEREAS, the said lessee has heretofore explored the lands hereinafter described, by test wells and by the sinking thereon of a shaft at large expense, and has discovered on said land potassium in commercial quantities, and the said lessee has heretofore begun and is now continuing the production on said land of potassium on a commercial basis, and has produced from the lands hereinafter described, and paid royalty on more than forty thousand tons of crude potassium salts in each of the years 1925 and 1936;

NOW, THEREFORE, in consideration of the said above tender ... the lessor does hereby grant ... to the lessee exclusively for the sole and only purpose of exploration, development, and production of potassium, sodium, phosphorus and other minerals of similar occurrence and their salts and compounds in, upon, and under the following described land ...:

SECTION 2. In consideration of the premises, the lessee hereby agrees as follows, to-wit:

(a) Unless extension be granted by the Commissioner of Public Lands, to produce from the lands hereinabove described, and to pay royalties hereinafter specified on, at least fifty thousand tons of crude potassium salts during each year of this lease ...

(c) To pay to the lessor annually in advance on the successive anniversary dates of this lease the sum of ten cents per acre for each and every acre of land as to which the lease may be in force ... . Provided that the annual rental on this lease shall not in any case be less than one hundred dollars ... .

(d) To pay to the lessor a royalty of five per cent of the minerals produced hereunder, except sodium chloride or common salt, such royalty to be computed upon the value of said minerals delivered at the nearest or most accessible railroad shipping point; and to pay the lessor a royalty of ten per cent of the actual sales price of all sodium chloride ... .

(h) To carry on all mining, reducing, refining, and other operations in a good and workmanlike manner in accordance with approved methods and practice, having due regard to the health and safety of employees, the prevention of waste, ...

(k) To pay when due all taxes lawfully assessed and levied under the laws of the State of New Mexico upon the improvements, output of mines and other rights, property and assets of the lessee.

(The lease is indeterminate in length.)

The actual payments made by the firms are not known (except in a very few scattered instances) since such data would reveal the relative outputs

of the firms. While these rates seem quite high,it will be shown that the profits of the firms are not thereby reduced to a dangerously low level.[49]

The New Mexico Severance Tax remains to be considered. The basic justification of a severance tax - the fact that natural resources are being depleted at a more or less rapid pace - will not be reviewed here. In view of the discussion of the magnitude of first-order reserves (above, Chapter II) it is obvious that the levy is not wholly without justification in the present case.

However, certain revisions were made in the law by the legislature in the session of 1949 which give the impression that the burden of the tax is not equitably distributed. At that time the tax rate on oil and natural gas and potash was raised from 2% and 1%, respectively, to 2½%. Copper was raised from 1/8 % to 1/2 %. In addition, a blanket exemption of $ 200,000 to be deducted from gross value before computation of the tax, was granted to each tax payer.[50] Certain pertinent sections of the amended law are reprinted below:

CHAPTER 103, SESSION LAWS, 1937

AN ACT TO LEVY AN EXCISE TAX UPON OILS, GASES, POTASH, TIMBER, GOLD, SILVER, LEAD, COAL, ZINC, COPPER, ASPHALT, AND STONE SEVERED FROM THE SOIL OF THE STATE OF NEW MEXICO:

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49. Prior to January 1, 1950, the royalty rates on land leased from the government by the New Mexico firms were as follows: USPC - 2%; IMCC - 3½% on products mined from sylvite (potassium chloride); PCA - 3½%. To quote from a letter written the author by Mr. Horace M. Albright, President of USPC, "The 2% royalty was granted our company in recognition of our discovery of potash in the New Mexico field - a reward, so to speak, for this pioneering achievement which was of such great importance to the nation." Today all firms pay 5% royalties.

50. The amendments were not clearly worded, but a recent decision of the State Supreme Court has upheld the above interpretation of the exemption clause.

Section 1. Taxes levied on Natural Resource Products - Lien of Tax. That from and after the effective date of this Act, taxes are hereby levied on all natural resource products severed and saved from the soil of thie State; provided,however, that water shall not be subject to the provisions of this Act.

Section 2. Tax on Gross Value at Severance - Gross Value defined - Rates - Exemption. - Taxes as levied by Section 1 of this Act shall be predicated upon a gross value, as hereinafter defined, of such products severed and saved from the soils of this State ... .

Gross value is defined as being sales value of the severed and saved product at the first marketable point ... without any deductions except those expenses of hoisting, crushing and loading necessary to place the severed product in marketable form and at a marketable place. ... .

The taxpayer is hereby granted an exemption from taxation of Two Hundred Thousand Dollars annually, which shall be deducted from the gross value as herein defined before computing the tax.

The calculation of gross value from sales value is predicated on the theory that the ore has no value until it is brought to ground level in a form suitable for refining. Data is not available for calculating the amount of this deduction, which might otherwise prove helpful in assessing production costs for the firms. For instance,in 1943, severance taxes paid by the three Carlsbad firms amounted to $109,600, representing agross value of output of $10,960,000. For the same year, production value for severance tax purposes is given as $23,840,000. Production costs are surely greater than 45.9% of sales value. To make matters worse, U. S. Bureau of Mines figures for value of production for that year are $21,920,000. Information concerning other costs and concerning the individual firms is not available. Even if 45.9% is to be accepted as the per cent production costs are of sales value, costs for the individual firms cannot be found.

That the exemption and rate increase discriminates against the larger producers, especially in the case of potash and oil and natural gas, may easily be seen. No detailed account of the actions of the legislature are available (since minutes are not kept), but from all accounts economic

considerations were secondary to politics. Lobbies from the major severing industries in the state were present in Santa Fe, and of all these the potash lobby seems to have fared least well.

In addition to these fiscal controls, certain direct controls are also exercised over the production of potash. The most important of these are those exercised by mining inspectors concerning safety and conservation. While both the U. S. Government and the State of New Mexico provide inspectors, the federal inspectors are more exacting. There seems, however, to be very little friction between the government and the firms on this subject, and the firms consider the regulation satisfactory. New methods are developed individually by the firms, and in most instances are approved by the inspectors when they have been proved in practice.

The government in the law cited earlier no longer reserves the right to purchase a stipulated amount of production. It does exercise certain controls over the Potash Exporting Corporation, chiefly concerning the quantity and destination of exports.

It would seem that the Federal Government, while exercising direct and indirect controls over the industry, is not at present hindering to any substantial degree the operation of private enterprise in the potash industry.

At present levels of profit, the New Mexico sales and severance taxes probably do not have a serious effect upon the potash industry. That this will always be the case is not, however, certain. This aspect will be discussed below.

Regarding the desirability of further government regulation and protection of the potash industry more will be said in the concluding chapter.

X - THE FIRMS' FINANCIAL STATUS

The financial data of the potash firms will reveal three things. First, how much profit, before and after taxes, is being made by the firms. Second, how much of this profit is being paid out in dividends and how much is being used to finance the growth of the firms. Third, how sound the firms are and what their ability to undertake a price war would be. There will also be included a discussion of the tendencies toward price wars in the European potash industry, which applies to present conditions in the American industry.

Table X gives selected data from the financial records of the four major firms for the past ten years. Data for Bonneville is not given in Moody's (or Standard and Poor's, for that matter) or by the Securities and Exchange Commission. A letter to the president of the firm has not been answered to date. Such a small per cent of the business of Dow Chemical and American Cement is from potash sales that an examination of those two firms would not be significant.

In the case of PCA and USPC, the financial reports represent only potash operations. APCC and IMCC, however, do considerable business in other lines as well. APCC derives most of its profit from the sale of boron products and potash. An estimate of 40% of total profit from potash might be made, but it would be little more than a guess. The figure certainly does not exceed 50% in any case. Since the price of potash has not changed since 1938, the net sales of PCA and USPC represent the increase in volume of potash sales. The same is not true of the other two, and the great increase in IMCC's sales during the war is probably largely due to price

TABLE X - Financial Records of the Major Firms, 1939 - 1949.
(All dollar columns multiplied by 1000.)

1	2	3	4	5	6	7	8	9	10
Year	Net Sales	Operating Profit	3 as a % of 2	Net Income	5 as a % of 2	Dividends	Added to Surplus	Total Assets*	5 as a % of 9
American Potash and Chemical Corporation									
1949	13,693	2,228	16.3%	1,791	13.1%	1,072	719		
1948	14,521	2,064	14.2	1,727	11.9				
1947									
1946	10,645	1,701	16.0	1,515	14.2	793	722	20,288	7.5
1945	10,342	1,339	12.9	1,177	11.4	793	384	18,973	6.2
1944	9,465	1,579	16.7	1,486	15.7	793	693	18,653	8.0
1943	9,152	1,323	14.5	1,383	15.1	793	590	22,061	6.3
1942	8,254	1,930	23.4	1,606	19.4	793	814	20,648	7.8
1941	6,797	1,648	24.2	1,056	15.5	1,057	-1,920	20,648	5.1
1940	7,972	2,645	33.2	2,378	29.8	2,246	132	20,999	11.3
1939	8,830	3,419	38.7	3,226	36.5	2,510	716	21,050	15.3
International Minerals and Chemicals Corporation									
1949	53,395			5,421	10.2	1,896	3,525	59,898	9.0
1948	50,123	7,096	14.2	5,016	10.0	1,657	3,359	56,542	8.9
1947	41,302	6,142	14.9	3,827	9.3	1,413	2,414	47,089	8.1
1946	34,373	4,111	11.1	2,926	7.9	1,021	1,905	40,844	7.2
1945	30,301	3,124	10.3	2,038	6.7	951	1,087	37,050	5.5
1944	27,349	3,200	11.7	2,016	7.4	894	1,122	32,641	6.0
1943	22,477	2,967	13.2	2,075	9.2	862	1,213	33,416	6.1
1942	18,123	2,701	14.9	1,786	9.8	99	1,687	31,729	5.6
1941	13,632	292	2.1	403	3.0	0	403	28,327	1.4
1940	12,328	114	0.9	14	0.1	0	14	27,751	0.1
1939	11,712	161	1.4	126	1.1	0	126	26,680	0.5
Potash Company of America									
1949				2,642		1,929	711	15,756	16.8
1948		3,422		2,590		1,154	1,446	14,875	17.4
1947				2,293					
1946	13,127	3,118	23.7	2,022	15.4	1,759	263	13,687	14.8
1945	12,693	3,230	24.7	1,818	14.3	1,319	498	11,922	15.2
1944	11,392	3,006	26.4	1,585	13.9	1,099	485	10,599	15.0
1943	10,012	2,500	25.0	1,208	12.1	1,099	108	9,157	13.2
1942	8,873	2,791	31.5	1,400	15.8	962	438	6,954	20.1
1941	7,440	1,977	26.6	1,310	17.6	687	623	7,942	16.5
1940	5,592	1,281	22.9	1,066	19.0	548	518	6,116	17.4
1939	3,191	630	19.8	552	17.3	271	281	5,064	10.9

TABLE X - Continued.

1	2	3	4	5	6	7	8	9	10
Year	Net Sales	Oper- ating Profit	3 as a % of 2	Net Income	5 as a % of 2	Divi- dends	Added to Surplus	Total Assets*	5 as a % of 9
United States Potash Company									
1949									
1948	10,904	2,752	26.2%	2,960	27.1%	1,758	1,175	9,982	29.6%
1947	10,329	2,951	28.5	2,933	28.4	1,680	1,253	8,943	32.8
1946	9,109	3,663	40.2	2,744	30.1	1,630	1,114	7,461	36.8
1945	8,039	1,815	22.6	1,645	20.5	1,393	252	7,627	21.6
1944	7,278	3,018	41.5	1,958	26.9	1,260	698	8,257	23.7
1943	7,250	3,292	45.4	1,926	26.6	1,531	395	10,707	18.0
1942	6,156	2,646	43.0	1,515	24.6	1,407	106	9,656	15.7
1941	5,714	2,633	46.1	1,774	31.1	1,557	217	8,980	19.8
1940	4,374	1,914	43.7	1,643	37.7	1,530	348	8,806	18.7
1939	3,972	1,895	47.7	1,433	36.1	1,135	297	7,852	18.3

* Since the policies of the individual firms differ with respect to the valuation of reserves, the value of total assets differs for the firms. In the case of PCA the valuation of reserves has changed several times in the past ten years, and for this reason the figure has even less validity for PCA. Data for the determination of total amount invested in the various firms is not available.

SOURCE: 1939 - 1946, Moody's Manual of Investment. 1947 1949, Company Annual Reports, where available.

increases, although the period coincides roughly with the beginning of their potash operations.

The data of Table X is largely self-explanatory, but some comments as to terms used and the main conclusions should be added. For IMCC and PCA the fiscal year ends on June 30, while for APCC and USPC it ends on December 31.[51] Net sales have been used instead of gross sales because for some of the years gross sales were figured c.i.f., some years f.o.b., and some years both c.i.f. and f.o.b. Operating profit is net sales less all operating, selling, administrative, and general expenses, as well as depreciation and depletion.[52] The per cent operating expenses of net sales has been calculated because this offers a much better index of the operational efficiency of the firms at existing price levels than does net income. Net income is operating income plus other income[53] and minus taxes, royalties, and provisions for various contingency reserves. The amount added to surplus each year is in all cases very nearly equal to net income less dividends, but it has been added to give a better picture of the undistributed profits for the year.

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51. This fact and the fact that U. S. Bureau of Mines figures for value of potash production do not correspond either to gross sales or net sales are the reasons why it is not accurate to try to calculate the percentage of business done by the individual firms from this basis. However, this method seems to have been used by Hayes in his paper.

52. APCC has throughout the years refused to deduct for the depletion of its reserves. It is not known whether the Carlsbad firms have changed their policies regarding calculation of depletion since the recent discoveries of new reserves and ore-bodies in that area. Depletion allowances have been allowed by U. S. tax officials.

53. APCC, for instance, receives income from its railroad, which it owns and operates separately.

All of the companies have been making substantial percentages of operating profits, with the exception of IMCC, which is by no means in the red, and has been doing better in the past few years. The relatively lower figures of IMCC and APCC are largely reflections of the fact that the other operations of the firms are not as profitable as those in potash.[54]

IMCC has by far the worst record as far as passing dividends along to the stockholders is concerned, although this is probably explained by their low profit rates. Of recent years PCA has been the best. However, all firms have reached at least a temporary peak of expansion of plant and output, and the next three or four years ought to see substantial dividends. The relatively high dividends of USPC up to 1945 reflect the earlier start and development of that firm, which reached firm financial footing only in 1937. The per cent net earnings of net sales is high enough to show that the high taxes and royalties have not impoverished the firms. However, the increase in federal royalties as of the first of this year are not yet reflected in any data. USPC, whose net earnings have of late been running above operating profits, has lost its preferential position and will be the hardest hit by the increase.

If one wishes to buy stock in one of the potash firms, one should prefer PCA, mainly because of its very low undistributed profits. USPC ranks a close second because of operating efficiency. APCC has the long-run advantage of not being solely dependent on potash profits.

Excess capacity has always been the chief cause of price wars in the potash industry. The theoretical considerations of excess capacity

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54. It is unfortunate that the annual statements issued by PCA conceal so much useful information. This is, however, in line with the general policies of the firm.

and its causes in mining industries in general, and in the German potash industry in particular, have been well presented by George Ward Stocking. The following discussion is based largely on Part I of his book.[55]

Because of the great variation in the thickness and K_2O content of the various veins of potash, which results in tremendous variation in operating cost for the various mines, speculation has always been a major factor in determining newpotash production. Since there has always been room for one more very low cost producer in the industry, the speculative element is always present. Since the German potash fields, although relatively compact in American terms, extend over six political units and countless different properties, speculative entry has always been relatively simple.

Therefore, neither average demand nor peak demand has been the controlling factor in fixing capacity for the European industry. The result has been great excess capacity. Under such circumstances, each producer has lowered his price in order to sell a reasonable portion of his output, to recover as much as possible of his original investment. This turns many of the high-cost, marginal producers into sub-marginal producers.

Exit from the industry is extremely difficult. The shafts and tunnels are useless in any other industry, and they represent large initial investment. Refinery plant is highly specialized, although obviously not to such an extent as are the diggings. It follows that exit by conversion of plant to some other use is not possible. Likewise, bankruptcy proceedings may allow a firm to emerge with greatly reduced overhead costs, but this will do nothing to reduce capacity, and will place the remaining firms in

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55. The Potash Industry: A Study in State Control. (New York: 1931).

an even worse position.

The only way to effect exit from the industry is to apply depreciation and depletion reserves to purposes other than maintaining facilities. This, however, is a lengthy process, and depends for its completion upon maintaining output at a high level.

Once the industry has become over-expanded there are two cures: price war or cartelization, either with rationalization or without it. Historically the order in which the alternatives have been tested has been price war, cartelization, and rationalization.

Because of the limitations upon exit, price wars have never yielded a solution to the problems of the industry. As long as the German cartel was unchallenged, the maintenance of some excess capacity at each mine proved feasible; but after World War I, the rise of the French industry in Alsace necessitated extensive rationalization.[56] Before this process of rationalization had been completed, the Franco-German cartel had been formed; but the work went on without interruption. This complete rationalization seems to have been the only workable solution to the problems of the German industry, although this is not intended to imply approval of the policies of this or any other cartel.

Prior to rationalization, the German cartel had proved unable to prevent the very favorable profit conditions from attracting further speculative capital, and the cartel thus fostered the condition for which it was supposed to be a remedy.

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56. Some 50% of former capacity was shut down, and the output of the remaining mines was increased. The process of rationalization involves concentrating production in the low cost producing units, and compensating the high cost producers for the loss of income suffered.

In the following chapter it will be shown that entry into the domestic industry is strictly limited, or at least, limitable. The development of excess capacity within the country is not likely. However, freight rates from Europe to this country are such that excess capacity there has potentially the same effect.

Without outside influence, the American firms are very unlikely to engage in price competition. They have a relatively stable and rational position, and they have the example of the German industry to guide them. However, in case the importers should initiate such competition, the American producers would not be able to combine, either to resist or to join them. The consent decree of 1940 has shown that the Justice Department is watching the actions of the industry. The only protections under these circumstances would be the purchasing policies of the fertilizer mixers, which is not to be counted on to the extent of refusing lower prices, or tariff protection. Potash has traditionally been a free good.

In case of a price war, both IMCC and APCC would be in a better position to maintain prices at less than cost, because both derive profits from other operations. USPC and PCA are both financially sound, but have all their eggs in one basket. APCC has the added advantage of not being dependent upon the Southern market, where most if not all of the foreign competition would occur. It is more than possible that they would not be involved at all, at least as far as agricultural sales are concerned.

XI - ENTRY

The only absolute bar to entry in the potash industry is the policy of the Secretary of the Interior regarding the granting of prospecting leases. This has already been discussed at length.

There are other obstacles which may prove more or less impenetrable to a new firm. First,financial problems may prevent it from securing the necessary capital for prospecting,shaft sinking, and plant and utility construction. Second, technological difficulties may beset the newcomer. Economical refining processes have not yet been developed for some of the potash minerals, and minor but vital parts of all current processes are covered by United States patents.

When the new firm has overcome the above difficulties it must still find ways to market its product. In the past, this problem has always been eliminated by the fertilizer companies, who purchased all of the output for the first few years,providing only that the price was identical with that of the existing firms. What the future policies of these consumers will be is not known, since the dependence upon foreign sources of supply has been eliminated.

It follows that entry into the market is always possible by means of price reductions. But here, the reactions of the other firms must be taken into consideration. They may either meet price reductions, initiate further price reductions of their own, or maintain their old prices in the face of competition, relying on sales ability and high demand to move their product. In the past,price reductions have always been met without fail. Cut throat competition does not seem likely. A policy of not reducing prices could only be effective if followed by all existing producers

and if the output of the new firm were not too large. This policy would result in the newcomer's successful entry and probable subsequent conformance with the higher price.

In most industries of an oligopolistic nature, entry has tended to become more difficult as the existing firms grew and consolidated their positions. Exactly the opposite has been true for the potash industry, and for the Carlsbad area in particular. This is so partly because previous operations have proved such enterprises to be possible, nd thus have removed the element of risk which made the financing of USPC so difficult; and partly because of the technological advances which have been made since the first plant at Trona.

Entirely aside from the problem of determining whether demand will be adequate to permit marketing of the product, the following steps must be taken by a firm entering the potash industry. Capital must be raised to finance the costs of prospecting, shaft sinking, and plant construction; a permit must be secured from the Secretary of the Interior; test cores must be sunk to locate the ore body and outline it, and then leases must be perfected for the region to be exploited.[57] A shaft must be sunk, ventilated, and sealed against leakage; and machinery for breaking, hauling, crushing, and hoisting must be provided. A process must be secured or developed, refinery built, and storage facilities provided. Water, power, rail, electric, and highway facilities must be secured with as little capital outlay as possible. A labor force must be recruited, together with the necessary trained personnel, and housing and recreational

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57. There is, of course, no guarantee that such an ore body will be found. In case of the salt lakes at Trona and Bonneville, these costs are not

facilities must be provided. Last, a sales force must be organized and good will must be built up. All this takes time and money.

A brief summary of past experience along these lines is in order. A chronological outline of the histories of the major firms may be found between the Thorp-Tupper Report (pages 24 to 44), and the Hayes article (pages 60 to 67).

The APCC, formerly the California Trona Company and then the American Trona Corporation, had no difficulty in financing its operations.[58] The main difficulties were developing an adequate refining process and providing the necessary facilities and housing, since there was no nearby place for its labor force to live. In this connection it had to pipe in water, build housing and stores (which are operated on a non-profit basis), and build its own railroad.

USPC, the pioneer New Mexico firm, had great difficulty securing the necessary capital. About $270,000 was spent on core tests, and another $336,000 was not enough to complete the shaft. Outside financing could not be secured, and finally the stockholders (who, up to that time, had all been associated with Snowden-McSweeny, the firm which sank the test core which first revealed potash) sold a 50% interest to the Pacific Coast Borax Company. In 1931-1932 further unsuccessful attempts to raise funds were made, despite an offer of 10% interest. Finally, Pacific Coast Borax pledged its security and bank loans were arranged. Beginning with 1932,

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57 (Cont'd) incurred. There is no likelihood, however, of entry at either of these two points.

58. This was to be expected, since no exploration or mining costs were necessary, and since a major part of its reserves were on land owned in fee.

profits were paid back into the business in increasing amounts; and the sale during 1937 and 1938 of over $800,000 worth of six per cent preferred stock to the general public enabled the company to retire its bank loans. Even the officers of the firm considered the whole undertaking a gamble until around 1935.

The success of this enterprise has greatly reduced the financial problems of later firms. PCA was financed entirely by stock issues, and no difficulty was encountered by IMCC in raising the funds necessary to gain control of Union Potash.

This company was formed in January, 1936,to consolidate the interests of four firms; Texas Potash Company, Independent Potash and Chemical Company, New Mexico Potash Company, and Carlsbad Potash Company; which held prospecting leases and had secured favorable test cores. In return for financial assistance, the International Agricultural Corporation acquired an interest in the new company.[59]

Union Potash perfected its leases and commenced operations. The International Agricultural Corporation continued its financial assistance, and by 1941 held sixty percent of the outstanding common stock. On March 31, 1942, International reorganized, added Union Potash as a subsidiary, and changed its name to International Minerals and Chemicals Corporation.

While lacking the accessible ore body of Trona, the Carlsbad firms have been more fortunate in other respects. The city of Carlsbad has

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59. This information on Union Potash is taken from the article "Potash" in the Mineral Yearbook of the United States Bureau of Mines, for the years 1937, 1941, 1942.

provided both a labor force and a place for the vast majority to live.[60] The Santa Fe Railroad has built spurs which serve the companies; and with some financial aid from the companies, the county has built roads out to the various plants.

USPC adopted the traditional German process of fractional crystalizatic when it entered the industry, although it added substantial improvements. PCA was the first to successfully apply flotation principles to potash, and IMCC added some further refinements to their flotation method. As far as the processing of sylvite and langbeinite are concerned, any new firm has few problems, at least at present price levels.

Since a firm is in the process of entering the potash industry, this discussion may be lifted out of the historical and hypothetical level usually necessary in discussing entry into an oligopolistic industry by a complete presentation of the available information concerning the progress of this new enterprise.

The firm is not starting from scratch. It is the Duval Texas Sulphur Company, with offices in Houston, Texas; a subsidiary of the United Gas Corporation, Shreveport, Louisiana, which owns 74.71% of the outstanding capital stock.

The company has spent about two years prospecting; it has outlined its ore body, and is currently engaged in perfecting its state and federal leases. Reserves are estimated at between 17,000,000 and 18,000,000 tons of ore, which at projected plant capacity will be exhausted in about twenty years.

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60. Some of the key workers live at the plants, while a few more live in Loving, New Mexico.

To gain capital for the undertaking, the company has petitioned the Securities and Exchange Commission for permission to increase authorized capital stock from 550,000 shares of no-par stock to 1,000,000 shares of no-par stock. Three hundred and fifty thousand shares of the newly authorized amount are to be offered to present shareholders in a ratio of three for four currently held, at a price of $13.50 per share. This will yield $4,725,000; and an additional $2,500,000 will be raised from 2-3/4% notes, maturing January 1, 1958, which will be offered to the public by the First National Bank of Boston. The S.E.C.has given its approval, and has also granted a request to change the name of the company to Duval Sulphur and Potash Company.

Plans call for two shafts, and a pilot hole is now being dug to determine what conditions will be encountered. The ore mined will be sylvite, but the exact K_2O content will not be known for some time to come.

The plant will be located at the diggings; it will be able to process 2500 tons of ore per day. A decision as to refining method has not been reached as yet, but is expected momentarily. Since the engineers were formerly with IMCC it has been assumed that the basic and unpatented elements of their flotation method would be used, but recent reports indicate that the PCA process is also being considered. It has not yet been decided whether to lease patents on refinements from one of the other firms, or whether to employ new methods.

The shaft sinking and construction jobs are being contracted out, and will not be complete for another eighteen months, according to present estimates. The company is currently dickering with the Santa Fe Railroad for a spur line; and is also making arrangements for power, gas, telephone, water

and if possible, a road. The site is halfway between PCA and IMCC, and a comparatively small mileage of road is required.

The potash will be marketed through brokers, or their sales organization but a decision on this matter has not yet been reached. The prospective labor situation in Carlsbad will be discussed in the next chapter. The technical staff has already been recruited from the other firms in the area.

After outlining the ore body, and before making definite commitments to enter the industry, the firm completed a careful survey of projected potash demand for the next few years. The details of this private survey are not available. It is reported, however, that the survey found room enough for one (and only one) more firm in the industry.

Since the beginning of World War II, potash supply has not kept up with demand, despite the tremendous increase in domestic production. This fact has been recognized by all writers in the field, and is further evidenced by the fact that inventories at all plants have been negligible during the period. A reliable industry source estimates that supply is about ninety percent of demand at the present time. This figure is subatantiated to within one half of one percent by the projected plant capacity of Duval, relative to the plant capacities of the existing firms.

On the basis of the survey, Duval has decided to commence operations to mine potash which will not appear on the market for another eighteen months. From this fact it is possible to draw the further inference that Duval does not expect foreign competition to become effective before the firm has had time to establish its product on the market.

The reactions of the other firms to the entry of Duval are not available for publication. A second firm is at present engaged in prospecting

in the Carlsbad area, and has discovered what is reported to be a workable ore-body. No information as to whether this firm intends to commence production is available at the present time.

XII - THE CARLSBAD LABOR MARKET

It is not the purpose of this paper to consider, even in the broadest terms, the recent strike in the Carlsbad area. There is material here for an extensive study and any attempt to compress the discussion into a few pages would do an injustice to one of the two parties concerned. Certain of the end results of the strike, however, have bearing on the future labor market around Carlsbad; and this is part of the topic.

There is and always has been an open shop in all of the Carlsbad firms. Prior to the strike about 90% of the refinery and mine workers were organized by the International Union of Mine-Mill and Smelter Workers, Loacl 415.[61] Smaller percentages of the machinists and carpenters are organized by the International Association of Machinists, and by the carpenters union.

In late November of last year the Mine-Mill Union, contending that recent reductions in production bonuses had reduced take-home pay, called its men out on strike. This action resulted in the closing of the mines and plants, and the other employees of the three companies were laid off. Late in January the clause of the Taft-Hartley Act, permitting replacement of economic [62] strikers, was invoked; and approximately 400 of the strikers were replaced by new hires in a short period of time. This action broke the strike, the union going back to work on exactly the same terms as had been in effect prior to the strike, but minus a contract and seventy-three days' wages.

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61. At the time of the strike, the union was affiliated with the Congress of Industrial Organizations. Since then, however, it has been expelled for alleged Communist tendencies.

62. That is, strikers who seek wage increases, rather than adjustment

As a result of the strike, five unions are now in the field trying to organize the plants. These are: The Mine-Mill, presently certified as bargaining agent; the I.A.M., seeking to extend its control; the International Chemical Workers Union, A.F. of L., which arrived on the scene in the closing week of the strike, when it was obvious that the union had lost; the United Steel Workers, representing the C.I.O.,and currently raiding Mine-Mill membership on a nation-wide basis; and John L. Lewis' United Mine Workers, unattached.

The outcome of this struggle will not be known until June, when the National Labor Relations Board is scheduled to conduct a certifying election. However, a responsible and well informed member of the industry suggests that the outcome is likely to be as follows: The Mine-Mill will be ousted everywhere; I.A.M. will organize the maintenance workers at all three plants, as well as the production workers at USPC; the ICWU will organize the production workers at IMCC; PCA's production workers are regarded as a toss-up at the present time.

Whether this change would bring about better employee relations, and which union is to be preferred from the companies' standpoint, is not clear. The firms cannot comment for fear of committing an unfair labor practice. Judging from comments made during the strike, any change will be for the better as far as the companies are concerned.

When USPC started operations, it recruited its entire labor force in the City of Carlsbad. Each succeding firm has done exactly the same thing. Since the entire population of Carlsbad was only 3708 in 1930, it is obvious that not all of the workers were natives of that city. The

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62. (Cont'd) of grievances.

original explanation is to be found in the fact that the potash firms were offering jobs during the depression, when they were extremely scarce. More recently, the industry has offered wages substantially above the national average. At the beginning of the recent strike the average hourly wage was $2.05, including a production bonus which had been averaging 20% of basic wages.[63] The men work a flat 40-hour week, with no overtime, and 52 weeks per year, including paid vacation of one week per year after the first year, and two weeks after two years.

These high wages have attracted workers from all over the United States. Some estimate of the origin of the working force may be gathered from the results of a 1950 survey of 75% of the 1040 students in the Carlsbad High School. Of the 759 considered; 337, or 44.4%, were born in the State of New Mexico; 215, or 23.3%, were born in Texas; 47, or 6.2%, were born in the Southern States; 75, or 9.9%, were born in Oklahoma; 27, or 3.6%, were born in the North Central States; and the remaining 12.6% were born in the remaining states and foreign countries.

Duval proposes to secure its labor force in Carlsbad without advertisin outside of that city. The firm expects no trouble in doing so, and does not intend to offer wages higher than those paid by the other firms. By the same token, the other firms do not expect their wages to be increased by Duval's hiring.

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63. This figure includes only hourly workers, and does not include executive, managerial, and technical salaries. This is employer's data. Union figures were substantially lower, but di not include production bonuses.

XIII - CONCLUSIONS AND RECOMMENDATIONS

In order to make recommendations concerning the future policy of the government towards the potash industry, it is necessary to reach some conclusions regarding the past performance of the industry. In particular, these conclusions must include the ability of the industry to supply the nation's needs, the degree of competition in the industry, the presence of collusion between the various firms, and the appropriateness of the present level of potash prices.

In drawing these conclusions, it is necessary to specify the point of view taken. Most of the recent proposals for the future of the industry have come either from the industry or from sources allied to the farmer as the main consumer of potash. An attempt will be made in this chapter to approach the problem from an impartial standpoint. The only previous evaluation along these lines was presented by the Thorp-Tupper Report in 1940.

The willingness of the potash industry to supply the domestic market has not been seriously questioned since the beginning of the recent war. That supply, however, has not been completely adequate is evidenced by government restrictions on exports and by the above discussion of the relation of supply to demand. It is doubtful whether government action could have improved the situation to any appreciable extent. When Duval's production reaches the market it is likely that supply will be equal to present demand. This will certainly be the case when the foreign producers reenter the market.

The level of farm income must play an important role in this discussion. As long as the government feels responsible for maintaining the national income at a high level, potash demand will probably not decrease

significantly. There is always the possibility, however, of a general depression or of a curtailment of the government's support of farm income.

In view of these facts it is highly unlikely that the supply of potash will be insufficient in the foreseeable future. On the other side, arguments in favor of curtailing production in order to conserve resources are believed, in the light of the earlier analysis, to be ungrounded in fact.

The ability of the potash industry to approximate competitive conditions is strictly limited by technical considerations. This is particularly true in regard to the number of firms. To quote from the Thorp-Tupper Report, (page 93):

"It is impossible for this industry to approximate the conception of a 'competitive' industry in which individual price and production decisions are made independently of their impact on the market. These existing companies cannot be 'atomized' without a serious loss in efficiency and such high costs as to destroy their ability to compete with the importer."

There is no evidence that the situation has changed in the past ten years.

In regard to selling policy there is evidence of considerable competition between the firms in any given product market area. The same is obviously not true of advertising, which is conducted for the industry by the American Potash Institute. Far from being undesirable, this method eliminates intra-industrial advertising and results in a considerable saving to the firms.

It is in the field of production technique that competition is most keen at the present time. This is natural, however, in any industry, and it certainly represents a desirable tendency.

Competition is most noticeably absent in the present price policy of the industry. When supply is equal to or greater than demand, such competition is not possible, because of the nature of the product and the

sophistication of the proximate consumers. During the past ten years supply has not been equal to demand, and it is therefore necessary to examine the situation further to seek evidence of collusion between the firms.

The task of establishing collusion is always a difficult one, since similarity of action does not offer proof of any sort of concerted action. This is especially pertinent in the present case, since the similarity is obvious.

The court order signed by APCC, PCA, and USPC on May 21, 1940, specifically prohibits these firms from agreeing:

a) to fix prices or terms or conditions of sale.
b) to refrain from competing with each other.
c) to refuse to sell potash to individual consumers, farm cooperatives, or fertilizer mixers not approved by all the defendants.[64]

Conditions a) and c) are specific and relatively enforceable, while b) is distinctly vague. It may be that taken in context it refers to agreements to divide the market into several non-competitive regions.

Positive evidence, presented in earlier chapters, shows that the firms are acting in accordance with clauses b) and c). In regard to a) it can only be said that no evidence has been uncovered which proves the existence of such agreements, although the prices, terms, and conditions of sale are identical for the three Carlsbad firms. The close cooperation between these firms in the recent strike is a fact, but no further inferences can properly be drawn.

Another approach to the establishment of the existence of collusion is by examination of the ownership and management of the various firms,

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64. This consent decree was the result of the prosecution undertaken by the Department of Justice on May 26, 1939. A search of the library,

The "proper" level of potash prices varies greatly with the interest involved. Prices have not changed since 1939. On the cost side this has been made possible by improved technique, which has just offset the considerable increase in the costs of labor and certain commodities purchased from other industries. In view of the facts that supply has never been adequate and that the national price level has risen considerably, it must be concluded that potash could have been sold in the past few years at a price considerably above present levels.

That potash prices are no higher than they are is due to the fact that any short-run gains secured by the firms would be seriously endangered by long-run threats of an over-expanded domestic industry, foreign competition, and increased government control.

Farm interests are unanimous in calling for a lower price on potash. In view of the slight relationship between potash price and fertilizer price, the lowering of potash prices could be effective only in conjunction with some program for the regulation of the entire fertilizer industry. Many of the recent proposals for governmental action are taken up by Jules Backman in a recent survey of the potash industry.[66] These proposals include government potash plants to provide additional capacity and to serve as pilot plants to control the private segment of the industry.

Basically, the problem should be divided into two parts. First, how much profit is to be allowed the private producers of potash; and second, at what price should potash (more directly, fertilizer) be sold to the

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66. The Economics of the Potash Industry. American Potash Institute, Washington D. C. 1946. This study was undertaken at the specific request of the Institute, and represents the industry's viewpoint in large measure.

farmer. In view of the above discussion of present levels of profit, it is probable that the private firms could remain in business at a somewhat lower level of prices. While total investment in the potash industry is not high, it seems desirable to stimulate new potash reserves and refinery methods by encouraging the present firms to carry on research. Further, any decision to limit profits by means more direct than the customary taxes on corporate income would be without precedent outside the field of public utilities. In the usual sense of the word, potash is not a public utility. Provided that supply is sufficient and that no collusion exists, there does not seem to be any reason why profits should be limited by direct means.

If it is agreed that the government should prevent depletion of our soil resources by establishing a low price on fertilizer, there seems to be no reason why this should not be accomplished by government purchase of fertilizer on the open market and resale at a lower price,provided that care is taken not to destroy the market of any particular group of producers without due cause.[67] Such action would be consistent with the precedent set by the present method of maintaining certain agricultural prices.

Certain recommendations for future government action have been implied in the paragraphs above. It is now desirable to make these explicit. Firs, except to remedy insufficient supply or to prevent collusive action, the government should refrain from direct intervention in the potash industry. Second, in the event of insufficient supply with no attempt on

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67. It should be noted that no evidence has been advanced in this paper to show whether or not the two provisos mentioned above in connection with the desirability of government intervention in the potash industry, namely the adequacy of supply and the absence of collusion, exclude government intervention in the fertilizer industry. This question is ovbiously beyond the scope of the present paper.

the part of the industry to remedy the situation, or in the event of collusion, the government should be prepared to take effective action. This action would take the form of granting new prospecting leases and the initiation of Sherman Act prosecution. In the event that prospecting is not attractive to private capital, federal construction of productive facilities may be necessary.

Two other lines of governmental action are also recommended for consideration. First, new reserves of potash should be developed, and methods for refining minerals other than sylvite and langbeinite should be carried to the pilot plant stage. If possible, this program should be carried on in a manner which will not discourage similar development by existing firms. This development should not be left solely in private hands for two reasons. First, additional reserves of this vital element will be required in the foreseeable future, and the need for potassium transcends the economic considerations which must govern private enterprise. Second, development of reserves by new firms necessarily involves subsequent production to recover the expenses incurred; and as long as supply is equal to demand this excess capacity is not desirable.

Second, some sort of policy with regard to foreign competition is necessary. Since the issues here are larger than the potash industry itself, some further assumptions must be made. The following recommendation is based upon three such assumptions: First, it is not desirable to reduce the profits of the domestic firms to a point where they cannot produce; second, it is not necessary to protect domestic reserves by encouraging imports to the point where the domestic firms have idle capacity; third, it is not equitable to make any industry suffer because foreign competitors

wish to sell an identical product below cost to secure American dollars.

The specific recommendation is as follows: The government should not permit a foreign producer to dump potash in this country at less than cost. The effectiveness of such a policy would depend in large measure upon the ability of the government to arrive at an equitable method of cost accounting for those foreign firms which are not privately owned. It should be pointed out that any other set of assumptions may lead with equal validity to a different conclusion in regard to policy towards foreign competition.

The record of the American potash industry during the war years has on the whole been excellent. Because of the lack of foreign or domestic competition, this has been relatively easy: the future holds problems which promise to be more severe. The price of failure is likely to be government intervention.

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Bureau of Mines.
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Information on the potash industry appears from time to time in the Garfield Daily Current-Argus.

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