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STRUCTURE, BEHAVIOUR AND PERFORMANCE OF
THE WORLD POTASH INDUSTRY

by

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A thesis submitted to Carleton University in
partial fulfilment of the requirements for the
degree of
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The undersigned recommend to the Faculty
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Finally, I wish to extend my gratitude to the secretarial staff of Mineral Resources Branch for typing.

ABSTRACT

The world potash industry is an oligopoly, the supply side of the market consisting of monopolistic organizations in France, West Germany, East Germany, the U.S.S.R., Israel, and the Republic of Congo, plus a few firms in Spain, Canada and the United States. Each seller has two potential markets, an overland or 'domestic' market and a seaborne market. This study deals primarily with the North American and seaborne markets.

Virtually all potash is consumed as fertilizers and demand is generally inelastic. When used in this sense, demand refers to a one-year time-span; demand is, however, subject to seasonal fluctuation so prices are structured to encourage year-round deliveries.

Over most of its lifetime, the world potash industry has not performed in a competitive manner. In post-war North America, natural and institutional barriers inhibited entry and a few sellers faced several hundred buyers, a situation that provided little incentive to sell at prices below a joint profit maximizing level. A subsequent easing of institutional barriers and the attending rise in the number of sellers accompanied by a decrease in the number of buyers progressively constrained collusion and resulted in secret price cutting; however, political forces intervened and a competitive outcome was never realized.

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INTRODUCTION

Potash is one of three key minerals used in the manufacture of commercial fertilizers; about 95 per cent of the world's potash consumption is in agriculture and about 90 per cent is consumed in the chemical form of potassium chloride, commonly known as muriate of potash. Although there are more than 70 different potassium-bearing materials, only a few of the soluble salts found in underground bedded deposits and lake or sea beds or brines are of economic significance and geologically and geographically speaking, such deposits are quite rare. Bedded subsurface deposits are being exploited in Saskatchewan, Canada, Utah and New Mexico, United States, Spain, France, East and West Germany, Italy, Republic of Congo, and three regions of the U.S.S.R. Potash from sea or lake brines and beds are being recovered at five locations, Great Salt Lake in Utah, Searles Lake in California, the Dead Sea in Israel, Tsinghai province in the Peoples' Republic of China, and in northern Chile.

Until about 20 years ago, potash was regarded as a relatively scarce mineral but during recent years the world potash industry has suffered from excess capacity and has been a subject of political controversy, especially in North America. For Canada, it has resulted in intervention by a provincial government to set production quotas thereby controlling output, sales and prices, and for the United States it has resulted in a variety of attempts to impose artificial trade barriers on a commodity that heretofore had access to world-wide markets free of tariffs and import quotas.

Scope and Purpose of the Study

This study is an economic analysis of the world potash industry. In general outline, the author has adopted Bain's methodology in describing the industry's structure and behaviour and assessing its performance.¹ Special emphasis is given to the conditions of entry into the industry and market; some economists regard the conditions of entry as the crucial factor in determining the ultimate performance of the industry. In view of the fact that mineral resources are normally held by government title, the central issue that evolves from this study relates to public policy or intervention with respect to the disposition of mineral rights and the consequent rate of mineral exploitation. This study does not seek a definitive answer to current questions of public policy for the potash industry; rather, its objective is to reveal the experiences of one industry in an effort to identify the importance of profit and other economic criteria that heretofore have not been given adequate consideration in formulating resource policy. Although there are numerous dimensions to sound resource policy, the central theme to be raised here reflects on the notion of economic welfare, a term used to convey the concept of efficiency, to be described later, and equity in the sense that the consuming sector does not suffer at the expense of excessive profits accruing to the producing sector.

Bain's analytical framework for examining various industries and testing hypothesis posed by price theory has been strengthened by statistical observation from which he had made certain postulates concerning the performance of industry when operating under different conditions. One postulate states

¹ Joe S. Bain, Industrial Organization (New York, 1968), 678.

that there is a significant positive relationship between the degree of seller concentration in an industry and profit rates on shareholders' equity; furthermore, this relationship is more pronounced if there are barriers to entry.² Bain's methodology has, however, been especially adapted to industry studies at a regional or national level and few, if any, empirical investigations of this nature have examined the world scene except for casual reference to situations involving cartels. The reasons for this may be obvious: not all nations have a market economy in which prices signal economic activity. Secondly, when employing simple economic models and empirical data, economists tactfully dodge political constraints inherent in national boundaries. Thirdly, for theoretical discussion, a 'market' is conveniently defined as a closely interrelated group of sellers and buyers and seldom does it attain international scale; rather, the market is typically represented as a state, a group of states, or a nation. Fourthly, the ultimate objective of industry studies has generally been to develop criteria for public policy to guide economic activity in the home market - i.e. the rules of competition.

Furthermore, industry studies have usually dealt with industries whose member firms are entirely or essentially privately-owned and are assumed to be motivated by profit maximization. Because a large part of the world potash industry is state-owned, the profit maximization assumption may not be entirely valid, especially for those organizations in centrally planned economies like the U.S.S.R. and East Germany. The matter of goals other than profit maximization can be circumvented to some extent by an appropriate definition of the relevant market. For example, although a state-owned

² Bain, Industrial Organization, ch. 11.

organization may operate for employment or autarchial reasons in supplying domestic needs as well as that of politically aligned nations, it may be assumed that they enter world markets solely for profit-seeking motives. The frequent claim that any particular sector of industry in a command economy exports to earn foreign exchange may be regarded in a broader sense as profit maximization by the central authority. Even if the profit maximization assumption can be validated, the matter of ownership mix poses the question whether profit rates differ between publicly- and privately-owned firms. Another aspect of the world potash industry uncommon to most industry studies is that many member firms are multinational corporations with subsidiaries in one or more foreign countries; this poses the question of what type of pricing policies are adopted for intra-company product transfers thereby influencing profit rates of the industries in various parts of the world. Neither of these two questions are believed to be a serious problem in the potash industry and consequently will not be examined in this study.

With all due respect to these considerations, it seems, however, that Bain's methodology of examining industry structure - behaviour - performance relationships can be conceptually applied to the international scene to devise criteria to guide public policy in the interest of both domestic and global economic welfare. Although some of the simple models found in standard price theory textbooks prove highly satisfactory in predicting short-run outcomes for the world potash industry, it will be shown that the structure of the international industry forms a strategic part of the environment in which member firms, frequently state-owned, engage in profit seeking activities. The number of sellers and buyers and the conditions of entry rank as three of the more important aspects of these profit-seeking activities and this in turn ultimately generates some sort of market performance.

Apart from theoretical considerations, this study consists of five chapters. Chapters 2 and 3 describe market structure, the former highlighting supply and demand aspects as related to the number of sellers and buyers and examining the competitive position of supply sources while the latter chapter deals with the conditions of entry. Chapter 4 outlines output and pricing policies. Much of the data presented in chapters 2 to 4 is drawn from statistics tabulated in Appendix I and a detailed chronological history of the world potash industry documented in Appendix II. Chapter 5 looks at the performance of the industry, the major concern being efficiency and the validity of profit data as a criteria for resource policy. In the final chapter, the major findings are summarized and additional criteria for public policy are reviewed.

CHAPTER 1

THEORETICAL CONSIDERATIONS

Bain has stated that market structure forms a strategic part of the framework or environment in which member firms engage in profit-seeking activities; market behaviour or conduct ranks as one of the more important aspects of these profit-seeking activities and this in turn ultimately generates some sort of market performance or end results that can be measured in several dimensions.¹ Four important aspects of market structure are: (a) the degree of seller concentration - described by the number and size distribution of sellers in the market; (b) the degree of product differentiation - i.e. the extent to which their outputs are viewed as nonidentical by buyers; (c) the degree of buyer concentration; and (d) the conditions of entry into the market - i.e. the relative ease or difficulty with which new sellers may enter the market.

Economic theory teaches that competition weeds out inefficiency and that competitive markets select those administrators of productive resources who employ the most efficient technology. Furthermore, theory predicts that a large number of sellers fosters competition but as argued by Demsetz, large numbers is not a necessary condition for competition - the key consideration being freedom of entry.² Brozen has pressed the issue further claiming that open entry is not only a necessary condition but a sufficient condition to

¹ Bain, Industrial Organization, 302.

² H. Demsetz, "Why Regulate Utilities?" Journal of Law and Economics, XI (April, 1968), 55-66.

yield a competitive result in the marketplace.³ In this study, the condition of entry emerges as a key dimension in the performance of the world potash industry, but unlike Demsetz and Brozen who focus on domestic competition policy, the central issue here revolves around public policy with respect to the disposition of mineral resources.

Market Structure and Behaviour

The world potash industry can be regarded as an oligopoly. An oligopoly is a market situation in which there is more than one seller but the number is not so large as to render negligible the contribution of each. The product of each firm is a good substitute for another's - i.e. they have high cross elasticities of demand. In standard oligopoly theories, pricing and output decisions of one firm must be considered by others in the industry and hence, the reactions of rivals to pricing and output decisions are very important - i.e. we say that each firm recognizes its interdependence in the market. Other, less classical, oligopoly models suggest that product, advertising, investment, and technology policies must be considered by competitors in interdependent markets. Some oligopolies have only three or four firms in the industry while others have as many as twenty or more. Although there are about 75 potash mines in operation throughout the world, the number of financially independent operating firms is much less and never do we find more than 20 firms selling in a readily definable market.

Because potash is a relatively high-bulk, low-value commodity, each mining community has a naturally protected market area largely dictated by

³ Yale Brozen, "Competition, Efficiency and Antitrust," Journal of World Trade Law, III (Nov/Dec, 1969), 659-670.

land transportation costs. But once it enters international seaborne trade, the product can be shipped long distances at little extra cost; in fact, by chartering larger vessels, unit costs can be substantially reduced. Each seller, therefore, has two potential market areas - an overland market, in which he competes (or shares through some form of collusion) with rivals located within the same continental region, and a seaborne market that is accessible by producers situated in various countries. In spite of this rather simplistic division of markets, the actions of each seller in both markets are not mutually exclusive.

It is generally argued that oligopolistic market structures result in higher prices and lower output than one expects from more competitive structures. The demand curve facing an oligopolist is negatively sloped so that the marginal revenue curve lies below the average revenue curve. Hence, price is greater than marginal revenue and pure profits are realized. Economists recognize, however, that any attempt to make an oligopoly a purely competitive industry can result in even higher prices because the industry resorts to less than optimum size plants.

If we adopt the traditional assumption that sellers in an oligopoly seek profit maximization as a goal,⁴ either individually or collectively, we must deduce some form of behaviour whereby they coordinate their intrinsically rivalrous decisions and actions. We can begin by postulating that oligopolists seek to maximize joint profits through some form of collusion. Collusion can be in the form of a merger, a cartel, or through joint determination of outputs and prices, whether achieved by express or tacit agreement or by

⁴ With specific reference to mining, it is usually assumed that the firm's objective is to maximize the present value of the assets both initially and in every period in which it must make decisions, but this should in no way distort the analysis.

4 Cont'd

The assumption of profit maximization has been attacked on several fronts during the past three decades. In brief, opponents argue that profit maximization is at best unappealing and at worst meaningless to businesses operating in an environment of dynamic uncertainty, organizational complexity, and conflicting goals; many of these charges emerge from the managerial theory of the firm. For discussion on this debate, consult some of the following contributions: K.E. Boulding, "The Theory of the Firm in the Last Ten Years", American Economic Review, XXXII (December 1942), 791-802; Herbert Simon, "Theories of Decision Making in Economics and Behavioral Science", American Economic Review, XLIX (June 1959), 253-283; Edward S. Mason, ed., The Corporation in Modern Society (Cambridge, 1960); and O.E. Williamson, "Managerial Discretion and Business Behaviour", American Economic Review, LIII (December 1963), 1032-1057; and John Kenneth Galbraith, The New Industrial State (Boston, 1967).

What emerges from the debate might be described as the 'external decision-making' of the Chamberlain-Mason-Bain approach to industrial organization and the 'internal decision-making' framework of Simon and Williamson for testing hypothesis about the firm. Within the context of the latter, it has been argued that firms do not have a well-defined objective function but 'satisfice' by setting a target rate of return on invested capital as its profit objective and, when that is achieved, other nonprofit objectives are pursued. There are two fundamental weaknesses of this hypothesis: first, it is not evident how the target is set in the first place and how it is modified in a dynamic world; secondly, it may invite a greater degree of business uncertainty as the firm in pursuing its profit target fails to recognize its interdependence on the marketplace. A further aspect of the Simon-Williamson approach is that the ability to pursue goals other than profit maximization increases with monopoly power of the firm.

In the case of the potash industry (i.e. for the two markets and the time framework discussed here), there is an absence of monopolistic tendencies and there is every indication that recognition of market interdependence has been crucial to output and pricing decisions. Hence, although one may hypothesize and, in fact, find evidence that individual firms do not have a well defined profit maximization objective for its internal decision-making, in view of the number of firms involved, a recognition of market interdependence, and the difficulties in attempting to reconcile multiple objectives to 20 different firms, the assumption of joint profit maximization is deemed the most sensible working hypothesis when considering the potash industry as a whole. The pursuit of monetary profit constitutes the main ordering principle of action by business firms and profit maximization represents a sort of central tendency of business endeavours. It is of interest to note that Williamson in presenting evidence suggesting that firms operated on the basis of a managerial model embracing multiple objectives, admitted that firms may be maximizing 'actual' profits but reporting reduced profits by absorbing a fraction of actual profits in executive salaries and other prerequisites. (Williamson, 1955).

'unspoken understanding'. Mergers have not occurred in the North American sector of the world potash industry, but this has been the route to monopolistic market power in the French and German potash industries. One might also regard the amalgamation of the U.S.S.R. potash industry as a type of merger. The closest example of merger in North America are several joint ventures or partnerships.

In a perfect cartel, a central management determines the cartels' marginal costs and then equates marginal cost and marginal revenue to determine profit maximizing output and prices. Perfect cartels seldom if ever exist; rather they have more commonly been instigated through some form of price fixing and then setting sales or output quotas. Moreover, such arrangements have often been the outgrowth of market situations involving excess capacity and price cutting. Cartels and cartel-like arrangements governed world potash trade prior to and after World War I when Germany and France were the only significant suppliers of world potash. Then as more firms whose supply bases were located in other countries entered the industry, the faltering cartel gave way to less rigid forms of price-output determination.

Price leadership by the dominant firm was the coordinating mechanism for determining prices and outputs in the late 1930s, at least in North America, and this eventually gave way to the customary practice of posting prices that bore resemblance to what has generally been described as barometric price leadership. Let it be emphasized that barometric price leadership is only a coordinating mechanism and is not necessarily linked to any principle of price-output calculation - e.g. in an oligopoly, the principle of price-output calculation could be either joint profit maximization of member firms

or individual profit maximization, or some combination of the two.⁵ Theory becomes meaningful only when specific patterns of interseller coordination of output and pricing policies can be systematically linked with specific principles of price-output calculation, and thus with market performance.

Examination of the potash industry from World War II onwards indicates that, although there were manifestations of behaviour similar to that of barometric price leadership, structural changes on both the selling and buying sides of the market progressively constrained the feasibility of collusion amongst member firms, particularly in North America. In this regard, Stigler's theory of oligopoly seems applicable:⁶ at the outset, firms find it mutually advantageous to become partner to a collusive organization seeking joint profit maximization but subsequently find it in their interests to depart therefrom and pursue individual profit maximization through secret price cutting. Stigler concluded that the amount by which prices can be raised above competitive levels through collusion depends upon the ease in which participants can infer that secret price cutting is taking place. Moreover, a collusive oligopoly will adopt a complex pricing structure that accounts for differences in costs of various classes of transactions. Enforcement of an agreed upon price structure, as well as levels and hence cost-price margins, consists basically of detecting significant deviations therefrom. As will be seen later, the potash industry employs a complex pricing structure. There is another important qualifying assumption to Stigler's theory: that all sellers and all buyers are initially of equal size. Needless to say, one must then

⁵ For a discussion on this matter, see J.S. Bain, "Price Leaders, Barometers and Kinks", Journal of Business, XXXIII (1960), 193-203.

⁶ G.J. Stigler, "A Theory of Oligopoly", Journal of Political Economy, LXXII (February, 1964), 44-61.

question how sensitive our conclusions are to this assumption, a question that cannot be fully answered. For other qualifying statements, see footnote 10 on page 71.

In practice, a secret price cutter can expect to increase his sales by granting concessions to old customers of rivals, to old customers who would ordinarily leave him, or to new customers entering the market. Alternatively, the behaviour of these three types of buyers may be viewed as evidence that secret price cutting is taking place within the industry. One qualitative rule is that, although the gain in sales from any one rival by secret price cutting is not very sensitive to the number of rivals, the probability of price cutting within the industry increases with the number of rival sellers - i.e. the gain in sales for a secret price cutter grows in proportion to the number of rival sellers. A second qualitative rule is that the incentive to cut prices rises as the absolute number of customers per seller falls.

In the introduction it was stated that the general format of this study would follow Bain's methodology. The reader should now be aware that incorporation of Stigler's theory of oligopoly results in a departure from the Chamberlain-Bain tradition in which much emphasis is placed on the degree of seller and buyer concentration. Stigler's approach emphasizes the absolute numbers of buyers and sellers. If, upon examination of the potash industry, we find that the number of rival sellers is small and the number of buyers is large we can make some inferences concerning market behaviour and performance: when a few sellers face many buyers, collusion on output and prices will be easy to enforce and market performance will be poor; if such a market

situation is reinforced by high barriers to entry, even poorer performance can be expected.⁷ The corollary of this statement is that collusion becomes progressively more difficult as the number of sellers rises through time and/or the number of buyers decreases. Accordingly, if market structure undergoes significant change in the direction of more sellers and fewer buyers it should be possible to observe improvements in market performance; similarly, any easing of entry into the industry should have a marked impact on performance. Before examining industry structure and behaviour, an introduction to the concept of market performance and definition of some terminology to be used are in order.

Market Performance

Industrial performance has an obvious bearing on the extent of efficiency achieved by the entire economy, both national and international, in providing goods and distributing incomes. Hence, the purpose of appraising industry performance is to indicate the impact of market power on public welfare. Performance is generally evaluated against the norm of perfect competition but in positive economics that is not always a satisfactory basis for appraising market conditions, especially where elements such as conservation and economies of scale are important.

Market performance for sellers is measured by the character of their adjustments to demand conditions. Some of the more common dimensions of market performance include:⁸

⁷ The level of prices and hence market performance will also depend upon elasticities of demand.

⁸ Bain, Industrial Organization, p. 11 and Ch. 10.

(a) The relative technical efficiency of production. All industrial output should be supplied by plants and firms of the most efficient scale while utilizing all resources allocated to each industry. Technical efficiency is measured by the level of unit costs of production attained by an industry in supplying its product and the degree of technical efficiency is measured by the relationship of actual unit costs to the minimum attainable unit costs of production. In many industries, firms seek to exploit economies of scale in production and distribution but tendencies of this nature can foster seller concentration to the detriment of allocative efficiency.

Three criteria for judging technical efficiency are: the extent to which firms and plants attain optimal scales; the extent to which firms and plants approach optimal degrees of vertical integration of successive manufacturing processes; and the extent to which firm and plants achieve the most efficient rate of plant utilization - i.e. the extent of 'chronic excess capacity'.

(b) The height of selling price relative to the long-run marginal cost of production and to the long-run average cost of production and the resultant profit margin; this is usually referred to as allocative efficiency.⁹ Since

⁹ Any measure of profitability involves some definition or concept of capital or assets, investment and time. To the economist, the term 'capital' generally implies any previously produced input or asset (e.g. factories, raw materials and machinery) of a business firm while investment refers to the production or acquisition of some capital asset. Occasionally in financial statements of firms engaged in mining one finds reference to valuation of ores in the ground as part of its assets or 'net worth'. Valuations of this nature are not distinguished in this study; rather, the terms investment and capital expenditure refer to actual expenses incurred in acquiring a mining property, exploration, and in constructing a mine. Aggregate figures imply a cumulative summation of actual expenses rather than an attempt to measure in monetary terms available capital stock at a point in time. A definition of 'capacity', which in theory is a measure of available capital

marginal costs are usually not directly measurable and in the long-run are typically about the same as average costs, in practice one can assess allocative efficiency by comparing long-run selling price to long-run average cost of production. The most convenient indicator of this relationship, according to Bain, is the long-run average profit rate that firms in an industry earn on owner's investment (i.e. the profit rate on equity). A long-run accounting profit rate that is equal to the market rate of interest would indicate optimal allocative efficiency, a higher profit rate would suggest that either too few resources are allocated to the industry or that there is some other

9 Cont'd

stock and hence a determinant of investment and price phenomena, will help skirt the problem of measuring capital stock.

Economists generally frown upon the usage of the term capacity on grounds that in the long-run a firm has no capacity limitation; even in the short run, output can be expanded by employing more variable factors. Some will concede that the term may have relevance if defined to take account of costs such as equality between short and long-run costs (See G.J. Stigler, The Theory of Price, (New York, 1966) 3rd ed., 156-8). But then it is implicitly assumed that capital is "maleable" and can be instantaneously and costlessly transformed to other forms of capital; let us accept the condition that a mine can be used for only one purpose. Given an estimate of ore reserves and working on the assumption that the firm will retain ownership of the orebody until depleted (and presumably some forecast of potential market penetration), the firm decides upon some rate of output that takes account of time preferences and then builds a mine according to engineering specifications that result in a fixed annual capacity. For a discussion on a production plan that departs from a constant annual rate see Anthony T. Scott, "The Theory of the Mine Under Conditions of Certainty" in Extractive Resources and Taxation edited by Mason Gaffney, (Milwaukee, 1967). The engineer will strive to design a plant with the least-cost per unit output but this may not necessarily correspond to the firm's chosen rate of output. Regardless of which rate of output is selected, once the mine is built its capacity remains fixed until further capital expenditures are authorized for expansion. Conversely, for practical purposes and unless otherwise stated, it is assumed that any expenditures necessary to maintain initial design capacity are provided indefinitely. Should a new mine fail to achieve designed output level as a result of some technological bottleneck in the system, actual output over a one- or two-year period may be adopted as mine capacity. For older mines, recent output levels are adopted as capacity.

constraint on the market mechanism that allows the industry to earn pure profits as defined by the economist.

(c) The size of sales-promotion costs relative to the costs of production.

(d) The rate of technological progressiveness of the industry in developing better products and improved production techniques, and

(e) Conservation.

CHAPTER 2

STRUCTURE OF THE WORLD POTASH INDUSTRY

Mining of bedded potash deposits is either by underground excavation or by solution extraction, the latter being rather uncommon as there are only two commercial, potash solution-mines in the world, both in North America. Depending on the nature of the deposits and to some extent the history of the industry in a particular country, underground excavation is generally by room-and-pillar or long-wall methods. Canadian operators employ electrically-powered, continuous-mining machines that cut openings ranging from 7 to 10 feet in height and 18 to 22 feet in width; mining is on one level and working depths (in Canada) range from 3,100 to 3,500 feet from one mine to another.¹ Elsewhere in the world, working depths are much shallower. Continuous-mining methods are used at some of the New Mexico mines and in the 1960's were also introduced to some of the mines in the U.S.S.R. Common practice among French and German operators is to use long-wall, integral miners and drilling and blasting techniques. The continuous-mining methods are regarded as the most efficient techniques of mechanical extraction.

The mined ore, consisting chiefly of sylvite (KCl), halite (NaCl), carnallite ($\text{KCl} \cdot \text{MgCl}_2 \cdot 6\text{H}_2\text{O}$), (and in some cases sulphates), and clay insolubles, is hoisted to a surface plant where the sylvite is separated out by flotation and/or crystalization.² Flotation is a wet mechanical procedure whereby the sylvite is floated off, dried and screened to provide as many as

¹ Canada, Department of Energy, Mines and Resources, Canadian Minerals Yearbook, 1969 (Ottawa), 414.

² R. Noyes, Potash and Potassium Fertilizers (New Jersey, 1966), 80-102.

four 'grades' of potassium chloride - granular, coarse, standard and special standard. Crystallization involves dissolving of the ore (in flotation plants, dust and fines are collected for dissolving and recrystallization), precipitation of potassium chloride, evaporation, drying and screening; this technique gives rise to what is commonly referred to as chemical or soluble 'grades', the product normally having a higher degree of purity than floated potash. In Canada, about 90 per cent of the potash mined by conventional methods is processed by flotation whereas in France this process accounts for about 30 per cent of the country's potash output. Flotation is a less costly method of processing as there is no large expenditure on fuel for heating. The evaporation-crystallization technique is used to refine potash recovered by solution-mining in Saskatchewan.

From the buyer's viewpoint, potassium chloride is essentially an undifferentiated product. Potassium minerals and compounds are normally graded in terms of potassium oxide (K_2O) equivalent; pure potassium chloride has a K_2O equivalent of 63.2 per cent ($KCl \times 0.632 = K_2O$ and conversely, $K_2O \times 1.58 = KCl$).³ Fertilizer 'grades' produced in North America range from a minimum of 60 per cent up to 63 per cent equivalent, which implies that the product has a purity of 95 per cent or more. The flotation process yields three 'grades' - standard, coarse and granular - depending on grain size, and the crystallization process yields higher purity, soluble and chemical 'grades'. Each grade generally commands a different price but since price is based on the K_2O equivalent and most producers offer the same grades, the buyer tends to regard each seller's product as a perfect substitute for another's.

³ Canadian Minerals Yearbook, 1969, 409.

Supply and the Number of Sellers

Brief History

A detailed history of the world potash industry is documented in Appendix II and a complete list of potash companies and mines is tabulated in Table A-1; this section dwells on the post-World War II structure of the industry and highlights a few historical aspects that are deemed relevant to gaining an appreciation of past behaviour and current market structures (current refers to the 1969-71 period; subsequent structural changes are identified in footnotes). An analytical summary of current market structures appears in Figures 1 and 2 and Table 1 (pages 20, 21 and 24, respectively).

The central theme that evolves from Appendix II is that throughout much of its history, the world potash industry has been highly concentrated. Subsequent to the discovery of potash deposits in Germany in the middle of the 19th century, many entrepreneurs established mines that were later brought under control by the central government and a syndicate was created to handle international sales. In the early 1900's a number of mines were developed in France, the outcome being that after World War I French and German producers competed vigorously for international markets and world prices dropped sharply. Concern for declining prices and profits led to the creation in 1924, of a French-German cartel whereby foreign sales were shared on the basis of 70 per cent for Germany and 30 per cent for France; joint sales offices were established in the principal importing countries and uniform prices were maintained.

During the 1920's and early 1930's, potash from Poland, Spain, United States (principally Carlsbad, New Mexico), Palestine and Russia began to enter world markets and, although output from these sources remained relatively small during the early years, world prices fell sharply in 1934 only to rise again as arrangements were made with the cartel. Both the Great Depression and World

War II resulted in interruptions in world output and following the division of Germany in 1945, the United States emerged as the world's leading potash producing nation. From that date onwards, the North American sector of the industry gradually became less concentrated while the European sector tended towards greater concentration. In effect, all the European and Asian potash producers became monopolies within their respective national boundaries, with the exception of Spain, which is by far the smallest exporter. The Spanish industry consists of three operating firms, one of which is partially state-owned and sales for the other two are handled by a joint marketing agency.

All French potash mines were integrated into a state-owned organization that eventually became known as Mines de Potasse d'Alsace S.A. In the post-war years, the West German potash industry was integrated into three operating groups, of which the two largest - Wintershall A.G. and Salzdettfurth A.G. - controlled about 83 per cent of the nation's total output; these two firms merged in 1970 to become known as Kali und Salz G.m.b.H., which was charged with the responsibility of marketing West Germany's entire potash production. The East German mines had come under control of the central government and Bergbau Handel G.m.b.H. was formed to handle export sales. Similarly, the Polish mines had come under the direct control of Russia in 1939, and in subsequent years the entire potash industry of eastern Europe was brought under the jurisdiction of the central government of the U.S.S.R.; export sales to non-Communist nations are handled by Promexport. The Palestinian potash works were destroyed following the outbreak of fighting in 1948 but were later restored and a new plant was constructed by the Israeli, government-owned Dead Sea Works Ltd.; virtually all its output was earmarked for export sales.

Figure 1
Structure of North American Potash Industry Showing Percentage of Intercompany Financial Interests, 1971

* All are in the Province of Saskatchewan. † Mines marked by a dagger are at Carlsbad, New Mexico.
Source: Appendix II and Annual Reports of the respective companies.

Figure 2
Structure of World Potash Industry
Showing Approximate Percentage of Installed Mine Capacity
and Intercountry Financial Interests, 1971*

* The absolute numbers represent installed mine capacity in thousand metric tons K₂O annually within that country. Percentages following mine capacities indicate that country's proportion of total world capacity whereas those following the name refer to the proportion of world mine capacity controlled by financial interests of the respective country. The other percentages refer to proportion of national mine capacity controlled by respective foreign financial interests. None of the percentages include small foreign shareholders. Source: Derived from Appendices I and II and Annual Reports of the respective companies.

Potash mining industries of commercial importance were established in two other foreign countries during the 1960's - Italy and the Republic of Congo - and at the close of the decade a mine was under construction to exploit subsurface deposits in England, with production scheduled to begin in 1973. Although the Italian mines are comparatively new, the industry has continually failed to reach output targets and has never become a major exporter. Furthermore, since virtually all of Italy's potash output is in the form of potassium sulphate, its industry plays an insignificant role in international trade of potassium chloride. The Congolese mine began producing in 1969 and is operated by the French potash organization, which in turn acts as marketing agent.

Turning to the North American scene, the 1950's witnessed the expansion of the New Mexico potash industry and the gestation of an industry in Saskatchewan that by 1970 had become the world's largest potential producer in terms of installed mine capacity. Two established New Mexico potash producers were the first to commence development in Saskatchewan and they were followed, in the 1960's, by a consortium of the French and German potash producers, two more New Mexico companies, and four new entrants to the North American and world potash industry. The United States industry also expanded in the 1960's with one new entrant to New Mexico and another at Moab, Utah, the latter being a new supply source.

Number of Sellers

As of the early 1950's the North American potash industry consisted of three large-scale producers in New Mexico, one medium-size producer in California, one small byproduct producer in Utah, and two importers - one representing the French potash industry and the other the West German. By 1970,

the industry had expanded to 21 mines or plants - 10 in Saskatchewan, 7 in New Mexico, 3 in Utah, and one in California - and three importers representing the French, West German and Israeli suppliers. Accordingly, the number of rival sellers in the North American potash market rose from 7 in 1950, to 13 in 1965, and 20 in 1970 (see Table 1).⁴

Similarly, the number of rival sellers in the international seaborne market rose markedly during the post-war era. Throughout most of the 1950's, virtually all potash sold offshore was handled by export agencies representing their respective national industries - West Germany, East Germany, France, United States, U.S.S.R., Spain and Israel. When Saskatchewan potash began entering world markets, the United States Potash Export Association became nonoperational thereby creating a situation in which individual United States-based producers would either refrain from selling in the seaborne market or be obliged to establish their own distribution and selling networks. Virtually all chose the latter option, the larger producers extending their North American sales offices to include the offshore and the smaller sellers simply hiring sales agencies specialized in international marketing. The outcome of this situation, coupled with the entry of several new producing firms, boosted the number of rival sellers in the international seaborne market from 7 in the

⁴ The number of producing plants is not to be construed with the number of operating companies or sellers; for example, one company had three mines while another five each controlled or held financial interests in two mines. Conversely, the ownership of one mine was shared by three companies or sellers.

Table 1

Sellers of Potassium Chloride in the North American
and International Seaborne Markets, 1970*

No.	Company	Current Supply Source	Date of Entry into Market
North American Market			
1a	Potash Import & Chemical Co.	West Germany	cartel from 1880 to 1940
2a	French Potash & Import Co.	France, Congo, Spain)	
3a	American Potash & Chemical Co.	California	1926
4a	U.S. Borax and Chemical Corp.	Sask. (former N. Mex.)	1931
5a	Potash Company of America	New Mexico, Sask.	1935
6a	Kaiser Aluminum & Chemical Co.	Utah	1938
7a	International Minerals & Chem.	New Mexico, Sask.	1940
8a	Duval Corporation	New Mexico, Sask.	1952
9a	Southwest Potash Corporation	New Mexico, Sask.	1952
10a	National Potash Co.	New Mexico	1957
11a	Kalium Chemicals Limited	Saskatchewan	1964
12a	Kermac Potash Co.	New Mexico	1965
13a	Texas Gulf Sulphur Company	Utah, Sask.	1965
14a	Alwinal Potash of Canada Ltd.	Saskatchewan	1968
15a	Swift & Company†	Saskatchewan	1968
16a	Cominco Ltd.	Saskatchewan	1968
17a	U.S. Potash & Chemical Co.§	New Mexico	1968
18a	Central Canada Potash Co. Ltd.†	Saskatchewan	1969
19a	H.J. Baker & Co. (agent)	Israel	1969
20a	Sylvite of Canada	Saskatchewan	1970
International Seaborne Market			
1w	Kali und Salz G.m.b.H.	West Germany, Sask.	1860s
2w	Mines de Potasse d'Alsace S.A.	France, Congo, Sask.	1911
3w	Union Explosives S.A.	Spain	1926
4w	Dead Sea Works Ltd.	Israel	1932
5w	Promexport	U.S.S.R.	1934
6w	Bergbau Handel G.m.b.H.	East Germany	1950
7w	Kerr-McGee Oil Industries	California, N. Mexico)	export assoc. from 1938 to 1960
8w	U.S. Borax & Chemical Corp.	Sask. (former N. Mex.)	
9w	Potash Company of America	New Mexico, Sask.	
10w	International Minerals & Chem.	New Mexico, Sask.	
11w	Duval Corporation	New Mexico, Sask.	
12w	Southwest Potash Corporation	New Mexico, Sask.	
13w	National Potash Co.	New Mexico	
14w	Potassas de Navarra S.A.	Spain	1963
15w	Kalium Chemicals Limited	Saskatchewan	1964
16w	Texas Gulf Sulphur Company	Utah, Sask.	1965
17w	Cominco Ltd.	Saskatchewan	1968
18w	U.S. Potash & Chemical Co.	New Mexico	1968
19w	Sylvite of Canada	Saskatchewan	1970

* This list excludes a few organizations that offered potassium chloride for sale, but because of financial ties or other marketing arrangements they are not regarded as selling rivals; for Canpotex Limited, see footnote 5 on page 26.

† These firms are not selling rivals in the usual sense as all their output is distributed through captive outlets.

§ Purchase of U.S. Borax & Chemical Corporation's New Mexico mine.

Table 2
World Output, Sales and Exports of Potash, 1969-70

	1969			1970						
	Output*	Sales*	Overland	Exports† Seaborne	Total	Output*	Sales*	Overland	Exports† Seaborne	Total
					('000 metric tons K ₂ O equivalent)					
U.S.S.R.	3,244	3,194	295	403	698	4,087	3,950	675	643	1,318
Canada	3,400	3,060	2,059	844	2,903	3,173	3,051	2,231	646	2,877
United States	2,544	2,784	22	543	565	2,476	2,421	33	402	435
Germany, East	2,346	2,330	1,011	646	1,656	2,419	2,400	1,061	678	1,739
Germany, West	2,283	2,271	400	427	827	2,306	2,300	280	494	774
France	1,794	1,802	222	361	583	1,768	1,770	209	272	481
Spain	551	550	21	321	342	521	520	31	257	288
Israel	363	430	-	410	410	546	543	-	504	504
Italy	175	196	-	-	-	139	139	-	-	-
Congo	41	30	-	30	30	125	122	1	120	121
Others	100	100	-	-	-	100	100	-	-	-
	16,841	16,747	4,030	3,985	8,014	17,660	17,316	4,521	4,016	8,537

Sources: Department of Energy, Mines and Resources, Canadian Minerals Yearbook, 1970 (Ottawa); United States, Department of the Interior, Bureau of Mines Minerals Yearbook, 1970 (Washington); Saskatchewan, Department of Mineral Resources, Monthly Potash Report, 1970 (Regina); The British Sulphur Corporation, Phosphorus and Potassium, various issues (London); and

* Includes potassium chloride, potassium sulphate, and potassium-magnesium sulphates and raw potash salts.
† Includes potassium chloride only.

latter part of the 1950's, to 17 in 1965, and 20 in 1970.⁵

Before closing, perhaps a few words on market domination are warranted; generally speaking, the degree of market control by the largest sellers in each of the two markets has been approximately the same. More specifically, in 1969-70 the six largest sellers (or their parent organizations) in the seaborne market (in descending order, numbers 6w, 1w, 10w, 5w, 4w, and 2w in Table 1) controlled about 60 per cent of total world potash productive capacity and accounted for about 70 per cent of seaborne sales. The six largest North American sellers (in approximate descending order, numbers 7a, 5a, 8a, 11a, 9a, and 18a in Table 1) controlled about 64 per cent of installed mine capacity in North America (or about one-quarter of total world capacity) and accounted for an estimated 65 per cent of sales in the North American market.

Comparative Production Costs

The industry's supply function is influenced by the nature of costs and indeed, the supply of potash to key sales outlets is influenced by cost advantages or disadvantages of the various sellers. In the short run, it is generally assumed that the number of plants and the level of output is relatively fixed. Unit production costs will be dependent upon the rate and

⁵ Another Canadian firm, Canpotex Limited, has also been selling potash in the international market since 1970 when it was incorporated under federal charter to represent most of the Saskatchewan producers in bidding for government contracts (e.g. foreign aid). As a result of a directive from the Saskatchewan Department of Mineral Resources dated May 23, 1972, Canpotex has been expanded to include all Saskatchewan-based sellers entering the seaborne market; henceforth it is to act as the sole selling agent for Saskatchewan potash in the offshore market. In effect, this arrangement eliminates four firms (number 8w, 15w, 17w and 19w in Table 1) from the seaborne market plus a substantial part of the output from five other firms (numbers 9w, 10w, 11w, 12w and 16w in Table 1).

volume of output, factor prices, and the firms' production function - i.e. the physical productivity or efficiency of management, labour and other factor inputs that are combined to operate the mine and plant; with special reference to potash, these include ore grade and depth, extraction rates, stage of ore-body depletion, mining methods, processing techniques, and the degree of product purity achieved. For the potash industry, the short run can vary from one to five years, depending upon the type of expansion undertaken. If a particular operation has sufficient mine and hoisting capacity it can respond to increased demand by expanding its surface plant, an undertaking that requires 12 to 18 months to complete. Should another shaft at an existent site be required, the construction period will approach 36 months. If an expansion involves the construction of a new mine and plant, whether it be by an existent firm or a new entrant to the industry, the completion period approaches five years.

There are three approaches to comparing production costs using engineering data; first, the scale of output for a given grade of ore and production technique - i.e. the shape of the average cost curve; secondly, one firm or mine to another in a given geographical region where the ore is assumed to be relatively similar - i.e. the level of the average cost curves; and thirdly, one country to another. The most extensive published studies relating to the first type were conducted by Ozsahin and Husband for Saskatchewan; Figure 3 summarizes their conclusions with respect to conventional mining and refining methods.⁶ These curves are long run average cost curves.

⁶ Ozsahin, S. and W.H.W. Husband, An Investigation of the Potential of Solution Mining of Potash in Saskatchewan, (Saskatchewan Research Council, Regina,

Figure 3
Average Cost Curves for Conventional Potash Mining
and Refining (Flotation and Crystallization) Methods in Saskatchewan, 1967

A downward sloping average cost curve implies that there are economies of scale, either internal to the plant or external in the sense that as industry output expands factor costs fall - e.g. machinery prices may fall if more units are purchased. Although both types are present in potash mining, the former commands greater importance. Firstly, a mine shaft must be sunk to the same depth and about identical diameter regardless of whether the mine produces at a rate of five-hundred thousand or one million tons yearly. Secondly, equipment costs per unit of capacity decline when larger sizes are purchased.

6 Cont'd
1965); and W.H.W. Husband and S. Ozsahin, "A Comparison of the Solution Mining and Refining of Potash With Conventional Methods in Saskatchewan", Can. Min. Met. Bull. LX (May, 1967), 565.

Note: These average cost curves are expressed in terms of annual production rates for potassium chloride; to relate them to capacity figures presented in Table A-1, multiply the entries by 1.102 to convert from metric tons to short tons K₂O equivalent and then by 1.58 to convert to potassium chloride.

And thirdly, specialized equipment to improve mill recovery rates are justified in larger plants.

For the second approach to comparing unit production costs, one is likely to draw attention to differences not only in scale of output, but also in age and efficiency of plant and equipment, stage of orebody depletion, and mining and processing techniques - e.g. conventional shaft mining versus solution mining. The authors of one study estimated that total production costs for the Saskatchewan mines, exclusive of depletion allowances, depreciation, amortization and interest, ranged from \$7.60 to \$13.30 a ton of potassium chloride.⁷ In a background study conducted by engineers of the U.S. Bureau of Mines for a report entitled The United States Position and Outlook in Potash, it was revealed that total production costs for five mines in New Mexico, exclusive of depletion allowances, ranged from about \$12.00 to \$21.00 a ton of potassium chloride.⁸

The third approach to comparing unit costs is of particular interest in this study. When comparing costs from one country to another, in addition to cost differences referred to in the previous paragraph special attention will be directed towards differences in the grade, thickness, and depth of ore; other considerations include differing factor costs, tax structures and rates, royalties, capitalization and amortization, and the age of mines and plants. The most detailed comparisons of this type was published by the United Nations Industrial Development Organization (UNIDO) showing figures for Saskatchewan

⁷ Cassels, Blaikie & Co., A Study of the Potash Industry (Toronto, 1965), 26.

⁸ United States, Department of the Interior, The United States Position and Outlook in Potash (Washington, 1970); and personal communication.

Estimated Production Costs for a 'Typical' Potash Mine,
Saskatchewan and New Mexico, 1967

Item	Saskatchewan		UNIDO	New Mexico UNIDO
	Ozsahin & Husband 1965est.	1967est.		
Capital investment (\$)	40,313,000	60,900,000*		
Mine	18,560,000	28,000,000		
Refinery	21,753,000	29,200,000	18,400,000	9,100,000
Annual capacity (st KCl)	1,140,000	1,200,000	880,000	880,000
Grade of ore (% K ₂ O)	25	25	26	18
\$ per short ton KCl				
Mining				
Variable	2.08	..	n.a.	n.a.
Fixed costs	<u>1.61</u>	<u>..</u>	<u>n.a.</u>	<u>n.a.</u>
Subtotal	3.69	..	7.60	9.59
Refining				
Variable				
Utilities	1.33	..	1.49	1.76
Labour, supervision and sales	1.27	..	1.65	1.65
Maintenance	1.53	..	1.24	.61
Plant supplies	.23	..	.18	.20
Flotation reagents	<u>.47</u>	<u>..</u>	<u>.35</u>	<u>.48</u>
Subtotal	4.83	..	4.91	4.70
Fixed costs				
Plant overhead	1.10	..	.55	.55
Depreciation, taxes and insurance	<u>2.10</u>	<u>..</u>	<u>2.85</u>	<u>1.40</u>
Subtotal	3.20	..	3.40	1.95
Royalty	.55	..	.76	1.44
Sales and severance taxes	<u>--</u>	<u>--</u>	<u>--</u>	<u>.55</u>
Total costs (excludes depletion allowances)	12.27	14.01	16.67	18.23

Sources: Adapted from Ozsahin, S., and W.H.W. Husband, An Investigation of the Potential of Solution Mining of Potash in Saskatchewan (Saskatchewan Research Council, Regina, 1965), 122-133; United Nations, Industrial Development Organization (UNIDO), Fertilizer Manual, (New York, 1967), 144-145; and W.H.W. Husband and S. Ozsahin "A Comparison of Solution Mining and Refining of Potash with Conventional Methods in Saskatchewan" The Canadian Mining and Metallurgical Bulletin (May, 1967), 560-567. * Includes \$3.7 million for start-up costs.

.. Not available; -- Nil.

and New Mexico (see Table 3).⁹ That estimate revealed a comparative advantage of \$1.56 a ton of product for a Saskatchewan mine over a similar sized mine in New Mexico. Had UNIDO made allowances for the larger Saskatchewan mines, the average being 1.4 million short tons of product compared to 0.85 million in New Mexico, the cost advantage would have been in the order of \$4.00 to \$4.50 a ton. The U.S. Bureau of Mines concluded that the average advantage enjoyed by Saskatchewan mines ranged from about \$1.00 a ton over the lowest cost New Mexico mines to about \$8.70 a ton for the highest cost New Mexico mines.¹⁰

Although the foregoing cost data may prove useful in estimating cost-price margins in North America, it fails to provide full insight into the relative competitive positions of the leading potash producers and how established sellers might react to the prospect of lower-priced material entering outlets traditionally regarded as theirs. Full appreciation of relative positions can only be realized after examining mining and processing costs as well as transportation and handling costs incurred in moving potash from mine to port of export, thence to the key outlets. Except for the above mentioned reports, published cost data is lacking; nevertheless estimates in Table 4 are presented as a reliable guide to the relative levels of unit production costs incurred by the leading firms. For these estimates the expression 'operating costs' was adopted to coincide with industry terminology; although in some instances the term approximates the economist's definition of 'variable costs', it includes cost items such as 'plant overhead', maintenance, property taxes, and royalties but excludes sales and senior administrative costs. Total unit costs become the summation of 'operating costs' and 'invisibles', the latter

⁹ United Nations Industrial Development Organization, Fertilizer Manual (New York, 1967), 144-145.

¹⁰ The United States Position and Outlook in Potash, 34-39.

Table 4

Estimated Production Costs for 'Typical' Potash Mines in Some Major Producing Countries and Transportation and Handling Costs to Ports of Export, 1967

Country and Origin of Potash	Ore Grade % K ₂ O	Production Costs		Transportation and Handling Costs	Total Cost fob Port of Export	Port of Export
		Operating	Invisibles			
		Total				
		\$ per short ton 60% KCl				
Canada (Sask.)	25	8.27	5.74	14.01	10.20	Vancouver, B.C.
United States (New Mexico)	18	15.00	3.23	18.23	10.37 10.58	Houston, Texas Long Beach, Cal.
Spain (Catalonia & Navarra)	16	17.50	3.76	21.26	2.22	Pasajes, Bay of Biscay
					2.22	Barcelona, Mediterranean
France	17	18.00	2.34	20.34	5.98	Antwerp, Belgium
West Germany	12	21.00	3.15	24.15	5.20	Hamburg & Bremen
Israel (Dead Sea)	brine	n.a.	n.a.	22.43	2.77 3.10	Asdod, Mediterranean Eilat, Red Sea

NOTE: The above production costs are engineering cost estimates compiled by the author using information and publications referred to in this report; they are believed to be indicative of the average-size mine, operating at full capacity, in the respective countries. (Refer to Table A-1 for approximate 'average sizes').

Other sources: For grade of ore, Department of Energy, Mines and Resources, Canadian Minerals Yearbook (Ottawa, 1965). For transportation and handling costs, excerpts from a transportation study, Potash Export Association, 1965.

being allowances or payments for depreciation, amortization, interest and sales and administration. The figures for Saskatchewan, New Mexico and Israel were adapted from published data (see footnote to Table 3) whereas operating cost estimates for Spain, France and West Germany were based on the author's familiarity with world potash mining.¹¹ For France and West Germany, the estimates for invisibles were calculated as a percentage of operating costs, the rate being 5 per cent in case of sales and administration and 8 and 10 per cent, respectively, for depreciation, amortization and interest; the latter percentages were derived from expenditure data documented in annual reports of Mines de Potase d'Alsace and Salzdefurth Aktiengesellschaft. For Spain, the estimate for invisibles was calculated using the same percentage relationship between operating costs and invisibles that is listed for New Mexico.

The estimates reveal that Saskatchewan producers have a marked cost advantage at the production stage, the advantage stemming largely from higher ore grades, use of the most modern mining methods and equipment, and higher productivity; for example, output per employee in 1966 at International Minerals & Chemical Corporation's K-1 mine in Saskatchewan averaged about 1,550 tons K₂O equivalent compared to 170 tons in the West German industry.¹² However, as a seller in the seaborne market, Saskatchewan's cost advantage is largely dissipated by transportation costs in hauling the material to a port of export.

¹¹ Since July 1965 the author has been an employee of the Department of Energy, Mines and Resources, Ottawa, charged with the responsibilities of a commodity officer specializing in potash and related minerals.

¹² "International Minerals Has World's Largest Plant", The Northern Miner (Toronto, July 14, 1966), 42; and "The West German Potash Industry in 1967", Phosphorus and Potassium (Sept/Oct, 1968), 35.

Transportation Costs

For many commodities, transportation costs are a key factor in determining plant location with respect to raw material procurement and to marketing. For potash, as is the case of most minerals, the location of the mine is dictated by the geological occurrence of economic deposits and the producer must then strive to develop a transportation and market distribution network to minimize costs.

Virtually all North American potash leaves the mine site by rail (in bulk) and is either transported directly to the consuming region or to a shipping port for furtherance by water, thence by rail or truck to the distributor. The New Mexico industry is served only by the Santa Fe Railway Company. When the industry was launched in 1931, a freight rate of US\$6.50 a ton was established for hauling potash from Carlsbad to Houston or Galveston, Texas, for shipment to east coast ports; shortly afterwards, a special rail rate was established for export and coastwise shipments from Carlsbad to Houston and Galveston, this rate being set in 1932 at US\$4.50 a ton.¹³ Over the years, this export rate was gradually increased and by 1964 it stood at US\$8.80 a ton of potash product.¹⁴ Also, following the conversion to a fob mine pricing system after the war, a freight rate schedule was established for railway shipments from Carlsbad to marketing outlets scattered across continental United States.

When the industry was founded in Saskatchewan, a competitive freight rate (competitive in the sense that a potash producer located in Saskatchewan

¹³ L.H. Kurrelmeyer, The Potash Industry (Albuquerque, 1951), 23.

¹⁴ E.J. Battison, The Competitive Position of Saskatchewan Potash Producers (The Pennsylvania State University, 1964), 121.

would face about the same freight rate when shipping to the port of export as would a producer located in Carlsbad, New Mexico,) of \$9.00 a ton of product was established by Canadian National Railways and Canadian Pacific Railway Company for shipping potash from the mines some 1,100 railway miles to Vancouver for offshore export. Similarly, competitive railway freight rates were established for shipping Saskatchewan potash to many of the large consuming areas of continental United States. For example, freight rates from Yarbo, (near Esterhazy), Saskatchewan to Sioux City, Iowa, Chicago, Illinois, Detroit, Michigan, Cleveland, Ohio, Buffalo and New York, New York, were identical to those from Carlsbad, New Mexico.¹⁵

Equalized freight rates gave Saskatchewan a comparative advantage in most key outlets in North America; in a speech before the Senate in Washington in October 1967, the Senator from New Mexico stated that "the only three States in the United States where New Mexico potash can compete pricewise with Canadian imports are in the States of New Mexico itself, Texas and Oklahoma. All other 47 states can acquire their potash cheaper from Canadian sources".¹⁶ This statement was largely substantiated by industry officials appearing before the United States Tariff Commission in 1969; however, the latter pointed out that by a co-ordinated system of railing potash to Vancouver thence by large seagoing vessels via the Panama Canal, Saskatchewan potash was able to compete freightwise with Carlsbad potash in the southwest Atlantic Coast markets.¹⁷ Further, that through the use of logistic exchanges or "swaps" (a practice

¹⁵ Battison, 121.

¹⁶ Congressional Record - Senate (Washington, October 18, 1967), S14912.

¹⁷ Brief for International Minerals & Chemical Corporation before the United States Tariff Commission (Washington, October 27, 1969), 15-17.

that enables producers in either the United States or Canada to compete in the freight advantaged area of the other), Canadian producers were also able to compete in the Central, Southern and Texas market. The Saskatchewan-Vancouver-south Atlantic Coast route for potash was inaugurated by IMC in 1965; phosphate rock from Florida became the backhaul cargo that was partially instrumental in achieving a favourable shipping rate. It was also pointed out that all producers in Canada were able to deliver potash at a lower total cost basis - production plus freight - to all markets in the United States except Texas and south-western Arkansas than producers in Carlsbad.

The weakening competitive position of Carlsbad potash prompted negotiations with the Santa Fe Railway that led to a decrease in the freight rate for potash shipments to the Texas Gulf ports; the new rates, effective August 1969, were US\$5.75 a ton for export shipments and US\$8.00 a ton for coastwise dispatches.¹⁸ Normally, about one half the potash exports from New Mexico were channelled through the Texas Gulf ports, the balance being shipped westward through Long Beach, California.

In November 1969, the Canadian railways announced a general 6 per cent increase in freight rates, which for potash exports through Vancouver would have resulted in a rate of \$9.54 a ton, effective December 20, 1969. At the request of the Premier of Saskatchewan, introduction of the higher rate was postponed until February 20, 1970, at which time the new schedule became effective. Potash railway rate negotiations continued throughout the summer of 1970 and in early November a reduction to \$8.48 a ton was announced for ship-

¹⁸ "Developments in Potash Transport", International Fertilizer (London, February, 1970).

Table 5
Estimated Cost of World Potash Delivered to Key Market Outlets, May 1967

Destination and Ports of Import	Origin of Potash					
	Saskatchewan	New Mexico	W. Germany	France	Spain	Israel
	\$ per short ton 60% KCl					
North, South & Central America						
U.S. Atlantic ports	30.45	32.05	33.38	30.11	26.69	29.37
Brazil, Santos	33.95	37.29	35.34	32.08	28.66	31.35
Columbia, Cartagena	30.20	34.17	34.39	31.13	27.70	30.38
Cuba, Havana	..	..	37.27	34.00	30.59	33.26
Europe						
Sweden, Landskrona	32.20	35.08	31.80	28.81	27.08	30.01
Denmark, Fredericia	32.06	35.03	31.65	28.67	27.03	29.95
Britain, Inningham	32.20	35.32	32.09	28.81	27.32	30.24
Ireland, Dublin	33.07	35.42	32.95	29.68	27.41	30.34
Netherlands, Rotterdam	29.71	34.36	31.27	27.66	26.36	29.29
Poland, Szczecin	32.83	35.08	31.75	28.87	27.08	30.01
Yugoslavia, Rijeka	33.62	35.67	34.00	30.74	26.07	28.27
Asia & Africa						
India, west coast	36.45	41.29	39.67	36.40	32.84	32.54
India, east coast	36.11	40.96	40.00	36.74	33.12	32.87
Taiwan, Chilung	32.70	37.55	40.63	37.36	33.80	33.50
Japan, Yokohama	31.65	36.47	40.63	37.36	33.70	33.40
Rep. of South Africa, Capetown	35.44	39.80	36.26	33.04	29.72	31.48
Oceania						
Australia, Sydney	32.70	36.97	40.60	37.60	33.94	33.69
New Zealand, Auckland	33.19	37.45	41.34	38.08	34.42	34.17

Source: Compiled from column 6 of Table 4 and Table A-7.

.. Not applicable.

ments on producer-owned or -leased rail cars for offshore exports through Vancouver.¹⁹

Turning to overland export and seaborne transportation costs, data presented in Tables 4 (column 5) and A-7 reveals that European and Asian producers had a comparative freight advantage in supplying most key sales outlets. For example, in 1967 plant to port of export costs (i.e. railway and/or barge and truck plus handling) plus ocean freight charges ranged from \$4.62 to \$9.34 a short ton of product for West European potash delivered to British Isles-Baltic Sea ports as compared to about \$18.50 for Saskatchewan potash. Even for deliveries to Japan, the west Europeans had a slight freight advantage over Saskatchewan prior to the June 1967 closure of the Suez Canal. However, the latter freight advantages were more than offset by the lower production costs in Saskatchewan thereby giving Canadian based operators a distinct advantage over the large European exporters in supplying Pacific Rim outlets and slight margin in most of southern Asia (see Table 5). In all key seaborne outlets, the Saskatchewan mines had a distinct cost advantage over New Mexico mines, the advantage ranging from \$4.26 to \$5.16 a short ton of product for Pacific Rim countries; Saskatchewan even had an advantage in supplying the eastern seaboard states.

Demand and the Number of Buyers

Nature of Potash Demand

Potash, or more correctly potassium, is essential to all plant and animal life. Although many soils contain between 2 and 3 per cent potassium, only

¹⁹ Canadian Minerals Yearbook, 1970, 431. As of June 1, 1972, the export rate to Vancouver was raised to \$9.18 a ton for producer-owned or -leased cars and \$10.24 a ton for carrier rail cars.

a small proportion is available to plants and consequently soils that are cropped continuously must be replenished with this nutrient to maintain soil fertility.²⁰ Theoretically, all agricultural areas of the world ought to be regarded as demand centres for potash. While this may be true at some future date, it certainly isn't today, the reasons being essentially fourfold: some soils are naturally rich in potash and have not yet been cropped heavily enough to deplete reserves (e.g. the Canadian prairie wheatlands); lack of information on use of commercial fertilizers; lack of availability or financial resources to purchase potash (e.g. most of the less-developed nations); and continual reliance on organic fertilizers such as animal manure and night soils (e.g. People's Republic of China).

Potash is seldom applied directly to the soils; rather, it is blended or granulated with other plant nutrients to manufacture mixed fertilizers. There are literally thousands of mixed fertilizer manufacturers (or bulk-blenders) scattered throughout the farming regions of the world who mix potash with other ingredients for eventual sale to farmers. The aggregate demand curve for potash is generally regarded as an inelastic function of an already inelastic fertilizer demand schedule.²¹ Fertilizer sales are closely correlated to farm incomes.

²⁰ W.E. Koepke, Fertilizers and Fertilizer Minerals in Canada (Ottawa, 1971) 61.

²¹ S.P. Hayes, Jr., "Potash Prices and Competition", Quarterly Journal of Economics LVII (November, 1942), 32-43. Hayes presented statistical evidence for 1911-39 showing that fertilizer price changes had little effect on the volume of fertilizer sales and that potash price changes are not translated into fertilizer price changes (potash is the least costly of the three key ingredients for mixed fertilizers). The traditional viewpoint of an inelastic market demand curve has been challenged as being inapplicable for less-developed nations; although, no empirical evidence was presented to substantiate the challenge, the argument seems quite plausible in view of the fact that many sales are transacted on a total value basis as in the

Markets and Market Growth Rates

This study is primarily concerned with two markets, designated as the North American and international seaborne markets for potassium chloride. Generally speaking, these two markets have been in the same order of magnitude during post-war years, together accounting for about one-half of total world demand. According to the North American Potash Institute, potassium chloride sales in North America in the fertilizer year 1969/70 (12 months ended June 30, 1970) totalled 4.2 million metric tons K_2O equivalent.²²

Two estimates of the international seaborne market have been made, one based on potassium chloride exports by destination and the other on potash fertilizer consumption. The former (see Table 2) averages 4.0 million metric tons K_2O equivalent yearly for 1969-70 and the latter (see Table 6) is 3.8 million metric tons for the fertilizer year 1969/70; the discrepancy can be explained on grounds that some of the potash exports are for industrial uses whereas the consumption estimate includes agricultural potash only. The key seaborne outlets are in Japan, Britain and Ireland, Scandinavia, Poland, Oceania, Brazil, Cuba, and India, which together accounted for 55 per cent of seaborne market in 1969/70.

Accurate statistics on the pattern of post-war consumption in the international seaborne market are lacking; however, one can make certain inferences with respect to market growth rates for different time periods by

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case of foreign-aid tenders. See J.B. Mitchell, "Population, Politics and Potash", paper presented at the Annual Meeting of American Institute of Mining Engineers, San Francisco, February, 1972.

22 North American Potash Institute Incorporated, Atlanta, Georgia, Notice that this figure is somewhat higher than listed in Table 6; the latter is compiled from consumption data and excludes potassium chloride used for industrial purposes.

Table 6

World Potash Production and Consumption, Fertilizer Year 1969/70

	Production	Consumption	Net Surplus or Deficit	Est. Seaborne Market
('000 metric tons K ₂ O equivalent)				
North America	5,738	3,851	+1,887	..
Canada	3,500	190		..
United States	2,238	3,661		..
Mexico, Cent. & S. America	16	618	-602	577
Mexico	--	27		
Cuba	--	184		184
Brazil	--	200		200
Columbia	--	48		48
Others	16	159		145
Western Europe	4,852	4,475	+377	1,035
Austria & Switzerland	--	212		..
Belgium - Luxembourg	--	195		..
Netherlands	1	123		..
France, W.Ger. & Italy	4,153	2,594		..
Spain & Portugal	697	232		..
Scandinavia & Finland	1	509		425
Britain	--	462		462
Ireland	--	141		141
Others	--	7		7
Eastern Europe	5,590	4,909	+681	375
Czechoslovakia	--	476		..
Germany, E.	2,346	623		..
Hungary	--	169		..
Poland	--	1,050		200
U.S.S.R.	3,244	2,319		..
Others	--	272		175
Asia	577	1,534	-957	1,385
India	--	151		151
Israel	437	9		..
Japan	--	690		690
Korea, South	--	84		84
China, Peoples' Rep.*	140	300		160
Others	--	300		300
Africa	67	239	-172	238
Rep. of Congo	67	1		..
Rep. of S. Africa	--	89		89
Others	--	149		149
Oceania	--	194	-194	194
Australia	--	94		94
New Zealand	--	99		99
Total	16,840	15,820	+1,020	3,804

Source: Food and Agriculture Organization of the United Nations, Annual Fertilizer Review, 1970 (Rome, 1971).

* Estimated; includes North Korea and North Vietnam.

-- Nil; .. Not applicable.

examining total world consumption. From 1950 to 1964, world potash supply and demand remained more or less in balance with output and consumption experiencing an average annual growth rate of 7 per cent. Over the same period, world potash output exceeded potash fertilizer consumption by an average of 6 per cent annually, the excess being used for industrial purposes and serving as inventory. The early 1960's witnessed a period when more than ever before agronomists recognized the importance of fertilizers in boosting crop yields and world humanitarians made greater pleas for the industrialized nations to help feed the starving and under-nourished populations in the less-developed countries. For example, one authority in 1962 predicted that in order to meet food requirements in the developing regions alone, fertilizer use must increase from 4 million tons in 1959/60 to about 30 million tons in 1980, the latter figure being only slightly higher than total world consumption in 1959/60.²³

Although Europe and United States dominated world consumption, south-east Asia and Oceania became key growth areas for potash demand in the early 1960's; in India for example, potash consumption soared from 32,000 metric tons K_2O equivalent in 1959/60 to 206,000 metric tons in 1967/68.²⁴ For the world as a whole, the period 1965-67 was marked by a sharp rise in demand with consumption increasing at a rate of 10 per cent annually, only to revert back to its earlier growth pattern from 1968-70. The reader might take note that this time-span more or less coincided with the period when plans for five of the ten Saskatchewan mines were announced.

²³ F.W. Parker, Fertilizers and Economic Development (Rome, 1962).

²⁴ United Nations, Annual Fertilizer Reviews.

Number of Buyers

Generally speaking, the European fertilizer industries have traditionally been integrated both vertically and horizontally within their national boundaries; horizontal integration means that all three sectors of the fertilizer industry - nitrogen, phosphate and potash - are connected through organizational (as in the case East Germany and the U.S.S.R.) or financial ties. These integrated outlets, which in effect represent the domestic markets of the European potash producers, absorb from one- to two-thirds of their output, the balance being sold to independent buyers on the continent or in the seaborne market. In the case of Israel, domestic potash consumption is very small so virtually all its potash output is earmarked for the seaborne market.

In North America, the potash producers had traditionally maintained a separate identity from the fertilizer industry, the latter having been integrated only in the phosphate-superphosphate-mixed fertilizer sector.²⁵ In spite of a considerable degree of integration in the phosphate sector, the number of buyers (i.e. independent mixed fertilizer manufacturers) in the North American potash market in 1950 totalled 750 in the United States and 19 in Canada.²⁶ Virtually all buy-sell transactions between the potash producers and mixed fertilizer manufacturers took place on a short-term, 'arms-length' basis.

About 1960, the concept of 'bulk-blending' began to change the method of fertilizer distribution in North America and this change had a three-

²⁵ Markham, J.W. The Fertilizer Industry (Nashville, 1958), Chap. 1.

²⁶ Markham, 27; and Dominion Bureau of Statistics, The Fertilizer Industry, 1950 (Ottawa).

fold impact on the potash industry.²⁷ Firstly, some of the large oil companies who had integrated forwards into fertilizer retailing, integrated backwards and horizontally by acquiring financial interests in potash mining (e.g. Kerr-McGee Oil Industries); this integrative process was also adopted by some companies already closely associated with the farm sector (e.g. Swift & Company). Secondly, some long-term contractual agreements were negotiated between potash firms and fertilizer manufacturers (e.g. in 1959, Central Farmers Fertilizer Co., a large Chicago-based farm co-operative agreed to take approximately five-sixths of National Potash Company's output from a 600,000 ton-a-year mine in New Mexico).²⁸ And thirdly, the integrative process that originated in the nitrogen-phosphate sector and led to a franchising of the bulk-blenders, greatly reduced the absolute number of potash buyers in North America (no accurate listing is available but there have been an estimated 200 independent buyers of potash in North America since 1965, roughly one-quarter the number that existed ten years prior).

Each of the three structural changes undoubtedly had a marked impact on the behavioural relationships of buyers and sellers in North America. Some industry officials have argued that "shrinkage of the free market" owing to the integrative links and long-term contractual agreements had an adverse impact

²⁷ 'Bulk-blending' embraces both a production and distribution concept; it originated from technological advances in the nitrogen and phosphate sectors where natural gas emerged as the key feedstock for producing ammonia which in turn is combined directly with phosphoric acid to manufacture nitrogen-phosphate compounds. This part of the production process takes place in large petrochemical-like complexes from whence the nitrogen-phosphate compounds are shipped to small satellite plants where they are blended with potash compounds prior to sale to the farmer. Some large oil companies seized upon the opportunity to integrate forwards via the natural gas-ammonia-phosphate link into fertilizer retailing.

²⁸ International Minerals & Chemical Corporation, Brief Before the United States Tariff Commission, (Washington, October 27, 1969), 20-21. In
Continued on Pg. 45.

on price behaviour during subsequent years.²⁹ However, a quantitative analysis suggests that absolute reduction in the number of buyers had a much stronger impact. After all, the integrative links and long-term contracts pre-empted the open market for less than one-third the potash sold in North America and less than one-fifth the potash produced in North America; moreover, dynamic market expansion from 1960 to 1965 compensated for the loss of captive users and never at any one point in time did these 'fiat' arrangements remove more than two sellers from the North American potash market.³⁰ Hence, even if the concept of bulk-blending had reshaped the method of total fertilizer distribution and marketing, most transactions involving potash in North America continued to be made at arms-length.

The buying side of the North American potash market can be summarized as follows: concomitant with a trend to bulk-blending, the absolute number of buyers was severely reduced but not to the extent of posing a serious countervailing threat to the sellers. Accordingly, the buyers may be regarded as price takers.

Evidence from the international seaborne market leads to quite different conclusions. Buyers in the larger consuming nations are quite concen-

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subsequent years, Central Farmers entered into a long-term contract (including an option to acquire a 49-per cent equity interest) with Noranda Mines Limited to take virtually all the output from a mine in Saskatchewan.

29 International Minerals & Chemical Corporation, Brief Before the United States Tariff Commission, 18-21.

30 The reader should be aware that the three structural changes in the market were not mutually exclusive; for example, the actions by Central Farmers not only reduced the percentage of potash sold on the open market but also reduced the number of buyers entering the market.

trated; in Japan for example, although 13 firms are listed as potash importers in 1971, all buying transactions were apparently handled by 3 companies and co-ordinated by Zen-Noh (formerly Zenkoren), a fertilizer co-operative.³¹ Similarly, in Brazil 42 firms were listed as importers of fertilizer materials in 1971, but buying transactions were reportedly handled by a few companies.³² Britain, Ireland, Scandinavia and Oceania also have only a few buyers and in India a large part of purchases are acquired as foreign-aid contracts. Furthermore in the Communist-bloc countries, including Cuba, all purchases are handled through central agencies.

In spite of a high degree of buyer concentration in the large consuming nations, they apparently did not exercise their potential bargaining power against sellers; for political reasons they spread their purchases among several nations instead of buying all their needs from the least costly source. Hence, much of their bargaining power rested on their ability or willingness to adjust annual quantities purchased from each seller. An examination of production and transportation costs facing the various suppliers in serving a few key outlets reveals that in some instances (e.g. Britain and Ireland, see Table 5) buyers faced sellers whose costs were roughly the same whereas in other cases (e.g. Japan and Australia) cost differences were relatively large.³³

³¹ International Trade and Mining News, Fertilizer Edition (Tokyo, July 3, 1972) and personal communication.

³² Personal communication.

³³ The first part of this statement may appear inapplicable for Spanish suppliers; however, in view of the fact that Spain's output was comparatively small, its market influence was not particularly strong.

CHAPTER 3

CONDITIONS OF ENTRY INTO THE INDUSTRY AND MARKET

In addition to the two aspects of market structure already discussed at length, the industry supply function is influenced by the conditions of entry. Viewed in a statistical setting of the past 110 years, entry into the world potash industry as defined in terms of a newly discovered deposit has occurred once every 14 years. The search for suitable potash resources continues year after year but the geological nature of potash deposits dictates that only a few geographic regions that are currently non-producers are likely to ever sustain large-scale commercial exploitation. Not only is entry made difficult by the sparse occurrence of exploitable deposits, but also by the necessary technological know-how and capital requirements to bring a newly discovered deposit into commercial production, by absolute cost advantages, by economies of scale, by trade barriers, and on occasion by institutional arrangements and public policy with respect to the disposition of mineral rights.

Technological and Capital Requirements

Following discovery of a new deposit, a great deal of time, technological know-how, and capital are required to bring a mine into commercial production. For example, the Saskatchewan deposits were first discovered at a depth of 7,600 feet while drilling for petroleum in 1943, but economic interest in them sharpened only after 1946 when another drill test some 200 miles distant penetrated a high-grade bed at a depth of 3,500 feet.¹ For the next few years

¹ J.T. Cawley, "Headframes on the Prairies - The Role of Government" Potash Show Proceedings (Saskatoon, 1965), 75-9.

various individuals, companies and governmental bodies collected relevant data from oil and gas wells in Saskatchewan and the bordering areas of Manitoba and Alberta. In 1950, the Saskatchewan Department of Mineral Resources (then known as the Department of Natural Resources) began actively participating in exploration by drilling a number of test holes and encouraging oil companies to core drill sections through the potash zones; some core sections were paid for by the Department.

Armed with geological data, the Department approached a number of Canadian-based mining companies as well as those producing potash in New Mexico for proposals to mine potash. Canadian financial interests were generally non-receptive to such a venture with the exception of Western Potash Corporation Limited, which was formed in 1951 and having authorized capitalization of 5 million shares (no par value), the first public offering being made at \$1 a share.² Western Potash initially undertook solution-mining tests near Unity, Saskatchewan, and then in 1952 began shaft sinking; financial difficulties eventually resulted in a reorganization to form Continental Potash Corporation Ltd. in 1955. Technical and financial problems continued to plague the venture and the project was abandoned in 1961 following a flooding of the shaft. Technical problems confronting shaft-sinking operations in Saskatchewan involve several high pressure water-zones and a thick, unconsolidated or loosely consolidated, water-bearing rock formation. Subsequent operators overcame these difficulties by freezing the substrata prior to shaft-sinking.

The second attempt to win Saskatchewan potash was undertaken by Potash Company of America, a New Mexico-based potash producer, who in 1954 formed a

² Western Potash Corporation Limited, Information Brochure, (Toronto, 1952).

wholly-owned Canadian subsidiary to sink a shaft near Saskatoon. Construction commenced that summer with the shaft and surface refinery being completed in 1958 after an expenditure of over \$20 million, the necessary capital being raised through a \$10-million direct loan from the parent firm and a \$12.5-million bank loan guaranteed by the parent firm.³ The first potash ore was hoisted in November 1958 and production continued for a year until the mine was forced to close because of water seepage into the shaft. Repairing of the shaft, rehabilitation of the underground workings, and installation of new equipment required another six years to complete and a further expenditure of about \$25 million.⁴

The next entrant to Saskatchewan was International Minerals & Chemical Corporation (Canada) Limited, a wholly-owned subsidiary of a U.S.-based company of the same name and an established potash producer in New Mexico; construction of its mine, which began in May 1957, was completed in July 1962 after an expenditure of \$40 million, the funds being advanced by the parent firm. The fourth attempt to mine potash in Saskatchewan was initiated by General Petroleum of Canada Limited in 1958; efforts were made to develop a solution-mine but the project was soon abandoned.⁵ Subsequent entries are identified in the following section, in Appendix II, and are summarized in Table 7.

Even after having overcome the technical difficulties of shaft-sinking, mine construction remains a long, arduous, and expensive task; shaft-sinking necessitates about three years of construction effort and then another 18 to

³ Potash Company of America, Annual Report, 1959 (Denver).

⁴ Canadian Minerals Yearbook, various editions.

⁵ Battison, 72.

Table 7
Summary of Potash Projects in Saskatchewan, 1951-70

Company	Location	Date of Initial Exploration	Date of Lease Acquisition	Date of Mine Initial Construction	Approx. Capital Outlay \$	Date of mine Completion or Project Status
Western Potash Corporation Limited	Unity	1951	-	1951	3	Abandoned
Potash Company of America	Saskatoon	1951	1960	1954	63	1965
International Minerals & Chemical Corporation, K-1	Esterhazy	1955	1960	1957	65	1962
	Esterhazy			1963	60	1967
General Petroleum of Canada Limited	Nokomis	1958	-	1958	1	Abandoned
Kalium Chemicals Limited	Belle Plaine	1960	1965	1961	60	1964
Alvinsal Potash of Canada Limited	Lanigan	1958	1964	1964	60	1968
Imperial Oil Limited	Findlater	1962	-	1962	1	Abandoned
Southwest Potash Corporation	Boulder Lake	1956	-	1963	3	Abandoned
	& Yorkton					
AFM Operators Ltd.	Allan	1954	1962	1964	80	1968
Duval Corporation of Canada	Saskatoon	1954	1962	1966	63	1968
Cominco Ltd.	Vanscoy	1964	1969	1965	65	1969
Central Canada Potash Co. Limited	Viscount	1964	1967	1966	89	1969
Sylvite of Canada	Rocanville	1957	1966	1967	70	1970
Others (about 40 firms and persons)		1950-60's	-	-	22	Abandoned or suspended
Total capital outlay*					705	

Sources: Department of Energy, Mines and Resources, Canadian Minerals Yearbook (Ottawa) various editions. Saskatchewan Department of Mineral Resources, Mineral Lands Branch Records.

* Excludes post-production expenditures on new or replacement equipment and repairs.

24 months are required to develop sufficient mine entries to continuously feed the surface mill. This implies that for a period of up to five years, the entrepreneur can expect little or no return on capital outlays approaching \$70 million. A lengthy time-span for developing a new deposit is not unique to Saskatchewan. A recently developed potash deposit in the Republic of Congo was first discovered in 1948; mine construction commenced in 1964 and was completed in 1969 after an expenditure of US\$82 million.⁶ In England, potash was first detected in the Yorkshire region in 1939 but early exploration proved rather discouraging; construction of the first mine began in 1968 with initial production scheduled for 1973.⁷

A second technological problem related to Saskatchewan involved the uncertainty of mining potash at depths greater than 3,000 feet; most other world potash mines are less than 2,000 feet deep. Potash and salt beds become quite plastic at great depths because of pressures from overlying strata; although most operators have experienced some closure and eventual collapse of their underground workings, caving is generally slow enough to not seriously jeopardize mining.

Absolute Cost Advantages and Scale Economies

If a potential entrant would have higher long-run costs than established firms, the latter are said to possess an absolute cost advantage thereby substantially inhibiting entry into the market. Such cost advantages can arise from control by established firms of potash deposits, especially the higher

⁶ "Potash in Congo Brazzaville" Phosphorus and Potassium (March/April, 1969), 42.

⁷ "Potash in Yorkshire", Industrial Minerals (May, 1968), 15.

grade reserves, and patents. The former will be discussed in a later section. Although the technology necessary to conventional potash mining and refining have not been subject to patents for quite some time, the fundamental techniques of underground procedures in thinly bedded 'soft rock' and surface processing had not been widely known within mining circles and only since the completion of the first few Saskatchewan mines could a prospective entrant approach one of several reputable engineering firms for plant design and construction.

As far as solution-mining is concerned, the question of availability of technological know-how differs as processes are subject to secrecy and patent rights. Although solution-mining had been used for a century or more to recover salt from underground beds, the techniques were never successfully applied to potash until 1960 when Standard Chemical Limited undertook a series of solution experiments in south-central Saskatchewan. Standard Chemical was a Canadian subsidiary of U.S.-based Columbia Southern Chemical Corporation and had acquired financial assistance from Armour & Company of Chicago and technical assistance from PPG Industries Inc.⁸ Early in 1963, the three companies (two U.S. and one U.S.-owned Canadian firm) jointly formed Kalium Chemicals Limited who shortly afterwards announced the success of the experiments and, after an expenditure of \$40 million, officially opened in August 1964 a commercial-scale potash solution-mine. Kalium became the third successful entrant in Saskatchewan and was a new-comer to the world industry. Staff members of the Kalium-PPG Industries organization are known to have acquired at least

⁸ Battison, 72-74.

four patents related to solution-mining, filed with U.S. Patent Office from 1960 to 1962.⁹

Absolute cost advantages also stem from the fortunes of entry prior to strong inflationary pressures that send mine construction costs spiralling upwards. The latter is of considerable importance in Saskatchewan. For example, International Minerals & Chemical Corporation (Canada) Limited completed construction of two mines in 1962 and 1967, respectively, with a total capital outlay of \$125 million and having an annual output capacity of 3.82 million short tons of product compared to Central Canada Potash Co. Limited's 1969 investment of \$89 million for a 1.5 million-ton-a-year mine.¹⁰ This comparison partially disguises another cost advantage for an established firm; by constructing its second mine on an adjoining lease, International Minerals avoided the expense of twin-shafts for both mines by simply connecting the six-mile span underground at the potash level. Sound mining practice dictates that there should be two access shafts.

Economies of scale internal to the plant have been alluded to in the previous chapter. The term as applied here refers to the percentage effect of a minimum optimal scale plant on the market. Should demand conditions not be adequate for the addition of another optimal scale plant and unit costs rise significantly for a prospective producer entering with a lower than minimum optimal scale, established firms may be prompted to lower prices to preserve their market shares thereby blocking entry. In addition to scale economies internal to the plant, multiplant firms gain advantages in marketing and

⁹ Noyes, 193-210.

¹⁰ Koepke, Fertilizers and Fertilizer Minerals in Canada, 98.

distribution; companies with mines in New Mexico and Saskatchewan have the option of supplying outlets in the midwestern states from either location depending on cost advantages. Similarly, the French producer with mines in France, Republic of Congo, and Saskatchewan, can advantageously choose from where it will supply key outlets.

Institutional Setting and Mineral Disposition Policies

To gain full appreciation of entry into the world potash industry, a lengthy discussion on market versus non-market economies is perhaps justified, but only brief mention of the latter is deemed necessary. The world potash industry spans three broad types of economic systems: the private enterprise market economy, typified by the United States where prices signal economic activity and firms respond to profits; centrally planned economies such as the U.S.S.R. and East Germany, where economic activity takes place in response to commands from a central authority; and mixed economies, where some degree of central or indicative planning is combined with the price mechanism (public-ownership of industry in these economies is common).¹¹ If technically and geologically possible, potash mining in a command economy will normally take place to supply domestic needs and those of politically aligned nations or trading blocs; while it is sometimes claimed that entry into the 'export market' stems from a desire to earn foreign exchange, the writer contends that this is little different from stating that the organization is maximizing profits. In any event, the state controls and directs entry into its domestic industry and the international market.

¹¹ See for example, Bornstein, M., Comparative Economic Systems - Models and Cases, (Richard D. Irwin, Inc., Homewood, Illinois), 452.

Likewise, in a private enterprise market economy, the state can control entry into the potash market by virtue of its ownership of mineral resources, but it cannot direct entry except through public undertaking. Occasionally, there may be situations in which mineral resources are not held by the government because of outstanding title agreements but the frequency of such circumstances and the size of the land parcels seldom poses a threat to public control.¹² Several options for parcelling out mineral resources for private development are available to the governing authority:¹³ (1) a 'partnership', whereby the state contributes the mineral resources while the operator supplies capital and technology (the state can also contribute some capital and technology); (2) a 'lease' or 'concession' or similar type of 'property right' whereby the operator is granted the privilege of exploiting minerals within a given parcel of land, subject to certain laws and statutes and the payment of royalties and/or taxes; this has been the traditional approach in most private enterprise economies; and (3) a 'contractual right' whereby an operator (in effect, a government contractor) exploits minerals for the benefit of the state and retains a share of the profits. The 'partnership' and 'concession' options differ in that the former implies equality while the latter generally provides the operator with a 'depletion allowance' within the tax structure to recover capital value of minerals removed from the land as a cost item.

The method of parcelling out mineral resources in New Mexico and Saskatchewan differed widely, although both fell within the realm of second

¹² Private ownership of mineral resources is largely confined to Anglo-Saxon countries. See C.J. Lipton, "Mining Legislation" paper presented at United Nations Seminar on Mineral Economics, Ankara, Turkey (October 1970), 4.

¹³ Lipton, 3-4.

option described above. In essence, the New Mexico authorities adopted a policy of discretionary controlled entry whereas Saskatchewan granted permits and leases to any firm or individual prepared to undertake the prescribed exploratory and development expenditures.

Following the discovery of potash on public lands in New Mexico in 1925, the Secretary of the Interior issued a number of permits that led to the eventual establishment of two mines, one in 1931 and one in 1934, but the output potential from these two mines was apparently considered adequate so further prospecting permits were withheld in order to prevent over-development of the deposits.¹⁴ Although about 200 prospecting permits were applied for between April 1934 and September 1937, none were issued until subsequent months and in 1940 a third mine was brought into production.¹⁵ Subsequent New Mexico mines came on stream in 1952, 1957 and 1965.

For Saskatchewan, the mineral resources on about 60 per cent of the lands concerned were held by the Crown in the right of the Province, the remaining acreage being free-hold lands for which Canadian Pacific Railway

¹⁴ Entry was controlled under an Act of Congress approved in February 1927, entitled "An Act to promote the mining of potash on the public domain", in which the Secretary of the Interior was authorized to issue prospecting permits for a period not to exceed two years, subject to prescribed rules and regulations. In the event of delineation of valuable potash reserves, the permittee was entitled to a 20-year renewable lease, subject to a royalty of not less than 2 per cent of the quantity or gross value of the potash produced and an acreage rental of up to US\$1 an acre, the latter being credited against royalties accruing for each year. Permits and leases could not exceed 15,360 acres but this was subsequently altered to allow a corporation to hold a lease of that size plus an additional 25,600 acres under permit for prospecting. Kurrelmeyer, 55-57.

¹⁵ Hayes, Jr., 45.

Company Limited, Canadian National Railways Limited and Hudson's Bay Company Limited ranked as the largest owners.¹⁶ Apparently, the owners of free-hold lands in their dealings with prospective producers adopted procedures similar to the Saskatchewan Department of Mineral Resources acting on behalf of the Crown. However, as far as the Province was concerned one distinct difference emerged at the production stage; in the absence of royalties accruing to the provincial treasury on potash mined from non-Crown lands (such royalties being payable to the free-hold land-owners), the Province imposed a production tax, averaging about 40¢ a ton of potassium chloride, payable by the owners of free-hold lands.¹⁷

The first two potash prospecting permits were issued in 1950 and by fiscal year 1956/57, 21 individuals or corporations including all the potash producers from New Mexico and the French-German firm had acquired potash mineral rights in Saskatchewan.¹⁸ The amount of Crown acreage outstanding rose from 1.6 million in 1955 to 3.1 million in 1962 and then peaked at 5.5 million in 1967, the last figure representing 52 disposition holders of which 16 eventually went to lease; in December 1971 there were outstanding, 10 leases comprising

¹⁶ Cawley, 79; and Saskatchewan, Department of Mineral Resources Annual Report (Regina, 1954), 23.

¹⁷ "Saskatchewan Taxes Potash Production", Financial Times (Toronto), July 12, 1965. More recently, the Saskatchewan potash producers became subject to a prorationing tax of 60¢ a ton of product, effective June 1, 1972.

¹⁸ The first two potash prospecting permits - one consisting of 100,000 acres of Crown lands and the other 200,000 acres - were issued by the provincial authority under the Potash Regulations, 1950, and amended Subsurface Mineral Regulations, 1953. The Regulations provided for three stages in the disposal of mineral rights: a "withdrawal" which was really an exclusive potash prospecting licence on up to 100,000 acres at a rental of 1½¢ an acre for six months; a "permit" which consisted of up to 100,000 acres for a 3-year period subject to an annual rental of 5¢ an acre and an expenditure requirement; and a "lease", which is discussed below. Saskatchewan, Department of Mineral Resources, Annual Reports (Regina, 1954, 1955,

816,276 acres (Crown lands), one 99,840-acre lease pending, and 8 permits totalling 693,307 acres.¹⁹

Saskatchewan's method of disposing mineral rights provided an opportunity for any bona fide firm or individual prepared to undertake the prescribed exploratory and development expenditures to enter the potash industry; in the absence of a sizable domestic market, a prospective producer would have to gain entry to foreign markets. From the prospective producer's viewpoint, there was a strong incentive to proceed with mine construction once it had

18 cont'd

1956 and 1957).

These Regulations were superceded by "The Subsurface Mineral Regulations, 1956" (Order in Council 1544/56) promulgated under the Mineral Resources Act. Under the new Regulations and Act, prospecting permits comprising up to 100,000 acres of Crown property could, upon a \$20,000 deposit, be acquired for a 3-year period on the condition that the permittee expend \$60,000 during the first year and \$80,000 during each of the second and third years. The permittee could then apply for a 21-year renewable lease comprising between 640 acres and 12,500 acres with a proviso that at least \$3 million be expended during the first three years for the purpose of mining. An annual rental of \$1 per acre was payable and royalties on production were to be based on the grade of mine-run ore, the average being about 5½ per cent of the net selling price or about \$0.50 a ton at the then prevailing price level and anticipated production cost. Saskatchewan, Department of Mineral Resources, The Subsurface Regulations, 1956 (Regina, 1956).

Subsequent amendments to the Regulations (Orders in Council 1577/60, 2106/63, 1755/64, 2197/67 and 937/70) extended the permit period from three to five years and provided for three, one-year extensions and substantially reduced exploration expenditure requirements; also, the lease area was substantially increased, the minimum being boosted from 640 acres to 12,000 acres and the maximum limit from 12,500 acres to 100,000 acres, to be reduced to a maximum of 37,500 acres after 15 years. Further, the requirement for a \$3-million expenditure on a lease could be extended for three, 12-month periods, and the lessee could obtain further extensions of his lease by payment of \$90,000 annually. Saskatchewan, The Saskatchewan Gazette (Regina, September 16, 1960, November 29, 1963, November 12, 1964, January 3, 1968, and July 13, 1970).

19 Saskatchewan, Department of Mineral Resources, Annual Reports (Regina, 1955, 1957 and 1962) and Disposition of Crown Acreage, Recap (Regina, 1967, 1970, and 1971).

explored its permit area and found adequate reserves; after the 3-year permit stage, (later 5 years plus up to three 12-month extensions), the permittee either surrendered his rights to the Crown or applied for a lease, which implied a commitment to proceed with mine construction. It should be noted however, that seven of sixteen leases issued were surrendered prior to mine construction.

Trade Barriers

Two broad types of artificial impediments to world potash trade may be distinguished. One type stems from imperfectly competitive market structures. The second type has its origin in the desire of national governments to alter the volume and pattern of world output and trade generated by free market forces; these barriers constitute direct instruments of governmental commercial policies - e.g. tariffs and quotas - and in some cases state buying practices. Cuba provides an example of the latter. Until 1960, the United States was the principal supplier of potash for Cuba but subsequent needs have been imported largely from East Germany and the U.S.S.R.,²⁰ today, ships carrying North American potash bypass Cuba en route to Europe while others transport European potash to Cuba.

Because fertilizers are a key input for agriculture and most countries lack domestic potash supplies, scarcely any country has imposed, at least in the twentieth century, trade restrictions in the form of tariffs or quotas on potassium chloride. However, a number of tariff and quota proposals were put before the U.S. Senate and House of Representatives from 1967 onwards in an

²⁰ Minerals Yearbook, various editions.

attempt to curb the free flow of potash into the United States and protect its domestic industry. The people of Carlsbad, New Mexico, depended upon the potash industry to generate 25 per cent of personal income and consequently any mine closures would create grave economic and social hardship and were bound to arouse local political concern.²¹

Following an announcement the first major lay-off of miners,²² a bill was introduced by a representative from New Mexico into the U.S. House of Representatives seeking to change the duty for potassium chloride entering that country from free to 8 per cent ad valorem.²³ No legislative action resulted and in October of the same year a bill was placed before the U.S. Senate calling for a quota which would limit potash imports to 25 per cent of estimated United States consumption for that year. Again, no legislative action resulted. In September 1969, a substitute bill was put forth that would have allowed up to 30 per cent of United States needs to enter the country duty free and all imports above that level would have been subject to a 40 per cent ad valorem tariff. Although none of the bills were enacted, sufficient concern for the domestic industry was aroused to launch an anti-dumping investigation that became a deterrent to the free flow of potash into the United States during 1968-69.

²¹ The United States Position and Outlook in Potash, 29-31.

²² United States Borax and Chemical Corporation had stated that its mine was nearly exhausted of "high-grade" potash beds and that a new refinery would be required to process lower grades. The mine was closed in November 1967 and 900 workers lost their jobs. In August 1968, the mine was sold to a group of Carlsbad and Dallas businessmen, who shortly afterwards reopened it producing at about 25 per cent of the previous scale of operation.

²³ The United States Position and Outlook in Potash, 16.

In the summer of 1967, a complaint was filed with the Treasury Department, apparently by Carlsbad business interests, claiming that potassium chloride from Canada, West Germany and France was being sold in the United States at less than fair value within the meaning of the Antidumping Act, 1921. The Bureau of Customs began withholding appraisement of potassium chloride imported from those three countries, effective June 11, 1968, and from that date onwards Canadian exporters were required to deposit a bond on potash moving into the United States pending a final decision which came on August 20, 1969, when the Treasury Department announced that potassium chloride from the above-named countries "is being, or likely to be, sold at less than fair value within the meaning of section 201(a) of the Act".²⁴ This was followed by U.S. Tariff Commission announcement in November 21, 1969, that the United States potash industry had been injured; when the findings were endorsed by the Treasury Department a month later, potassium chloride imported from the three named countries became subject to special dumping duties. This meant that Treasury officials had to examine literally thousands of transactions dealing with potash imports dating back to June 11, 1968, a process which reportedly had not yet been completed in late 1972.

The proceedings and the issues raised were perhaps one of the most bizarre cases in United States antidumping history. When the investigation was launched, France and West Germany were only minor suppliers to the United States market so most of the Commission's probing was directed towards Canadian exporters of whom there were only three at the time - International Minerals & Chemical Corporation (Canada) Limited, Kalium Chemicals Limited,

²⁴ United States, Federal Register (Washington), Vol. 33, No. 13, January 19, 1968; and Vol. 33, No. 118, June 18, 1968; and Vol. 34, No. 163, August 26, 1969.

and Potash Company of America. All three firms were owned and controlled in the United States and two had potash mines in New Mexico so in effect, U.S. companies were being accused of dumping in their own market. Partly because of the ownership aspect, potash was commonly "swapped" as logistic exchanges; in practice, a "swap" meant that firm A would deliver potash to a customer at the request of firm B at a price set by B. If A were a firm in Canada and B a firm in New Mexico, B could sell A's potash in the U.S. market at a price lower than A obtained elsewhere. In addition, it was found that IMCC had not sold sufficient potash in the home market (Canada) to establish a fair value for its potash. The criterion applied by the Treasury Department in an apparently unprecedented move was to determine fair value of IMCC's exports to United States by reference to the price of potash sold in Canada by another Canadian producer.²⁵

A further complication in the case arose when the Antitrust Division of the U.S. Department of Justice in March 1970 petitioned the Tariff Commission and Treasury to reconsider their findings. The Division argued that the United States potash industry is "highly concentrated and that historically it has enjoyed large profits and the absence of price competition", and "the trend in industry towards use of Canadian reserves represents a more efficient allocation of resources by American companies and should not be discouraged by invocation of the antidumping law".²⁶ The petition was denied.

²⁵ Federal Register, Vol. 34, No. 163, August 26, 1969.

²⁶ "Potash, Glass Anti-Dump Rules", Chemical Marketing Reporter, June 7, 1971, 3.

CHAPTER 4

MARKET BEHAVIOUR OF THE WORLD POTASH INDUSTRY

This chapter examines output and pricing policies prior to and after the entry of Saskatchewan potash into the North American and seaborne markets and relates behavioural responses to changing structural conditions in both the selling and buying sides. The reader is reminded that, although transportation costs frequently exceeded mining costs and tended to insulate certain market areas from foreign competition, pricing and output decisions for the two markets - overland and seaborne - were not mutually exclusive. Producers generally had little or no control over freight charges, either overland or seaborne, but they could penetrate each others market spheres by adjusting mine prices. In some instances, producers eventually gained some degree of control over transportation charges.

Traditional Output Policies

Traditional short-run output policies are best explained in terms of installed mine capacities. Even though potash was consumed on a seasonal basis, customary practice amongst the mining companies was to operate steadily on a 24-hour-day basis throughout the year with the exception of a two week maintenance period during the slack summer months. Daily mine capacities could readily be translated into annual output rates, thereby providing ample opportunity for rival firms to predict individual and industry yearly output schedules. Furthermore, a lengthy construction period for new mines allowed established firms to predict long-run output levels as new firms entered the market or ex-istant firms expanded.

Most operators maintained on-site storage space for about one-quarter annual output and additional storage needs were provided at buyer-owned fertilizer plants scattered throughout the farming communities of North America. Because of caking problems inherent to idle potash piles, both the producers and dealers attempted to rid themselves of stocks at the close of the main shipping season, which for North American operators corresponded to the end of June. Should spring demand fall short of supply, the summer shutdown period could be extended to 3 or 4 weeks. Export deliveries moved on a fairly regular schedule with sales to the southern hemisphere helping to equalize year-round shipments.

Short run cost curves for potash mining are not unlike those for manufacturing - i.e. as a function of the rate of output, the total cost curve is ogive-shaped and the average and marginal cost curves are U-shaped. The upward sloping portions of these last two curves represent the limiting factor in the short run, but unlike many manufacturing plants, the downward sloping portions tend to be quite steep because of the large investment in shafts and other pre-production items that must be amortized.¹ Accordingly, the firm is interested in operating at capacity and is likely to resort to price cutting to achieve full output. Moreover, because of losses to be incurred upon exit from the industry, the firm will be willing to operate for considerable periods at prices just covering variable costs.

¹ One Saskatchewan producer claimed that a 7 per cent reduction from capacity output resulted in a loss of recoverable fixed production costs of \$2.50 a ton of product, which with reference to Table 3 implies an 18 per cent increase in production costs.

Traditional Pricing Policies

In considering price policy, it is convenient to distinguish between price level and price structure; changes in price structure have on occasion resulted in subtle changes in the level of prices.

Prior to the growth of the United States potash industry, potassium chloride was offered for sale by the importers c.i.f. (cost, insurance and freight) at Atlantic and Gulf ports, priced by the ton of product with a guarantee of 60% K_2O .² In 1934, following the entry of two United States potash producers, (one in California) a pricing technique was devised in North America in which potash prices were quoted on the basis of a 20-pound unit of K_2O . This meant that potash grading 60% K_2O and having a unit price of \$0.38 would sell for \$22.80 a ton of potassium chloride ($\$.38 \times \frac{60}{100} \times 100 = \22.80 , there being 100 units in one ton). Also a basing-point system was adopted whereby potash was offered for sale at various Atlantic and Gulf coast ports, New Mexico potash being shipped by rail to Galveston or Houston, Texas, thence by sea to eastern ports. Following the entry of a second New Mexico producer, Carlsbad was also made a base-point for pricing. As a result of recommendations arising out of a U.S. Department of Justice investigation in 1939, the United States producers began making some sales f.o.b. (free on board) mine. Vessels for hauling potash by sea became difficult to charter during the war years and by 1949 the producers resorted to offering all sales f.o.b. mine.

As the 1950's progressed, the New Mexico producers became accustomed to posting a price list (about April or May) stipulating the conditions of sale and

² Kurrelmeyer, 40-43.

prices per unit K_2O according to 'grade', date of order, and delivery.³ By structuring prices according to 'grade', which to a large extent simply reflected particle size, producers were able to take account of differences in final processing costs, and by structuring prices according to season (June-September, October-January, and February-May) some storage costs were transferred to the buyer and the shipping season was lengthened. Shipments were made in 40-ton carlots, in bulk, or if necessary, in bags subject to an additional charge of US\$4.00 to US\$6.00 a ton; bagged orders came from small customers in North America or from occasional offshore buyers (e.g. foreign-aid purchases), both classes of sales entailing unusually high transaction costs. The price lists applied for North American shipments whereas a Potash Export Association set up in 1938 was responsible for sales in the international seaborne market where contracts were apparently negotiated in confidence for a one-year term with prices being adjusted according to the volume of business.

The Saskatchewan industry adopted a similar procedure for posting prices - i.e. f.o.b. mine and according to grade and season. Companies with mines in Saskatchewan and New Mexico issued only one price list for sales in United States with the option of shipping from either location, subject to freight equalization. After the appearance of Saskatchewan potash in world markets, the above-mentioned U.S.-based Export Association became non-operational and North American producer sales in the seaborne market began to take place on an f.o.b. mine basis, with the exception of foreign-aid and foreign-government purchases, which were made on a c.i.f. basis, port of export.

³ Minerals Yearbook, various editions; and Kurrelmeyer, 42-46.

The French and West German potash producers had become accustomed in 1950's and 1960's to quoting domestic prices f.o.r. (free on railway) purchaser's nearest railway station and, because of freight equalization, all buyers within their respective national boundaries presumably paid identical prices subject to seasonal differences in delivery. Sales in the seaborne market were contracted for a one-year period with prices being negotiated on a f.o.b. or c.i.f. basis depending upon buyer preferences, and being related to quantities purchased, grade, season, and to some extent the vigor of competition for particular customers.

Although data on international prices is meager, empirical evidence suggests that sellers, especially the Europeans and probably the Carlsbad producers as well, practiced price discrimination between domestic and foreign buyers, domestic prices being the higher (see Table A-9). Retail prices paid by farmers in Japan and some European export markets were on occasion lower than in the United States and France; for example, in virtually all years from 1959/60 to 1967/68 Japanese retail prices were lower than in United States, and in 1958/59 retail prices in Belgium, Netherlands and Norway were lower than in France. Comparisons with prices in West Germany are difficult because of subsidies. Moreover, as indicated in Figure 4, wholesale prices in France and West Germany exceeded those in the United States and yet the Europeans exported substantial quantities to the eastern seaboard states until 1967.⁴ Further support to the

⁴ Fertilizers, An Annual Review of World Production Consumption, Trade and Prices, various editions. The reader is to be cautioned that wholesale prices in France and West Germany include freight costs to the purchaser's nearest railway station but the differences between European and United States prices are believed to be far greater than actual transportation charges.

Figure 4

Wholesale Prices for Potassium Chloride in United States,
France and West Germany, Years Ended June 30, 1952-68.

contention that west European producers commonly sold potash in export markets at less than domestic prices manifested itself in 1968-69 when they failed to defend their position before the U.S. Tariff Commission after having been accused of 'dumping' potash on the United States market; the Commission found that "the margin of dumping determined for these imports [i.e. from France and West Germany] was enormous".⁵

⁵ United States, Tariff Commission, Potassium Chloride (Muriate of Potash) from Canada, France and West Germany, (Washington, November, 1969), 30.

Post-war pricing policies in overland and seaborne markets can be summarized as follows: sellers posted their prices f.o.b. mine in North America and f.o.b. buyers railway station in Europe for 'domestic' overland deliveries and negotiated in confidence prices for seaborne deliveries; no discounts were officially granted to large volume 'domestic' buyers of bulk material whereas prices in the seaborne market reflected quantity purchases. There was little incentive or opportunity for sellers to engage in secret price cutting. For example, in North America in 1950 when there were 7 sellers and 770 buyers, it is estimated that according to Stigler's criterion a secret price cutter could have boosted his domestic sales by only 9 per cent without being detected.⁶ Moreover, there was no opportunity for a single North American producer to secretly cut prices in the seaborne market as sales were handled by an export association. This implies that in the post-war years the ability to collude was virtually complete and one would expect little change in market performance from the prewar years when collusion was achieved through cartel-like arrangements with the French-German industry acting as a price leader.⁷

⁶ Stigler, A Theory of Oligopoly, Table 5-1. The above estimate is based on the assumption of a probability of 0.9 for repeat sales to old customers; a higher probability would imply a lower potential increase in sales.

⁷ Apart from market performance considerations, two pieces of information, one for just prior to World War II and one for recent years, are cited as evidence of collusive conduct. In May 1939, the three United States potash producers and the importer (of French and German potash) were indicted by the U.S. Department of Justice on criminal charges of conspiring to fix and maintain prices, to dominate and monopolize production and sales, and to sell potash only on terms and conditions of sale agreed upon by them and only to purchasers approved by them. During the investigation that ensued, an examination of customer invoices from the four sellers in 1938/39 revealed no evidence of price concessions. See Hayes, 58. In May 1973, the Commission of the EEC announced that it was prohibiting a sales cooperation agreement between Société Commerciale des Potasses et de l'Azote (the marketing arm of the state-owned French potash industry) and Kali und Salz (the owner of 90 per cent of West Germany's potash industry). The agreement had allowed the two firms to jointly fix the quantities and qualities of potash exports. Although there was no indication when the agreement had been drawn up, the two firms had for some time maintained joint distribution outlets in the Netherlands and Italy, a situation that gave rise to standardization of prices and conditions of sale. Community News, European Communities Press & Information, London Office, May 24, 1973.

Secret and Announced Price Cutting: 1965 to 1969

North American potash prices reached a post-war high in 1965 and then began to decline as supply outpaced demand and sellers resorted to price cutting. According to industry officials, prices were 'stable' in the years immediately prior to 1965/66 as "all [United States] sales were made on the basis of published price lists.... Just before the start of that fiscal year [i.e. the fertilizer year 1965/66], as was customary in the potash industry, price lists were announced for each company.... IMC had announced its price list just before April 1965 ... [but its] price list was ... not accepted by the industry. Late in April, U.S. Borax - in Carlsbad at the time - published a price list with reductions in prices which was accepted by other domestic [United States] potash producers for that fiscal year and IMC was forced to follow."⁸ Nevertheless, sales supposedly continued at listed prices until March 25, 1966, when Southwest Potash Company announced price reductions of up to 10 per cent, retroactive to February 1st. Apparently, all North American producers followed but in the spring of 1967 and again in 1968 a number of them attempted to restore higher prices as well as the practice of selling according to posted prices, but each attempt failed. By 1969, North American potash prices dipped to their lowest level on record and seaborne prices fell accordingly. With specific reference to Saskatchewan, f.o.b. mine prices fell from a high of \$37.53 a ton K_2O equivalent in 1965 to \$19.87 a ton in 1969, a decrease of 46 per cent;⁹ translated into product tons, the latter represents a price of \$12.16, which is \$1.85 below total production costs listed in Table 3.

⁸ Brief for International Minerals & Chemical Corporation Brief before the United States Tariff Commission, (Washington, October 27, 1969), 11-12. [Brackets added by writer].

⁹ Canadian Minerals Yearbook, 1966 and 1970.

Although it is imperative that one distinguish between secret price cutting and announced price cutting, a few observations on structural changes in both the selling and buying sides reveals a marked tendency for sellers in the 1960's to engage in secret price cutting that eventually resulted in announced price cuts. During the period 1950 to 1965/66, the number of sellers in the North American market rose from 7 to 11 while the number of buyers fell from 770 to an estimated 200; thus, using Stigler's criterion and a probability of 0.9 for repeat sales to old customers, a secret price cutter could have boosted 'domestic' sales by about 36 per cent in 1965/66 without being detected.¹⁰ The implication is, of course, that the ability to collude had been seriously eroded from earlier years and one would expect a marked change in market performance. Not only was there an incentive to cut prices in the North American market, but by that time there was also an opportunity to cut prices in the seaborne market as the Potash Export Association had become non-operational so virtually all North American producers emerged as sellers in the seaborne market.

¹⁰ Stigler, A Theory of Oligopoly, Table 5-1; A few words of caution are in order: Firstly, Stigler's analysis rests on the assumption that all sellers and all buyers are of equal size; it does, however, make provisions for very small buyers by excluding them. Secondly, this analysis does not take account of dynamic market expansion over a lengthy time span. And thirdly, unlike many manufacturing industries where aggregate production statistics are not readily available, precise statistical reports on mineral production and revenues must be reported to state or federal agencies and these are subsequently published; any significant increase in sales is likely to be detected shortly. Alternatively, in view of the fact that virtually all shipments leave the mine by railway, each firm can simply contact the local shipping agent to obtain the number of carloads shipped by rivals each week or month; information gathered by this procedure is, however, subject to error and misinterpretation because a vendor may simply be transferring stocks to an off-site location rather than filling a sales contract.

Four pieces of information are presented as evidence of secret price cutting: (1) as shown in Figure 5, realized f.o.b. mine prices (unweighted averages) for both 'domestic' and seaborne sales from 1966 to 1968 were well below posted prices; (2) IMC customer information reports taken in North America in January 1967 showed discounts of 20 per cent off published list prices;¹¹ (3) from 1965-67, IMC chartered, on a long-term basis, a number of ocean-going vessels that enabled the company to supply 'domestic' and seaborne outlets at delivered prices rather than f.o.b. mine prices (one run was from Vancouver to Tampa, Florida, with phosphate rock as a backhaul and another run was from Vancouver to Rotterdam). Although these shipping arrangements did not necessarily mean that IMC was undercutting its posted f.o.b. mine prices, the fact that the company had preempted normal shipping practice (i.e. via tramp charter vessels whose operators frequently posted shipping rates) and penetrated the European market at prices that were never revealed, left little doubt that a form of price cutting was taking place;¹² and (4) five bids for a 45,000-ton Canadian Development Assistance Loan contract for East Pakistan tendered in October 1968, revealed price spreads of 16 per cent for potash to be shipped from Vancouver; all five bids were different. Similarly, five bids for 40,000 tons for India tendered in June 1969 revealed price spreads of 6 per cent.¹³

¹¹ International Minerals & Chemical Corporation, Brief Before the United States Tariff Commission, (October 27, 1969), 17.

¹² "Florida Phosphates and Canadian Potash Are Entering New Markets" Chemical Week, (September 4, 1965); and "IMC's Big Slice of Large U.K. Potash Market", The Northern Miner (September 14, 1967). The reader should be aware that the IMC charter arrangement was a significant departure from the Cominco Ltd. - Canadian Pacific corporate link as identified in Figure 1, page 20. Railway freight rates for potash are fixed and posted and apply to all shippers regardless of corporate integration; hence Cominco had no bargaining advantage or 'secret' rate. Ocean freight rates on the other hand are subject to 'spot' negotiation. This implies that unless a long-term charter is arranged, rates will vary from one shipment to another; the 'market' dictates that in the short-term these rates will vary only slightly and most shippers will be reasonably well informed of such.

¹³ Communication with Canadian International Development Agency, Ottawa.

Figure 5

Posted and Realized Prices, f.o.b. mine, for Potassium Chloride
In United States, 1961 to 1970

Saskatchewan's Production and Price Control Program

The Government of Saskatchewan, recognizing the problems confronting the potash industry, delegated in February 1968 a four-man potash committee to provide background information on the world potash industry for use in making

policy decisions regarding the production and sale of potash from the province.¹⁴ Among its findings issued in July 1968, the committee concluded that the excess of North American and world potash production capacity would extend beyond 1975. The committee examined the pros and cons of prorationing potash production and although no specific recommendations on the matter were made, the majority of evidence put forth did not favour the concept. It was specifically stated that "most potash companies presently operating or committed to operate in Saskatchewan do not favour prorationing. They believe in settling the oversupply situation on a freely competitive basis with prices determining the outcome".¹⁵

Attitudes changed in 1969 in the wake of further profit decline and the finding that Canadian potash had been dumped on the United States market. On November 17, 1969, the Government of Saskatchewan introduced production controls and four days later price controls, both being effective January 1, 1970.¹⁶ Under the production controls, quotas were allocated using a formula that included factors of plant capacity, market requirements and inventory needs.¹⁷

¹⁴ Saskatchewan, Department of Mineral Resources, Saskatchewan Mineral Spotlight IV (Regina, February 10, 1968), 11.

¹⁵ Saskatchewan, Department of Mineral Resources, World Supply and Demand for Potash and Its Impact upon the Saskatchewan Industry (Regina, 1968), 78.

¹⁶ The production controls, known as The Potash Conservation Regulations, 1969, were promulgated under the Mineral Resources Act as Saskatchewan Regulation 287/69, O.C. 1733/69, The Saskatchewan Gazette (Regina), Nov. 21, 1969, 568-9. See also amendment O.C. 937/70, The Saskatchewan Gazette (Regina), July 17, 1970. The price control appeared as a ministerial order, O.C. 1754/69, The Saskatchewan Gazette (Regina), December 5, 1969. They are administered by a three-member board, chaired by the Deputy Minister of Mineral Resources, which initially held a public inquiry in Regina each quarter (later half-yearly) for purpose of determining demand and other related matters.

¹⁷ Canadian Minerals Yearbook, 1970, 423-5.

In essence, each mine was granted a basic quota of 40 per cent rated capacity, an inventory allowable, plus a sales allowable based largely on past sales performance and captive needs. If during any particular quarter a firm could sell more than the basic quota and sales allowable, it could obtain a supplemental licence provided each producer had already met its quota.¹⁸ The 40 per cent operating rate implied that for a 1.5 million-ton-a-year, unit production costs would be about 85 per cent higher than incurred at full capacity.¹⁹ In other words, each producer would be operating in the region where both the average and marginal cost curves slope steeply downwards; furthermore, unit costs would be significantly higher than normal long run average costs.²⁰

¹⁸ As of July 1, 1972, the method of prorating production was altered, the new quotas being allocated solely on the basis of installed productive capacities at each of the ten mines. "Potash Changes Are Proposed by Province" The Globe and Mail (Toronto, June 6, 1972), B7. The revised method of allocating production quotas prompted Central Canada Potash Co. Limited to seek a writ of mandamus against the Saskatchewan Government's control program in July 1972. Under the initial program, Central Canada Potash by virtue of its captive outlets was able to obtain quotas that gave it a 72 per cent operating rate for 1971/72 compared with an industry average of about 48 per cent; the revised formula reduced the company's operating rate for 1972/73 to 49 per cent, which is comparable to all other producers. Central Canada's writ of mandamus application was rejected by the lower court and two appeals, one to the Saskatchewan Supreme Court and the other to the Supreme Court of Canada, have also been rejected. In a second case, Central Canada Potash filed on December 11, 1972, a \$2-million claim of damages from the Minister of Mineral Resources and the Saskatchewan Government. The suit also seeks a court declaration that the control program is beyond the constitutional authority of the Saskatchewan Legislature. The outcome of this suit is being awaited. Globe and Mail press clippings, July 19, 1972, B4; December 12, 1972, B2; and February 7, 1973, B7.

¹⁹ International Minerals & Chemical Corporation, The Canadian Potash Industry, 23.

²⁰ Had 10 mines been built each to produce at a rate of 600,000 tons annually (i.e. 40 per cent of 1.5 million tons) capital expenditures and hence fixed costs would have been substantially lower.

The ministerial order on prices stipulated that a fair and reasonable price to the producer, f.o.b. mine, should be not less than 33.75¢ Cdn per unit K_2O equivalent; it was applied to all potash produced in Saskatchewan subsequent to January 1, 1970, but not to stocks, amounting to 863,545 tons K_2O equivalent, that were held over from 1969 and shipped prior to March 31, 1970. With the control measures in effect, prices rose to \$31.78 a ton K_2O equivalent in 1970 and \$36.72 a ton in 1971 (unweighted averages); the fact that 1971 prices were higher than the floor price reflected premiums obtained during peak shipping periods and from higher grades.²¹

According to various statements following the November 17th announcement, the majority of firms participating in the Saskatchewan potash industry endorsed the provincial action as a short-term measure. Among the dissidents were Noranda Mines Limited, Hudson Bay Mining and Smelting Co., Limited, and Kalium Chemicals Limited, all of whom had potash mines in Saskatchewan only. They were especially opposed to price controls and were critical of the fact that New Mexico producers would be able to operate at full capacity while the Saskatchewan mines were held to about 50 per cent. However, the Premier of Saskatchewan stated that he had support and assurances of co-operation from the potash firms and the Government of New Mexico. In the early part of 1970, the Premier toured parts of Europe and Asia and apparently met with representatives of the potash industries in an effort to gain international support for the Regulations.²²

²¹ Canadian Minerals Yearbook, 1970 and 1971 editions.

²² "Thatcher Goes to Europe in Bid for Potash Pact", The Globe and Mail (Toronto, Jan. 6, 1970), B6.

The Saskatchewan initiative, although it bore overtones of a loose international cartel, failed to achieve universal compliance on prices and output. New Mexico producers followed Saskatchewan's price leadership, at least according to their price lists, but the Europeans adopted a more moderate approach, raising prices by only \$3 to \$4 a metric ton.²³ Operating rates in New Mexico in 1970-71 remained virtually unchanged from previous years and in France output levels were maintained but sales by the French organization increased, the additional volume coming from the Congolese mine.²⁴ East and West German output and sales increased slightly in 1970-71 while the U.S.S.R. and Israel recorded in 1970 their largest annual gains in history. Spain and Italy registered lower output levels in 1970-71 than in 1969, apparently because of internal difficulties. The outcome was that Saskatchewan bore the burden of excess world capacity and output in 1970 decreased 9.5 per cent from the previous year. Production rallied in 1971 to slightly exceed the 1969 level, but this could be attributed to overall market expansion in a dynamic sense and to technical difficulties that hampered Spanish and Congolese output.²⁵

²³ Canadian Minerals Yearbook, 1970, 434.

²⁴ Minerals Yearbook, 1971. Output in New Mexico declined somewhat as a result of mine closures, but the industry continued to function at its traditional pattern of approximately 85 per cent of installed mine capacity.

²⁵ It is interesting to note that the behaviour of the world potash industry under the Saskatchewan production and price control program fits the predictions of the price leadership model of the dominant seller in an oligopoly as found in most standard economic textbooks. In effect, the Saskatchewan industry was obliged to behave as single decision-maker in both the North American and seaborne market and as such became the dominant seller. When the latter's prices were raised and output lowered thereby increasing its average and marginal costs and decreasing its market share, the small firms either maintained or boosted output.

CHAPTER 5

MARKET PERFORMANCE OF THE WORLD POTASH INDUSTRY

Chapter 1 introduced five dimensions of market performance - technical efficiency, allocative efficiency, selling costs, technological progressiveness, and conservation - that are sometimes regarded as indicators of how well the market activity of firms has contributed to the betterment of economic welfare. Let it be emphasized, however, that in contrast to market structure and behavioural analysis, performance evaluation is largely qualitative in nature. One is simply judging an industry's performance against the norm of perfect competition, which by itself may not provide a valid basis for comparison; this may be especially true for measures of technological progressiveness and conservation.¹

Technical Efficiency

Technical efficiency is influenced by two elements, the organization of production and the internal efficiency of member firms. Three criteria were cited previously for judging technical efficiency. First and most important, is the extent to which firms and plants attain optimal scales - i.e. how closely member firms approximate the lowest attainable unit costs of production in their operations. Little can be said concerning the optimal size of potash firms, but

¹ See for example C.F. Phillips, Jr., Competition in the Synthetic Rubber Industry (North Carolina, 1961), where on page 202 he states "... there are no analytical standards to measure progressiveness since innovation has not been dealt with by competitive models".
See also Anthony Scott, Natural Resources: The Economics of Conservation (Toronto, 1955), who contends that monopoly, through a restriction of output, serves the cause of resource conservation more effectively than competition. "It may even follow that when conservation policy has the higher priority, the state should actively encourage monopoly as an ally in this programme".
84.

reference to Figure 3 and Table A-1 reveals that all the Saskatchewan mines, perhaps with the exception of one, have been built to achieve the lowest unit cost of production. Evaluation of foreign producers is more difficult; judging by Table A-1, one is apt to conclude that most foreign potash mines would not be capable of achieving the lowest unit costs of production with the exception of two in New Mexico, one in Spain, the Israeli and Congolese mines, two in Germany and the bulk of those in U.S.S.R. - i.e. only 16 of 69 foreign mines or plants. However, one must recognize that internal economies of scale in a 700,000-ton-a-year plant using 14 per cent K_2O ore might match those in a 1.4 million-ton-a-year plant using 28 per cent K_2O ore; the richer deposits are in Saskatchewan, U.S.S.R. and Republic of Congo. Moreover, one must consider the fact that many foreign firms produce from shallower depths and on occasion, mine potash beds that are somewhat folded and faulted; consequently, they cannot use the continuous mining techniques employed in Saskatchewan and for this reason comparisons are weakened.

Another criterion relates to the extent to which firms and plants approach optimal degrees of vertical integration of successive manufacturing processes. Here, the world potash industry performs well. Potassium chloride is essentially fully processed as it leaves the mine site, the product simply being granulated or blended with other fertilizer materials at distribution centres scattered throughout farming communities.

The third criterion of technical efficiency relates to 'chronic' excess capacity. An earlier chapter alluded to the fact that immediately following the discovery of potash in Germany, rampant development and exploitation of the deposits lead to excess capacity towards the end of the 19th century. Although statistical data for subsequent years is lacking, the descriptive evidence pre-

sented in the appendix suggests that from the end of World War I until 1960, the industry operated at virtually full capacity. Using engineering data on productive potential in relation to output and consumption, Thomason has shown that in 1960 the world potash industry operated at 98 per cent of capacity; by 1965, the percentage had dropped to 79 and it continued to decline to the extent that by 1970, world potash consumption was only 70 per cent of installed mine capacity.² If examined in isolation, one finds that in 1970 the Saskatchewan industry operated at only 46 per cent of potential while the U.S.S.R. industry reached about 70 per cent of capacity and the French and German mines attained virtually full capacity.

To summarize, the evidence indicates that in recent years the world potash industry has not performed well in terms of technical efficiency. According to Bain, optimal efficiency in plant utilization occurs when industry can adapt to high levels of demand without price-elevating shortages, the higher levels of demand arising from such disturbances as swings in business cycles.³ The world potash industry responded to higher demand by adding new, efficient plants but as supply outpaced demand, output at some new, lower-cost mines was reduced while the higher-cost mines maintained full factor utilization. The outcome was that barely 25 per cent of the potassium chloride sold in the international seaborne market in 1970-71 was produced at lowest attainable unit costs. However, if provisions are made for transportation costs, the proportion of efficient potash sold in the seaborne market rises to about one half.

² J.C. Thomason, "Potash Markets During the Seventies", paper presented at the 74th National Western Mining Conference, Denver, Colorado, Feb. 4, 1971.

³ Bain, Industrial Organization, 382.

Allocative Efficiency

In judging allocative efficiency, it is imperative to distinguish between profits as defined by the economist and 'accounting profits' traditionally presented in business bookkeeping. The former is frequently referred to as 'economic', 'pure' or 'excess' profits and is defined as the residual of sales revenue less all incurred costs, including all contractual and imputed costs; imputed costs include the value of services of funds invested by owners and is measured by interest on owners' equity. Accounting profits differ in that they seldom, if ever, make provision for interest cost on equity.

Because marginal costs are not directly measurable, Bain has contended that the most convenient indicator of price-cost margins is the long-run average profit rate that firms earn on owners' equity.⁴ On the other hand, some economists have concluded that profits, even if properly measured, are irrelevant and misleading guides to either the existence or severity of allocative losses due to monopolistic tendencies. They argue that we face a conceptual shortcoming in that accounting profits make no provision for risk nor do they provide sufficient correction for price-level changes; further, high profit rates might be indicative of short-run disequilibrium.⁵ The difficulty in using profit rates as an indicator of allocative inefficiency is further compounded when transcending international boundaries where accounting practices differ. For

⁴ Bain, Industrial Organization, ch. 10.

⁵ See for example, J.S. McGee, In Defense of Industrial Concentration, (New York, 1971), 84; and Yale Brozen "The Antitrust Task Force Deconcentration Recommendation, Journal of Law and Economics, XIII (October, 1970), 279-292; and "Bain's Concentration and Rates of Return Revisited" Journal of Law and Economics, XIV (October, 1971), 351-370. Mining officials are quick in pointing out that their business is risky; but when applied to mining, the term generally conveys the notion of uncertainty with respect to a size and grade of an orebody. In the case of potash, although a great deal of risk capital is required to develop a deposit, subsequent risk relates to engineering and marketing problems that are not unlike manufacturing industries.

example, Servan-Schrieber stated that net profits expressed as a percentage of equity capital are in the order of 12 to 13 in the United States and barely 4 per cent in France; he also claimed that French firms fraudulently evade direct taxation by understating their profits to the extent that, in 1963, one-third of French businesses declared a deficit on their tax returns.⁶ In spite of any misgivings that some economists may have concerning profit margins, the evidence to be presented here is deemed highly relevant in judging allocative efficiency in the world potash industry. One must recognize, however, that while persistent above-average profits for member firms in an industry are almost prima facie evidence of noncompetitive performance, the existence of an average rate of return is not proof of competition.⁷

Profit data is not available for most world potash producers; in fact, only a few firms publish annual financial statements from which profit data can be extracted. The problem is especially acute for recent years as most firms have diversified their activities beyond potash mining. For example, since 1967 no North American firms can be regarded solely as potash producers; profits and losses accruing from potash mining are incorporated into consolidated balance sheets of firms whose total sales double or quadruple that attributed to potash mining. Nevertheless, data has been collected on seven of the larger corporations, four North American, one German, and the French and Israeli firms (see Table 8 and A-10 to A-16).

For the respective time-periods presented, only three companies - Potash Company of America, Mines de Potasse d'Alsace, and Dead Sea Works Ltd. -

⁶ J.J. Servan-Schrieber, The American Challenge, (New York, 1968), p. 62 and ch. 23.

⁷ G.J. Stigler, Capital and Rates of Return in Manufacturing Industries, (Princeton, 1963), 55.

Table 8
After Tax Profit Rates on Shareholder's Equity for Selected World
Potash Producers, 1939-71

	Potash Company of America	United States Potash Co.	International Minerals & Chemical Corp.	Duval Corporation	Mines de Potasse d'Alsace	Salzdetfurth Aktiengesell- schaft	Dead Sea Works Ltd.
				Percentage			
1939	13.4	44.1	0.6	..	..	..	..
1940-44	23.6	46.0	6.3	..	..	..	..
1945	26.7	34.2	7.4	..	..	..	..
1946	26.6	46.5	19.3	..	..	..	..
1947	32.3	41.0	10.5	..	..	..	..
1948	28.0	35.6	12.5	..	..	..	..
1949	26.4	29.6	12.4	..	..	..	..
1950	24.4	30.6	12.2	..	..	..	..
1951	24.8	28.8	10.8	..	..	..	..
1952	25.5	23.3	9.6	23.7	..	..	..
1953	24.3	18.1	9.1	22.9	..	..	..
1954	24.2	20.1	7.6	20.4	..	..	..
1955	23.4	18.7	7.7	18.1	17.4	..	..
1956	22.7	2.1	6.5	13.8	12.0	..	..
1957	21.9	7.9	8.0	12.7	10.0	..	..
1958	17.3	3.4	6.0	9.3	12.0	..	..
1959	18.7	8.2	6.8	8.0	2.8	..	..
1960	13.6	8.7	8.1	14.3	2.9	..	..
1961	16.4	7.7	9.3	11.8	8.5	..	..
1962	19.1	7.8	7.7	12.0	6.5	..	..
1963	17.0	8.4	8.6	11.0	1.2	12.1	..
1964	21.8	11.2	10.9	12.5	2.3	13.3	5.0
1965	21.8	10.8	12.7	15.8	9.7	14.1	5.9
1966	20.7	6.1	13.8	15.8	-1.9	12.1	4.4
1967	17.3	..	7.1	15.2	-3.3	10.0	3.6
1968	..	..	5.8	..	-29.1	10.1	-8.6
1969	..	..	1.6	..	-30.2	10.0	-15.5
1970	..	..	2.3	..	-19.7	..	-24.1
1971	..	..	6.8	..	..	..	1.2

Note: All data refers to calendar years except for PCA and IMC whose fiscal years ended on June 30th and Dead Sea Works whose fiscal years ended on March 31st of the listed year. Compiled from Tables A-10 to A-16. .. Not available or not applicable.

can be regarded as solely potash firms, as the remainder derive a significant share of their income from other sources. United States Potash Co. can also be listed as a true potash firm prior to its 1956 amalgamation with the United States Borax Company. Duval Corporation earned a larger part of its income from sulphur and copper sales. In the case of International Minerals & Chemical Corporation, although potash accounted for barely one-fifth the value of total sales for the period prior to 1967 and in subsequent years it fell to one-tenth, a close relationship between its profit rates and potash prices suggests that a much greater share of its profits were derived from potash. The German firm, Salzdettfurth Aktiengesellschaft, in the time-period presented controlled about 40 per cent of the potash sales now handled by Kali und Salz and although some revenues were derived from other activities, the former's profit rates are believed to be indicative of the West German industry.

The reader should be aware that the equity data for all North American firms is based on book entries for shareholder's equity (i.e. the par value of shares outstanding). In this regard, data for the Asian and European producers is regarded as comparable to the North American data.

Most economists would agree that the profit rates for Potash Company of America, as well as United States Potash Co. prior to 1956, are abnormally high.⁸ Likewise, with reference to Servan-Schrieber's work cited earlier, profits for Mines de Potasse d'Alsace prior to 1963 tend to be somewhat higher than the French average. Little comment is offered for the German and Israeli producers.

⁸ Bain found that the average profit rate on equity for all corporations in United States was 8.2 for 1942-6, 10.5 for 1947-52, and 6.7 for 1953-61; furthermore, for a sample of seven industries for the period 1957-61, the profit rates ranged from 4.7 for the rayon industry to 14.3 for the cigarette industry. Industrial Organization, 405-409.

Figure 6

Posted Prices for Potassium Chloride and Producer Profit Rates (on Equity)
in United States, 1922-71

Under competitive conditions, one would expect that as the industry expanded both the profit rate and price would decline. Figure 6 and Table 8 show that although profits declined for most of the time-periods covered, prices remained relatively strong until 1966 and then both prices and profits dropped sharply with the French and Israeli producers experiencing severe losses.

In general, the profit data indicates that the years 1964-6 were especially rewarding to potash firms; this time-period corresponds to both the surge in world demand for potash and in investment in Saskatchewan. Normally one expects rising demand and investment to go hand in hand, prices and profits

being the coordinating mechanism; but the type of entrant to the industry and the rapidity of investment will be influenced by past profit levels and expected rates of return. Upon examination of the North American potash industry, Phillips concluded that industry profits were set at a level that effectively impeded entry of vigorous new competitors.⁹ He postulated that at an 8 per cent return on investment existent firms expand, while at 12 per cent large conglomerate corporations enter the industry, at 16 per cent young aggressive companies enter, and at 20 per cent new firms are incorporated for the purpose of entering the industry. The present writer would accept the latter postulate but disagrees with the conclusion that low profits impeded entry. On the contrary, institutional and natural barriers to entry as discussed in chapter 3 contributed to high profit levels (at least in North America) that persisted throughout the post-war years. Furthermore, since aggregate demand for potash was price inelastic and since departures from posted prices could have been readily detected, there was little incentive for producers to cut prices or to expand output. The prospect of earning high profits must have been extremely inviting to prospective entrants, but a lack of potash deposits other than in the established mining communities prevented further expansion. Following the discovery of potash in Saskatchewan, the first attempt to mine the resource was by a non-producer and its failure temporarily discouraged firms unfamiliar to potash mining. With the exception of Kalium Chemicals Limited, the first six entrants to

⁹ G.E. Phillips, Some Economic Aspects of the North American Potash Industry (Kingston, 1967). This conclusion was based on time series data for Potash Company of America in which net income was expressed as a percentage of 'net worth', the result being that his so-called 'rate of return on investment' ranged from 2.54 in 1939 to a high of 9.9 in 1952, the average for the 1950's being about 9.5 per cent; however, the 'net worth' included valuation of ore reserves thereby giving rise to a strong downward bias for profit data. Markham listed rates of return on investment for Potash Company of America that averaged 24.2 per cent for 1936-51; this compares favourably with the data presented here in Tables 8 and A-10. The Fertilizer Industry, 95.

Saskatchewan were the experienced potash producers from New Mexico and Europe, all of whom were anxious to maintain their relative marketing positions in the rapidly expanding North American and seaborne markets. The concomitant easing of entry combined with the prospect of continued high profits surely influenced the entry in 1965-7 of three new firms to Saskatchewan. The 1960's also marked the entry of three more entries to the international scene - one each in New Mexico, Utah and Spain - plus initiation of mine construction in England.

In summary, if one accepts the competitive norm in which economic profits are zero as the datum for allocative efficiency, the potash industry has performed poorly. Since the foregoing analysis rests on accounting profits, allowance must be made ^{for} the appropriate interest rate, but even then, the evidence suggests that prior to 1967 price-cost margins have ranged from significant to enormous. Collusion had been prevalent in the pre- and post-war years; high seller concentration and fairly high barriers to entry facilitated the opportunity to collude on prices and output thereby allowing the industry to earn high profits. Eventual easing of entry and a resultant broadening structure of the selling side of the market combined with a narrowing structure of the buying side led to secret price cutting and a drop in profits. Price cutting soon became widespread and the entire price structure collapsed the result being that virtually all sellers experienced severe financial losses. Political forces then intervened, the outcome being that a competitive outcome was never realized and the industry remains in a state of disequilibrium.

Other Measures of Performance

In addition to technical and allocative efficiency, industry studies have employed a number of other indicators of market performance; these include: selling expenditures, technological progressiveness, and conservation. Although

consideration of these factors adds little analytical content to the world potash industry, brief mention will further one's understanding of the industry.

In the usual sense, selling expenditures have not been large. Shortly after the founding of the New Mexico industry, the producers formed the American Potash Institute, Inc. as a research and educational organization to promote the use of potash in agriculture; from 1936 to about 1962, its expenditures were just over US\$1.5 million.¹⁰ At the outset, its membership included European producers whereas in the post-war years the French and West German firms joined to form the International Potash Institute, headquartered in Switzerland. Subsequent to the founding of the Saskatchewan industry, the American Potash Institute was expanded and renamed the Potash Institute of North America and a sister organization established as the Potash Institute of Canada. The Institute's activities are financed by membership fees that are prorated according to sales volume; the current annual budget is about \$3/4 million.

The matter of technological progressiveness has already been alluded to and little comment is offered here apart from the fact that over the years, industry productivity improved substantially, particularly in North America. For example, Potash Company of America reported that while the index for mine prices in 1956 remained virtually unchanged from 1939, wages had risen by 230 per cent.¹¹ Much of the improved technology is attributed to the development of continuous-mining methods for conventional shaft mining and the application of solution-mining methods to potash. The continuous-miners were innovated for

¹⁰ The American Potash Institute (Information Brochure, Washington).

¹¹ Potash Company of America, Annual Report, 1957, 8. The deflated price index for all minerals in the United States rose from 100 in 1939 to 110 in 1954. O.C. Herfindahl, Mineral Economics (Washington, 1961), 24.

the Saskatchewan deposits by the first entrants to that area (i.e. the established producers) working in conjunction with mining-equipment manufacturers in the United States. As noted previously, solution-mining of potash was an innovation of Kalium Chemicals, a newcomer to the industry.

The notion of conservation takes on different meanings depending in what context the term is used and perhaps by whom. One widely favoured definition is the following: "Conservation is the use of natural resources for the greatest good of the greatest number for the longest time".¹² For some so-called 'conservationists' or 'environmentalists' the term means protection or preservation under the supervision of some administrative body, while for others it simply implies development with due consideration for future generations. A world-wide scarcity of 'economically exploitable' potash deposits alluded to previously suggests that officials should have paramount concern for future generations; for example, known reserves (at an average grade of 16 per cent K_2O) in the Carlsbad, New Mexico region contain sufficient ore for only 27 years if produced at a rate of 3 million tons annually (i.e. the average rate for most of the 1960's).¹³ In other sedimentary basins the notion of conservation takes on a slightly different dimension; in Saskatchewan, for example, one estimate places recoverable reserves at depths of less than 3,500 feet (ore grades of 25 per cent K_2O or higher) at 6.4 billion tons.¹⁴ Others have made allowances for solution mining techniques and estimated Saskatchewan reserves (grading 25 per cent K_2O or higher) in excess of 50 billion tons, an amount

¹² Gifford Pinchot, Breaking New Ground (New York, 1947), 326.

¹³ United States Position and Outlook in Potash, 18-21.

¹⁴ Saskatchewan, Department of Mineral Resources, Potash in Saskatchewan (Regina, 1965), 7.

sufficient to last 3,000 years at the world's current consumption rate.

When 'The Potash Conservation Regulations' were introduced in Saskatchewan the term was not defined; however, expressions like "proper utilization" and "protection of correlative rights of the owners of mineral rights" were used,¹⁵ the implication being that if prices were extremely low, producers might bypass lower-grade portions of their orebody and that these reserves would never be recovered. Although such reasoning is valid, difficulties arise when attempting to determine optimum recovery both in underground mining and in refining. Current practice yields a mining recovery rate of about 40 per cent (i.e. the volumetric proportion of the interval being extracted) and a mill recovery of 85 to 95 per cent. Apart from cost considerations, mine safety is a critical factor in determining recovery rates.

In conclusion, it is difficult to assert whether the industry has performed well or poorly in terms of resource conservation and utilization. There is no well defined provincial or federal policy that articulates the many parameters of resource conservation and utilization from which inferences can be drawn. Moreover, as intimated above the notion of conservation takes on different meanings for different persons, places, and political and economic ideology. Casual observation does, however, reveal several instances in Saskatchewan in which refinements in mining and processing could yield better mineral recovery and therefore improve conservation in the eyes of the geologist and engineer. Further research is needed to determine whether these refinements could constitute a part of the 'learning process' for incorporation in the production process as the industry matures or whether such refinements would comply with an economist's concept of conservation.

¹⁵ The Saskatchewan Gazette (Nov. 21, 1969), 586.

CHAPTER 6

SUMMARY AND CONCLUSIONS

Analysis of the world potash industry was undertaken with the view of investigating the degree of market power and evaluating the implications for economic welfare and public policy with respect to the disposition of mineral resources. This chapter summarizes the important aspects of the industry and market and sets forth a number of criteria that heretofore have not been given adequate consideration in formulating resource policy.

Summary

1. Geologically and geographically speaking, economically exploitable potash deposits are quite rare. Bedded subsurface deposits, which provide the source of most world potash supplies, are being exploited in Saskatchewan, Canada, Utah and New Mexico, United States, Spain, France, East and West Germany, Italy, Republic of Congo, and three regions of the U.S.S.R.; potash from sea or lake brines or beds are being recovered at five locations, only one of which (the Dead Sea in Israel) ranks as an important world supplier. The U.S.S.R. and Canada are the two largest producing nations, the latter emerging as a producer in 1962.

2. Potash is used mainly in the manufacture of commercial fertilizers for which there are no substitutes for the potassium element and demand is generally regarded as an inelastic function of an already inelastic fertilizer demand schedule. Virtually all producers enjoy the opportunity of selling in two markets - an overland market in which he competes or shares with rivals located in the same continental region, and the international seaborne market

that is accessible from all major supply sources. This study has dealt only with the North American and seaborne markets.

3. There have been high barriers to entry into the industry. Barriers stem from the sparse occurrence of exploitable deposits, technological and capital requirements to bring a newly discovered deposit into commercial production, absolute cost advantages and economies of scale, and institutional arrangements and public policy with respect to the disposition of mineral rights. On the matter of disposition rights, two policies have been used to parcel out publicly-owned potash lands to prospective entrants who would then operate within the framework of a private enterprise, market economy; United States authorities adopted a policy of discretionary controlled entry whereas in Saskatchewan permits and leases were issued more or less automatically to any firm or individual prepared to undertake the prescribed exploratory and development expenditures.

4. From a production viewpoint, Saskatchewan has a distinct cost advantage over other world sources, the advantage stemming largely from higher-grade ore, relatively flat-lying beds that permit the use of continuous-mining machines, and the attendant economies of scale inherent to large, modern equipment and plants. Saskatchewan's land-locked position and concomitant transportation costs do, however, offset much of the production-stage advantage in supplying many key North American and seaborne outlets. For example, in spite of a \$10-a-ton production cost advantage in Saskatchewan (\$14.01 a ton in Saskatchewan compared to \$24.15 in West Germany) a West German producer could in 1967 supply outlets in the British Isles and Scandinavia at slightly lower

cost; only in the Pacific Rim area did Saskatchewan potash have a cost advantage over other supply sources (see Table 5, page 37).

5. For many years the world potash industry consisted of only a few sellers and a large number of buyers. For example, in 1950 there were 7 sellers (3 New Mexico producers, 2 other producers and 2 importers) and about 770 buyers in the North American market; likewise, there were only a few sellers in the seaborne market. As the 1950's progressed, 3 new firms entered the industry in the United States and in subsequent years each of the three long-established New Mexico producers constructed mines in Saskatchewan. During the 1960's, several other firms entered the industry and by 1970 there were 20 rival sellers in the North American market and 19 in the seaborne market. The structure of the buying side of the market followed a somewhat different course with the number of buyers in North America decreasing from 770 in 1950 to an estimated 200 in 1966.

6. Traditional short-run output policies are best explained in terms of installed mine capacity. Because mine capacities were common knowledge within the industry, each firm was in a position to relate total supply to anticipated demand for the forthcoming season (i.e. year); when supply exceeded actual sales, the annual maintenance shut-down period could readily be lengthened from two to four weeks to clear inventories held over at the close of the fertilizer year.

7. During the 1920's and early 1930's, world potash trade was controlled by a French-German cartel that maintained a monopolistic pricing policy in all markets; as output from other world producers began to penetrate the cartel's traditional outlets, its monopolistic pricing policy gave way to dominant price leadership in the latter part of the 1930's. Once the North American industry

had become firmly established in the post-World War II years, it adopted the practice of posting prices f.o.b. mine; although such practices bore manifestations of behaviour resembling barometric price leadership, structural changes on both selling and buying sides progressively constrained the feasibility of seller collusion that had been especially imminent in pre- and post-war years. Except for some price weakening that accompanied a general economic slowdown in the latter half of the 1950's, potash prices remained relatively constant from 1956-63 but price-cost margins narrowed.

8. World demand for potash began to rise quite sharply after about 1963 in response to the so-called 'green revolution'. (It was in this period that several firms decided to enter the potash industry.) Supply tightened and North American prices reached a post-war high in 1965 but in the following year, the competitive effects of an ever-broadening industry structure began to unfold and sellers resorted to price cutting. By 1969, North American prices were slashed to their lowest level on record but a competitive outcome was never realized as political forces intervened, first in the United States and then in Saskatchewan, to prevent the closure of higher-cost mines. As a result of the intervention, the world industry has for the past 5 years suffered severe excess capacity, with Saskatchewan producers bearing the bulk of the burden.

9. Since January 1970, a relative balance between world supply and demand has been maintained via production and price controls instituted by the Saskatchewan government. Although world output has not declined, production in Saskatchewan has been prevented from exceeding about one half installed mine capacity and prices have risen sharply in both the North American and seaborne markets. During the first 30 months of the Saskatchewan production and price control program, each producer was more or less given an opportunity to sell as

much potash as possible, subject to a floor price and provided each rival had reached its basic allowable. Effective July 1, 1972, the control program was revised whereby each mine is granted a quota based solely on mine capacity. Although most Saskatchewan producers endorsed the control program as a short-term measure, the revised method of issuing production quotas has prompted one firm to seek court action to have the regulations declared unconstitutional. Also as of July 1, 1972, all Saskatchewan producers engaged in offshore marketing joined Canpotex Ltd., which is now responsible for handling all Saskatchewan potash sales in the seaborne market. This step effectively reduces the number of sellers in the seaborne market from 19 to 15 and places about 85 per cent of total seaborne sales under the control of six firms.

10. Judged by the competitive norm of technical and allocative efficiency, the industry has performed quite poorly. Except for World War II disruptions, the industry operated at virtually full capacity from 1920 to 1960, but in 1965 and 1970 world consumption was only 79 per cent and 70 per cent, respectively, of mine capacity. Moreover, engineering cost data indicates that a significant share of potash sold in the North American and international seaborne markets during the past 5 years has come from mines that are not capable of achieving the lowest unit costs. In fact, since political intervention in 1969-70, barely one-half the potassium chloride sold in the seaborne market has been supplied at the most efficient combination of production and transportation costs; for the North American market, the proportion of efficient potash is even lower.

11. Analysis of after tax profit rates on shareholder's equity earned by firms in the industry reveals abnormally high profit rates, particularly in the United States. Data for Potash Company of America, the only North American firm whose sole business for the years under investigation was potash, earned

profits averaging 24.9 per cent from 1940-57 and 18.3 per cent from 1958-67. The state-owned French producer, Mines de Potasse d'Alsace, declared profits averaging 7.7 per cent from 1955-65 and losses averaging -16.8 per cent from 1966-70, while one German producer, Salzdettfurth Aktiengesellschaft, earned profits averaging 11.7 per cent from 1963-69. Profits for the state-owned Israeli producer, Dead Sea Works Ltd., declined from an average of 4.7 per cent from 1964-67 to a loss of -16.1 per cent from 1968-70. The high profit rates on equity are viewed as evidence that prices far exceeded marginal costs, both in the short and long run. In all instances, the data reveals a marked decline in profits after 1965 with most firms experiencing losses; industry earnings in United States swung from a US\$9.2-million profit in 1966 (on sales of US\$116 million) to a US\$9.2-million loss in 1968.¹ Although data is scanty, indications are that slight losses were incurred in 1970 and that normal profits as defined by the economist were realized in 1971.

Conclusions and Policy Implications

Over most of its lifetime, the world potash industry has not performed in a competitive manner, prices being substantially higher than average and marginal costs. High barriers to entry protected the established producers, who, being few in number and facing many buyers in the North American market, had little or no incentive to sell at prices below a joint profit maximizing level. In the seaborne market on the other hand, the degree of seller concentration was equally high but buyers were not as numerous (relative to the North American market) and price-cost margins were narrower. Although one is tempted

¹ United States, Tariff Commission, Potassium Chloride (Muriate of Potash) from Canada, France and West Germany, (Washington, November, 1969), 8.

to conclude that behavioural differences in the two markets clearly supports Stigler's theory of oligopoly, the reader should be cautioned that the size of buyer in the seaborne market varied greatly; furthermore, had the large buyers exercised their potential bargaining power, price-cost margins may have been narrower.

Saskatchewan's easy entry policy allowed several new firms to enter the industry while at the same time the number of buyers in the North American market decreased markedly. Under the new structural conditions, sellers found it in their interests to engage in secret price cutting, which spread from the North American to seaborne markets and eventually became so widespread that prices were driven below costs as vendors attempted to rid themselves of stocks and keep their mines operating. Such behavioural responses are in accord with theoretical predictions and had political forces not intervened, the world potash industry would probably have approached a workably competitive outcome, at least in the North American and seaborne markets.

Excess profits were, however, only one of the underlying causes to the rampant build-up in world potash capacity. Several economists have recently argued that many entrepreneurs have either lacked marketing skills or failed to give marketing adequate assessment when developing new products.² The potash industry has been no exception although not necessarily because of lack of marketing skill or error in predicting world needs. Rather, management failed to recognize that effective demand could fall well short of agricultural needs -

² I.A. Litvak and C.J. Maule, "Managing the Entrepreneurial Enterprise" The Business Quarterly, (London, Ontario, Summer 1972), 42-50; and Blair Little, R.G. Cooper, and R.A. Moore, "Putting the Market into Technology to get Technology into the Market", The Business Quarterly, (London, Ontario, Summer 1972), 62-69.

i.e. demand was predicted by estimating food requirements to properly nourish world populations and then calculating the optimal method of producing food-stuffs. Needless to say, such an approach is virtuous but it remains questionable in the market-place as it derives from the humanitarian's perception of proper nourishment for the world's population. Moreover, the assumption of inelastic demand with respect to price may not have been entirely valid in less developed countries where a large proportion of potash sales are aid-sponsored.

A third aspect and perhaps the most crucial consideration underlying the current excess capacity problem stems from the fact that management failed to acknowledge political constraints inherent to international trade and assumed that market forces would prevail - i.e. that lower-cost mines would displace higher-cost mines. Even for those companies who had captive outlets abroad, this was no assurance that a sudden influx of imported potash to areas hitherto served from domestic sources would be allowed to proceed unchecked. Certainly, efficient resource allocation requires that market forces prevail, but time and time again we find ourselves settling for second best solutions.

And finally, management either lacked perfect information with respect to output potentials in eastern Europe or were skeptical that projected targets could be met. In either case, western world producers underestimated supply from the U.S.S.R.

This study has identified four criteria that did not receive adequate consideration in formulating public policy with respect to the disposition of potash mineral rights in Saskatchewan - profit rates, information on foreign supply potentials, the size of the market, and the location of market outlets. The policy implications should be obvious. Faced with the dilemma of high seller concentration and abnormally high profit rates and the discovery of

natural resources to serve export markets currently supplied from internal sources, authorities should opt for a policy of discretionary controlled entry onto publicly-owned lands. Needless to say, such a recommendation may fail to yield an optimal outcome in terms of global welfare and remains a second-best solution, but it is deemed better than the alternative - controlled output and administered prices.

In closing, perhaps a few comments on Saskatchewan's production and price control program and subsequent structural changes and events are appropriate (see footnotes on pages 26 and 75). When instigated, the production and price control program was viewed as a short-term measure to mitigate possible adverse trade and employment effects arising from excess supply and depressed prices; there were fears that permanent trade barriers would be erected against Saskatchewan potash and that some of the newly-opened mines would face closure thereby disrupting employment. The control program is, however, emerging as a long-term phenomenon perpetuating a state of disequilibrium in the industry; the instigators of the program argue that demand is price inelastic and that dynamic market expansion will eventually overtake installed mine capacity. Such reasoning overlooks the supply side of the market; long-run price support is likely to be perceived by foreign producers and prospective entrants as price stability. Should the floor price provide an opportunity to earn profits elsewhere in the world, mines will be constructed or expanded even when excess capacity prevails in Saskatchewan.

Although for reasons other than just alluded to, the long-run question for Saskatchewan's production and price control program has been brought into sharp focus with Central Canada Potash's recent damage suit in which the company is seeking a declaration that the measures are beyond the authority of the

provincial legislature. Should the courts rule in favour of the claimant, the marketing of potash in both the North American and seaborne markets is likely to return to a situation posed in 1965-66, provided other forms of governmental control are not adopted.

And finally, the writer readily admits that this study has only scratched the surface of economic research pertaining to the world potash industry and that several other questions should be examined. In particular, it would seem useful to examine the net long-term benefits (or costs) to the host country or region of having its natural resources developed by an industry structured along the lines of the potash industry (i.e. the predominance of multinational corporations), or by some other form of entrepreneurial endeavour (e.g. home-based private enterprise or public undertaking). A second area of study has already been identified; it relates to the notions of conservation and utilization as defined by the geologist, engineer and economist. The question of currency exchange rates and transportation rates also deserves further investigation vis a vis the competitive position of potash in various key world outlets.

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APPENDIX I
STATISTICAL TABLES

Table A-1
Summary of World Potash Mines, 1971

Country and Company or Operating Name	Mine and/or Plant Location	Initial Production	Annual Capacity '000 mt K ₂ O equiv.
CANADA			
International Minerals & Chemical Corporation (Canada) Limited	K-1, Esterhazy, Saskatchewan	1962	1,160
Kalium Chemicals Limited	K-2, Esterhazy, Saskatchewan	1967	950
Potash Company of America	Belle Plaine, Saskatchewan	1964	850
APM Operators Ltd.	Saskatoon, Saskatchewan	1965	415
Alwinal Potash of Canada Limited	Allan, Saskatchewan	1968	825
Duval Corporation of Canada	Lanigan, Saskatchewan	1968	545
Cominco Potash	Saskatoon, Saskatchewan	1968	665
Central Canada Potash Co. Limited	Vanscoy, Saskatchewan	1968	655
Sylvite of Canada	Viscount, Saskatchewan	1969	820
	Rocanville, Saskatchewan	1970	665
Total Canada			7,550
UNITED STATES			
American Potash & Chemical Corporation	Trona, California	1926	230
United States Potash & Chemical Co.	Carlsbad, New Mexico	1931	165
Potash Company of America	Carlsbad, New Mexico	1935	545
International Minerals & Chemical Corp.	Carlsbad, New Mexico	1940	220
Duval Corporation	Carlsbad, New Mexico	1952	315
Southwest Potash Corporation	Carlsbad, New Mexico	1952	545
National Potash Co.	Carlsbad, New Mexico	1957	320
Kermac Potash Co.	Carlsbad, New Mexico	1965	270
Texas Gulf Sulphur Company	Moab, Utah	1965	320
Kaiser Aluminum & Chemical Co.	Wendover, Utah	1938	50
Great Salt Lake Minerals and Chemical Corporation	Great Salt Lake, Utah	1970	110
Total United States			3,090

Cont'd		1800's	20
CHILE			
Cia Salitrera Anglo-Lautauco	Coya Sur, Antofagasta		
ITALY			
Industria Salti Potassici e Affini I.S.	Santa Caterina, Caltanissetta	1960	35
	San Cataldo-Palo, Caltanissetta	1960	125
	Pasquasia-Corviglia, Enna	1964	215
	Rocalmuto, Agrigento	1971	100
	Total Italy		475
SPAIN			
Minas de Potasas de Suria S.A.	Suria, Catalonia	1926	150
Union Explosives Rio Tinto S.A.	Cardona, Catalonia	1930	90
	Balsareny, Catalonia	1948	40
	Sallent, Catalonia	1932	60
Potasas de Navarra	Pamplona, Navarra	1963	600
	Total Spain		940
FRANCE			
Mines de Potasse d'Alsace S.A.	Amelie, Alsace	1911	360
	Anna-Fernand, Alsace	1914	230
	Bollwiller-Rodolphe, Alsace	1914	160
	Enisheim, Alsace	?	140
	Joseph-Else, Alsace	1914	250
	Marie-Louise, Alsace	1914	300
	Theodore, Alsace	1914	360
	Total France		1,800

Cont'd

GERMANY, WEST

Kali und Salz G.m.b.H.

Hattorf, Hessen	1910	300
Salzdettfurth, Niedersachsen	1900	300
Sigmundshall, Niedersachsen	1900-10	300
Hansa, Niedersachsen	1900-10	20
Neuhof-Ellers, Hessen	1956	175
Wintershall-Herfa-Neurode, Hessen	1903	525
Bergmannesegen-Hugo, Niedersachsen	1900-10	160
Siegfried-Giesen, Niedersachsen	1906	140
Niedersachsen-Riedel	1900-10	150
Buggingen, Baden-Wurtemberg	1915	120
Friedrichshall, Niedersachsen	1930-40	160
Ronnenberg, Niedersachsen	1905	100

Kalie Chemie A.G.

Total West Germany 2,450

GERMANY, EAST

V.E.B. Kaliwerk Stassfurt

V.E.B. Kaliwerk Bernburg

V.E.B. Kalikombinat Werra
(4 mines & 3 plants)

V.E.B. Kaliwerk Deutschland

V.E.B. Kaliwerk Heinrich Rau

V.E.B. Kaliwerk Gluckauf

V.E.B. Kaliwerk Volkenroda

V.E.B. Kaliwerk Karl Marx

V.E.B. Kaliwerk Karl Liebknecht

V.E.B. Kaliwerk Thomas Munzer

V.E.B. Kombinat Kali

Stassfurt, Halle	1860-70	30
Bartensleben, Magdeburg	1870-80	20
Bernburg, Halle	1889	50
Untereizbach-Merkers-Dorndorf, Suhl	1900-10	950
Teutschenthal, Halle	1907	35
Rossleben, Halle	1905	250
Sondershausen, Erfurt	1895	175
Muhlhausen, Erfurt	1909	80
Sollstedt, Erfurt	1905	145
Bleicherode, Erfurt	1902	175
Bischofferode, Erfurt	1915	300
Zielitz Wolmirstedt	1971	500

Total East Germany 2,710

Cont'd			
POLAND	Klodawa	1968	25
U.S.S.R.			
Ukrainian Potash Combine	Kalush, Ukraina	1920	40
	Stebnik, Ukraina	1923	40
	Dombrou, Ukraina	1967	200
Solikamsk Potash Combine # 1	Solikamsk, Perm	1932	640
Berezhniki Potash Combine # 2	Berezhniki, Perm	1933	800
	Berezhniki, Perm	1969	1,500
Soligorsk Mining and Chemical # 1	Soligorsk, Byelorussia	1963	1,050
Combine # 2	Soligorsk, Byelorussia	1965	700
	Soligorsk, Byelorussia	1969	1,400
	Total U.S.S.R.		6,370
ISRAEL			
Dead Sea Works, Ltd.	old plant, Sedom	1930-40	120
	new plant, Sedom	1964	600
	Total Israel		720
CHINA, PEOPLES' REPUBLIC			
	Lake Cha-erh ham, Tsinghai	1959	80
CONGO (BRAZZAVILLE)			
Compagnie des Potasses du Congo	Saint Paul	1969	500
	WORLD TOTAL		26,730

Source: Adapted from Canada, Department of Energy, Mines and Resources, Potash, Canada and the World, (Ottawa, 1970), Map MR5.

Table A-2

World Potash Production, 1913-44

	France	Germany	Poland	USSR	Spain	Israel	U.S.A.	Total*
('000 metric tons K ₂ O equiv.)								
1913	48	1,110	-	-	-	-	-	1,160
1914	45	903	-	-	-	-	-	950
1915	16	680	-	-	-	-	1	700
1916	28	884	-	-	-	-	9	920
1917	44	1,004	-	-	-	-	30	1,108
1918	46	1,002	-	-	-	-	50	1,100
1919	96	812	-	-	-	-	29	940
1920	194	924	1	-	-	-	44	1,160
1921	145	911	3	-	-	-	9	1,070
1922	212	1,246	9	-	-	-	11	1,480
1923	262	1,041	12	-	-	-	18	1,330
1924	272	886	16	-	-	-	21	1,200
1925	312	1,386	34	-	-	-	23	1,740
1926	367	1,090	40	-	5	-	21	1,520
1927	372	1,261	52	-	15	-	39	1,740
1928	411	1,430	65	-	20	-	54	1,980
1929	494	1,483	67	-	20	-	56	2,120
1930	506	1,381	70	-	25	-	56	2,040
1931	369	941	75	-	25	-	58	1,470
1932	326	787	81	1	50	11	56	1,310
1933	332	906	58	19	85	7	130	1,540
1934	379	1,176	56	82	120	7	131	1,950
1935	347	1,396	81	121	110	9	175	2,240
1936	369	1,441	84	169	45	12	224	2,340
1937	490	1,969	106	148	n.a.	18	258	2,990
1938	582	1,874	108	149	n.a.	29	288	3,030
1939	612	1,751	-	159	23	32	283	2,860
1940	517	1,746	-	221	88	45	344	2,960
1941	672	1,824	-	n.a.	99	51	476	3,120
1942	619	1,745	-	n.a.	85	52	616	3,120
1943	665	1,747	-	n.a.	90	47	670	3,220
1944	467	1,604	-	n.a.	102	53	757	2,980

Source: The British Sulphur Corporation, World Survey of Potash (London, 1966), 90.

* Totals not necessarily additive due to rounding and estimates.

n.a. Not Available; - Nil.

Table A-3
World Potash Production and Consumption of Potash Fertilizers, 1945-70

	France	West Germany	East Germany	USSR	Spain	Italy	Israel	U.S.A.	Canada	Total*	Consumption
					('000 metric tons K ₂ O equiv.)						
1945	130	41	200	54	109	-	47	793	-	1,370	n.a.
1946	560	293	500	85	132	-	45	845	-	2,460	n.a.
1947	629	346	700	149	149	-	62	934	-	2,970	n.a.
1948	677	538	800	194	156	-	-	1,034	-	3,400	n.a.
1949	788	749	1,050	247	149	-	-	1,015	-	4,000	n.a.
1950	896	906	1,200	312	159	-	-	1,168	-	4,640	n.a.
1951	867	1,098	1,275	341	174	-	-	1,288	-	5,040	n.a.
1952	925	1,310	1,225	376	165	-	-	1,511	-	5,510	4,480
1953	899	1,321	1,260	436	163	-	-	1,734	-	5,810	4,954
1954	1,077	1,615	1,340	539	186	-	-	1,768	-	6,530	5,336
1955	1,180	1,697	1,426	790	191	-	8	1,875	-	7,170	5,990
1956	1,324	1,655	1,440	871	227	-	27	1,970	-	7,510	6,450
1957	1,395	1,690	1,490	961	218	-	47	2,056	-	7,860	6,820
1958	1,470	1,711	1,540	1,004	238	-	64	1,948	-	7,980	7,130
1959	1,460	1,838	1,540	1,029	242	2	63	2,162	42	8,380	7,390
1960	1,580	1,978	1,598	1,084	265	25	83	2,394	-	9,010	7,900
1961	1,710	2,044	1,584	1,145	262	81	86	2,478	-	9,390	8,200
1962	1,722	1,938	1,648	1,330	235	106	87	2,224	136	9,430	8,500
1963	1,722	1,948	1,845	1,530	260	123	113	2,598	569	10,750	8,670
1964	1,807	2,201	1,857	1,900	293	152	256	2,628	779	11,900	9,280
1965	1,888	2,385	1,926	2,368	364	169	293	2,849	1,470	13,732	10,010
1966	1,782	2,291	2,006	2,626	418	182	314	3,012	1,820	14,471	10,980
1967	1,818	2,131	2,206	2,868	507	163	300	2,993	2,340	15,346	12,180
1968	1,719	2,220	2,293	3,120	543	174	366	2,469	2,800	15,724	12,981
1969	1,794	2,283	2,346	3,244	551	175	363	2,544	3,400	16,840	13,955
1970	1,765	2,306	2,419	4,087	521	139	546	2,476	3,173	17,655	14,637

Sources: The British Sulphur Corporation, World Survey of Potash (London, 1966), 91-2; Department of Energy, Mines and Resources, Canadian Minerals Yearbook, 1970; United Nations Food and Agricultural Organization, Annual Review of Fertilizers (Rome) various editions.

* Totals not necessarily additive due to rounding and estimates to include others. - Nil.

Table A-4
World Potassium Chloride Exports, 1969*

Importing Countries	Canada	U.S.A.	France	Exporting Countries				Spain	Israel
				W. Germ.	E. Germ.	USSR			
				('000 metric tons K ₂ O equiv.)					
North America									
Canada	-	.5	-	2.8	-	-	-	-	-
United States	2,058.7	-	4.8	35.9	-	-	-	-	25.5
Mexico, Central & S. America									
Mexico	-	21.6	-	6.5	-	-	-	2.9	-
Cuba	-	-	-	39.7	80.0	34.0	-	-	-
Brazil	21.8	73.5	14.1	20.9	16.6	-	-	-	35.2
Columbia	6.8	10.3	-	-	-	-	-	20.1	-
Others	-	26.1	-	17.4	-	-	-	12.7	6.4
Western Europe									
Austria & Switzerland	-	-	47.2	37.3	62.9	19.0	-	1.5	226.0
Belgium - Luxembourg	-	-	94.9	133.9	44.5	76.0	-	3.7	-
Netherlands	87.2	6.5	51.8	47.6	33.0	14.0	-	2.4	-
France, W. Germ. & Italy	-	-	27.6	12.6	-	20.0	-	23.3	-
Scandinavia & Finland	50.0	5.5	47.8	126.0	50.0	52.0	-	52.0	-
Britain	50.0	-	58.3	48.2	135.3	43.0	-	34.2	-
Ireland	23.0	12.0	-	28.4	-	-	-	18.8	-
Others	-	-	-	-	-	-	-	18.2	-
Eastern Europe									
Czechoslovakia	-	-	-	-	417.8	55.0	-	-	-
Hungary	-	-	-	-	77.9	110.0	-	-	-
Poland	-	-	93.0	154.7	452.2	24.0	-	113.9	-
Others	-	-	-	-	-	75.0	-	2.9	-
Asia									
India	16.3	-	-	-	58.6	18.0	-	-	-
Japan	332.0	182.7	25.1	49.0	-	113.0	-	-	61.2
Korea, South	56.6	43.2	-	-	-	-	-	-	-
Others	39.1	56.0	17.9	20.3	-	-	-	1.8	39.4
Africa									
Republic of S. Africa	18.6	.3	9.6	39.9	-	-	-	18.7	16.2
Others	-	-	-	3.4	-	-	-	16.4	-
Oceania									
Australia	30.0	48.2	-	.4	-	-	-	-	-
New Zealand	63.8	34.5	-	-	-	-	-	-	-
Total†	2,903.0	565.0	583.4	826.9	1,656.0	698.0	342.3	410.0	-

Sources: United States, Department of the Interior, Minerals Yearbook, 1970 (Washington, 1971);
Compagnie Française d'Éditions, Annales des Mines, (Paris, July-August 1970);
British Sulphur Corporation, Phosphorus & Potassium, (London, various issues); and personal correspondence.

* Excludes 30,000 metric tons from Republic of Congo.

- Nil or negligible; .. not available or undetermined.

† The columns are not additive because many small export shipments are not identified in official statistics.

Table A-5
World Potassium Chloride Exports, 1970*

Importing Countries	Exporting Countries							
	Canada	U.S.A.	France	W. Germ.	E. Germ.	USSR	Spain	Israel
('000 metric tons K ₂ O equiv.)								
North America								
Canada	-	12.7	-	-	-	-	6.7	40.5
United States	2,230.7	-	-	-	-	-	-	-
Mexico, Central & S. America								
Mexico	-	19.8	-	4.4	100.0	32.0	-	59.0
Cuba	-	46.6	-	76.2	40.2	-	7.2	-
Brazil	-	31.7	31.9	-	-	-	5.9	-
Colombia	-	25.8	-	-	-	-	11.2	27.4
Others	-	-	-	14.6	-	-	-	230.9
Western Europe								
Austria & Switzerland	2.4	-	58.0	26.9	75.5	26.0	-	-
Belgium - Luxembourg	4.6	-	78.2	134.0	31.6	103.0	4.6	-
Netherlands	6.9	-	43.4	53.0	33.3	21.0	5.2	-
France, W. Germ. & Italy	17.5	-	29.4	13.4	-	19.0	14.4	-
Scandinavia & Finland	6.8	4.7	24.6	181.9	70.6	42.0	68.4	-
Britain	23.6	-	27.4	37.6	182.6	50.0	53.9	-
Ireland	8.4	-	-	36.6	-	-	14.7	-
Others	-	-	-	-	-	-	23.3	-
Eastern Europe								
Czechoslovakia	-	-	-	-	434.1	64.0	-	-
Hungary	-	-	-	1	104.4	152.0	-	-
Poland	-	-	-	33.7	447.3	554.0	54.5	-
Others	-	-	-	4.7	-	84.0	2.6	-
Asia								
India	74.1	-	11.8	-	11.8	3.0	-	-
Japan	318.6	109.2	29.5	50.1	-	118.0	-	77.8
Korea, South	33.1	7.8	-	-	-	-	-	-
Others	53.5	65.3	17.7	33.2	-	-	2.5	46.9
Africa								
Republic of S. Africa	1.8	-	19.2	34.2	-	-	2.4	21.5
Others	-	-	-	1.7	-	-	11.1	-
Oceania								
Australia	12.4	43.6	-	7.4	-	-	-	-
New Zealand	56.0	36.4	-	-	-	-	-	-
Total†	2,877.0	435.0	481.0	774.1	1,739.0	1,318.0	288.4	504.0

Sources: See table A-4 for sources (1971 editions).

* Excludes 121,000 metric tons from Republic of Congo.

- Nil or negligible; .. not available or undetermined.

† The columns are not additive because many small export shipments are not identified in official statistics.

Table A-6

Canada, Potash Exports by Destination, 1962-70

	1962	1963	1964	1965	1966	1967	1968	1969	1970
('000 short tons K ₂ O equiv.)									
United States	47	340	513	920	1,246	1,407	1,964	2,270	2,459.2
Offshore									
Japan	8	140	210	300	340	261	347	366	351.2
Netherlands*	-	-	-	-	130	215	303	233	7.6
Australia	-	-	-	-	-	3	8	27	13.7
Belgium	-	-	-	-	-	-	-	-	5.1
Brazil	-	-	-	-	-	5	27	24	-
England	-	-	-	-	..	..	..	..	26.0
Germany, W.	-	-	-	-	-	-	-	-	6.7
India	-	-	-	..	..	64	20	18	81.7
Ireland	-	-	-	-	..	..	..	..	9.3
Italy	-	-	-	-	-	-	16	-	12.7
Korea	-	-	-	-	-	32	29	62	36.5
Malaysia-Sing.	-	-	-	-	-	-	15	16	16.0
New Zealand	-	-	10	40	84	61	51	70	61.8
Pakistan	-	-	-	-	-	-	-	21	15.9
Philippines	-	-	-	-	-	8	9	6	12.5
S. Africa Rep.	-	-	-	-	-	14	8	21	1.9
Sweden	-	-	-	-	..	..	..	..	7.5
Switzerland	-	-	-	-	-	-	-	-	2.7
Taiwan	-	-	25	35	..	3	19	-	10.1
Vietnam, S.	-	-	-	-	-	-	-	-	4.3
Undetermined	-	-	-	25	60	100	9	66	29.1
Total offshore	8	140	245	400	614	766	861	930	712.3
Grand Total	55	480	758	1,320	1,860	2,173	2,825	3,200	3,171.5

Sources: For 1970, Saskatchewan, Department of Mineral Resources, Monthly Potash Report (Regina, 1970). For 1962-69, are estimates based on data compiled by the National Harbors Board; Statistics Canada, Trade of Canada - Exports by Commodity, (Ottawa, various issues); and United States, Department of the Interior, Minerals Yearbook, (Washington, various issues).

- Nil or negligible; .. not available or undetermined.

* Most of the exports to Netherlands for 1966-9 were transhipped to England, Ireland and other west European markets.

Table A-7
International Seaborne Freight Rates for Potash, May 1967

Destination and Ports or Import	Origin of Potash and Ports of Export										
	Saskatchewan Vancouver	New Mexico		W. Germany		France		Spain		Israel	
		Houston	Long Beach	Hamburg & Bremen	Antwerp Belgium	Pasajes Barcelona	Asdod Eilat	Cdn \$ per short ton product			
North, S. & C. America											
U.S. Atlantic ports	6.24	3.45	..	4.03	3.79	3.45	3.21	4.17	..		
Brazil, Santos	9.74	8.69	9.46	5.99	5.76	5.43	5.18	6.15	..		
Columbia, Cartagena	5.99	5.57	5.70	5.04	4.81	4.46	4.22	5.18	..		
Cuba, Havana	..	..	..	7.92	7.68	7.34	7.11	8.06	..		
Europe											
Sweden, Landskrona	7.99	6.48	..	2.45	2.49	3.12	3.60	4.81	..		
Denmark, Fredericia	7.85	6.43	..	2.30	2.35	3.07	3.55	4.75	..		
Britain, Inningham	7.99	6.72	..	2.74	2.49	3.36	3.84	5.04	..		
Ireland, Dublin	8.86	6.82	..	3.60	3.36	3.45	3.93	5.14	..		
Netherlands, Rotterdam	5.50	5.76	..	1.92	1.34	2.40	2.88	4.09	..		
Poland, Szczecin	8.62	6.48	..	2.40	2.55	3.12	3.60	4.81	..		
Yugoslavia, Rijeka	9.41	9.17	6.86	4.65	4.42	3.41	2.59	3.07	..		
Asia & Africa											
India, west coast	12.24	12.72	12.48	10.32	10.08	9.84	9.36	..	7.01		
India, east coast	11.90	13.05	12.15	10.65	10.42	10.13	9.64	..	7.34		
Taiwan, Chilung	8.49	12.09	8.74	11.28	11.04	10.80	10.32	..	7.97		
Japan, Yokokama	7.44	11.04	7.66	11.28	11.04	10.71	10.22	..	7.87		
Rep. of South Africa, Capetown	11.23	11.04	10.99	6.91	6.72	6.72	6.24	7.11	5.95		
Oceania											
Australia, Sydney	8.49	10.08	8.16	11.52	11.28	10.94	10.46	..	8.16		
New Zealand, Auckland	8.98	10.56	8.64	11.99	11.76	11.43	10.94	..	8.64		

Sources: Compiled from a 1965 study on ocean rates for the Potash Export Association and adjusted to May 1967 using "Index for Fertilizers", Daily Freight Register (London, 1970); The Vancouver to Rotterdam rate is based on tramp charter rates from the Daily Freight Register; other rates to northwestern Europe are a summation of the Vancouver-Rotterdam rate and the entries from Antwerp.

Note: These rates apply for the period prior to the closure of the Suez Canal. .. Not applicable.

Potassium Chloride Prices in the United States, 1922-70

			<u>fob Carlsbad, New Mexico</u> *	
Year	cif Atlantic and Gulf Ports	Year	Posted	Realized
(US \$ per unit K ₂ O equiv.)				
1922	\$ 0.700	1941-46	\$ 0.423	
1923	0.640	1947	0.375	\$ 0.318
1924	0.620	1948	0.375	0.301
1925	0.620	1949	0.375	0.300
1926	0.599	1950	0.375	0.346
1927	0.620	1951	0.420	0.357
1928	0.669	1952	0.420	0.372
1929	0.689	1953	0.430	0.374
1930	0.703	1954	0.430	0.372
1931	0.703	1955	0.430	0.378
1932	0.703	1956	0.380	0.377
1933	0.703	1957	0.380	0.371
1934	0.703	1958	0.360	0.349
1935	0.396	1959	0.350	0.340
1936	0.450	1960	0.350	0.339
1937	0.500	1961	0.385	0.383
1938	0.535	1962	0.415	0.387
1939	0.535	1963	0.415	0.382
1940	0.535	1964	0.415	0.394
1941-46	0.535	1965	0.445	0.413
1947	0.535	1966	0.445	0.370
1948	0.535	1967	0.440	0.319
1949	0.535	1968	0.330	0.279
		1969	0.250	0.257
		1970	0.370	0.352

Sources: J.W. Markham, The Fertilizer Industry (Nashville, 1966) 94;
 United States, Department of the Interior, Minerals Yearbook
 (Washington, 1947 to 1970 editions).

* All prices are for material grading 60 per cent K₂O equivalent; posted prices are for granular grade from 1958 to 1966 and coarse grade 1967 to 1970 and cover the peak shipping months of February to May; realized prices represent an unweighted average for all grades during the entire year.

Table A-9
Potash Fertilizer Prices Paid by Farmers in Selected Countries, 1958/59 to 1968/69*

	1958/59	1959/60	1960/61	1961/62	1962/63	1963/64	1964/65	1965/66	1966/67	1967/68	1968/69
	(US \$ per 100 kilogram of K ₂ O equiv.)										
North America											
Canada	-	-	12.9	12.2	-	10.7	11.9	10.4	10.0	-	-
United States	9.4	9.3	9.4	9.5	9.8	9.9	10.7	10.9	10.7	9.8	8.8
Europe											
Belgium	8.3	8.3	7.7	8.3	8.3	8.2	8.2	8.7	8.4	8.1	8.0
Britain	10.1	10.0	10.0	10.5	10.5	10.3	11.3	11.0	10.4	9.1	-
Denmark	-	8.0	8.0	7.2	7.7	7.5	7.7	7.8	7.8	6.9	7.3
France	8.9	8.1	8.3	7.5	7.7	8.2	9.1	9.1	9.1	9.3	-
Germany, West	5.8	6.5	6.7	7.0	7.1	7.9	8.0	8.0	8.0	8.0	8.4
Netherlands	8.4	8.9	8.3	8.8	8.9	8.8	9.2	9.4	9.4	9.3	9.2
Norway	8.7	8.2	8.2	8.8	9.5	9.7	-	-	-	-	-
Poland	-	5.0	-	9.2	9.2	9.2	9.2	9.2	9.2	9.2	-
Spain	-	5.0	5.6	6.1	6.5	7.4	7.4	7.9	8.0	7.3	-
Sweden	9.2	9.1	9.1	9.5	9.7	9.6	9.9	10.4	10.1	10.2	10.3
Asia and Oceania											
Australia	12.8	11.6	11.0	11.4	11.5	11.3	11.3	11.5	11.6	11.6	11.6
India	-	13.9	13.0	13.0	10.1	10.1	10.5	10.3	7.4	-	-
Japan	9.7	9.2	9.2	9.7	9.7	9.7	9.7	10.2	10.0	9.7	9.7
Taiwan	13.4	-	12.8	12.9	12.5	12.5	12.5	12.5	12.5	12.5	12.5

Source: United Nations. Food and Agriculture Organization, Fertilizers, an Annual Review of World Production, Consumption, Trade and Prices (Rome, various editions).

* Prices are those paid by farmers at the farm gate or nearest railway station, in bags, except France (from 1961/62 to 1963/64) and Netherlands (1958/59) which are in bulk; entries for Poland are for the calendar year referring to the last of the years listed. Subsidies have been deducted except for Denmark and West Germany, which for the former was 10 per cent and the latter ranged from 20 per cent in 1958/59 to 10 per cent in 1962/63.

- Not available

Summary of Shareholder's Equity and Profits for
Potash Company of America,
Years Ended June 30, 1939-67

Years	Shareholder's Equity*	Profit [†]		Profit to Equity	
		Before Taxes	After Taxes	Before Taxes	After Taxes
		'000 US dollars		per cent	
1939	4,117	635	552	15.4	13.4
1940	4,654	1,302	1,066	28.0	23.0
1941	5,279	1,777	1,310	33.7	24.8
1942	5,720	1,956	1,400	34.2	24.5
1943	5,831	1,621	1,208	27.8	20.7
1944	6,317	2,116	1,585	33.5	25.1
1945	6,815	2,384	1,818	35.0	26.7
1946	7,601	2,704	2,022	35.6	26.6
1947	7,091	3,073	2,293	43.3	32.3
1948	9,256	3,473	2,590	37.5	28.0
1949	10,017	3,407	2,642	34.0	26.4
1950	10,380	3,297	2,533	31.8	24.4
1951	10,916	3,705	2,707	34.0	24.8
1952	11,296	3,977	2,877	35.2	25.5
1953	11,629	4,101	2,825	35.3	24.3
1954	12,045	4,365	2,909	36.2	24.2
1955	12,466	4,179	2,914	33.5	23.4
1956	12,894	4,129	2,924	32.0	22.7
1957	13,313	4,112	2,915	30.9	21.9
1958	13,640	3,598	2,357	26.4	17.3
1959	13,689	3,891	2,561	28.4	18.7
1960	15,174	3,130	2,058	20.6	13.6
1961	17,062	4,049	2,794	23.7	16.4
1962	19,491	5,645	3,723	29.0	19.1
1963	20,677	5,137	3,506	24.8	17.0
1964	22,589	7,599	4,918	33.6	21.8
1965	24,529	8,343	5,350	34.0	21.8
1966	28,060	8,705	5,800	31.0	20.7
1967	30,887	7,139	5,347	23.1	17.3

PCA became a division of Ideal Basic Industries Inc., Dec. 31, 1967

Sources: Potash Company of America, Annual Reports (Denver);
John Moody, Moody's Industrial Manual (New York).

* Excludes valuation of potash ore reserves in New Mexico, which from 1947-66 were valued at \$17.6 million.

† Excludes expenses from Canadian operation while on standby basis 1960-65.

Summary of Shareholder's Equity and Profits for
United States Potash Company,
Years Ended December 31, 1939-66*

Years	Shareholder's Equity	Profit		Profit to Equity	
		Before Taxes	After Taxes	Before Taxes	After Taxes
		'000 US dollars		per cent	
1939	3,253	1,566	1,433	48.1	44.1
1940	3,661	1,882	1,643	51.4	44.9
1941	3,666	2,220	1,774	60.6	48.4
1942	3,372	1,976	1,515	58.6	44.9
1943	3,947	2,501	1,926	63.4	48.8
1944	4,558	2,571	1,958	56.4	43.0
1945	4,811	2,040	1,645	42.4	34.2
1946	5,895	3,688	2,744	62.6	46.5
1947	7,149	3,873	2,933	54.2	41.0
1948	8,324	3,900	2,960	46.9	35.6
1949	9,293	3,628	2,754	39.0	29.6
1950	10,742	4,355	3,287	40.5	30.6
1951	12,139	4,912	3,497	40.5	28.8
1952	13,081	4,127	3,042	31.5	23.3
1953	13,658	3,118	2,467	22.8	18.1
1954	14,458	3,932	2,900	27.2	20.1
1955	15,206	3,916	2,848	25.8	18.7
1956	66,800	1,872	1,372	2.8	2.1
1957	69,419	7,121	5,471	10.3	7.9
1958	68,709	2,620	2,370	3.8	3.4
1959	74,016	8,123	6,048	11.0	8.2
1960	79,414	9,270	6,920	11.7	8.7
1961	83,046	8,637	6,387	10.4	7.7
1962	84,393	8,935	6,585	10.6	7.8
1963	87,651	9,956	7,356	11.4	8.4
1964	79,392	12,038	8,913	15.2	11.2
1965	83,814	10,709	9,054	12.8	10.8
1966	79,392	9,603	4,933	12.0	6.1

Source: John Moody, Moody's Industrial Manual, (New York).

* From 1939-55, United States Potash Company; from 1955 to present, United States Borax & Chemical Corporation.

Summary of Shareholder's Equity and Profits
for International Minerals & Chemical Corporation,
Years Ended June 30, 1939-71

Year	Shareholder's Equity	Profit*		Profit to Equity	
		Before Taxes	After Taxes	Before Taxes	After Taxes
		'000 US dollars		per cent	
1939	21,570	86	126 [†]	0.4	0.6
1940	21,584	14	14	0.1	0.1
1941	31,859	413	402	1.3	1.3
1942	13,198	2,602	1,786	19.7	13.5
1943	24,251	3,311	2,076	13.7	8.7
1944	25,977	2,685	2,016	10.3	7.8
1945	27,580	2,785	2,038	10.1	7.4
1946	15,163	7,496	2,926	49.4	19.3
1947	36,605	5,852	3,826	16.0	10.5
1948	40,022	6,741	5,016	16.8	12.5
1949	43,566	7,496	5,421	17.2	12.4
1950	47,234	7,902	5,777	16.7	12.2
1951	60,343	9,639	6,514	16.0	10.8
1952	69,055	9,678	6,653	14.0	9.6
1953	77,471	9,880	7,030	12.8	9.1
1954	79,471	7,114	6,044	9.0	7.6
1955	81,955	7,397	6,322	9.0	7.7
1956	83,511	6,395	5,402	7.7	6.5
1957	87,053	8,536	6,961	9.8	8.0
1958	88,194	6,303	5,273	7.1	6.0
1959	90,593	7,389	6,189	8.2	6.8
1960	94,922	9,760	7,644	10.3	8.1
1961	105,953	11,766	9,806	11.1	9.3
1962	116,317	10,332	8,932	8.9	7.7
1963	119,515	10,395	10,295	8.7	8.6
1964	144,747	17,927	15,777	12.4	10.9
1965	160,108	23,543	20,343	14.7	12.7
1966	177,827	30,327	24,627	17.1	13.8
1967	207,631	19,705	14,655	9.5	7.1
1968	224,048	14,511	13,086 [†]	6.5	5.8
1969	197,705	306	3,096 [†]	0.2	1.6
1970	200,090	6,724	4,503	3.4	2.3
1971	213,979	20,049	14,529	9.4	6.8

Sources: International Minerals & Chemical Corporation Annual Report (Skokie, Illinois); John Moody, Moody's Industrial Manual, (New York).

* Excludes special and extraordinary charges and credits.

† Includes an income tax credit.

Table A-13

Summary of Shareholder's Equity and Profits
For Duval Corporation,
Years Ended December 31, 1939-67*

Year	Shareholder's Equity	Profit		Profit to Equity	
		Before Taxes	After Taxes	Before Taxes	After Taxes
	'000 US dollars			per cent	
1939	2,539	998	628	39.3	24.7
1940	2,795	955	579	34.2	20.7
1941	2,845	859	709	30.2	24.9
1942	2,640	953	795	36.1	30.1
1943	2,593	834	703	32.7	27.1
1944	2,539	830	696	32.7	27.4
1945	2,700	938	786	34.7	29.1
1946	2,962	1,217	1,012	41.1	34.2
1947	2,329	1,372	1,073	58.9	46.1
1948	3,468	945	764	27.2	22.0
1949	3,750	855	781	22.8	20.8
1950	5,304	1,293	1,007	24.4	19.0
1951	9,626	1,337	1,187	13.9	12.3
1952	11,323	3,839	2,681	33.9	23.7
1953	13,274	4,261	3,045	32.1	22.9
1954	15,090	4,419	3,071	29.3	20.4
1955	16,930	4,183	3,063	24.7	18.1
1956	18,160	3,306	2,507	18.2	13.8
1957	24,519	4,051	3,110	16.5	12.7
1958	28,483	2,669	2,645	9.4	9.3
1959	29,206	3,019	2,349	10.3	8.0
1960	32,176	5,841	4,595	18.2	14.3
1961	34,655	5,700	4,104	16.4	11.8
1962	37,298	5,880	4,463	15.8	12.0
1963	39,842	5,980	4,364	15.0	11.0
1964	43,463	6,908	5,442	15.9	12.5
1965	60,956	12,547	9,604	20.6	15.8
1966	69,822	12,993	11,036	18.6	15.8
1967	79,836	16,412	12,183	20.6	15.2

Duval was taken over by Pennzoil United, Inc. in 1968

Sources: Duval Corporation Annual Reports (Houston);
John Moody, Moody's Industrial Manual (New York).

* From 1939 to February 13, 1950; Duval Texas Sulphur Co.;
From February 13, 1950 to March 15, 1963, Duval Sulphur & Potash Co.;
From March 15, 1963, Duval Corporation.
Duval entered the North American potash industry in 1952.'

Table A-14
 Summary of Shareholders' Equity and Profits for
 Mines de Potasse d'Alsace, S.A., 1955-70

Year	Shareholder's Equity*	After Tax Operating† Profit	Total§ Profit	Operating Profit to Equity
	'000 francs			percent
1955	22,570,990	3,892,126	3,923,347	17.4
1956	22,570,990	2,650,930	2,715,794	12.0
1957	22,736,321	1,380,414	2,267,076	10.0
1958	24,147,234	1,866,649	2,908,669	12.0
1959	25,830,223	426,769	713,535	2.8
1960	309,079 ^{ca}	415	8,964	2.9
1961	306,377	22,247	26,102	8.5
1962	321,893	7,694	20,815	6.5
1963	322,077	143	3,811	1.2
1964	335,970	4,883	7,726	2.3
1965	346,362	27,418	33,726	9.7
1966	358,865	-4,561	-6,810	-1.9
1967	382,681	-3,980	-12,729	-3.3
1968	195,169	-51,529	-56,834	-29.1
1969	224,769	-61,059	-70,201	-30.2
1970	224,769	-41,680	-44,370	-19.7

Source: Mines de Potasse d'Alsace, Exercice (Mulhouse).

* "Capital propre et réserves".

† "Profits et pertes de l'exercice (résultat d'exploration)", after taxes.

§ "Includes "Profits et pertes sur exercice antérieur et exceptionnels", after taxes.

Table A-15

Summary of Stock Capital and Profit
For Salzdetfurth Aktiengesellschaft (Hannover), 1963-69

Year	Stock Capital	Profit After Taxes	Profit to Stock Capital
	'000 Marks		percent
1963	125,000	15,106	12.1
1964	125,000	16,622	13.3
1965	125,000	17,569	14.1
1966	125,000	15,151	12.1
1967	125,000	12,565	10.0
1968	125,000	12,602	10.1
1969	125,000	12,586	10.0

Source: Salzdetfurth Aktiengesellschaft, Annual Reports (Hannover).

Table A-16

Summary of Share Capital and Profits for Dead Sea Works Ltd.,
Years Ended March 31, 1964-71

	Share Capital	Operating Profits*	Profit for Year	Profit to Share Capital
	'000 Israeli Pounds			per cent
1964	57,600	3,539	2,890	5.0
1965	57,600	6,506	3,390	5.9
1966	57,600	8,464	2,511	4.4
1967	57,600	8,869	2,065	3.6
1968	57,600	5,271	-4,929	-8.6
1969	65,350	-8,574	-10,140	-15.5
1970	78,100	-13,874	-18,162	-24.1
1971	90,940	5,707	1,056	1.2

Source: Dead Sea Works Ltd. Report of the Directors (Beer-Sheva, Israel).

* Note: Operating profits exclude taxes; operating profit for 1962-67 refer to gross profits less management fees and general expenses.

APPENDIX II

CHRONOLOGICAL HISTORY OF THE WORLD POTASH INDUSTRY

Prior to World War II

The world potash industry was founded in 1861 at Strassfurt, Germany, and the first exports were shipped four years later. Potash mining mushroomed throughout that part of Germany and in fact, it got out of hand so a number of larger companies formed a syndicate to control production, trade and prices.¹ Nevertheless, many new mines continued to open and by the early 1900's the syndicate began to collapse. Competition and price cutting became so severe by 1910 that the central government deemed it necessary to take over the industry and allot quotas on the basis of the number of mining shafts. The new system proved unsatisfactory as any company that wanted a larger quota simply sunk another shaft, and a new round of expansion occurred. By the spring of 1913, 127 mines were operating and another 132 shafts were being driven.² Then as war broke out and exports were curtailed, the industry declined sharply.

In the meantime, a number of mines had also been developed in the Alsace-Lorraine area of France but they were seized by the German Government in 1914.³ Immediately after the war, these same mines were sequestered by the French government, who formed Mines Domaniales de Potasse d'Alsace to operate

¹ G.S. Rice and J.A. Davis, Potash Mining in Germany and France (Washington, 1927), 19.

² Rice and Davis, 21.

³ Rice and Davis, 23.

them and Societe Commerciale des Potasses d'Alsace to market the output along with that from some privately-owned mines.

Prior to World War I, the German syndicate had a virtual monopoly over international potash trade and was in a position to dictate the terms of trade for North American supplies. In 1913, over one million tons of potash products were imported into the United States from Germany; when German exports were curtailed in 1915, North American supplies were cut off and potash prices along the eastern seaboard jumped from the 1914 level of US\$45.58 a ton of potassium chloride to an unprecedented US\$483.63 a ton in 1916 and remained above US\$200.00 a ton until the end of 1919.⁴ The high prices and shortage resulted in a flurry of potash exploration activity in Canada and the United States and the installation of numerous byproduct recovery plants - for example, flue dust from cement plants and municipal incinerators - and the restoration of early pioneer asheries. North American potash output increased substantially, but only one operation, American Trona Corporation later known as American Potash and Chemical Corporation, based at Searles Lake, California, survived the precipitous price declines that followed the resumption of imports in the 1920's.

Competition between the French and German potash industries became vigorous in the immediate post-war years with North American eastern seaboard prices being driven from US\$5.65 to US\$0.62 a unit K_2O equivalent (a unit being 20 lbs) between 1919 and 1923.⁵ The Germans were deeply concerned about weakening world prices so initiated negotiations with the French whereby, under an agreement reached in 1924 and revised in 1926, arrangements were made to

⁴ J.W. Markham, The Fertilizer Industry (Nashville, 1958), 85-86.

⁵ Markham, 86.

share foreign potash markets on the basis of 70 per cent for Germany and 30 per cent for France.⁶ Joint sales offices of Deutsches Kalisyndikat Gesellschaft and Societe Commerciale des Potasse d'Alsace were set up in the principal importing countries and uniform prices were maintained. A joint sales office was established in New York and was known as the Potash Importing Company. Its operations apparently contravened the United States Sherman Act and in 1927 the French and Germans were charged with conspiring to restrain trade in the sale of potash in United States.⁷ The outcome of such charges was that the French and Germans formally established in 1927 a cartel incorporated under the laws of the Netherlands, known as Naamlooze Vennootchap Potash (Kali) Export Maatschappij, hereafter referred to as N.V. Potash Export My; it remained the chief foreign supplier of potash for the United States until the outbreak of war in 1939.⁸ A branch sales office of the cartel was established in Montreal, Canada in 1928, and in 1932 it was incorporated as Potash Company of Canada Limited.

In the meantime, potash deposits were being developed and brought into production in Poland (1920), Spain (1926), United States (Carlsbad, New Mexico - 1931), Palestine (1932) and Russia (1932). Although production from the new sources remained comparatively small during early years and some arrangements were apparently made with the cartel for market allocations, pressure gradually increased from Russian and Spanish producers and in 1934, potash prices at United States ports were slashed by 50 per cent. Prices in the United States were reduced from US\$0.70 to US\$0.35 a unit K₂O equivalent from

⁶ Canada, Report of Commissioner, Combines Investigation Act (Ottawa, 1945), 3.
⁷ Markham, 86-87.

⁸ S.P. Hayes, Jr., "Potash Prices and Competition", Quarterly Journal of Economics, LVII (November, 1942), 44.

April to May 1934 and kept below US\$0.40 for the following 15 months.⁹ In the latter half of 1934, the Spanish producers joined the cartel and, as a result of apparent acceptance of price leadership by the Russians, North American prices gradually moved upward.

The rise of a potash industry in New Mexico exerted further pressure on the French-German cartel. Subsurface potash deposits had been discovered near Carlsbad in 1925 on public lands; issuance of a number of permits led to the eventual establishment of two potash mines, one in 1931 by United States Potash Company and the other in 1934 by Potash Company of America.¹⁰ Output from the two mines expanded slowly, accounting for only one-fifth of the United States market from 1934-36, but the potential from these mines was apparently considered adequate to prompt the Secretary of the Interior to restrain further expansion until 1940 when a third mine was brought into production by Union Potash Company.¹¹

In 1938, the United States potash market (including domestic and export sales), which amounted to about 500,000 tons K_2O equivalent, was shared 37 per cent by N.V. Potash Export My., 8 per cent by other importers, 19 per cent by United States Potash Company, 14 per cent by Potash Company of America and 22 per cent by the Searles Lake and other minor domestic producers.¹² Canada's potash fertilizer market, amounting to about 22,000 tons K_2O equivalent annually in 1937 and 1938, for the two-year period was shared 60 per cent by Germany, France, Netherlands and Belgium (presumably all from N.V. Potash

⁹ Markham, 88.

¹⁰ L.H. Kurrelmeyer, The Potash Industry (Albuquerque, 1951), 55-60.

¹¹ Hayes, 45.

¹² Hayes, 44.

Export My.), 31 per cent by United States, and 9 per cent by Russia.¹³ In 1939, the United States share of the Canadian market jumped to almost 70 per cent.

As output expanded in the United States, significant quantities were shipped to offshore markets; for example in 1938, 63,000 tons of potash, exclusive of that for Canada, were exported from United States. In order to achieve further harmony in world potash trade and pricing and to gain a better bargaining position with the European cartel, the three United States based producers formed, in December 1938, a Potash Export Association to handle export sales.¹⁴ The Association apparently made arrangements with the cartel for a share of various markets and to quote prices only on the basis of c.i.f. at a small number of recognized ports. Thus, from the time the United States potash industry first became a significant world market force to the outbreak of World War II, a formal arrangement for market sharing and preserving a basing point system of pricing had evolved with the European cartel.

1945 to 1960

The United States became the world's leading potash producer in 1945, following the division of Germany. Although the German mines suffered relatively slight damage during the war, output declined sharply owing to a lack of transportation facilities and replacement machinery and didn't recover to its pre-war level until 1949 when it reached 1.8 million metric tons K₂O equivalent. The situation was further complicated by the fact that the industry was split, 61 per cent of the active mines being located in what eventually

¹³ Canada, Dominion Bureau of Statistics, Trade in Canada, 1939 (Ottawa, 1940), 475.

¹⁴ United States, Department of the Interior, Minerals Yearbook, 1939 (Washington, 1939), 1330-1337.

became commonly known as East Germany and the remainder in West Germany.¹⁵ The U.S.S.R. "requisitioned" all the mines in East Germany in 1946, but subsequently returned most of them to the country as peoples' enterprises with the exception of seven large mines that were retained for direct control for a number of years. The industries in both the eastern and western zones remained members of the pre-war cartel for selling in western world markets until the early 1950's when British buyers apparently persuaded the East Germans to break away from the cartel.¹⁶

In post-war years the West German potash industry was integrated into three operating groups; Wintershall A.G., which controlled about one-half the productive capacity; Salzdettfurth A.G., which controlled about one-third the productive capacity; and Kali-Chemie A.G., which controlled the balance. With the exception of partial state financial interests in one mine, all three companies were part of the private sector and through subsidiary companies engaged in the production and distribution of a wide range of fertilizers and chemicals.¹⁷ Sales for both domestic and export markets from all three companies were handled by a Hannover-based agency, Verkaufsgemeinschaft Deutscher Kaliwerke GmbH.¹⁸ From 1948 to 1959, output from the West German potash industry expanded from about 500,000 to 1.8 million metric tons K_2O , about one-half of which was exported, mainly to other West European countries but with significant quantities going to Japan and United States. The East German industry more or less kept pace with the West German industry but output fell slightly behind in the mid-1950's; about two-thirds of East Germany's

¹⁵ Kurrelmeyer, 18.

¹⁶ "Potash Today" Industrial Minerals (March 1971), 23.

¹⁷ "The West German Potash Industry" Phosphorus and Potassium (May/June 1967), 31.

¹⁸ The British Sulphur Corporation, World Survey of Potash (London, 1966), 17-30.

output was exported, mainly to other Communist countries and Britain.

The French potash mines suffered fairly extensive damage during the war, but under a 10-year plan launched in 1946, output recovered to the pre-war level of about 630,000 metric tons K_2O in 1947. Some economic aid for the French industry was granted through the Economic Co-operation Administration and apparently involved the introduction of new processing techniques developed in the United States.¹⁹ During the next ten years, all the French potash mines were integrated with those of the government-operated Mines Domaniales de Potasse d'Alsace with sales being handled by Societe Commerciale des Potasse d'Alsace. About one-half of France's potash output was exported.

Output from Spain's potash industry ceased temporarily in the immediate pre-war years, but rallied sharply during the war years and then expanded from 109,000 metric tons K_2O in 1945 to just over the 200,000-ton level in the late 1950's. The Spanish potash industry consisted of three companies; Minas de Potasas de Suria SA, a subsidiary of the Belgium group Solvay et Cie; Union Espanola de Explosivos SA; and Potasas Ibericas SA, a subsidiary of Mines Domaniales de Potasse d'Alsace. Domestic and export sales from the operations of all three companies were handled by a single agency, Potasas Espanolas SA.²⁰ Nearly all of Spain's output was exported.

World War II had little effect on the potash industry in Palestine but all production facilities were destroyed following the outbreak of fighting in 1948. In 1952, Dead Sea Works Ltd. was founded by the Israeli government

¹⁹ Kurrelmeyer, 19.

²⁰ World Survey of Potash, 7-10.

to take over and restore the potash operations; production resumed in 1955 and reached 63,000 metric tons K_2O in 1959.²¹

Poland's potash industry, centered in the Kalush-Stebnik area of the Carpathian Mountains, came under direct control of the USSR in 1939 when East Galicia was ceded to Russia. Apart from the newly-acquired mines, the Russian potash industry was centered around the towns of Solikamsk and Berezniki, on the west side of the Ural Mountains, about 120 miles north of Perm. U.S.S.R. output expanded from 149,000 metric tons K_2O equivalent in 1947, to just over 1 million metric tons in 1959, virtually all being used domestically.

On the North American scene, the post-war years witnessed a continuing growth of the New Mexico potash industry and the gestation of the Saskatchewan potash industry. Development of the potash deposits in these two regions was in many ways complimentary in that most of the Carlsbad-based producers sought to gain a stronghold in the Canadian industry as a means of acquiring a second source to supply the expanding United States and seaborne market. Union Potash Company, which had been formed in 1936 through a consolidation of four small firms, was acquired by International Minerals & Chemical Corporation (IMC) in 1942. In 1952, Duval Sulphur & Potash Company, a subsidiary of the Louisiana-based United Gas Corporation (subsequently known as Pennzoil United Inc.), brought a mine into production near Carlsbad thereby becoming the fourth New Mexico producer.²² Also in 1952, Southwest Potash Corporation, a subsidiary of American Metal Company (now American Metal

²¹ World Survey of Potash, 42.

²² World Survey of Potash, 69.

Climax Inc.) began producing potash near Carlsbad.²³ A sixth producer, National Potash Co., whose majority interest was shared equally between Freeport Sulphur Company and Consolidation Coal Company and a minority interest was held by Central Farmers Fertilizer Company, began operations near Carlsbad in 1957; Freeport gained full ownership of National Potash in 1966.²⁴

After World War II, potash consumption in the United States increased about 6.5 per cent annually with the potash content of fertilizers growing at a faster rate than total fertilizer consumption. Many United States buyers of potash, particularly those along the eastern seaboard continued to rely on imports from East and West Germany, France and Spain, but as output from the domestic industry expanded, United States became a net exporter of potash in 1956.

In the meantime, work was underway to develop potash deposits that had been discovered in southern Saskatchewan. Chapter 3 has outlined the unsuccessful attempts of two companies - Western Potash Corporation Limited and General Petroleum of Canada Limited - and sketched the highlights of the first three successful entrants to the Saskatchewan scene, Potash Company of America, International Minerals & Chemical Corporation (Canada) Limited and Kalium Chemicals Limited.

1960 to Present

In June 1963, Alwinal Potash of Canada Limited, a consortium of west European potash producers, announced plans to construct a potash mine at

²³ World Survey of Potash, 70.

²⁴ World Survey of Potash, 72.

Lanigan, Saskatchewan. A 50 per cent interest was owned by Mines de Potasse d'Alsace and the remaining 50 per cent interest was shared by Wintershall A.G. and Salzdettfurth A.G. The \$60-million mine and refinery was completed in mid-1968 thereby making Alwinsal the fourth successful entrant to Saskatchewan. About that time, the head office of Potash Company of Canada Limited - the Canadian importing arm of the old French-German cartel - was moved from Montreal to Toronto and it became a marketing subsidiary of Alwinsal.²⁵

The period 1964-65 witnessed an even greater interest in Saskatchewan potash. IMC expanded the productive capacity of its K-1 mine and began construction of a second, K-2. Other announcements for multi-million dollar potash mines in Saskatchewan were as follows:²⁶ (1) May 1964, United States Borax & Chemical Corporation, which was the successor to the Carlsbad-based United States Potash Company but then under financial control of a British firm, Borax (Holdings) Ltd. After construction was underway, the venture became known as Allan Potash Mines with an 80 per cent interest being shared equally by US Borax and the US-based Homestake Mining Company, the remaining 20 per cent being held by a wholly-owned Canadian subsidiary of Swift and Company. (2) January 1965, Cominco Ltd., a subsidiary of the Canadian Pacific Railway Company Limited; Cominco is a large Canadian mining company and upon completion of its potash mine became the only Saskatchewan potash producer to be fully integrated in the manufacture and distribution of fertilizers in Canada. (3) February 1965, Noranda Mines Limited, a large Canadian-owned

²⁵ Canada, Department of Energy, Mines and Resources, Canadian Minerals Yearbook, (Ottawa), 1963, 484; and 1968, 397-398.

²⁶ Canadian Minerals Yearbook, 1964, 497-501; 1965, 342-346; and 1968, 397-398; and 1969, 413-414.

mining company. Before it's decision was announced, Noranda contracted with a large Chicago-based fertilizer co-operative, Central Farmers Fertilizer Company, for the sale of virtually all the potash output and granted an option for Central Farmers to acquire a 49 per cent interest in the mine; the option was taken up in June 1970 following completion of the mine. And (4) July 1965, Duval Corporation, which was the successor to the US-based Duval Sulphur and Potash Company. Completion dates for the five new mines spanned the interval 1967 to 1969.

The final entry to the Saskatchewan scene was Sylvite of Canada Ltd., who in June 1970 announced plans to establish a \$70-million potash mine. Sylvite was 51 per cent controlled by Hudson Bay Mining and Smelting Co., Limited, a large Canadian-based mining company that was partially owned by the world-wide Anglo-American Group; Sylvite became a division of Hudson Bay after the latter acquired full ownership of the new venture in December 1968.²⁷ Completion of the Sylvite mine in late 1970, brought the total number of potash mines in Saskatchewan to ten, with a combined annual productive capacity of 8.3 million short tons K_2O equivalent and representing a capital investment of about \$700 million.²⁸

Although the bulk of North American interest in potash during the 1960's focused on Saskatchewan, the United States industry continued to expand as well. In 1964, Duval Corporation expanded its Carlsbad operation and in November 1965, Kermac Potash Corporation became the seventh New Mexico producer. Kermac was jointly owned by Kerr-McGee Oil Industries Inc. and the National

²⁷ Canadian Minerals Yearbook, 1967, 383; and 1968, 398.

²⁸ Canadian Minerals Yearbook, 1970, 429.

Farmers Union; mining for the Kermac operation actually commenced in 1957, but the ore was processed on contract by another operator.²⁹ In 1964, Texas Gulf Sulphur Company brought a potash mine into production at Moab, Utah. Subsequently additions to the United States potash industry included some co-product brine recovery operations at Great Salt Lake. According to the United States Bureau of Mines, productive capacity of the seven Carlsbad operations as of December 1969, totalled 3.48 million short tons K_2O and a further 0.62 million short tons of capacity were available from other locations.³⁰

Potash production in the U.S.S.R., mainly in the Ural Mountains region, had expanded quite sharply in the 1950's; the first post-war exports were recorded in 1955 and then rose sharply to about 25 per cent of Soviet output in 1960. The 1970 Soviet target for total fertilizer production was set at 62 million metric tons of products, of which potash was to account for about 30 per cent (about 7.5 million metric tons K_2O).³¹ Much of the increase in output was to come from newly-discovered deposits near Soligorsk, about 75 miles south of Minsk, Byelorussia (White Russian SSR). Development of the Soligorsk deposits began in 1958 with the first and second sections of No. 1 Combine commencing production in 1963 and 1964, respectively. The first and second sections of No. 2 Combine came on stream in 1965 and 1967 and the first and second sections of No. 3 Combine in 1969.³² Although the 1970 target was

²⁹ World Survey of Potash, 73.

³⁰ United States, Department of the Interior, The United States Position and Outlook in Potash, (Washington, 1970), 7.

³¹ Oil Paint and Drug Reporter (New York), August 19, 1968.

³² The British Sulphur Corporation, Phosphorus and Potassium, January/February, 1968, 38-40; January/February, 1971, 41.

was not attained, output did reach a level of 4.2 million metric tons K_2O and installed mine capacity approached 6.4 million with a further 2.2 million metric tons under construction.

The potash industry in East Germany consolidated its position during the 1960's with output rising from 1.5 million metric tons K_2O in 1959, to record high of 2.3 million metric tons in 1969. The rise in output was attributed primarily to the installation of new mining equipment, new processing methods and a rationalization of existent facilities. In 1967, construction of a mine was started at Zielitz, about 85 miles distant from the hub of the old potash industry. The new Combine was reportedly designed to mine 24,000 tons of potash ore daily, almost equal to one quarter of East Germany's 1970 mining rate. East Germany exports about two-thirds its output, sales being handled by Bergbau Handel G.m.b.H. of Berlin.

For the West European potash producers, the 1960's was essentially a decade of rationalization and reorganization. France's potash output peaked at 1.9 million metric tons in 1965 and then levelled off at a slightly lower level. In 1967, the state-owned Mines Domaniales de Potasse d'Alsace was renamed Mines de Potasse d'Alsace SA and merged with another state-owned group to create a new holding organization, Entreprise Miniere et Chimique, which embodies all segments of the mineral-based fertilizer and related chemical industries. The marketing arm, known as Ste. Commerciale des Potasse et de L'Azote, was also charged with the responsibility of marketing potash from a newly-established mine in Africa, Cie des Potasses du Congo. Entreprise Miniere et Chimique also became the French parent firm for that country's interests in Alwinal Potash in Canada, Potasas Ibericas in Spain, and Cie

des Potasses du Congo.³³ As part of the rationalization program, over US\$50 million was spent on sinking two new shafts and expanding and modernizing the processing plants at two locations. A number of small mines were closed and the number of processing plants was being reduced from seven to two.³⁴

The West German potash industry had also been the focal point of a reorganization and rationalization program whereby a number of mines and processing plants were closed. Its output reached 2.4 million metric tons K_2O in 1965 and then stabilized at approximately 2.3 million metric tons for the remainder of the decade. In 1968, Badische Anilin und Soda Fabrik A.G. (BASF), a large German producer of industrial chemicals and buyer of potash products, gained effective control of Wintershall A.G. One of the next moves by BASF was to acquire a major interest in Salzdettfurth A.G.; share-buying was first reported in 1969 and in May 1970 BASF revealed that it controlled 43.4 per cent of Salzdettfurth's capital share.³⁵ Effective July 1, 1970, all assets of Wintershall A.G. and Salzdettfurth A.G., as related to potash and salt mining were transferred to a new organization, Kali und Salz G.m.b.H., and effective January 1, 1971, the German potash sales agency Verkaufsgemeinschaft Deutscher Kaliwerke G.m.b.H. became a division of Kali und Salz. Kali und Salz also became the new holder of the 50 per cent interest in Alwinal Potash in Canada. As a result of the amalgamation, the new firm became the owner and operator of 10 of West Germany's 12 potash mines or about 90 per cent of its mine capacity.³⁶ The other mines remain under the ownership of Kali Chemie A.G., a subsidiary of the Belgium group, Solvay et Cie.

³³ Phosphorus and Potassium, January/February, 1969, 40-42.

³⁴ Phosphorus and Potassium, January/February, 1969, 41.

³⁵ Phosphorus and Potassium, January/February, 1971, 47-49.

³⁶ Phosphorus and Potassium, January/February, 1971, 49.

Spain's potash industry continued to expand during the 1960's and it too underwent some reorganization. As indicated previously, three companies had been mining potash in Catalonia province; in 1960, Potasas de Navarra SA was formed under the auspices of the partially state-owned Instituto Nacional de Industria to exploit potash deposits near Pamplona, Navarra province. Two shafts were sunk and a processing plant was built with technical assistance from the French potash industry; production commenced in 1963. Also in that year, Union Espanola de Explosivos SA established a second mine in Catalonia. In 1969, a majority interest in Potasas Ibericas SA was taken over from the French-owned Enterprise Miniere et Chimique by Union Espanola, and the latter was subsequently merged with another firm to become Union Explosivos Rio Tinto S.A., in which the British-based international mining group of the Rio Tinto name has a 13.75 per cent equity interest.³⁷ Hence, Spain's potash industry currently consists of three companies: the partially state-owned Potasas de Navarra which retains about 64 per cent of the industry's productive capacity; Union Explosivos Rio Tinto which controls 20 per cent of mine capacity; and the Belgium-controlled Minas des Potasas de Suria. Sales for the last two-mentioned firms are handled by a single agency that apparently has been negotiating with Potasas de Navarra to form a joint marketing organization.³⁸ During the decade, Spain's potash output increased from the 250,000-ton mark in 1960 to over 500,000 metric tons K₂O equivalent in 1970; in the five-year period 1965-70, the proportionate share of exports decreased from two-thirds to just over one-half the level of output.

³⁷ The Rio Tinto-Zinc Corporation Limited, Annual Report and Accounts (London, 1971), 32.

³⁸ Phosphorus and Potassium, January/February, 1969, 44; and May/June 1971, 37-39.

In Israel, Dead Sea Works Ltd. continued to expand operations and potash output rose from 83,000 metric tons K_2O in 1960 to 540,000 metric tons in 1969. Nearly all Israel's output is earmarked for export sales.

Potash industries of commercial importance were established in two other countries during the 1960's - Italy and the Republic of Congo - and at the close of the decade, a mine was being constructed to exploit subsurface deposits in Yorkshire, England. Commercial production from the Italian industry, centred on the Island of Sicily, began in 1960 and by 1969 rose to 175,000 metric tons K_2O . When launched, the industry was largely privately-owned by two large Italian firms, Montecatini Sp.A. and Societa Edison.³⁹ As the years passed, a need for co-ordination of the various operations was recognized and the Italian government intervened; the first step in the re-organization began with a merger of the two private firms in 1966 to become Montecatini Edison Sp.A., subsequently known as Montedison S.A. Between 1967 and 1970, all operations were co-ordinated into Industria Sali Potassici e Affini I.S., whose shares are held 50 per cent by the state-owned Ente Minerario Siciliano, 6 per cent by the state-owned Ente Nazionale Indrocarburi, and 44 per cent by Montedison.⁴⁰ The bulk of Italian output is in the form of potassium sulphate and consequently the industry plays an insignificant role in international trade of potassium chloride.

In the mid 1960's, Compagnie des Potasses du Congo started construction on a US\$82 million potash mine and shipping facilities near Saint Paul, Republic of Congo. The French potash industry provided technical expertise

³⁹ World Survey of Potash, 49-51.

⁴⁰ Phosphorus and Potassium, March/April, 1970, 55; and March/April, 1971, 38.

and was the driving force behind the project with funds being supplied as follows: US\$30 million from the International Bank for Reconstruction and Development; US\$19 million from the European Investment Bank. US\$6 million from the Banque Nationale de Paris; and the balance from the Congolese Government and a mining syndicate that includes Mines de Potasse d'Alsace. Production from the 500,000-ton-a-year mine (K_2O) commenced in 1969; nearly all the output is for export markets with sales being handled by the French potash industry's marketing organization.

The most recent entry to the world potash industry is Cleveland Potash Ltd., a joint venture financed by two large British-based firms - Charter Consolidated Ltd. and Imperial Chemical Industries Ltd.⁴¹ In 1969, Cleveland Potash began constructing a US\$60 million mine in Yorkshire, England; production from the one million ton-a-year mine (potassium chloride) was expected to commence in 1973.

⁴¹ Industrial Minerals, September 1969, 7.